Life Events and Psychiatric Disorder:
The Role of a Natural Disaster

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Examining the impact of natural disasters on psychological health provides an opportunity to study the role played by extreme adversity in the onset of psychiatric disorder. Four hundred and sixty-nine fire-fighters who had been intensely exposed to an Australian bushfire disaster completed a detailed inventory of their experiences four months later. They also completed a brief life events schedule and the 12-item General Health Questionnaire. Only 9% of the GHQ score variance could be accounted for by the disaster and other life events; the effects of the disaster appeared to be separate and additive. This is similar to the relationship between life events and psychiatric illness found in other settings. It is suggested that vulnerability is a more important factor in breakdown than the degree of stress experienced.

Much research has tested the hypothesis that adverse life events are causally related to the onset of psychiatric disorder (Brown *et al*, 1976; Paykel, 1978; Tennant, 1983; Cooke & Hole, 1983). Most of this research has examined the additive effect of a range of diverse experiences on psychiatric impairment. An alternative method is to study a population comprised of people who have all experienced the same life event, but with a range of intensities. This research design has been used infrequently. One setting where it might be utilised is in investigating the effects of a natural disaster on psychological disorder, since the individual experiences of disaster victims vary, although they have all been exposed to the same highly distressing event.

Previous disaster research has not universally supported the conclusion of life events research that adversity is causally related to the onset of psychiatric disorder (Green, 1982). There is a range of opinion about the psychological consequences of disasters, extending from the claim that the level of morbidity is high and long-lasting (Gleser *et al*, 1981; Leopold & Dillon, 1963) to the view that disasters have little or no important effect on mental health (Quarantelli & Dynes, 1977). A major reason for this controversy lies in the failure of much disaster research to use a quantitative rather than a qualitative methodology. Green (1982) has argued that future disaster research must carefully document the intensity of exposure and the nature of the losses sustained in the disaster, and must relate these to the levels of psychiatric morbidity.

Many potential problems exist in using this approach, because accepted measures of the impact of a disaster have not been developed. Furthermore, their validation presents problems for most researchers, because major disasters are infrequent. The experience of researchers into other life events could assist in this process of validation.

Although there are a number of common methodological and theoretical issues, there has been little cross-fertilisation of ideas between disaster research and life events research (McFarlane, 1985). For example, it has been concluded that although a link exists between adversity and neurotic impairment, the relationship accounts for only about 10% of the variance of disorder (Tennant, 1983). On the other hand, life events researches generally accept that "disasters show that when psychological stress is sufficiently severe, virtually everyone decompensates and becomes demoralised, dependent, and identifiable as a psychiatric case" (Andrews & Tennant, 1978). Such assertions about the level of psychiatric morbidity following a natural disaster were quantitatively investigated in the present study.

The nature of the interaction between different major adverse life events and the onset of psychiatric disorder is another issue to be examined in disaster victims. Holmes & Rahe (1967) suggested that events had an additive effect, whereas Brown & Harris (1978) assumed that once a single event of sufficient intensity had been experienced, other events were relatively unimportant. If the first hypothesis were correct, the experience of substantial adversity prior to a disaster would have an effect additive to that of the disaster; if the second were correct, prior adversity would have a more powerful association with psychiatric morbidity than would the disaster event.

The present study examined the two hypotheses by investigating the impact of a bushfire disaster on a group of fire-fighters who had varying exposure to it. The first hypothesis was that a significant relationship would exist between the degree of adversity experienced by individual fire-fighters and their level of psychiatric morbidity but that this would not account for more than 10% of the total variance. The second hypothesis was that major adverse life events would show a relationship with psychiatric disorder which was independent of the effects of the natural disaster.

Method

The setting: disaster and fire-fighters

On 16 February 1983 several disastrous bushfires burnt 2804 km^2 of bush, grazing land, orchards, forests, and national parks in South Australia. Twenty-eight people were killed and many hundreds injured, and over 250 000 stock animals were killed. The fire destroyed or severely damaged 385 homes, and 3200 properties were affected in some way. A conservative estimate of the cost of the damage was $A200 million. The psychological impact of the disaster has been reported elsewhere (McFarlane, 1984; McFarlane & Raphael, 1984).

A large organisation of volunteer fire-fighters exists in Australia to combat such fires. Several thousand of these firefighters, living both within and outside the fire-devastated area, attempted to control the blaze. Three were killed, a number lost their homes, others had their stock and farms destroyed, and many were injured. This group provided an ideal opportunity to study the onset of psychiatric morbidity following a disaster, because of its wide range of exposure and losses.

Questionnaire design

A preliminary questionnaire was designed, comprising an inventory of the impact of the disaster, a brief life events inventory, and the 12-item General Health Questionnaire (Goldberg, 1972). It was administered to 26 senior fire-fighters and then discussed with them. Ambiguities were corrected, and several questions added to ensure that a complete description of the fire-fighters' experiences was obtained. The inventory of the impact of the disaster consisted of 15 questions about personal and property losses, 9 about the nature and duration of the fire-fighters' exposure to the fire, and 8 documenting the injuries sustained and the type of treatment received. These allowed an overall rating of severity.

The brief inventory of life events experienced before the fire was based on items 2, 12, 13, 14, 15, 45, and 60 from Tennant & Andrews' (1976) life event inventory. These items focused on financial and legal difficulties, bereavement, and ill-health – factors that might be expected to influence the experience of a disaster.

The final part was the 12-item General Health Questionnaire (Goldberg, 1972). This has been validated as a reliable measure of psychiatric impairment in an Australian population (Tennant, 1977), in which setting, used as a 'caseness' measure, it has been shown to have a specificity of 91.7%, a sensitivity of 86.6%, and a misclassification rate of 10%. For correlational analysis the Likert score of the GHQ was calculated. A cut-off of 1/2 was used for definition of 'caseness'; the prevalence of cases was also calculated at a cut-off of 2/3.

Sampling method

The sample was chosen from the volunteer fire-fighting service. This did not have an accessible current membership list at the time of the disaster, and therefore the questionnaires had to be distributed through headquarters staff. They passed them on to the brigade commanders, who in turn gave them to the volunteers. A total of 1500 questionnaires were delivered for distribution three months after the disaster. Despite a request, no record was made of exactly how many of the 1500 questionnaires were given to fire-fighters. No follow-up reminders could be sent to improve the return rate, because the names of the fire-fighters who had received the questionnaires were not recorded. A total of 489 questionnaires were returned, by prepaid postage, a mean of one month later, i.e. four months after the disaster. Twenty questionnaires were excluded because the reponses were not sufficiently complete.

The apparent low return rate of 30% raises the possibility that a potential bias existed in the sampling. However, it may have been an artefact, as subsequent discussion with headquarters staff revealed that a significant number of questionnaires had possibly not been distributed by the brigade officers, some of whom had sustained major losses themselves in the disaster and had no time to spare from reconstruction. A comparison sample of fire-fighters was therefore studied in an attempt to ascertain whether a range of demographic variables, or the nature of the individual's experience of the disaster, had biased the initial sampling. Eleven months after the fire the fire-fighting organisation had updated its membership records and these were made available. Seven brigades, selected on advice from headquarters staff because they were seen to be representative of the fire-fighters in terms of experience of the disaster and membership composition, were chosen for study as a comparison group. The original sample was resurveyed at the same time (this data is not reported in this paper, except for the GHQ scores).

Two follow-up letters were then sent to those comparison group subjects who did not return the questionnaire, to ensure an adequate response rate. By comparing this group with the original sample over a range of variables it was possible to establish the representativeness of the original sample within the organisation. Most members of the fire-fighting organisation were involved in the disaster, so no non-exposed control group was available.

Method of scaling

The range of exposure and losses sustained in the diaster was known to be substantial. The questionnaire was therefore designed to allow separate scaling of four aspects of the fire-fighters' experience of the disaster. Firstly, the personal loss sub-scale recorded the number of people known to the fire-fighter who were killed in the fire and the nature of their relationship to the subject. The weighting of losses was based on the relative weighting for change of the items in the Tennant & Andrews (1976) life events inventory, which has been validated in an Australian population (e.g. death of a close friend = 1, death of a sibling = 2, death of a spouse = 3). The names of all those killed or seriously injured in the fire were published in the media. This made it possible to validate the reporting of deaths or injury in next of kin or first degree relatives by cross-referencing the surnames of the victims with the research subjects. No misreports of personal losses were found.

Secondly, the injury sub-scale was weighted on the basis of the type of treatment required, rather than on reported severity of injury which might have been subjective (e.g. hospitalisation = 3, medical out-patient care = 2, nurse or ambulance officer = 1).

Thirdly, the exposure sub-scale items (which measured the time spent fighting the fire, the use of emergency procedures to protect the fire unit, whether the subject was trapped by the blaze, etc.) were additive and unweighted. The inter-relater reliability of this sub-scale was found to be acceptable by comparing the reports of members of the same units who had had similar, but not identical, experiences of a fire ($r = 0.76$).

Finally, the scoring of the property loss sub-scale covered a range of damage and losses. This included complete destruction of a fire-fighter's home or other property and buildings, as well as damage in varying degrees. Because a number of fire-fighters were farmers, loss of income was also recorded. The items of this sub-scale were weighted according to the amounts of practical assistance require to reparate for losses. The weighting was obtained by surveying the special team of 20 bushfire relief workers appointed to assist the disaster victims, who were able to assess independently the impact of losses in the context of the disaster; their averaged responses were used as weighting. Thus the scaling of losses was not contaminated by the distress generated. The procedure is to be described in more detail elsewhere.

Statistical analysis

The data were analysed using the Statistical Package for the Social Sciences (SPSS) (Nie et al, 1975; Hull & Nie, 1981); a probability level of one in twenty was used. Groups were compared using chi-squared, Mann-Whitney U and Student's t-tests, according to the characteristics of the variable being examined. The variance of the GHQ score was investigated using a multiple regression analysis (Hull & Nie, 1981) which only examines the contribution of significantly loading variables. Pearson's correlation coefficients were calculated, because of the size of the sample studied and because the SPSS only computes regression analyses using parametric statistics.

Results

Sample

When the original cohort of 469 fire-fighters was compared with the comparison group on a range of demographic variables, several statistically significant, but small, differences emerged (Table I). The mean age of the study sample was less by two years than that of the comparison group, and the comparison group was of slightly higher social class (Krupinski et al, 1966), more of its members being farmers. The two groups' experience of the disaster, measured by the sum of their fire-related experiences, was not significantly different, and they did not differ significantly on GHQ scores.

Disaster experience

Individual experience of the disaster varied widely. Some degree of property damage was suffered by 23% of the sample, in many cases enough to affect their livelihood. None of the subjects had lost a first degree relative,

TABLE I
Study sample and comparison group data

	Study sample (n = 469)	Comparison group (n = 162)	Statistical comparison
Return rate: %	30	59	
Married: %	73.6	72.2	$\chi^2 = 0.54$
Australian born: %	87.7	87.7	$\chi^2 = 0.0000$
Social class[1]: %			$\chi^2 = 14.0*$
1	19.3	23	
2	32.7	37.9	
3	7.4	5.0	
4	28.4	16.8	
5	5.1	10.6	
Other	7.2	6.8	
Age[2]: years			$t = 2.6*$
Mean	35.1	37.8	
s.d.	10.6	13.1	
Disaster experience			Mann-Whitney U test: $z = 0.26$
Mean	8.9	9.2	
s.d.	3.0	4.2	
GHQ[3] score			$t = 0.41$
Mean	1.4	1.5	
s.d.	2.3	2.9	
Proportion of cases found by GHQ: %	26.8	26.3	$\chi^2 = 0.0012$

1. Classified following Krupinski et al (1966).
2. At time of comparison.
3. GHQ scores 11 months after the fire.
*$P \leqslant 0.05$.

TABLE II
Pearson correlations between GHQ and other variables (n = 469)

| Variable | Rating[1] | | | |
	Mean	s.d.	r	P
Exposure	7.0	1.5	0.12	0.007
Perceived threat	2.7	0.8	0.13	0.004
Injury	1.5	0.9	0.02	0.3
Property loss	0.7	1.7	0.20	0.000
Personal loss	0.5	1.2	0.03	0.2
Recent life events	0.9	1.0	0.17	0.000
Previous fires	4.8	8.2	0.12	0.006
Age	33.7	10.6	-0.01	0.4
Social class	3.6	2.1	0.06	0.1

1. Based on questionnaire score.

although 7% had experienced some bereavement due to the death of a more distant relative or close friend. The mean during of time fighting the fire was 15.6 hours. During that time 19.7% of subjects believed they had come close to dying, and 41.2% had had to protect themselves from the fire using emergency procedures. Of the 26.6% injured, 12% had been admitted to hospital.

Relationship between GHQ and fire experience

The relationship between the GHQ and a range of variables was examined (Table II). Most fire-related variables were significantly correlated with the GHQ score, with the exception of personal loss and injury. Experience of previous fires was also significantly associated with the GHQ score, although age and social class (Krupinski *et al*,

TABLE III
Comparison of cases with non-cases (as defined by GHQ scores)

| Variable | Rating for cases[1] (n = 146) | | Rating for non-cases (n = 311) | | t (2-tailed) | P |
	Mean	s.d.	Mean	s.d.		
Exposure	7.3	1.6	6.9	1.4	-2.3	0.02
Hours fighting	18.9	19.2	14.3	12.8	-3.0	0.003
Perceived threat	2.8	0.8	2.6	0.7	-2.5	0.01
Personal loss	0.5	1.2	0.4	1.2	-0.8	0.4
Property loss	1.3	2.2	0.5	1.4	-4.7	0.000
Injury	1.5	0.9	1.5	0.9	-0.7	0.5
Previous fires	5.7	10.5	4.5	7.0	-1.4	0.2
Age	32.5	8.8	33.9	11.1	1.4	0.2
Social class	3.2	1.6	2.9	1.4	-1.4	0.1
Recent life event	1.14	1.19	0.77	.93	-3.6	0.000
GHQ	4.76	2.8	0.19	0.4	-28.3	0.000

1. Based on GHQ ≥ 2.

1966) were not. Experience of recent adverse events prior to the disaster was significantly correlated correlated with the GHQ score. The size of these correlation coefficients was generally small, in part owing their significance to the size of the sample.

The 146 'cases', defined by using a cut-off point of 1/2 on the 12-item GHQ, were compared with 311 'non-cases' (Table III). On all variables that were significantly different, those subjects demonstrating psychiatric impairment had a higher level of exposure to the disaster. Again, personal loss and injury were not significantly different between cases and non-cases.

Prevalence of disorder

The prevalence of cases among the fire-fighters was 30% using a 1/2 cut-off. When the 2/3 threshold was used, the prevalence was 23.2%.

Variance attributable to the disaster

The proportion of the variance of psychiatric impairment that could be explained by experience of the disaster and other recent life events was examined using stepwise multiple regression analysis of the GHQ. The fire-fighters' exposure, perceived threat, severity of injury, personal loss, property loss, and the recent events score were included in the equation. The only significantly loading variables were property loss, accounting for 4.9% of the variance (multiple $r = 0.23$, adjusted $r^2 = 0.049$, $f = 19.03$, $P = 0.000$), and recent life events, which predicted a further 3.8% (multiple $r = 0.30$, adjusted $r^2 = 0.087$, $f = 17.69$, $P = 0.000$). None of the other variables predicted a significant percentage of the variance.

Discussion

The data from this study provided support for the first hypothesis, i.e. that a significant relationship would exist between the degree of adversity experienced by individuals in a disaster and their level of psychiatric morbidity. However, it should be noted that this relationship was weak. For example, although the cases and non-cases were significantly different on a number of fire-related variables, the differences in mean values were not great.

The second hypothesis, about the magnitude of this association, was supported by the finding that only 9% of the variance of the GHQ could be accounted for by the disaster and recent life events. This confirms the strength of the association previously postulated as existing between life events and the onset of psychiatric disorder (Andrews & Tennant, 1978; Paykel, 1978). Thus a consensus arises from two quite different methodological approaches – one looking at the effect of multiple random life events (Holmes & Rahe, 1967; Tennant & Andrews, 1976; Paykel *et al*, 1971) and the other, employed in this study, looking at the impact of one threatening and destructive event.

There was also support for the last hypothesis examined: that major adverse life events have independent relationships with psychiatric disorder. Firstly, the effect of the disaster was independently associated with psychiatric impairment, not being 'partialled out' in the regression analysis by the contribution of threatening life events experienced before the fire. In other words, people who had experienced life events before the fire remained equally, if not more, susceptible than others to the emotional effects of the disaster itself.

Secondly, the impact of the disaster was sequential in time, the fire-fighters being exposed to the disaster before being in a position to establish their personal and property losses. All but 9% were unable to defend their own property, because they were fighting the fire elsewhere. Although exposure and perceived threat correlated with the GHQ score, the most powerful association was with property loss (Table II). It is probable that the ongoing stresses of property loss, such as loss of income for farmers, accounted for the strength of the association, which provides further support for an additive effect. Furthermore, the fact that the two variances (i.e. that accounted for by events experienced prior to the disaster and that accounted for by the disaster itself) were of a similar order of magnitude supports the view of Holmes & Rahe (1967) that major adverse life events have an additive and relatively independent effect.

This study demonstrates that investigating the psychological impact of a natural disaster provides an opportunity to examine the relationship between minor psychiatric disorder and a recent life event in the absence of several methodological problems often encountered in life event research (Paykel, 1983). This is because recall of a disaster is likely to be more consistent than that of other events, its impact is easier to document than that of a wide range of life events (Finlay-Jones, 1981), and a disaster is not a consequence of illness (Brown, 1974).

However, the current study has limitations that need to be considered in the interpretation of the data. Firstly, the questionnaire return rate was low, as is often the case in disaster research (Logue et al, 1981). However, the study sample was not skewed to any substantial degree. In particular, the fire-fighters studied and the comparison group did not significantly differ in their experience of the disaster or the prevalence of psychiatric morbidity, the two variables that would have suggested biased sampling. Secondly, the inventory used in this study has not been formally validated. However, there appeared to be face validity in its construction. For example, in the personal loss sub-scale the weighting was based on a carefully validated life events scale measuring these same losses (Tennant & Andrews, 1976). Formal validation can only occur following a disaster, and such events are infrequent. To this end, Green (1982) has called for careful reporting of quantitative methodology so that standardised checklists can be developed for disaster research. The present paper is an attempt to begin the process.

Finally, it is difficult to know how typical this population was of the victims of the Ash Wednesday disaster. While it is reasonable to speculate that fire-fighters were significantly affected by exposure to the disaster, the study does not establish whether the same magnitude of association between experience of the fire and psychiatric impairment would occur in an unbiased community sample.

However, fire-fighters are of particular interest because, unlike others involved in disasters who, in general, attempt to protect themselves, most of these people were committed to facing extreme danger for hours on end, as well as risking serious injury and substantial personal and property losses. This would suggest that the relatively small association between psychiatric impairment and exposure to the disaster cannot be explained away by a relative absence of danger or loss.

Furthermore, the validity of these data is substantial because a number of potentially confounding variables, often present in disaster victims, were not operating. Two factors that can influence the reporting and prevalence of neurotic impairment among disaster and accident victims are compensation payments for psychological trauma and the neurological sequelae of head injuries (Lishman, 1973). The voluntary nature of the organisation to which the fire-fighters belonged, and the absence of head injuries among them, meant that neither of these potentially confounding variables was operating here.

In conclusion, the data suggest that the majority of the fire-fighters studied did not become cases, despite experiencing prolonged life-threatening stress, frequent injury, and property loss. This raises the possibility that psychiatric morbidity in a population affected by disaster can perhaps better be explained using a model where the disaster acts as a trigger to most of the individuals who are already vulnerable to decompensation (Hendin et al, 1983; McFarlane, 1984). If this proposition is correct, the exact prevalence of cases following a disaster may be more influenced by the prevalence of premorbid risk factors than by the severity of the disaster. Although the prevalence of psychiatric impairment in a population after a disaster may be substantial, such a trigger effect would lessen the size of any linear

correlation between the disaster experience and psychiatric disorder if individual thresholds for decompensation were variable, as has been suggested by Paykel (1978). This may explain why only 4.9% of the variance of minor psychiatric disorder in this population could be explained by the intensity of the individual's disaster experience.

The small proportion of the variance of disorder successfully accounted for in this population raises the question of what factors may explain the rest of it. Some disaster literature has proposed that problems with mental health, where they exist, can be attributed to the destruction of kinship or social networks (Perry & Lindell, 1978). However, these firefighters had high levels of social support before, during, and after the disaster from within the firefighting organisation. Also, two studies of psychiatric morbidity among victims of this same bushfire disaster found little or no relationship between social support and the GHQ score (Hill, 1983; Wallace et al, 1985). Thus lack of social support did not appear to be a major factor contributing to psychological impairment.

Therefore, the other variables which may influence an individual's vulnerability to psychiatric morbidity following a disaster – such as genetic predisposition to psychiatric disorder, personality type, psychodynamic characteristics, and family relationships – all require further investigation. If preventive mental health services are to be provided after disasters, definition of the characteristics of those who are at risk of decomposition is of central importance.

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