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ORIGINAL PAPER

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Surviving adversity: event decay, vulnerability and the onset of anxiety and depressive disorder

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Abstract Knowledge concerning the temporal relationship between adverse experiences and the onset of anxiety and depressive disorders remains sparse despite life stress forming a pivotal component to social, neurological and cognitive science models of their aetiology. In this study two groups of married women were selected through their shared adverse experiences; for one group, the marital partner had recently died, and in the second group, the marital partner had recently experienced a myocardial infarction. These groups were assessed in close proximity to their event experiences and again approximately 3 months later. Adaptations of both the Longitudinal Interval Follow-up Evaluation and the Life Event and Difficulty Schedule were used to provide a detailed clinical and event history both preceding and following their experiences. Analysis showed clear evidence for the progressive decay in the adverse effects of life events over time; an attribute thus far largely neglected in work seeking to clarify event–illness relationships. Comparisons between fixed and time-varying effects, representative of precisely formulated models of vulnerability/resilience, confirmed the role both of previous psychiatric consultation history and of limited individual coping skills as risk factors for the onset of diagnosable disorder. Improvements in the specification of stress modelling procedures should facilitate the integration of ideas from competing aetiological models of the onset and subsequent course of anxiety and depressive disorder.

Key words Depression · Life events · Survival analysis · Vulnerability

Introduction

Studies seeking to improve understanding of the relationship between adverse experience and the onset of depressive and anxiety disorder have been limited by inadequate methods for the assessment of event histories, by the (relative) unreliability of approaches to characterizing mental state and, until recently, by the absence of any formal criteria by which to specify the clinical course of psychiatric conditions. Over the past two decades these limitations have been reduced progressively by three strategies: (a) the development of more formal approaches to the assessment of adverse experience (e.g. Brown and Harris 1978, 1989; Paykel 1983, 1997); (b) improvements in the reliability of diagnostic schemes (Segal et al. 1994; Sartorius et al. 1995); and (c) the publication of guidelines (and suggested procedures) for documenting clinical course (Keller et al. 1987; Frank et al. 1991). The combined use of these approaches, e.g. within the context of a longitudinal research design, now provides a firmer basis for evaluating the role of social factors in psychiatric disorder and affords new opportunities for directly testing hypotheses considered increasingly pivotal for models of vulnerability or resilience. Therefore, in part, the evolution in assessment procedures has been driven by the need to improve scientific rigour and to meet the challenges posed by the increasing complexity of ideas concerning the social aetiology of psychiatric states.

A central foundation to much of this work has been to improve understanding of the relationship between adverse experience and the onset and course of (clinical) depression and anxiety. However, with advances in assessment methodology, the research focus has moved progressively away from this specific issue to seek a more sophisticated understanding of the health consequences of adversity through detailed study of individual differences (e.g. in cognitive coping; see Hammen 1992; Bifulco and Brown 1996), and through classifying the characteristics of stress experience, enabling, for example, links to be drawn between the special salience of certain adverse experiences with matching individual circumstances (Brown et al. 1987, 1995; Lam et al. 1996). This work stems directly from the primary finding of an excess of stressful events occurring prior to the onset of depression. However, with few exceptions, this now routine finding has re-

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ceived little further attention from researchers seeking to clarify the temporal process of health change following adverse experience. As a consequence, this process remains poorly understood with analytical strategies often relying upon a distillation of detailed event histories (gathered by extensive interview) from those judged either to have, or not to have, been exposed to adverse experiences within pre-specified time periods. Such binary measures (usually of severely threatening events) have formed a basis for determining, for example, the extent to which such exposures differ prior to the onset of endogenous or non-endogenous depressive episodes (Brown et al. 1994; Frank et al. 1994) or carry diagnostic specificity (e.g. "loss" events and depression, "danger" events and anxiety; Brown et al. 1992, 1993). Findings therefore stem from measures that, although endowed with "meaning" through a sophisticated rating process, have been analysed through methods that typically have taken little or no account of the temporal patterns of events or of possible time-varying effects.

Whereas there have been attempts to investigate hypotheses concerning the relevance of particular, perhaps global, event attributes for improving understanding of the onset of predominantly depressive states (e.g. concerning additivity; Brown and Harris 1978; Miller and Ingham 1985; Frank et al. 1996; Surtees et al. 1997), or to test more sophisticated models of adversity that have allowed for special event qualities (e.g. the postulated decay of event effects over time (Surtees 1989) or stress incubation effects (Bebbington et al. 1993), formal investigation of these *assumed* properties has been constrained in the past by the evident lag between such ideas and the capacity for data derived from the prevailing assessment methodologies to permit their investigation. As a consequence, understanding of the relationship between adversity and change in psychiatric health status remains limited even in fundamental ways. This has served to restrict further research progress in, for example, charting individual vulnerability/resilience, or in improving our ability to test and integrate specific models of the aetiology of depressive disorders that depend fundamentally in some sense upon adverse experience, e.g. that take social (Brown and Harris 1978), developmental neurobiology (Post et al. 1995) or cognitive science perspectives (Segal et al. 1996).

For this work a discrete time survival method was employed with combinations of time-dependent covariates used to examine the influence of adversities on onsets of (anxiety and depressive) disorder and also to formulate and test specific vulnerability hypotheses. Such methods are recognised as useful tools for the analysis of survival data when covariate values vary with time (see e.g. Kessler et al. 1997; Willett and Singer 1997) and the approach holds the promise of relative ease of interpretation of findings over other more complex procedures.

Subjects and methods

A sample of bereaved subjects was recruited through regular contact with 13 general practitioner (GP) practices within Lothian Region, Scotland (every 2 weeks from April 1988 until the end of May 1989). Such contact identified those married men of working age who had died during the preceding 2 weeks. Shortly after each death, and through the GP, a research interview was undertaken with the deceased's spouse. Over the same time period all married male patients who had been admitted either to the Royal Infirmary or to the Western General Hospital in Edinburgh, Scotland, following their experience of a myocardial infarction (MI) were approached. Suitable patients were married, of working age and were living within the areas served by the two hospitals. Following appropriate agreement, a research interview was completed with the spouse approximately 1 month after the husband had experienced his MI. Those few wives who would have been interviewed because of their husband's MI, but whose husbands had died before leaving hospital, were included within the bereavement group. Full details of the research design have been provided elsewhere (Surtees and Miller 1993). An initial interview was undertaken on average approximately 6–7 weeks following the bereaved and coronary events. This interview included assessments of the life stress and psychiatric status of each respondent over the period from 6 months prior to event occurrence up to the time of interview. A follow-up assessment was completed between 3 and 4 months after the first interview and covered the time period between interviews. The principal parts of the initial assessment were repeated at follow-up.

Assessment of adverse experiences

Interviewers were trained in the collection of routine demographic information, social support, coping styles, the assessment of life stress and psychiatric status. The assessment of life stress was through an adaptation of the Life Events and Difficulties Schedule (LEDS) developed by Brown and Harris (1989). Details of the methods and ratings completed are provided elsewhere (Miller and Surtees 1993). Briefly, the semi-structured interview focused initially upon the study event and obtained a detailed history of all the circumstances that led up to its occurrence and then particulars of all other life events and long-term difficulties that were present and satisfied the assessment criteria. Ratings made were those derived from the work of Brown and colleagues (Brown and Harris 1978; Brown et al. 1987) and from developments of that work completed in Edinburgh (Miller et al. 1987).

Measurement of psychiatric status and clinical course

Schedules were designed to enable trained interviewers to assess the variation over time of the psychiatric status of respondents in accordance with the Research Diagnostic Criteria (RDC; Spitzer et al. 1978) and according to Longitudinal Interval Follow-up Evaluation procedures (LIFE; Keller et al. 1987). As appropriate, LIFE-based diagnostic assessments were completed for major and minor depressive disorders, intermittent depressive disorder (and features), panic disorder, generalized anxiety disorder (with and without depression) and phobic disorder. Use of LIFE enabled all changes in psychiatric episode status over the study period to be mapped in terms of psychiatric status ratings (PSRs) operationally linked to the RDC for those conditions assessed. The timing of the event that recruited women to the study was regarded as having occurred on the last day of week 26, the timing of the first and follow-up interviews relative to the event could then be charted as could the PSRs based on the formal assessments of mental state of the respondents. Rules concerning the course status of episodes were imposed based on the general principles of the RDC. These rules, although developed specifically for this project, largely overlap with the recommendations

proposed by Frank and colleagues (1991). On conclusion of data collection, a joint review of the charts resulting from use of the assessment methods was completed with the developers of the LIFE. Further details of the approach adopted in this study are available elsewhere (Surtees 1995).

Coping scale ratings

Assessments of coping style were completed by interviewers on the following five-point scales: fighting spirit, helpless/hopeless, fatalistic, avoidance and anger/frustration. These scales were derived from previous work investigating the psychological adjustment to breast cancer and its effect on outcome (e.g. Greer and Morris 1978; Greer et al. 1979; Dean and Surtees 1989). In this work, cognitive and behavioural responses to being told of a diagnosis of cancer were assessed using a clinical interview and later through a questionnaire method, the Mental Adjustment to Cancer (MAC) scale (Greer and Watson 1987; Watson et al. 1988). For this study rating decisions were made by interviewers on the completion of their assessments and were based on the subject's behaviour and responses throughout the interview. Guide notes assisted with this process. Details of these coping style assessments have been described elsewhere (Surtees and Miller 1994) and enabled the derivation of a global summary coping index that was included in the analyses for this paper.

Social support

All subjects were asked at their first interview about the comfort and support that they received during the first week immediately following their event experience. Those questions that established whether the subject had expected support from friends or family but felt that she had been "let down", either through their failing to offer help and support or by being deliberately unhelpful or critical, provided the measure used in the analysis. Further details of these measures are provided elsewhere (Miller and Surtees 1995).

Statistical analysis

Observed survival (without onset of either anxiety or depressive disorder) was examined via Kaplan-Meier curves and a discrete (grouped time) method of survival analysis (see Kalbfleisch and Prentice 1980; Allison 1984) was employed to examine the relationship between exposure to the primary study adverse events and new onsets of RDC disorder. The logistic regression model[1] of Thompson (1977) was employed using SPlus (Chambers and Hastie 1992) with results summarised as odds ratios along with corresponding 95% confidence intervals. Pearson's χ^2 Statistic was used to compare observed and expected counts and χ^2 tests of differences in residual deviance were used to compare nested models. The occurrence of the primary study event was modelled using a time-dependent covariate[2]. This was allowed to adopt different forms and these were compared both to explore the temporal variation in the influence of this event on RDC onset rates and to examine ideas of vulnerability and resilience. Figure 1 shows the time-dependent covariates used in the analysis, relative to the timing of the primary study events. In Fig. 1, x_1 represents the most commonly used form of a time-dependent covariate and *restricts* the influence of the event to time periods *after* they have occurred. The second covariate x_2, has the additional attribute that this influence is of fixed duration, and the final two covariates (x_{t-1}, x_{t-2}) allow effects of different duration and timing to be studied. By investigating combinations of these simple time-dependent covariates, a model can be constructed to represent relationships that would otherwise have to be expressed in a more complicated way (as an example, a comparison of x_2 vs x_1 provides an explicit test of whether or not the effect of the event is of *fixed* duration)[3].

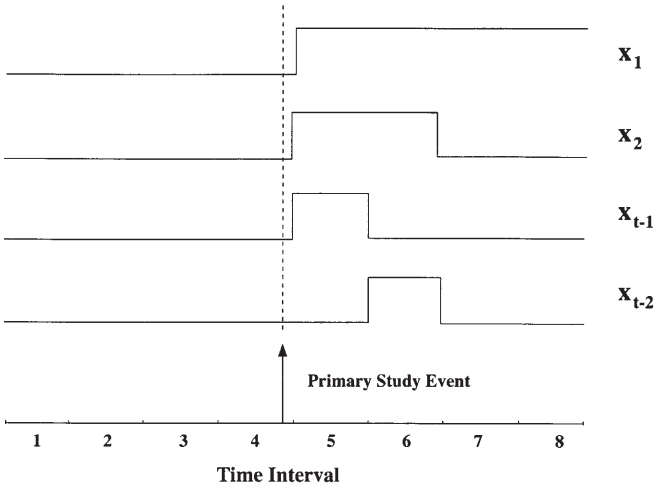

Fig. 1 Four functional forms representative of variation in the hazard of RDC onset following exposure to the study events

In this paper, therefore, we focus exclusively on two groups of married women selected through their shared adverse experiences. For one group, the marital partner had recently died (the bereaved group), and in the second group the marital partner had recently experienced a myocardial infarction (the coronary group). We believe that through adopting this "event-specific" design, together with the employment of well-developed event and psychiatric history methodologies, the resulting longitudinal data set provides a firm basis for advancing understanding of the temporal relationship between adverse experience and (psychiatric) health change. In addition, the design should permit distinctions to be made between models that seek to explain such variation through their dependency upon time-varying or time-independent effects. For brevity, the bereavement and coronary events are referred to herein collectively as the "primary study events". Our specific aims were to: (a) establish a relationship between the timing of the primary study events and the timings of onsets of RDC defined disorder; (b) explore the temporal variation in this relationship (e.g. to establish the duration for which these events appear to influence RDC onset rates and to entertain ideas of event-decay effects); and (c) examine other factors that may account for this temporal variation (fixed risk-factor effects and time-varying effects representative of vulnerability/resilience).

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[1] The discrete time survival model requires data expansion so that each individual contributes one observation for each time interval at risk. Outcome is a series of binary indicators, y_{it} for individual i at time t and analysis can be performed as in a standard logistic regression model

[2] The discrete time hazards model provides a natural framework for the inclusion of time-dependent covariates. Each outcome y_{it} is associated with corresponding covariate value x_{it} and for each individual i these x_{it} may be fixed or may vary with each time interval, t (no further data expansion is required)

[3] When comparing two functional forms for the time-varying effect of a covariate, these forms ($x_1(t)$ and $x_2(t)$) were regarded as separate time-dependent covariates. If $x_1(t)$ was significant with $x_2(t)$ already in the model, but not vice versa, this was regarded as strong evidence that $x_1(t)$ was a better representation of the functional form of the effect. If both $x_1(t)$ and $x_2(t)$ were significant when on their own, but neither was significant when the other was already in the model, there was no strong evidence either way

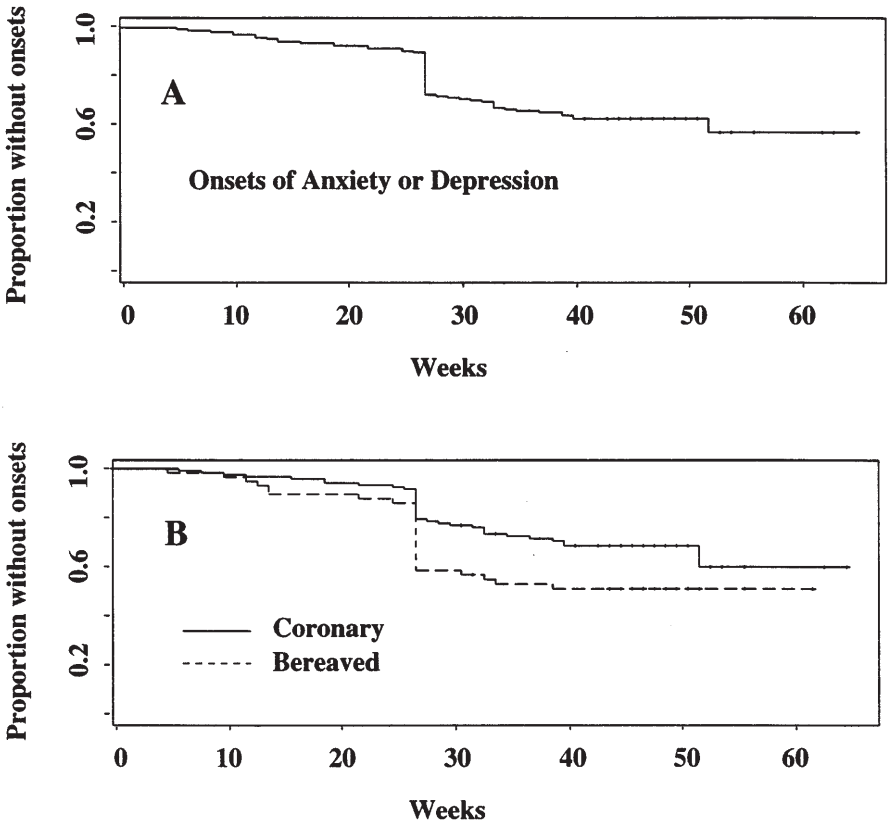

Fig. 2 Kaplan-Meier plots showing observed survival without RDC onset for **A** the RDC anxiety and depression groups combined, and **B** combined onsets for the coronary and bereaved groups separately

Results

A total of 207 women were recruited into the study groups (143 to the coronary group and 64 to the bereaved group); of these, 27 were subsequently excluded because they were already in episode at the start of the study period, leaving 180 (122 and 58 in the coronary and bereaved groups, respectively) for inclusion in the analysis. Within the study period 37% (n = 66) of the available sample experienced an onset; 40 with RDC-defined depressive disorder and 26 with anxiety disorder (see Surtees 1995 for further details).

Relationship between the timing of the primary study events and the timings of onsets of RDC-defined disorder

Separate survival (Kaplan-Meier) plots for time without anxiety and time without depression showed a steady rate of onsets of RDC disorder until week 26 of the study (the time, by study definition when the events occurred), then in week 27 a marked increase in the number of onsets of both anxiety and depression, followed by a period of approximately 10 weeks when the onset rate was marginally higher than the pre-event period. Whereas there was a greater incidence of depression throughout the study period, the temporal patterning of onsets was broadly similar for both conditions; consequently, for subsequent analysis both disorder groups were combined to achieve a more effective sample size for analysis. Figure 2 A shows the Kaplan-Meier curve for these combined onsets of either RDC-defined anxiety or depression. Figure 2 A emphasises the usefulness of these data for our purposes. Firstly, by observing onsets prior to the primary study events we have a baseline onset rate for this (combined) sample against which rates following the events can be compared; the assumption that observed onsets were due only to the occurrence of the life events under study was unnecessary in these data. Secondly, as time is measured relative to the primary study events, the time-varying influence of these events can be easily observed. Figure 2 B shows the Kaplan-Meier curve for onsets of either RDC-defined anxiety or depression by study group, and while revealing the bereaved group to fare less well throughout the study than the coronary wives group, the temporal patterning for both groups was again broadly similar.

The 66-week study period was divided into eight time intervals[4]. The primary event occurred in interval 4, and a total of 180 individuals were observed in interval 1 dropping to 99 by interval 7, and 49 in interval 8. Figure 3 shows a plot of the observed hazard by discrete time interval, and corresponds directly to the continuous time survival plot of Fig. 2 A. The study events occurred towards the end of interval 4, following which the hazard of

[4] These intervals, expressed in weeks, were [0, 6], [7, 13], [14, 19], [20, 26], [27, 32], [33, 39], [40, 46] and [47, 66], and were chosen to be of similar duration (except for the last one which was double the length due to sparse data) and so that occurrence of the study event and subsequent onsets of disorder were distributed across different intervals

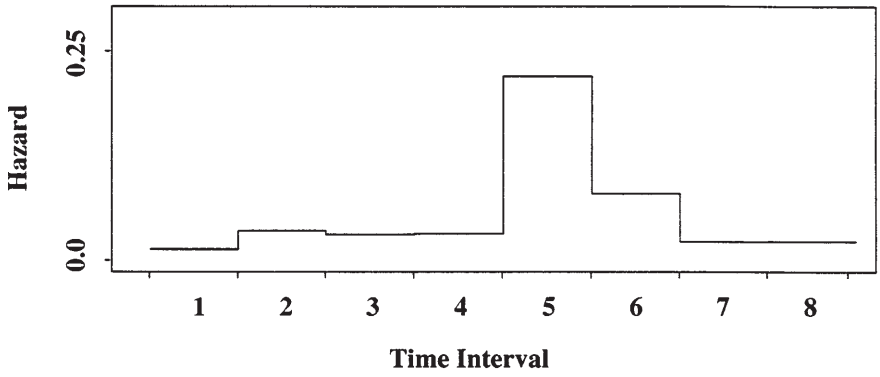

Fig. 3 The observed hazard of RDC onset by discrete time interval

an onset of RDC disorder increased substantially in interval 5, and less so in interval 6.

A simple discrete survival model allowing a separate effect in each time interval showed a significantly increased rate of onsets only in intervals 5 and 6 ($p < 0.01$), the first two time intervals following the study event. This indicates that the events that recruited the samples to the study were associated with a subsequent increase in the onset of RDC disorder and implies that their influence on the development of new episodes was of relatively short duration.

Temporal variation in the influence of the primary events on onset

There was a suggestion that the primary study events influence RDC onsets for two time intervals following the event after which they no longer had an effect. (Their influence was restricted to intervals 5 and 6.) To test this explicitly a comparison was made between the two time-dependent covariates x_1 and x_2 (displayed in Fig. 1). With x_1 already in the model, x_2 was found to be highly significant ($\chi^2 = 24.7$ on 1 *df*, $p < 0.001$). However, with x_2 in the model, x_1 was no longer significant ($\chi^2 = 0.2$ on 1 *df*, $p = 0.7$). These findings provide strong evidence that x_2 gives a *better* representation of the influence of the primary events than x_1, and this implies that the influence on new RDC onset rates lasted for a fixed duration (of two time intervals, approximately 13 weeks), after which it no longer had an effect. To test whether the risk of onset was *different* in intervals 5 and 6, a comparison was made between a model with two separate effects (x_{t-1} and x_{t-2}, as displayed in Fig. 1) with the simpler model (containing only x_2). There was support here for the more complex model ($\chi^2 = 10.9$ on 1 *df*, $p < 0.001$) implying that the hazard for RDC onsets was found to be different in the first and second intervals following the primary events.

This model[5] for the risk of onsets in relation to the time-varying influence of the primary study events contains a single intercept along with parameters to represent an increased rate of onset in the time interval after the event (an effect at lag 1) and a different increased rate two intervals after the event (lag 2). A goodness-of-fit test comparing observed with expected RDC onsets in each time interval gave $\chi^2 = 2.4$ on 7 *df* [$\chi^2_{0.95}(7\ df) = 14.1$], indicating that the model provides an adequate fit to the observed baseline hazard rate. Odds ratios (95% confidence intervals) are 11.2 (6.4–19.7) for the lag 1 parameter and 3.4 (1.5–7.5) for lag 2. Similar analyses were performed separately both by group and by RDC diagnosis. For the group analysis this gave odds ratios (95% confidence intervals) of 8.9 (4.3–18.5) and 3.4 (1.2–9.0) for lag 1 and 2 effects, respectively, in the coronary group, and 16.5 (6.7–41.2), 3.5 (0.9–14.2) for the bereaved group. For the analysis by diagnosis, these odds ratios were 8.7 (4.1–18.3) and 3.6 (1.4–9.5) for those with depression, and 4.0 (1.6–10.2) and 1.0 (0.2–4.7) for those with anxiety. The bereaved group showed a much larger lag-1 effect than the coronary group, whereas the effect at lag 2 fell just short of statistical significance. Similarly, the lag-1 effect for those with depression was more pronounced than in those with anxiety, and the lag-2 effect in this latter group was not observed. Although caution should be exercised when drawing inference from these results, due to the reduced sample sizes involved, there is an indication that there may be differences across study group and by diagnosis, although the temporal patterns remain broadly similar.

This sequence of analyses has provided specific tests for whether the influence of the primary adverse events were of fixed duration and whether this effect, while it lasted, was constant or varied with time. Results have shown that the influence was of relatively short duration (ca. 13 weeks) and with very high risk of onset of RDC disorder in the initial time period following the event (6.5 weeks), with reduced risk in the second time period. This latter result can be seen as evidence for the progressive *decay* in the adverse effects of the events over time.

Vulnerability–resilience

Building on this approach, other risk factors were considered, firstly within univariate models and then through a multivariate model to determine the relative importance of

[5] The model is: $logit(\lambda_{it}) = \alpha + \beta_1 x_{i,t-1} + \beta_2 x_{i,t-2}$, where λ_{it} represents the risk of onset for individual i in time interval t, $x_{i,t-1}$ represents an increased rate of onsets in the time interval after the events for individual i (an effect at lag 1) and $x_{i,t-2}$ represents the increased rate two intervals after the event (lag 2)

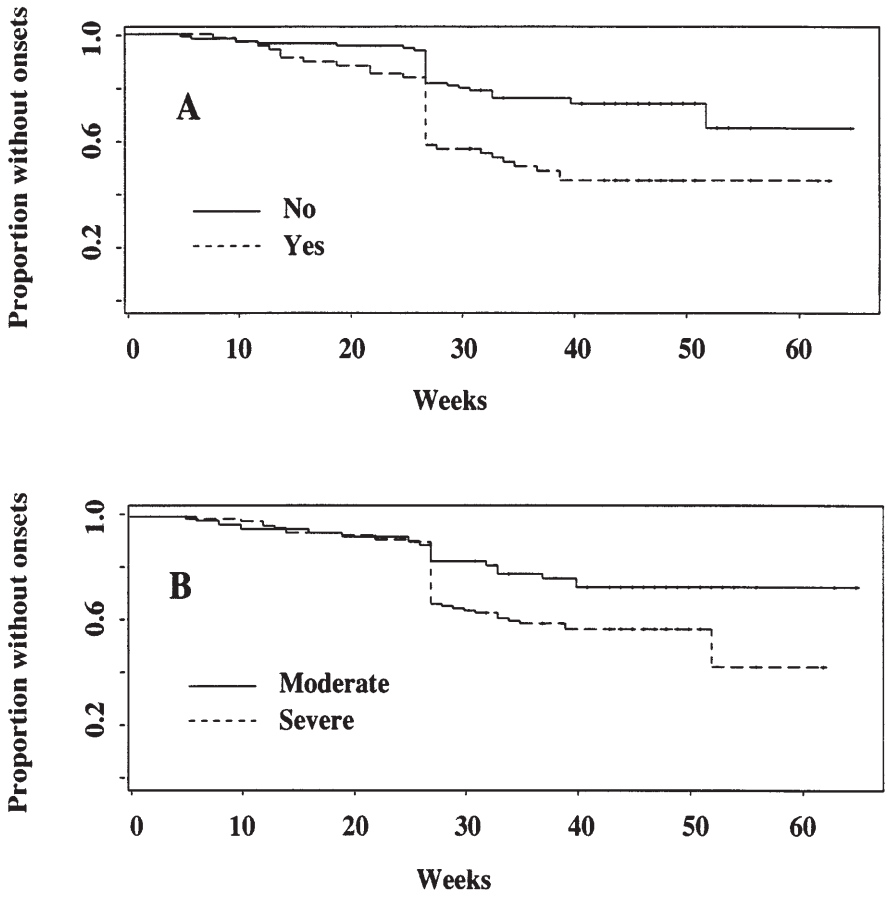

Fig. 4 Kaplan-Meier plots of the observed sirvival without RDC onset by **A** psychiatric consultation history, and **B** by the threat ratings of the study events

these variables. Factors considered were the age of the women (after exploratory analysis, included as a linear variable), their group (whether the women were recruited into the bereaved or the coronary samples), previous psychiatric history (represented here by any previous contact with services for psychiatric reasons), social support (based upon previous work (Miller and Surtees 1995), a measure of being "let down" by friends or family during the week immediately following their event experience), coping (as a binary measure), the threat rating of the bereaved/coronary events and rate per 6-month period of additional events of either moderate or severe threat (LEDS ratings) experienced prior to RDC onset. Kaplan-Meier plots are shown in Fig. 4 for onsets by the measure of previous psychiatric consultation history and by the threat rating of the study events.

The plot by previous history suggests an increased rate of onsets for those with a previous psychiatric consultation history and shows a strong effect due to the primary study events. Also note that the group with a prior consultation history fared less well (in terms of RDC onsets) over the whole time scale. The plot for the threat ratings of the study events shows similarly an increased onset rate among those with a severe threat rating. Note that this difference was only apparent *after* week 26, following occurrence of the events. This is logical as this rating was associated directly with occurrence of the event. In subsequent analyses, the threat rating of the study event was treated as a time-dependent covariate of the form of x_1 in Fig. 1. In a similar way, other risk factors were regarded as either fixed or time dependent. A fixed effect would imply that the hazard was increased over the whole time scale of the study. A time-dependent effect, of the form of x_2 in Fig. 1, would imply that the covariate had an effect only after week 26, following occurrence of the primary event. This in turn would imply that the covariate had an effect *only in the presence of this life stress*, as opposed to a fixed effect which had an effect *regardless of life stress*

Table 1 Odds ratios for the onset of RDC disorder (adjusted for the influence of the study events), according to fixed and time-varying factor effects (univariate analysis)

	Odds ratio	95% CI
Fixed effects		
Study group (bereaved: coronary)	1.85	1.1–3.2
Previous psychiatric consultation history (yes: no)	2.73	1.6–4.6
Time-varying effects representing vulnerability to study events		
Coping (limited vs excellent/good)	4.90	2.7–8.9
Event threat (severe vs moderate)	2.15	1.2–4.0
No strong evidence either way (fixed effect reported)		
Age (increased rate of RDC onsets for 1 SD decrease in age, 9 years)	1.58	1.2–2.0
Support (none vs one or more family/friends outside household who "let down" the subject)	2.11	1.2–3.6

exposure. A comparison of this particular time-varying effect with a fixed effect for the same covariate would then constitute a test of resilience/vulnerability.

Results of univariate analyses are shown in Table 1. Strong evidence was found both for group and previous psychiatric consultation history to have a fixed effect, whereas strong evidence was found for a time-dependent effect (representing vulnerability/resilience) for the measure of coping. No strong evidence was found supporting resilience or otherwise either for age or social support, but these factors did significantly alter the hazard and fixed effects are reported. Threat rating was found to significantly increase the hazard and, as discussed previously, was identified as a time-dependent effect. Increased rates of moderate or severe events prior to onset did not significantly alter the hazard (data not shown).

All effects were allowed to compete in a full model looking at both fixed and time-dependent effects for each covariate (except threat rating), although interactions with the parameters of the primary study events were not considered. Results of a stepwise backward selection procedure are shown in Table 2. The final model includes parameters for the effects of the study events at lags one and two; study group and previous psychiatric history were included as fixed effects, age and coping as time-dependent effects (group and the lag-2 effect fell just short of the 5% significance level).

Figure 5 illustrates the difference in the estimated hazards of onset of RDC disorder between a fixed and a time-dependent effect, with Fig. 5 A displaying the estimated hazard for those women who learn of their husband's death (or coronary) at week 26 and who have no vs a previous psychiatric consultation history (Fig. 5 A, solid and dashed lines, respectively). As this covariate has a fixed effect, the women with a previous history have an increased hazard over the whole range. Fig. 5 B shows the hazard for two women, again with their study events experienced at the end of week 26. The first is rated as having a good (or exceptionally good) coping style (solid

Table 2 Odds ratios for the onset of RDC disorder following event experience and according to fixed and time-varying factor effects (multivariate analysis)

	Odds ratio	95% CI
Study event parameters		
Increased risk of RDC onset during first time interval following event (x_{t-1})	5.39	2.7–10.8
Increased risk of RDC onset during second time interval following event (x_{t-2})	2.16	0.9– 5.3
Fixed effects		
Study group (bereaved: coronary)	1.79	1.0– 3.2
Previous psychiatric consultation history (yes: no)	2.71	1.5– 4.8
Time-varying effects representing vulnerability to study events		
Age (increased rate of RDC onsets for 1 SD decrease in age, 9 years)	2.01	1.4– 2.9
Coping (limited vs excellent/good)	5.29	2.7–10.4

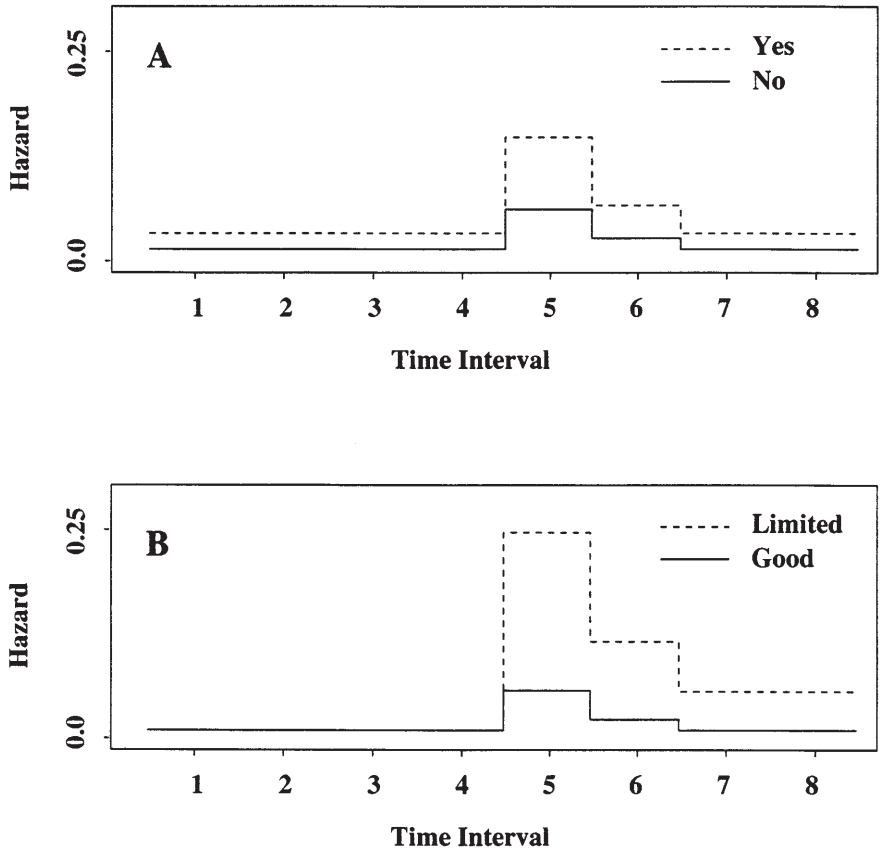

Fig. 5 The predicted hazard of RDC onset by **A** psychiatric consultation history, and **B** coping style

line), whereas the second is rated as having a limited (or poor) coping style. As this is considered as a time-dependent covariate that only had effect after week 26, the hazards for these two women are identical until their event experience; thereafter, the woman rated as having a "limited or poor" coping response to the event has a markedly increased hazard of RDC onset.

Discussion

Discrete (grouped time) survival methods were used in this paper as a means of investigating the form of the time-varying effect of extremely traumatic life experiences. Such methods are computationally straightforward and allow great flexibility for the inclusion of time-dependent covariates. The logistic model adopted in this paper is linked to the proportional hazards model of Cox (1972); if separate intercept parameters are included for each time interval, it will tend to the Cox model as the length of these intervals is decreased towards zero (Thompson 1977). As time was measured relative to exposure to the primary study events, the time-varying influence of this exposure and the baseline hazard overlap making them impossible to distinguish. (Because this baseline hazard is modelled non-parametrically in the Cox model, it is not possible to include further parameters to explicitly model its effect.) It is noted that if baseline hazard and time-varying covariate effects did not overlap (were not on the same time scale), it would be possible to incorporate similar time-dependent covariates into the Cox model; however, it is our belief that even when the Cox model is applicable, the discrete method described above remains a better tool for investigating the time-varying effects of exposure to adversity. As noted by Aalen (1989), the Cox model is not well suited to the detailed description of the time-varying effects of covariates (see also Willett and Singer 1997). Combinations of simple time-dependent covariates in a discrete time survival framework allow a model which incorporates and tests ideas, such as decay and vulnerability, without the need to resort to more complex approaches (e.g. one with explicit exponential decay terms) which may entail more assumptions and reduce ease of interpretation. It is also noted that by ordering time around the adverse event of interest, the time-varying influences reported here (fixed duration and decay) are readily observed. It remains important, though, to establish these relationships through proper statistical tests, particularly as cell sizes are reduced in the latter stages of these studies. Where time is not ordered around the exposure of interest and the patterning of its influence is not so easily observed, it becomes even more important that the nature of this influence be properly tested.

It may be argued that the choice of time intervals will have important consequences for findings, in terms of both length and placement (e.g. in relation to the primary study events). Smoothing is desirable as there was a pronounced increase in onsets in the first week immediately following the event, and this was likely to represent, at least to some degree, a reporting bias. Length of interval determines the degree of smoothing imposed, and this was chosen to ensure that although intervals were not so wide that information on genuine variation was lost, they were not so narrow that data became too sparse for efficient parameter estimation. Time intervals chosen were of alternate 6- and 7-week durations as care was taken in the placement of boundaries so that events and the RDC onsets that followed were distributed across different intervals. This latter requirement was considered to be of higher order than choosing intervals of exactly the same length. Results have been presented by interval and not by week, and minor changes in interval length would produce only small changes in results.

This work may be perceived as weakened through being based on an analysis of data derived from two groups of women who had experienced quite different events. Whereas it has been shown elsewhere (Surtees 1995) that the diagnostic profile of those conditions that followed these events were distinct, it was our intention to ensure that the sample size remained as large as possible so that the strength of the core relationships could be exposed. Sub-analyses were performed on the two study groups separately and according to diagnosis, and although these revealed that while there were differences in the temporal influences of the two events, the results remained broadly similar.

By measuring time relative to a single adverse life event, effects could be shown graphically with a clarity not normally associated with these types of data. This provides visual justification for the types of effects modelled. A comparison of different (simple) functional forms allowed explicit inferences to be drawn about the nature of this time-varying effect. Firstly, we can conclude that the effect of these adverse life experiences on new onsets of disorder does not last indefinitely (in these data, the effect lasts for approximately 13 weeks, two discrete time intervals). Secondly, there was evidence for decay; the hazard was greatly increased immediately following the primary study event and much less so in the second time interval following the event. A combined measure of other event exposures did not significantly alter the risk of new onsets, but this may be due, in part, to the dominant effect of the primary events around which the study was based. The use of time-dependent covariates in the survival analysis allowed a specific vulnerability hypothesis to be formulated and tested. Strong evidence was found for a vulnerability component to the coping measure, in that those with limited coping showed an increased risk of onset, with this risk being apparent only in the presence of the life stress associated with the primary study events.

Frank and colleagues (1994) concluded a recent paper by expressing the view that gains in understanding the relationship between psychosocial factors and symptom patterning should follow from focusing on measures of coping and of support resources in the context of longitudinal studies of samples where knowledge of the history of depression recurrence of those groups was well estab-

lished. Also, recently these same authors have sought to encourage others to seek ways of developing and applying more sophisticated analytic approaches to the study of adversity-disorder relationships (Frank et al. 1996).

In this paper, we have attempted to draw together some of these objectives in the context of a short-term longitudinal event-specific research design. We have pursued a clear agenda of seeking to discover, through sequential focused analysis, those event attributes that may be important for informing the achievement of more elegant and broadly encompassing approaches to adversity quantification, and through this to contribute to the continuing debate on vulnerability/resilience to life stress (Brown et al. 1987; Aneshensel and Stone 1982; Parker and Brown 1982; Fergusson and Horwood 1987; Surtees and Wainwright 1996). This debate has continued over the past two decades to affirm the need for refinements in study design, life event measures and analytic approaches to deal with the evident complexity of the adversity health-change relationship, together with suggestions for increased collaboration between non-experimental stress researchers and those who practice preventive intervention (Rabkin and Struening 1976; Kessler 1997). It is possible that if the challenge presented by this complexity can be met by advances in analytic approach, such that the stress adaptive capacities of individuals are represented, then further gains in the understanding of the role of adversity in disease aetiology may follow.

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