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ORIGINAL PAPER

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A synthesis of the findings from the Quake Impact Study: a two-year investigation of the psychosocial sequelae of the 1989 Newcastle earthquake

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Abstract This paper summarises the major findings from the Quake Impact Study (QIS), a four-phase longitudinal project that was conducted in the aftermath of the 1989 Newcastle (Australia) earthquake. A total of 3,484 subjects participated in at least one component of the QIS, comprising a stratified sample of 3,007 drawn from community electoral rolls and 477 from specially targeted supplementary samples (the injured, the displaced, the owners of damaged businesses, and the helpers). Subjects' initial earthquake experiences were rated in terms of weighted indices of exposure to threat and disruption. Psychological morbidity was measured at each phase using the General Health Questionnaire (GHQ-12) and the Impact of Event Scale (IES). Selected findings and key conclusions are presented for each of six areas of investigation: service utilisation during the first 6 months post-disaster; patterns of earthquake experience and short-term (6-month) psychosocial outcome; earthquake exposure and medium term (2-year) psychosocial outcome; vulnerability factors and medium-term psychosocial outcome; specific community groups at increased risk (e.g., the elderly and immigrants from non-English-speaking backgrounds); the effects of stress debriefing for helpers. Threshold morbidity (i.e., likely caseness) rates are also presented for a broad range of subgroups. In addition to presenting an overview of the QIS, this paper synthesises the major findings and discusses their implications for future disaster management and research from a mental health perspective.

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Introduction

Amongst the growing research literature on the psychosocial impact of disasters [1–11] there have been calls for the use of comparable research methods, for greater attention to be paid to the various dimensions of disaster exposure, and for more longitudinal and prospective research [11–15]. There is also a need for studies of the community prevalence of psychological morbidity consequent to disasters and the identification of those at greater risk of such morbidity. From a public health perspective, information of this kind should enhance our preparedness for future disasters by helping to gauge the following: their likely mental health impact; the nature, extent and cost of services needed to absorb that impact; the time course within which those services will be required; the extent to which maintenance health and welfare services will be needed to assist those with permanent disability. Additionally, from a social psychiatry viewpoint, more careful attention to the choice of research methodology should permit clarification of the contributions of sociodemographic, vulnerability, and exposure factors to the development of post-event psychosocial morbidity.

The Newcastle earthquake of 28 December 1989 provided a unique opportunity to document a community's initial and ongoing disaster experience and to assess its medium to long-term psychosocial sequelae. Newcastle is Australia's sixth most populous city, with 429,000 people residing in the Lower Hunter Region of whom 130,000 live within the boundaries of the Newcastle City Council. The earthquake was of moderate magnitude (Richter scale = 5.6) and was the first Australian earthquake to cause loss of life (13 deaths). Over $900 million Australian worth of property damage resulted from the disaster. A detailed account of the earthquake and its immediate aftermath has been provided previously [16].

Since the impact of the earthquake was widespread but not so devastating as to destroy the city's

infrastructure, it was possible to use epidemiological methods to select a representative sample of the Newcastle community and, using local agencies, to identify additional putative 'at risk' groups within which to study the effects of the disaster. Systematic assessment methods were used in order to facilitate comparisons with other disaster studies [14]. Finally, because of the relative stability of the community, a longitudinal research methodology was readily implemented enabling the pattern of recovery to be plotted over 2 years.

This paper aimed to draw together the findings of a 2-year study of the psychosocial sequelae of the Newcastle earthquake, known as the Quake Impact Study (QIS). The results of this study have been reported in several papers [16–25] and presented at a range of scientific meetings. A number of theses have also been produced [26–28] or are in preparation [29]. However, nowhere before have the findings been synthesised to present a broad overview of the study and to examine its implications for future disaster management from a mental health point of view.

Methodology

Subject recruitment

As described elsewhere [21], a community sample was selected from suburbs of moderate property damage ($n = 3{,}718$) and minor property damage ($n = 1{,}282$) within the Newcastle City Council area. Subjects recruited by this method enabled us to obtain community prevalence data. In addition, supplementary samples were drawn from groups of special interest thought likely to be at increased risk of post-disaster psychological morbidity ($n = 1{,}061$): namely, the injured, those displaced from their homes, owners of businesses damaged by the earthquake, and the helpers (e.g., emergency/rescue, welfare and public utilities workers, and armed services personnel) [24].

Instruments, procedures and data analysis

The phase 1 screening survey distributed by mail 6 months post-earthquake was designed to collect the following information: demographic data; personal earthquake experiences and reactions (including perceived stressfulness); psychological morbidity, both general psychological distress (General Health Questionnaire; GHQ-12 [30]) and posttraumatic stress (Impact of Event Scale; IES [31]); social support [32]; coping strategies [33]; use of support services, including visits to a medical practitioner. Where possible, we followed the recommendations of Raphael et al. [14] in developing the screening survey. Three follow-up surveys (phases 2–4) were distributed by mail and returned, on average, at 50, 86, and 114 weeks post-earthquake. They included: the GHQ-12; IES; the Revised Symptom Checklist-90 (SCL-90-R) [34]; the short Beck Depression Inventory (BDI) [35]; a measure of social relationships; a general measure of life events [36]. These follow-up surveys also included questions designed to elicit details of ongoing disruptions experienced as a result of the earthquake, from which an index of ongoing disruptions was derived [24]. Three dispositional measures were included in these surveys: the short Eysenck Personality Inventory (EPI) [37], which measures neuroticism and extraversion; a scale of personal hopefulness (HOPES) [38]; a revised version of the Defense Style Questionnaire (DSQ-40) [39, 40], which measures the maturity of ego defense mechanisms [25]. Each of these instruments was administered on two occasions in order to estimate their temporal stability and to obtain aggregate measures so that 'measurement error' due to current state influences could be minimised.

Data cleaning and analysis were undertaken using BMDP statistical software [41]. Where appropriate, Bonferroni-adjusted error rates were used to control for the number of statistical tests. IES total scores (range 0–75) were used in all analyses as the intrusion and avoidance subscales of this instrument were highly correlated ($r = 0.78$, $P < 0.001$). The IES measures important psychological features of the posttraumatic stress response, and a cut-off point of 25, along with other criteria, has been used as a threshold to identify those with a high likelihood of having posttraumatic stress disorder (PTSD) [8]. Two scoring systems were used for the measure of general psychological distress (GHQ-12), the traditional or binary scoring method (range 0–12) and the Likert method (range 0–36). The former scoring method was applied in the evaluation of threshold morbidity levels using established GHQ-12 cut-offs (e.g., 1/2 or 3/4), while the latter was used in all correlational analyses and in those evaluating mean differences between groups.

Determination of earthquake exposure levels

It was possible to characterise each individual's level of exposure in four ways: by area of residence (moderate vs minor damage area); by location at the time of the earthquake; by self-reported earthquake experiences; by membership of special interest groups. Self-reported earthquake experiences were used to quantify the extent to which each respondent was exposed to threat events (i.e., injury or the likelihood of injury) and disruption events (i.e., damage to home or business, displacement from home, other earthquake-related losses). The method for deriving the exposure indices based on self-reported experiences is described in detail elsewhere [21]. Using these exposure indices and identifying suitable cut-off points, each respondent's level of exposure to threat and/or disruption could be categorised as either high or low [21].

Patterns of participation

Of the 5,000 surveys distributed to the community at phase 1, 70% could be accounted for (including completed surveys, known refusals, and surveys not received). Adjusting for the 234 surveys that were not received (i.e., returned to sender), there was an overall response rate of 63% [21]. The socio-demographic profile of the respondents ($n = 3{,}007$) did not differ significantly, except in minor detail, from that of the whole sample originally selected [16, 21]. In the supplementary samples of special interest groups, 59% of the 1,061 phase 1 surveys sent out were accounted for and a 50% adjusted response rate was obtained ($n = 464$) [24]. We did not have access to data that would have enabled a comparison between respondents and non-respondents in these samples.

Phase 1 respondents in the community sample were allocated to four exposure subgroups on the basis of their self-reported earthquake exposure index scores: low exposure ($n = 2{,}480$); disruption only ($n = 161$); threat only ($n = 250$); disruption *and* threat ($n = 86$) [21]. All available members of the three more highly exposed subgroups were selected for the longitudinal component of the study, together with a 1/12 random sample of the low exposure subgroup (total $n = 688$) [24, 25]. All subjects in the supplementary samples whose membership in the special interest groups was confirmed were invited to participate in the longitudinal component of the study ($n = 388$). The 845 subjects who completed the phase 1 survey and at least one of the three follow-up surveys comprised 78% of those selected for the longitudinal component of the study [24]. Sample sizes across the four phases were: 845, 753, 721, and 619.

Table 1 Summary of major findings from the Quake Impact Study (QIS); (*Ph.* phase, *GHQ* General Health Questionnaire, *IES* Impact of Event Scale, *EPI* Eysenck Personality Inventory, *DSQ* Defense Style Questionnaire, *HOPES* Hunter Opinions and Personal Expectations Scale, *NESB* non-English-speaking backgrounds)

Area of investigation	Key publication	Methods	Major findings
1. Service utilisation in the first 6 months	16	Ph. 1 screening questionnaire distributed to a stratified community sample of 5,000 adults (n = 3,007 respondents)	21% of adults used general and/or disaster-related support services; users of these services reported greater earthquake exposure and higher psychological morbidity and were also more likely to seek support from family and friends; 69% of the community's needs for assistance were met by existing support services
2. Patterns of earthquake experience and short-term (6 month) outcome	21	As above; includes a more comprehensive account of the weighted exposure indices (threat and disruption)	Earthquake exposure and use of avoidance coping were the strongest predictors of GHQ-12 & IES scores 6 months post-disaster; threat and disruption indices based on self-reported exposure were better predictors of psychological morbidity than area of residence or location at the time of the quake; 15% of adults were exposed to high levels of threat/disruption, of whom 25% experienced significant distress
3. Earthquake exposure and medium-term (2-year) outcome	24	Four-phase postal survey; drawn from Ph. 1 community sample and 'at risk' special interest groups (n = 845)	Psychological morbidity declined over time but stabilised at about 12 months for general (GHQ-12) distress and at about 18 months for posttraumatic (IES) stress; threat/disruption exposure had superior predictive power to membership of the targeted groups (the injured, those displaced from their homes, owners of damaged small businesses, helpers in threat & non-threat situations); degree of ongoing disruption and other recent life events were also significant predictors of morbidity
4. Vulnerability factors and medium-term (2-year) outcome	25	As above; includes a detailed assessment of the dispositional measures (Short EPI, HOPES & DSQ-40)	Dispositional characteristics (e.g., neuroticism, hopefulness) were the best predictors of psychological morbidity throughout the study, contributing more to the variance in morbidity (12–39%) than did initial exposure (5–12%); avoidance coping, ongoing disruptions and other recent life events were also important predictors
5. Community groups at risk			
(a) The elderly	23	Adults aged $\geq$ 65 years (n = 636) vs < 65 years (n = 2,371)	Older subjects reported fewer earthquake experiences and used fewer support services, however, the effects of exposure were more marked amongst the elderly;
(b) People from non-English-speaking backgrounds	20	NESB sample (n = 250) vs matched controls (n = 250)	NESB females had the highest levels of morbidity, particularly those who were older on arrival in Australia and those who experienced high levels of disruption
6. Stress debriefing	22	Debriefed (n = 62) vs non-debriefed helpers (n = 133)	No evidence for an improved rate of recovery among those helpers who were debriefed; more rigorous investigation of the effectiveness of debriefing is required

Findings and conclusions

All the results described here (with the exception of the data in Table 2) have been reported in more detail in other publications to which the reader is referred for more information [16–25]. Table 1 presents an overview of the major findings from the QIS. The results described in this paper have been brought together from several sources in order to provide a summary of the entire study and, especially, to help draw conclusions relevant to future disaster management and research.

1. Service utilisation in the first 6 months [16]

Results

Overall, 21.3% (20,300 people) of the adult Newcastle population were estimated to have used the various general support and/or disaster-related services that were available to help them deal with the stressful effects of the earthquake (see Carr et al. [16] for a complete list). Furthermore, 56.9% used personal sources of support (family, friends, neighbours, etc.) for the same purposes. Just over one-third of the population relied

exclusively on these personal supports. The number of people estimated to have obtained help from general support services (32,500 contacts: 20.0% of the population) was twice that receiving assistance from disaster-related services (14,300 contacts: 10.2% of the population), with 8.9% of the Newcastle community using both sources of support. Of the general supports, medical services were used by 6.2% of adults. While it was estimated that 1.5% of the adult population was injured in the earthquake, only 0.4% required medical treatment for their injuries. Virtually all medical contacts used for dealing with the emotionally distressing aspects of people's individual earthquake experiences appear to have taken place in the course of consultations for other matters, so that the overall frequency of visits to doctors did not increase in the first 6 months post-disaster.

More than two-thirds of the support services accessed by the population in the first 6 months post-earthquake were provided from within Newcastle's existing services, leaving one-third of the community's needs to be met by the extra resources specifically mobilised in response to the disaster. Ratings of perceived helpfulness of all services were high and taken to be a true reflection of the services provided rather than a reflection of recipient characteristics, which is not to imply that perceived helpfulness equates with the effectiveness of these interventions in relation to the reduction of psychological morbidity.

The likelihood of using support services increased as the individual's level of earthquake exposure (to both threat and disruption) increased and/or their level of psychological morbidity increased. However, the number of general services used, especially medical services, was more closely related to psychological morbidity than to degree of exposure, whereas the number of disaster-related services used was related more to degree of exposure than psychological morbidity.

Conclusions

Pre-existing services can be expected to take the brunt of any increased need for psychosocial assistance experienced by a community in the short-term aftermath of a disaster of the magnitude of the Newcastle earthquake. There will be an exclusive reliance on pre-existing services in the medium to long term, after the withdrawal of temporary additional resources that have been mobilised to deal with the crisis. Prior capacities and the flexibility with which those capacities can be suitably redirected will determine the success with which these services can absorb the increased demands made upon them. Supplementary services have to be made available if the demands made are likely to exceed capacity.

It is important for the providers of those services to be equipped with some knowledge of post-disaster psychological distress, the skills to detect it, the capacity to provide support where necessary (and feasible), and the discernment to identify those who are not coping adequately but require referral to specialist services for additional assistance. This is because those more severely distressed by the disaster and, to a lesser extent, those more highly exposed are likely to be heavier users of existing services (especially medical services). It is also important to be aware that the manifest reason for accessing an existing service may not appear to be directly related to the disaster or its psychosocial sequelae. It is therefore necessary that service providers have the skills to detect psychological distress in these circumstances and to deal with it appropriately.

The most frequently used source of support was personal (family, friends, and neighbours). Therefore, the general community will require education about post-disaster psychological reactions and what they can do to help.

Personnel providing existing services need to attend more to personal distress than to actual experience of the disaster in gauging the need for extra assistance. This is particularly so in frequent and multiple service users, especially if the level of distress seems to be incommensurate with the level of exposure. This conclusion flows from the finding that level of distress was more strongly related to number of general support services used (especially visits to a medical practitioner) than to level of exposure.

The Newcastle earthquake left the city's infrastructure sufficiently intact that its facilities were able to be used for the community's service needs in the disaster aftermath. Secondly, the destruction of dwellings was not so severe or widespread as to cause large scale displacement of the population beyond the region. Thirdly, the magnitude and timing of the earthquake were such as to occasion a relatively minor degree of injury and loss of life. Consequently, sufficient local resources were available for an identified, cohesive community in its own milieu. Under similar circumstances, it is likely that the comparatively modest additional needs for mental health care due to the earthquake would be fulfilled. However, a larger scale community disaster with infrastructure destroyed, population dispersed, and widespread death and injury would be likely to present a much more difficult task in terms of meeting service needs.

2. Patterns of earthquake experience and short term (6 month) outcome [21]

Results

Persons living in suburbs of moderate earthquake damage were twice as likely to experience high levels of disruption as those in minor damage areas, but there was no difference in exposure to threat. While there

were statistically significant differences in psychological morbidity between those residing in the two damage areas (in the expected direction), these were small and not likely to be clinically significant. In terms of personal location at the time of the earthquake, people who were inside large buildings experienced higher levels of threat than those who were outdoors, at home, or in transit. While personal location was only weakly associated with general psychological distress, posttraumatic stress was significantly higher in those who were inside or near large buildings, or at home. Thus, in spite of those at home reporting lower levels of threat, they experienced levels of posttraumatic stress comparable to those in locations of high threat.

A much clearer picture emerged from the analyses in which the more detailed, self-report-based exposure indices were used. Greater usage of support services, higher perceived stressfulness of earthquake events, and increased psychological morbidity were associated with high levels of exposure, in which the effects of exposure to threat and exposure to disruption were largely additive. However, community members who experienced both high threat and high disruption reported disproportionately high usage of disaster-related support services. At the same time, this subgroup reported somewhat lower stressfulness ratings than might have been expected if the exposure effects were simply additive. Threat effects were equally evident in relation to both morbidity measures, whereas disruption had a greater effect on general psychological distress.

It was estimated that approximately 15% of the adult population (i.e., 14,100 people) experienced high levels of exposure to either threat or disruption due to the earthquake. In the first 6 months, almost 50% of this group would have reached the 1/2 threshold for caseness on the GHQ-12, with 38% reaching the more conservative 3/4 cut-off. Corresponding GHQ-12 threshold morbidity estimates for those experiencing low exposure were 21% and 13%, respectively. Thus, adjusting for the level of psychological morbidity had there not been an earthquake, it was estimated that 28% of the community *highly exposed* to the earthquake (i.e., 4,000 people) experienced moderate to severe psychological distress as a direct result of the disaster. Using the more conservative GHQ-12 cut-off, 25% of the highly exposed (i.e., 3,500 people) would have experienced significant psychological morbidity due to the earthquake. However, it should be noted that the mean weighted exposure scores for the entire community suggest that the population as a whole experienced a negligible level of earthquake exposure.

The likely prevalence of PTSD was calculated by determining the number of respondents who reported high exposure, significant general psychological distress (GHQ-12 score > 3), and significant posttraumatic stress (IES score > 25) [8]. This produced an estimate of 18.3% of those exposed to high levels of threat, which corresponds to 2.0% of the adult population (i.e., 1,900 people) with likely PTSD in the first 6 months post-earthquake.

In the case of general psychological distress, where exposure to disruption exerted a greater effect than threat exposure, the best predictors of psychological morbidity, after exposure, were avoidance coping style, low social support, and female gender. The effects of disruption on general psychological distress were more marked in those who used avoidance as a coping strategy. Older respondents with high threat exposure reported disproportionately high levels of general psychological distress. With regard to posttraumatic stress, where exposure to threat exerted a greater effect than disruption exposure, the best predictors of morbidity, after exposure, were avoidance coping (and, to a lesser extent, active-behavioural coping), female gender, and older age. Social support was not a significant predictor of posttraumatic stress. Again, older respondents with high threat exposure reported disproportionately high levels of posttraumatic stress.

Conclusions

Location at the time of the earthquake gave a coarse estimate of exposure and likely associated morbidity, which may obscure the fact that some individuals within those locations may have experienced high levels of exposure and suffered correspondingly high levels of psychological morbidity. In disasters with widespread and relatively even effects (e.g., floods, cyclones), methods for identifying those at risk of psychological morbidity on the basis of their exposure would likely be subordinate to methods based on direct estimates of individual responses. In other words, detailed estimates of exposure may be superfluous since there would be little variance in the nature and severity of exposure under these conditions. In disasters where the distribution of effects is uneven (e.g., bushfires, Newcastle earthquake), estimates of community exposure need to go beyond global measures, such as area of residence, and take into consideration individual experiences in as fine-grained a manner as is feasible since such measures of exposure are far stronger predictors of short-term psychological morbidity than the coarse measures.

The reason that individuals in or near large buildings at the time of the earthquake reported high levels of threat and corresponding high levels of posttraumatic stress symptoms should be self-evident. It is less clear why those at home at the time should also report high levels of such symptoms but low threat exposure. An explanation may lie with the possibility that the earthquake violated the occupant's safety assumptions associated with the familiar home environment [42]. Appraisal of the nature of the event and the attribution

of meaning to it may have been quite different, with more distressing implications. For example, the individual who was in a 'safe haven' (i.e., at home) when the disaster occurred may have experienced a greater challenge to their assumptions about safety than someone who was in a public place at the time. In other words, one 'expects' disasters to occur in more remote, less familiar settings but not in one's home; therefore, such events are likely to be more distressing when they occur in the former context.

Whereas exposure to threat contributes equally to general psychological distress and posttraumatic stress, exposure to disruption contributes more strongly to general psychological distress and is associated with greater usage of support services, particularly disaster-related services. While the two types of exposure are largely additive in their effects, clearly each has different consequences in the short term and requires correspondingly different responses, both quantitatively and qualitatively, from health and welfare services.

The overall impact of the earthquake on the Newcastle community, in terms of mental health consequences, was small with low levels of exposure generally and low likelihood of psychological morbidity. Nevertheless, 2% of the population were likely to have suffered PTSD as a result of the earthquake (i.e., 1,900 people) in the first 6 months.

While exposure is the best predictor of psychological morbidity in the short term, other non-earthquake-related factors also make significant contributions, particularly avoidance coping and female gender (dispositional factors were not examined during phase 1 of the QIS–see section on Vulnerability factors and medium-term outcome). Gender differences in psychological morbidity post-disaster were interpreted as being consistent with the findings of others [5, 43]. Older people were particularly vulnerable to posttraumatic stress and, when highly exposed to threat, showed disproportionately high levels of both general psychological distress and posttraumatic stress. Avoidance coping magnified the effects of disruption exposure on general psychological distress. While social support had some protective effects in relation to general distress, this was not the case for posttraumatic stress. If this finding stands up to replication, it suggests that in the short term at least, posttraumatic stress reactions may emerge and follow a natural course over time regardless of the potential buffering or healing effects of social support (or other environmental influences). In contrast, general psychological distress may be more readily preventable or responsive to amelioration by factors such as social support. In terms of early intervention post-disaster, women, older age groups, and those with an avoidance coping style are clearly at higher risk for psychological morbidity, and efforts ought to be made to target these 'at risk' groups for preventive interventions in future disasters.

3. Earthquake exposure and medium-term (2-year) outcome [24]

Results

An estimated 17.1% of the adult population of Newcastle (i.e., 16,300 people) would have met criteria for membership of the special interest groups (the injured, 1.5%; the displaced, 4.5%; owners of damaged businesses, 5.0%; helpers in threat situations, 4.1%; helpers in non-threat situations, 5.9%). There was, however, considerable cross-representation in that 21% of the study respondents met criteria for membership of two or more special interest groups. Each of these groups reported higher exposure to disruption than those who did not fall into these categories. However, only the injured and both helpers groups reported higher exposure to threat. All except the helpers in threat situations reported higher levels of ongoing disruptions compared to non-members of the special interest groups. Only the injured and the displaced differed from those not in special interest groups in having higher levels of psychological morbidity throughout the 2-year follow-up, although their morbidity levels declined over time. Helpers in both threat and non-threat situations had low levels of morbidity, which was comparable to those not in the special interest groups.

Although ongoing disruptions (e.g., displacement, household repairs, business disruptions, employment changes, etc.) declined over time, with the maximum rate of reduction occurring between 12 and 18 months post-earthquake, ongoing disruptions continued for up to 2 years after the disaster. Overall, those people who were more highly exposed initially (particularly to disruption) continued to report higher levels of ongoing disruption. Financial problems associated with either employment, business, or other disruptions contributed most to the levels of ongoing disruptions experienced at 12–18 months by those most highly exposed to initial disruption.

Post-disaster psychological morbidity declined over the 2 years of the study, but the influence of initial exposure persisted throughout the follow-up period with higher exposure being associated with higher levels of morbidity. Thus, 114 weeks post-earthquake the effects of initial exposure on psychological morbidity were still evident, especially in relation to posttraumatic stress. The results of this medium-term follow-up also confirmed the short-term findings that initial threat exposure contributed equally to both types of morbidity, while initial disruption exposure contributed more to general psychological distress. The types of exposure that contributed most to psychological morbidity were, for threat, the 'possibility of injury' (e.g., danger of things falling on you; time spent in danger) and, for disruption, the 'need to change personal plans and daily activities' (e.g., having to stay at home more; changed holiday plans). While women

reported higher morbidity levels overall, their general psychological distress levels converged to the levels reported by men after 2 years, but their levels of posttraumatic stress symptoms did not. Instead, they remained higher than those of men at the end of the study. General psychological distress declined most sharply between phases 1 and 2, while posttraumatic stress remained constant during this time and, if anything, peaked slightly at the 1-year mark before declining most sharply between phases 2 and 3.

In comparing the contributions to psychological morbidity of demographic factors, special interest group membership, exposure levels, ongoing disruptions, and other life events (before and after the earthquake), initial exposure level - especially threat - was the strongest predictor of psychological morbidity. By comparison, special interest group membership (as an indirect exposure measure) was a weak predictor, with only the injured category having a significant association with psychological morbidity. Female gender and life events prior to the earthquake were significant predictors of general psychological distress, but the effect was smaller than the effects of older age and pre-earthquake life events in relation to posttraumatic stress. Ongoing disruptions and life events since the earthquake, even after controlling for all other variables above, were significant predictors of both types of morbidity, but made proportionately greater contributions to general psychological distress rather than posttraumatic stress.

Conclusions

The positive relationship between individual levels of exposure and measures of psychological morbidity, which was evident in the short term, persisted throughout the study, such that the effects of initial exposure were still discernible more than 2 years after the disaster. There was a striking lack of convergence of morbidity levels within the exposure subgroups, particularly in relation to posttraumatic stress; that is, initial earthquake experiences have an enduring adverse psychological effect that is only partly ameliorated after an extended time. The fact that general psychological distress levels appeared to stabilise at 12 months post-disaster and those of posttraumatic stress at about 18 months suggests that whatever residual morbidity remains is likely to persist at levels proportionate to initial exposure. In other words, in some individuals there is a high likelihood of permanent psychological morbidity caused by the earthquake.

Special interest group membership was a weak predictor of psychological morbidity compared to individual exposure (possibly because a large proportion belonged to more than one such group, the groups differed on several demographic variables, and there was a great diversity in individual earthquake experiences, as measured by the exposure indices). Therefore, a priori assumptions about exposure based on simple categorisations of disaster experience (e.g., group membership) are likely to be unreliable in terms of actual exposure and predictions of subsequent psychological morbidity. Consequently, if there is a need to identify those at risk of post-disaster psychological morbidity based on type and degree of exposure, there appears to be no substitute for obtaining sufficiently detailed accounts of personal exposure – there are no short cuts.

Ongoing disruptions, although declining with time, continued throughout the 2 years of the study at levels generally proportionate to initial (disruption) exposure levels. This demonstrates that the earthquake constituted a series of events that continued to impact upon people's lives over a prolonged period, rather than a circumscribed event with a defined endpoint. Health and welfare agencies need to appreciate the fact that the material consequences of such a disaster do not end when the danger has passed, but may continue for years.

Persistent or recurring disruptions attributable to the earthquake contributed substantially to psychological morbidity on top of the effects of initial exposure. This suggests that reliance on initial exposure to identify persons at risk for psychological ill-health post-disaster will exclude a significant number of victims in whom the impact of the disaster is latent, emerging as ongoing disruptions begin to accumulate. Furthermore, prompt attention to repair work, rapid settlement of insurance claims, ready financial assistance, minimisation of displacement, sympathetic employment arrangements, and other means of reducing disruption may help to prevent or reduce psychological morbidity. Ongoing disruptions, which contribute to both general psychological distress and posttraumatic stress, may augment the morbidity by acting as reminders of the disaster (i.e., 'secondary exposure') and thereby triggering intrusion and avoidance phenomena.

The finding that women were more likely to continue to experience posttraumatic stress (while their levels of general psychological distress equalised with those of men after 2 years) may be due to the effect of being at home at the time of the earthquake (see Conclusions, in section on patterns of earthquake experience and short-term outcome), having borne the brunt of ongoing disruptions in the home with their attendant financial problems, and having carried more of the burden of consoling others in the aftermath of the earthquake, all in addition to the general socio-cultural factors believed to contribute to psychological ill-health in women [44, 45]. Whatever the explanation, specific post-disaster interventions aimed particularly at women appear to be indicated, possibly targeted at the potential contributing factors mentioned here, as well as those that apply generally.

4. Vulnerability factors and medium-term (2-year) outcome [25]

Results

The dispositional measures that made significant contributions to psychological morbidity over the 2 years of the study were neuroticism, hopefulness, and maturity of defenses. When these factors and all other potentially predictive variables were examined together in order to determine their relative contributions to psychological morbidity, dispositional factors overall accounted for 26–39% of the variance in general psychological distress and 12–27% of the variance in posttraumatic stress. Thus, dispositional characteristics were more important in relation to general psychological distress. In total, all relevant predictor variables contributed 56–58% of the variance in general psychological distress and 44–47% of the variance in posttraumatic stress. Therefore, vulnerability factors were the largest contributors to psychological morbidity in the 2 years post-earthquake.

Demographic factors made small but significant contributions (2–4% of the variance): female gender was associated with general psychological distress and both older age and female gender were associated with posttraumatic stress, confirming the particular vulnerability of women post-disaster and the greater vulnerability of older persons to posttraumatic stress. However, initial earthquake exposure remained a significant predictor of morbidity after dispositional characteristics were taken into account, contributing 5–9% of the variance in general psychological distress and 7–12% of the variance in posttraumatic stress. Threat exposure contributed more to posttraumatic stress symptoms than disruption exposure, while the opposite pattern was found in relation to general psychological distress. Avoidance coping made an approximately equal contribution to both types of morbidity (3–6% and 3–7% of the variance respectively). Even after all these variables were controlled for, life events since the earthquake, ongoing disruptions due to the earthquake, and poor social relationships contributed significantly to general psychological distress (9–11% of the variance), whereas only ongoing disruptions contributed significantly to posttraumatic stress (3–5% of the variance). This helped to confirm that only post-disaster life events that are related in some way to the earthquake and its aftermath (i.e., 'secondary exposure') contribute to posttraumatic stress and that social support, while protective or ameliorative in relation to general psychological distress, has no such effects in the context of posttraumatic stress.

Conclusions

Dispositional characteristics were the major predictors of post-earthquake psychological morbidity. They accounted for 8 times the variance in general psychological distress and about 4 times the variance in posttraumatic stress than did initial exposure. However, after taking dispositional factors into account, initial exposure still made a significant contribution to psychological morbidity over 2 years, threat exposure contributing more to posttraumatic stress and disruption contributing more to general psychological distress. Any attempt to identify persons at high risk of psychopathology post-disaster must take into consideration individual differences in vulnerability (i.e., dispositional characteristics) and, possibly, coping style.

Whereas social support may serve a protective or ameliorative function in relation to general psychological distress, it does not appear to do so in relation to posttraumatic stress. Therefore, in the context of preventive interventions or attempts to ameliorate the psychosocial sequelae of a disaster, bolstering social support may have a beneficial effect in relation to general distress, but it cannot be expected to have a similar effect in relation to posttraumatic stress.

5. Community groups at risk [20, 23]

Results

The elderly [20]. Given the findings reported above on the role of increasing age in relation to psychological morbidity, a set of analyses was undertaken in order to determine whether the elderly were at additional risk of psychological morbidity 6 months post-disaster. Comparisons were made between adults aged less than 65 years ($n = 2,371$) and those aged 65 years and older ($n = 636$). Older respondents reported fewer threat and disruption experiences and used fewer general and disaster-related support services, although they reported a larger number of visits to a doctor post-earthquake. The elderly were also less likely to use avoidance coping strategies. In some respects, therefore, it would appear that the elderly could be at lower risk of psychological morbidity, although they were more likely to be living alone and possibly socially isolated.

However, the elderly reported higher levels of posttraumatic stress at phase 1, particularly if they experienced higher degrees of exposure. Those with high levels of posttraumatic stress were more likely to use avoidance coping strategies. While, as a group, the older respondents did not report higher levels of general psychological distress, elderly women did experience more distress. Patterns of change in psychological morbidity with time did not differ from those reported previously for the entire study sample.

People from non-English speaking backgrounds [23]. Of the subjects who completed the phase 1 survey, 7.2% ($n = 250$) were of non-English-speaking backgrounds (NESB). This sample was matched with Australian-born English speaking controls for age, gender, and self-reported level of exposure; those in the community sample were also matched for area of residence and those in the special interest groups were matched for type of earthquake-related experience. The NESB respondents reported higher levels of both types of psychological morbidity, with women in particular experiencing high levels of posttraumatic stress at 6 months post-disaster. NESB women who reported high levels of disruption were especially likely to experience increased general psychological distress, and NESB women who were older on arrival in Australia reported more posttraumatic stress.

Although NESB immigrants, particularly women, were at higher risk of psychological morbidity post-earthquake, level of exposure and avoidance coping contributed more to psychological morbidity than ethnicity. NESB persons did not differ from controls in terms of support services used, including visits to a medical practitioner.

Conclusions

Older people were at greater risk of experiencing posttraumatic stress in spite of having less disaster-related experiences. They also appeared to under-utilise services. Older women in particular and elderly persons with avoidance coping styles appeared to be most vulnerable. The elderly require particular intervention strategies that take account of their enhanced vulnerability, lack of access to services, and social isolation in order to meet their health and welfare needs post-disaster.

While NESB respondents reported higher levels of psychological morbidity post-earthquake, they accessed the available support services at the same rate as Australian-born English speaking persons, possibly because such services happened to be located near areas with high concentrations of NESB immigrants, and specific attempts were made after the earthquake to target certain ethnic groups through local ethnic health and welfare groups. NESB women were particularly vulnerable to psychological morbidity post-disaster, especially if high levels of disruption were experienced. This may justify extra resources for this group post-disaster.

6. Stress debriefing [22]

Results

Stress debriefing was readily available in the aftermath of the earthquake and was used by a wide variety of individuals, including emergency service personnel and other disaster workers. There were 195 subjects who completed at least three phases of the study and who also reported that they had acted in the role of helper in threat and/or non-threat situations. Of these respondents, 62 had been involved in debriefing sessions and 133 had not been debriefed. On average, each of the debriefed group had attended 1.5 debriefing sessions; however, no information was collected on the content of these sessions or the method of debriefing. There was no evidence that debriefing was associated with a reduction in psychological morbidity over time in terms of either general psychological distress or posttraumatic stress.

Conclusions

There is no evidence that stress debriefing in the aftermath of the Newcastle earthquake was effective in reducing psychological morbidity. While it makes intuitive sense and seems to be a humane response to disaster victims to provide stress debriefing, it is time for a rigorous assessment of the goals and procedures of formal stress debriefing. First, consolation of the distressed can probably be effectively provided within the individual's own social network: 57% of respondents reported using their own personal sources of support in dealing with the stressful effects of the earthquake, and approximately 90% of those who accessed general and disaster support services also used personal sources of support. Second, there is currently no justification for formal debriefing services to offer any more than information about the nature of post-disaster morbidity and where to get help for persons who are not coping satisfactorily.

Anyone wishing to provide debriefing services whose goals extend beyond the simple provision of information, such as symptom relief or prevention of psychological morbidity, should be expected to justify their intended intervention with evidence of its efficacy. Failing that, they should be required to undertake a methodologically sound evaluation of their debriefing intervention. This would require careful definition of the characteristics of their target group(s), clear specification of the debriefing objectives (these should be realistic and appropriate for the debriefing procedures to be used), precise delineation of their debriefing procedures, appropriate pre- and post-measures using instruments of demonstrable reliability and validity that are compatible with the defined outcome objectives, adequate quality control mechanisms to ensure that the debriefing procedures are actually delivered as they intend, and, preferably, a non-debriefed control group with which to compare the effects of the intervention and independent ratings of outcome by assessors blind to debriefing status.

Should evaluations of stress debriefing as described above be planned with the aim of reducing or preventing psychological morbidity, then consideration should be given to targeting high risk groups for intervention as a more efficient means of providing the service for those who, ostensibly, most need it rather than a non-discriminating approach that incorporates individuals with a low likelihood of experiencing significant psychological morbidity. According to the present study, important risk factors include: female gender, increased age, predispositional characteristics (e.g., anxiety proneness, low hopefulness, immature defensive style), high exposure (initial and ongoing), avoidance coping, and low social support.

The efficacy of stress debriefing remains a controversial issue. The recent study by Deahl et al [46] of debriefed and non-debriefed soldiers who participated in the Gulf War has also failed to find evidence of a specific debriefing effect. Whilst further debate is useful [47, 48], we believe that "rigorous and high-quality" evaluation research is urgently required [48].

Threshold morbidity levels

To facilitate comparisons between the different subgroups examined during the various components of the QIS, threshold psychological morbidity rates (i.e., likely caseness) were calculated for both the GHQ-12 and the IES. A cut-off score of 3/4 was used for the GHQ-12 (binary scoring), such that respondents with scores greater than 3 were regarded as having significant symptoms of general psychological distress (i.e., 'threshold cases'). Likewise, respondents with scores greater than 25 on the IES were regarded as having significant posttraumatic stress symptoms. The chosen cut-off scores are similar to those used by McFarlane [8] and others.

Table 2 presents threshold morbidity rates for the GHQ-12 and IES for QIS subgroups selected according to the six areas of investigation covered earlier, together with comparative data from three Australian studies [8, 49, 50]. In addition, Table 2 reports relative risk (RR) values and associated confidence intervals (CI) based on comparisons between the threshold morbidity rates for focal subgroups and those for their most relevant comparison group (e.g., users of general support services vs non-users of general support services). Thus, the first entry in Table 2, showing an RR of 2.2, is simply the threshold morbidity rate for users (33%) divided by that for non-users (15%) of general support services. Because of the large number of statistical comparisons in Table 2, 99% CIs are reported. Partly for convenience, and based on our knowledge of the statistically significant findings from the various multivariate analyses conducted during the QIS, an RR of 2.00 or greater was regarded as non-trivial and indicative of a finding that is worthy of consideration with respect to future disaster management and research.

As shown in Table 2, the highest threshold caseness rates on the general measure of psychological distress were found for those reporting high exposure to disruption *and* threat at phase 1 (58–64%), while, as expected, the lowest rates occurred among the low exposure group at phase 4 (13%). The latter figure is comparable to that found in past general community surveys [50]. Several of the other subgroups also experienced threshold caseness rates in excess of 50% for the GHQ-12, namely the injured (51%), the displaced (53%), those with high neuroticism scores (51%) and those with high use of avoidance coping (59%). The same subgroups also experienced the highest threshold caseness rates on the posttraumatic stress measure, with each subgroup's rate being above 30% (see Table 2). In addition, 38% of respondents with low levels of personal hopefulness were above the chosen morbidity threshold for the IES.

Using the RR values in Table 2 as a guide, a clear profile emerged as to the characteristics of those respondents who were above the threshold for caseness on the GHQ-12. They were more likely to have experienced high disruption and threat (either alone or in combination), to have reported above average levels of ongoing disruptions, and to have made greater use of support services. With respect to vulnerability factors, they were also more likely to have had higher neuroticism scores and to have used avoidance as a coping strategy. A similar profile could be constructed for the IES findings based on RR values $\geqslant 2.00$ (Table 2). In addition, respondents who were above the threshold for caseness on the IES were more likely to be female and/or from a NESB, to have been at home or in a large building when the earthquake occurred, to have been injured, and to have a low level of personal hopefulness.

Although the publications summarised in this paper did not focus on clinical diagnosis, some clinical validation work was undertaken as part of the QIS [29]. Based on the 142 interviews conducted between phases 3 and 4 using the revised Anxiety Disorders Interview Schedule (ADIS-R) [51], the sensitivity of the IES against a current DSM-IIIR diagnosis of PTSD was 77% (using the IES $>$ 25 cut-off reported earlier), while the corresponding specificity was 78%. Furthermore, by applying appropriate backweights to adjust for sampling bias, it was estimated that 7.2% (95% CI: 3.0–11.5%) of the community would have met diagnostic criteria for PTSD at some stage during the first 2 years post-disaster.

Methodological lessons

At the conclusion of a large project such as the QIS it is useful to re-evaluate the methods that were used. Below are the main issues that need to be considered.

Table 2 Threshold psychological morbidity rates for selected Quake Impact Study (QIS) subgroups

Area of investigation[a] QIS subgroup (sample size)		GHQ-12[b]		IES[b]	
		% > 3	RR[c]	% > 25	RR[c]
1. Service utilisation in the first 6 months					
Users of general support services (631)		33	2.2 (1.8–2.7)	21	2.1 (1.6–2.7)
Non-users of general support services (2,288)		15		10	
Users of disaster-related support services (346)		34	2.1 (1.7–2.7)	22	2.0 (1.5–2.7)
Non-users of disaster-related support services (2,596)		16		11	
2. Patterns of earthquake experience and short-term (6-month) outcome					
Males (1,270)		14		8	
Females (1,737)		22	1.6 (1.3–1.9)	16	2.0 (1.5–2.6)
Area of residence:					
Moderate damage area (2,186)		20	1.3 (1.0–1.7)	13	1.3 (1.0–1.8)
Minor damage area (821)		15		10	
Location at time of earthquake:					
Not in region (411)		14		6	
Shopping centre/large building (523)		22	1.6 (1.1–2.3)	15	2.5 (1.4–4.3)
At home (1,160)		20	1.4 (1.0–2.0)	13	2.1 (1.3–3.7)
Self-reported earthquake experiences:					
Low exposure (2,480)		14		10	
Disruption only (161)		37	2.7 (2.0–3.6)	20	2.0 (1.3–3.1)
Threat only (250)		34	2.4 (1.9–3.2)	25	2.5 (1.8–3.5)
Disruption and threat (86)		58	4.2 (3.2–5.4)	33	3.3 (2.1–5.0)
3. Earthquake exposure and medium-term (2-year) outcome[d]					
Special interest group membership:					
Injured (75)		51	1.8 (1.2–2.7)	42	2.4 (1.5–3.8)
Displaced (155)		53	1.9 (1.4–2.6)	32	1.8 (1.2–2.8)
Owners of damaged businesses (183)		35	1.3 (0.9–1.8)	21	1.2 (0.7–1.9)
Helpers in threat situations (151)		24	0.9 (0.5–1.3)	15	0.8 (0.5–1.5)
Helpers in non-threat situations (204)		27	1.0 (0.7–1.4)	16	0.9 (0.5–1.5)
Non-members of special interest groups (294)		28		18	
Self-reported earthquake experiences:					
Low exposure (264)	Ph. 1	15		11	
	Ph. 4	13		3	
Disruption only (182)	Ph. 1	40	2.6 (1.7–4.1)	19	1.8 (1.0–3.2)
	Ph. 4	19	1.5 (0.8–2.6)	8	2.7 (0.9–8.2)
Threat only (293)	Ph. 1	34	2.3 (1.5–3.5)	23	2.1 (1.2–3.5)
	Ph. 4	21	1.6 (1.0–2.7)	13	4.3 (1.6–11.4)
Disruption and threat (106)	Ph. 1	64	4.2 (2.8–6.4)	40	3.6 (2.1–6.2)
	Ph. 4	34	2.6 (1.5–4.5)	19	6.2 (2.2–17.5)
Ongoing disruptions index:					
Low ongoing disruptions ($\leq$ 0.66; 503)	Ph. 2	19		13	
	Ph. 4	15		7	
High ongoing disruptions (> 0.66; 338)	Ph. 2	44	2.3 (1.7–3.1)	27	2.1 (1.4–3.0)
	Ph. 4	26	1.7 (1.2–2.5)	15	2.2 (1.3–3.7)
4. Vulnerability factors and medium-term (2-year) outcome[d]					
Low neuroticism (< 5; 512)		22		12	
High neuroticism ($\geq$ 5; 320)		51	2.3 (1.8–3.0)	35	2.9 (2.0–4.2)
Low personal hopefulness ($\leq$ 50; 258)		48	1.8 (1.4–2.3)	38	2.9 (2.0–4.1)
High personal hopefulness (> 50; 535)		27		13	
Low use of avoidance coping (< 50; 596)		25		14	
High use of avoidance coping ($\geq$ 50; 208)		59	2.4 (1.9–3.0)	39	2.8 (2.0–3.9)
5. Community groups at risk:					
(a) The elderly					
Adults aged < 65 years (2,371)		19		11	
Adults aged $\geq$ 65 years (636)		15	0.8 (0.6–1.0)	20	1.8 (1.4–2.3)
(b) Non-English speaking					
NESB sample (250)		24	1.2 (0.8–1.9)	25	2.1 (1.2–3.5)
Matched controls (250)		20		12	

(Table continued on the next page)

Table 2 (continued)

Area of investigation[a] QIS subgroup (sample size)	GHQ-12[b]		IES[b]	
	% > 3	RR[c]	% > 25	RR[c]
6. Stress debriefing[d]				
Debriefed helpers (62)	27	1.0 (0.5–1.9)	11	0.9 (0.3–2.6)
Non-debriefed helpers (133)	27		13	
Possible comparison studies (Australia)				
Ash Wednesday bushfire [8] – firefighters 4 months post-disaster:				
Low exposure (213)	20		19	
High exposure (246)	15	0.7 (0.4–1.3)	33	1.8 (1.1–2.7)
Queen Street shooting [49] – 8 months post-disaster:				
Trauma group (330)	36	2.3 (1.3–4.1)	34	20.9 (3.4–128)
Contrast group (123)	16		2	
General community surveys [50] – not following a traumatic event:				
Gosford/Wyong (2,900)	13			Not applicable
Wollongong (3,600)	10			

[a]See Table 1 for major findings and key publications
[b]Based on phase 1 General Health Questionnaire (GHQ-12) and Impact of Event Scale (IES) data unless otherwise specified
[c]Relative risk (RR) and associated 99% confidence interval (CI), that is, the morbidity rate for the subgroup relative to that for the most appropriate comparison group at the same phase (e.g., versus non-users, or those experiencing low exposure)
[d]Based on data from the (stratified) longitudinal data base, in which subjects experiencing high earthquake exposure and the members of the special interest groups were over-represented

Scope of the study: general vs specific

Following Green's [12] recommendations, in the QIS we attempted to collect longitudinal data that could be used both to characterise the whole community's response to the disaster [21] and to quantify the reactions of specifically targeted 'at risk' groups (e.g., the injured, the displaced) [24]. Because of our primary focus on a representative community sample, the issues that were addressed in our surveys had to be relevant to the majority of potential participants. By comparison, if we had concentrated solely on post-disaster responses among the elderly, for example, then we would probably have included instruments that screened for dementia. Likewise, if our focus was solely on helpers, then we would have collected more detailed information about past disaster exposure and current and past debriefing experiences. In short, the QIS enabled us to give more comprehensive accounts of the *overall* psychosocial impact of the disaster on the Newcastle community and the factors associated with diminished or increased psychosocial effects [21, 24, 25]. Nevertheless, where appropriate, we used the data collected to comment on specific issues of relevance to the disaster and life events literature, such as the patterns of post-disaster service utilisation [16], post-disaster psychological morbidity among immigrants [20] and the elderly [23], and the utility of stress debriefing for helpers [22].

Sampling issues

The sampling techniques used in the QIS were generally satisfactory and served their intended purposes well. In essence, these involved stratified selections from community electoral rolls, with supplementation from specifically targeted agencies to increase the sample sizes, in particular 'at risk' groups. As several community studies had been conducted in the Hunter Region prior to the earthquake, an alternative strategy may have been to seek to follow-up participants in these earlier studies. Ethical considerations aside, such a strategy may have provided an opportunity to examine more closely the contributions of premorbid factors to post-disaster morbidity. An additional concern was that the first phase of the QIS was not conducted until 6 months after the earthquake. This was partly because of the intended (2-year) longitudinal nature of the research design, but also because of our own and the Australian research community's general lack of preparedness for disaster studies and the difficulty in obtaining funding at the time of greatest need.

Instrument selection

The non-use of the SCL-90-R [34] during the phase 1 screening survey (owing to its length) was somewhat problematic, however, the relatively short GHQ-12,

which was included in each phase, appears to have performed adequately. On the other hand, we may have been over-inclusive in our use of *self-report* morbidity measures (GHQ-12, IES, SCL-90-R, and BDI), and may have benefited from the use of additional validation interviews (e.g., addressing the issues of earthquake exposure, service utilisation, clinical diagnoses, adequacy of personal and community supports, and ongoing disruptions). On the positive side, the principal vulnerability measures (neuroticism, personal hopefulness, and defense style) were included in two phases each, thereby enabling a more thorough assessment of their characteristics and correlates. In view of the findings with respect to the use of avoidance as a coping strategy, the Billings and Moos [33] instrument should have also been repeated. It is difficult to disentangle whether or not instruments such as this are measuring a trait characteristic (e.g., coping style) or the particular strategy used to deal with the focal event. While the item format focuses attention on typical strategies for dealing with stressful events, there may have been strong context effects. After all, the coping strategies measure was completed 6 months after the earthquake and was embedded in a detailed questionnaire asking about personal earthquake experiences.

Earthquake exposure and ongoing disruptions

Finally, as noted earlier, the threat and disruption exposure indices developed during this study [21, 24] were better predictors of post-disaster psychological morbidity than either the location-based or the group membership based measures of exposure. Likewise, the findings with respect to the contributions of ongoing disruptions to post-disaster morbidity [24, 25] suggest that it is imperative that suitable measures of initial exposure and ongoing disruptions be included in future disaster and life events research. In the QIS, the exposure measures were 'tailor-made' (i.e., based on measurement of each person's unique experiences) and not 'off-the-rack' - as a consequence, they had face validity (and demonstrable predictive validity). Thus, although the specific content of the exposure measures may not generalise to other studies, the strategy that we adopted may have widespread application.

Postscript

The Newcastle earthquake's effects were of a magnitude and distribution that was conducive to an epidemiological study of the entire community's disaster response. This enabled the longitudinal examination of the relative contributions of background factors, disposition, exposure type and extent, ongoing events, and social support to medium-term psychological morbidity. We believe our findings are likely to be valid for a population similar to Newcastle's experiencing a disaster of the nature and extent of the 1989 earthquake. However, we would caution against extrapolating these findings to disasters of greater magnitude, personal stressors of catastrophic severity (e.g., combat, hostage-taking, etc), and populations dissimilar to that of Newcastle.

Where should disaster research go from here? We believe that three areas in particular are in need of attention at this stage. First, there needs to be a clearer articulation of vulnerability factors and the development of practical means for their identification in victims of disasters. Second, there is a need for controlled trials of preventive interventions with disaster survivors, with the samples stratified for exposure and vulnerability. Third, a more microscopic examination of the evolution of post-disaster psychological morbidity should be undertaken, in particular, the interaction between (1) premorbid characteristics, (2) exposure, and (3) other extrinsic factors such as social support, life events, and other disaster sequelae that take account of such phenomena as salience and meaning of the event, cognitive schemata of safety or vulnerability, attributional style, the appraisal process, coping style, and the processes involved in resolving (or failing to resolve) the posttraumatic symptomatology. Finally, the problem of accessing sufficient resources for such studies needs to be addressed since disasters occur without regard to the calendar cycle of research grant preparation and evaluation, which is appropriate for most other research endeavours.

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