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Sex differences in event-related risk for major depression

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ABSTRACT

Background. This study sought to determine if women are more likely than men to experience an episode of major depression in response to stressful life events.

Method. Sex differences in event-related risk for depression were examined by means of secondary analyses employing data from the Americans' Changing Lives study. The occurrence and time of occurrence of depression onset and instances of stressful life events within a 12-month period preceding a structured interview were documented in a community-based sample of 1024 men and 1800 women. Survival analytical techniques were used to examine sex differences in risk for depression associated with generic and specific stressful life events.

Results. Women were approximately three times more likely than men to experience major depression in response to any stressful life event. Women and men did not differ in risk for depression associated with the death of a spouse or child, events affecting their relationship to a spouse/partner (divorce and marital/love problems) or events corresponding to acute financial or legal difficulties. Women were at elevated risk for depression associated with more distant interpersonal losses (death of a close friend or relative) and other types of events (change of residence, physical attack, or life-threatening illness/injury).

Conclusion. Stressful life events overall, with some exceptions among specific event types, pose a greater risk for depression among women compared to men.

INTRODUCTION

Although it is well recognized that women are more likely to develop depression than men (Amenson & Lewinsohn, 1981; Myers *et al.* 1984; Kessler *et al.* 1994), the reasons for this remain largely unknown (Nolen-Hoeksema, 1987; Paykel, 1991; Bebbington, 1998). In a critical review of the explanations offered for sex differences in risk for depression, Nolen-Hoeksema (1987) concluded that neither artefact explanations (e.g. differences in income (Ensel, 1982), reporting biases (Chevron *et al.* 1978), differences in symptom constellations (Winokur & Clayton, 1967)), biological factors (e.g. hormonal fluctuations (Rubinow & Roy-Byrne, 1984), genetic factors (Winokur & Tanna, 1969)), psychoanalytical theories (Mitchell, 1974), sex role hypotheses (Aneshensel *et al.* 1981), nor learned helplessness models (Radloff & Monroe, 1978) adequately account for the magnitude for sex differences in depression. In a more recent review, Bebbington (1998) also concluded that sex differences in rates of depressive disorder have not been explained convincingly.

There is overwhelming evidence that stressful life events are closely associated with the occurrence of major depression (Paykel *et al.* 1969; Brown & Harris, 1978; Kendler *et al.* 1995; Mazure *et al.* 2000). Paykel observed that although women do not appear to have more life events than men and do not rate the stressfulness of events differently from men (Paykel *et al.* 1971), women react with higher

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symptom intensities to the same stress (Uhlenhuth & Paykel, 1973). If this is the case, then sex differences in risk for depression may be associated, at least in part, with gender-based differential response to stressful events.

Evidence suggests that women experience more severe psychological distress (Kessler & McLeod, 1984) and are at greater risk for onset of depression (Nazroo *et al*. 1997) than men due to particular types of events that have a greater impact on women. Kessler & McLeod (1984) found that sex differences in psychological vulnerability to undesirable life events are largely confined to events that occur not to one's self but to someone within one's social network whom one considers important. They argue that women have greater emotional involvement in the lives of those around them, and that elevated levels of psychological distress in women relative to men due to undesirable events within their social network is the 'cost of caring' associated with these deeper interpersonal commitments. Nazroo *et al*. (1997) reported that women's higher risk for depression within couples with a shared life event was due to crises involving children, housing and reproductive problems. According to these authors, these events fell within domains in which women had more involvement than men. They argue that elevated risk for depression for women relative to men associated with these types of events is likely to be the product of the combination of greater social responsibility for women in these family-related roles and feelings of self-blame that can result when things go wrong in these areas. Both of these studies (Kessler & McLeod, 1984; Nazroo *et al*. 1997) would suggest that if there are sex differences in risk for depression associated with differential response to life events, then these differences may pertain to events presumably falling within gender-specific role domains.

The aim of this study was to determine if women were more likely than men to experience an episode of major depression in response to a broad array of stressful life events, considered both generically and more specifically. Similar to the study of Kessler & McLeod (1984), we used a large, epidemiological sample to conduct the current investigation. This allowed us to examine infrequent but severe events and 'non-shared' events falling beyond the scope of the study of Nazroo *et al*. (1997). Similar to the study of Nazroo *et al*. (1997), we adopt major depression as our outcome variable. This allowed us to estimate sex differences in risk for depression associated with differential response to life events, rather than sex differences in a less specific measure such as 'psychological distress' as reported by Kessler & McLeod (1984).

METHOD

Results of the current investigation were derived from a secondary analysis of the Americans' Changing Lives (ACL) dataset. The community-based ACL study was conducted by the Survey Research Center of the University of Michigan and the database was obtained through the Inter-university Consortium for Political and Social Research (House, 1994). The ACL is a multi-stage stratified area probability sample of people over the age of 25 living in the United States with an over-sampling of African Americans and those 60 years of age and older. Designed as a longitudinal study of productivity and successful ageing in the middle and later years of life, the ACL database includes a variety of measures relevant to the study of psychosocial influences on depression.

The ACL survey contains two waves, a baseline survey in 1986 (Wave I) and a follow-up survey in 1989 (Wave II). At baseline, a sample of 3617 respondents was interviewed in their homes. At follow-up, 2867 of those respondents who were interviewed at baseline were re-interviewed, representing 83% of the respondents at baseline who were still living at the time of the follow-up interview. Non-response did not vary significantly by age, race or other known respondent characteristics. Further information about the ACL study is provided elsewhere (House *et al*. 1990). The sample used in our study included those respondents interviewed at Wave II ($N = 2867$) and excluded those missing data for any of the measures described below ($N = 43$). The sample of 2824 respondents used in the current analyses represents 98·5% of the 2867 respondents interviewed at Wave II.

For each of the measures that follow, 'baseline' refers to data obtained at the Wave I (1986) interview; 'follow-up' refers to data acquired at the Wave II (1989) interview.

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Measures

At follow-up, both occurrence and time of occurrence (calendar year and month) of: (*i*) stressful life events; and (*ii*) onset of severe depressive symptoms were reported retrospectively and documented within the context of a structured interview. In order to limit the potential effects of recall bias, only events and onsets of severe depressive symptoms reported to have occurred during a period of 12 calendar months immediately preceding the calendar month of each respondent's follow-up interview were included in the current analyses. Kessler & Wethington (1991) demonstrated in a community survey that use of a structured interview for the assessment of life events has good reliability over a 12-month period of recall.

Major depressive episode

Episodes of major depression within 12 months prior to each respondent's follow-up interview were determined according to DSM-IV symptom criteria using 10 individual symptoms representing the nine 'category A' criteria for major depression in the DSM-IV (including two items for criterion A5 to assess separately psychomotor retardation and psychomotor agitation). The full battery of symptom criteria used subsequently for identifying episodes of major depression was administered only to those who indicated that they had suffered a period of severely depressed mood that occurred between their baseline and follow-up interviews and lasted at least 1 week. These respondents were asked to supply detailed information pertaining only to their most recent onset of severe depressive symptoms. If the respondent's record indicated he or she had met DSM-IV symptom criteria for major depression within 12 months prior to his or her follow-up interview, then the time of onset (calendar year and month) was documented. Survival time, defined as the number of months from 12 months prior to the month of the follow-up interview until the occurrence of the most recent episode of depression, was used to estimate the Cox (1972) proportional hazards regression models described below. Survival time was censored at 12 months for those not identified as having had an episode of depression within 12 months prior to the month of their follow-up interview.

Stressful life events

The occurrence and time of occurrence (calendar year and month) of 11 specific life events were documented for the 12-month period preceding the calendar month of each respondent's follow-up interview. These were: (*i*) death of a child; (*ii*) death of a spouse; (*iii*) death of a parent; (*iv*) death of a close friend or relative; (*v*) divorce; (*vi*) other marital or love-related problem; (*vii*) personal financial problem; (*viii*) financial or legal problem within one's family unit; (*ix*) move to a new residence; (*x*) physical attack; and (*xi*) life threatening illness or injury. These events represent severe undesirable life events as demonstrated by Grant *et al.* (1981), Brugha *et al.* (1985), and Kendler *et al.* (1995), and such events are those most clearly associated with depression (Dohrenwend *et al.* 1995). For each of these events, the interviewer asked the respondent if and when (most recently) the specific event occurred, with the exceptions of 'other marital or love-related problem' and 'financial or legal problem within one's family unit'. Events falling into these latter two categories were determined from the participant's response to the question 'has anything (else) bad happened to you that upset you a lot and that you haven't already told me about?'. Within the context of our Cox regression models, the occurrence of an event, for each event considered, was modelled as a time-dependent covariate on a month by month basis relative to 12 months prior to the month of the respondent's follow-up interview. Risk ratios for each event variable can be interpreted as the risk of onset of depression during a month in which a life event occurs relative to the risk of onset of depression during a month in which a life event does not occur.

Interactions between sex and stressful life events

Interactions between sex and event variables were constructed by multiplying, on a month by month basis, a fixed covariate indicating the subject's sex with a time-dependent covariate indicating the occurrence of the corresponding event. Risk ratios for each of these interaction terms can be interpreted as the elevated risk for depression associated with the event if the subject is a woman.

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Control variables

Certain factors found to be associated with depression (Amenson & Lewinsohn, 1981; Myers *et al*. 1984; Kessler *et al*. 1992, 1994; Paykel *et al*. 1996; Zeiss *et al*. 1996; Brown & Moran, 1997; Black *et al*. 1998; Maciejewski *et al*. 2000) were entered as control variables in our models. These included respondent age, race (non-Caucasian/Caucasian), socio-economic status, martial status (married/not married), history of at least one extended period of depressed mood, number of chronic health conditions, functional impairment, chronic financial stress, social support and self-efficacy. With the exception of marital status, each control variable was treated as a fixed covariate within the context of our Cox regression models. Martial status was modelled as a time-dependent covariate to account for the events of death of spouse, divorce and marriage within the 12-month period prior to the month of the follow-up interview.

Socio-economic status was assessed using years of education reported at baseline and the average of baseline and follow-up reports of income to classify respondents into four categories corresponding to low, lower-middle, upper-middle and high socio-economic status (Duncan *et al*. 1972). Measures of number of chronic health conditions, functional impairment, chronic financial stress, social support and self-efficacy were each assessed as the average of corresponding baseline and follow-up assessments of these measures described as follows. Number of chronic health conditions was assessed as the number of conditions afflicting the respondent and included arthritis, lung disease, hypertension, heart attack, diabetes, cancer, foot problems, stroke, broken bones and urine beyond control. Functional impairment was assessed by an index reflecting degree of difficulty in walking, climbing stairs, bathing and performing heavy housework. Chronic financial stress was assessed by an index based on the work of Pearlin & Schooler (1978). This index assessed the respondent's degree of satisfaction with his/her present financial situation, degree of difficulty paying monthly bills, and ability to meet monthly financial obligations. Social support was assessed by an index based on a combination of the ACL's measure of 'informal social integration' (i.e. frequency of telephone conversations and visits with friends, neighbours and relatives) and the ACL's measure of 'formal social integration' (i.e. frequency of attending meetings or programmes of groups, clubs or organizations including religious services). Self-efficacy was assessed by an index based on a combination of Rosenberg's (1965) self-esteem scale and Pearlin & Schooler's (1978) mastery scale. Measures of functional impairment, chronic financial stress, social support and self-efficacy were each standardized to the present sample.

History of severely depressed mood was assessed as follows. At the time of follow-up interview, respondents were asked whether they experienced a period in their life lasting at least 1 week when they felt sad or depressed most of the time, or when they lost all interest and pleasure in things about which they usually care or enjoy. If they answered 'yes' to this question, then they were considered to have had a history of severely depressed mood at the time of the follow-up interview. Respondents falling within this category were also asked how many such episodes they had experienced in their lifetime and whether such an episode has occurred since their baseline interview. If they answered 'yes' to this latter question, then the time of occurrence (calendar year and month) of the most recent such episode was documented. If, at the time of the follow-up interview, the respondent reported only one prior episode of severely depressed mood, and if it was determined that this one episode occurred within the 12 month period preceding the follow-up interview, then the respondent was considered to have no history of severely depressed mood 12 months prior to the follow-up interview. Otherwise, respondents reporting a history of severely depressed mood at the time of the follow-up interview were also considered to have a history of severely depressed mood 12 months prior to the follow-up interview. Among the 508 respondents within the current sample who reported an episode of severely depressed mood between interviews, 413 respondents (81·3%) also met full DSM-IV symptom criteria for major depression during their most recent such episode.

Because status of prior depression may modify the relationship between stress and depression (Post, 1992), interactions between a history of

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severely depressed mood and life events were included as covariates within the context of our Cox regression models. These interactions were constructed by multiplying, on a month by month basis, a fixed covariate indicating a history of severely depressed mood with a time-dependent covariate indicating the occurrence of a life event.

Analyses

Chi-square and *t* statistics were used to test for differences between women and men with respect to each of our control variables. Chi-square statistics were used to test for sex differences in 12-month incidence of examined stressful life events. Sex differences in risk for 12-month incidence of major depression were evaluated in the full sample and in subsamples corresponding to those reporting and those not reporting the occurrence of at least one of the examined stressful life events during the same time period. These relative risks were estimated from generalized linear models using a logarithmic link function and a binomial error structure with an adjustment to ensure that the predicted probabilities remained within the range of 0 to 1 (Wacholder, 1986). Likelihood ratio-based χ^2 statistics were used to evaluate their significance. Explicit sex differences in risk for depression associated with examined stressful life events were investigated within the framework of survival analysis by means of Cox proportional hazards regression models (Cox, 1972). Two sets of Cox models were considered, one set of models to evaluate sex differences in risk for depression associated with life events considered generically, and another set of models to evaluate sex differences in risk for depression associated with life events considered more specifically. Wald χ^2 statistics were used to evaluate the significance of the relevant risk ratios associated with each Cox model.

As noted above, at the time of the follow-up interview respondents reported only the most recent episode of depression. As a consequence of this limitation imposed by the structure of the ACL data, those reporting a recent recurrent episode of depression within 12 months prior to the month of the follow-up interview might also have had earlier, unreported episodes within the same 12-month time period. Despite this possibility, our operating definition of 'survival time' was the number of months from 12 months prior to the month of the follow-up interview until the month of the most recent episode of depression. Additional analyses were conducted to assess the sensitivity of the results of the Cox regression models to the tacit assumption that respondents had no more than one episode of depression within the 12-month period preceding the follow-up interview.

RESULTS

Women significantly differed from men on each of the control variables presented in Table 1. Women were more likely than men to be older, non-Caucasian, of lower socio-economic status, unmarried, to have some history to extended periods of depressed mood, to have more chronic health conditions, to have greater functional impairment, and to have higher levels of chronic financial stress and social support. Women were less likely than men to have high feelings of self-efficacy.

As indicated in Table 2, women were not significantly more likely than men to have experienced stressful life events, considered either generally or specifically, within the 12-month period immediately preceding their follow-up interview. Indeed, women did not significantly differ from men in reporting any of the specific life events presented in Table 2.

Results for sex differences in risk for major depression are illustrated in Table 3. Women in our full sample were significantly more likely than men to have experienced an episode of major depression within the 12-month period immediately preceding their follow-up interview. Women were also at significantly greater risk for depression than men among those reporting the occurrence of at least one examined stressful life event over the same 12-month period. No sex differences in risk for depression were found among those not reporting at least one stressful life event.

Although women were not more likely than men to experience life events, they were significantly more likely than men to become depressed in response to life events according to results from our Cox regression models. As indicated in Table 4, women were approximately three times more likely than men to experience major

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Table 1. *Differences between women and men with respect to covariates used to model depression* (N = 2824)

Covariate	Categories	Women $N = 1800$ %	Men $N = 1024$ %	Difference? χ^2_1	Difference? OR (95% CI)
Race	Non-Caucasian	35·2	30·6	6·35*	1·23 (1·05, 1·46)
	Caucasian[a]	64·8	69·4	—	—
Socio-economic status[b]	Low	31·8	24·4	50·76***	2·52 (1·95, 3·24)
	Lower middle	31·7	23·3	54·60***	2·62 (2·03, 3·38)
	Upper middle	26·9	33·7	11·67***	1·54 (1·20, 1·97)
	High[a]	9·6	18·6	—	—
Marital status[c]	Married	49·4	67·9	90·00***	0·46 (0·39, 0·54)
	Not married[a]	50·6	32·1	—	—
History of depressed mood[c]	Yes	39·4	32·2	14·62***	1·37 (1·16, 1·61)
	No[a]	60·6	67·8	—	—

Covariate	Mean (S.D.)	Mean (S.D.)	t[f]	ΔM[g] (95% CI)
Age[c]	56·0 (17·2)	52·1 (16·8)	5·82***	3·89 (2·58, 5·20)
# Chronic health conditions[d]	1·52 (1·30)	1·09 (1·21)	8·89***	0·43 (0·34, 0·53)
Functional impairment[d,e]	0·12 (1·04)	−0·21 (0·88)	8·84***	0·33 (0·25, 0·40)
Chronic financial stress[d,e]	0·05 (1·02)	−0·08 (0·96)	3·33***	0·13 (0·05, 0·20)
Social support[d,e]	0·12 (1·00)	−0·21 (0·96)	8·34***	0·32 (0·25, 0·40)
Self-efficacy[d,e]	−0·07 (1·00)	0·12 (0·98)	−4·96***	−0·19 (−0·27, −0·12)

* $P < 0{\cdot}05$; *** $P < 0{\cdot}001$.
[a] Reference category used to evaluate chi-square statistic(s) and odds ratio(s).
[b] Based on years of education assessed at baseline and the average of baseline and follow-up assessments of income.
[c] Corresponding to 12 months prior to the month of the follow-up interview.
[d] Average of baseline and follow-up assessments.
[e] Index standardized to the present sample, $N = 2824$.
[f] For age, social support, and self-efficacy, df = 2822. For number of chronic health conditions, df = 2250. For functional impairment, df = 2433. For chronic financial stress, df = 2240.
[g] Difference in means, mean for women minus mean for men.

Table 2. *Differences between women and men with respect to* 12*-month incidence of examined stressful life events* (N = 2824)

Event variable	Women $N = 1800$ %	Men $N = 1024$ %	Difference? χ^2_1	Difference? OR (95% CI)
Death of spouse	1·33	0·68	2·54	1·96 (0·84, 4·57)
Death of child	0·83	0·29	3·01+	2·86 (0·83, 9·90)
Death of parent	3·11	3·52	0·34	0·88 (0·58, 1·35)
Death of friend or relative	22·44	21·78	0·17	1·04 (0·86, 1·25)
Divorce	1·17	1·37	0·21	0·85 (0·43, 1·68)
Marital/love problem	0·56	0·78	0·52	0·71 (0·28, 1·80)
Personal financial problem	7·28	5·86	2·08	1·26 (0·92, 1·73)
Family financial/legal problem	0·67	0·98	0·81	0·68 (0·29, 1·58)
Change of residence	10·89	11·62	0·35	0·93 (0·73, 1·18)
Physical attack	0·44	0·39	0·04	1·14 (0·34, 3·79)
Life-threatening illness/injury	3·39	3·71	0·20	0·91 (0·60, 1·37)
Any examined event	41·61	41·21	0·04	1·02 (0·87, 1·19)

+ $P < 0{\cdot}10$.

depression in response to stressful life events considered generically, adjusting for age, race, socio-economic status, marital status, history of depressed mood, the interaction between history of depressed mood and life events, number of chronic health conditions, functional impairment, chronic financial stress, social support and self-efficacy. This risk ratio was slightly higher if unadjusted for these covariates.

Table 5 provides statistical tests for sex differences in risk for major depression associated with sex-based differential response

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Table 3. *Sex differences in* 12*-month incidence of major depression and relative risk for major depression in full sample and in subsamples stratified by the reporting of any examined life event within the same time period*

	12-month incidence of major depression				Relative risk for major depression			
	Women		Men		Unadjusted estimates		Adjusted estimates†	
Sample	(*n*/*N*)	%	(*n*/*N*)	%	RR (95% CI)	*P*	RR (95% CI)	*P*
Full sample	(173/1800)	9·61	(64/1024)	6·25	1·54 (1·17, 2·04)	**	1·37 (1·08, 1·76)	**
Those reporting a life event	(134/749)	17·89	(36/422)	8·53	2·10 (1·50, 3·02)	***	1·75 (1·32, 2·44)	***
Those not reporting a life event	(39/1051)	3·71	(28/602)	4·65	0·80 (0·05, 1·29)	NS	0·74 (0·46, 1·18)	NS

** $P < 0{\cdot}01$; *** $P < 0{\cdot}001$.

† Adjusted for age, race, socio-economic status, marital status, history of severely depressed mood, number of chronic health conditions, functional impairment, chronic financial stress, social support and self-efficacy.

Table 4. *Risk for major depression associated with sex*, *any event*, *and the interaction between sex and any event* (N = 2824)

	Hazard (risk) ratio for major depression			
	Unadjusted estimates		Adjusted estimates†	
Risk factor	Risk ratio (95% CI)	*P*	Risk ratio (95% CI)	*P*
Sex	1·16 (0·84, 1·61)	NS	1·02 (0·73, 1·43)	NS
Any event	4·08 (2·08, 8·03)	***	10·50 (4·13, 26·72)	***
Any event × Sex	3·26 (1·55, 6·85)	**	2·96 (1·41, 6·24)	**

** $P < 0{\cdot}01$; *** $P < 0{\cdot}001$.

All estimates are adjusted for other risk factors listed in the Table.

† Adjusted for age, race, socio-economic status, marital status, history of severely depressed mood, interaction between history of severely depressed mood and any life event, number of chronic health conditions, functional impairment, chronic financial stress, social support and self-efficacy.

to specific clusters of stressful life events. In both models, one excluding and the other including covariates, a sex difference in event-related risk for depression was statistically significant for death of friend or relative (including parent). In the model excluding covariates, there was also a significant sex difference in risk for depression associated with change of residence, physical attack or life threatening illness/injury. This sex difference in the effect of change of residence, physical attack or life threatening illness/injury on depression was marginally non-significant in the model including covariates. In neither model presented in Table 5 did women and men differ in risk for depression associated with: (*i*) death of spouse or child; (*ii*) divorce or marital/love problem; or (*iii*) personal financial or family financial/legal problem.

The main effect of sex was not significant in any model used to estimate sex differences in event-related risk for major depression, i.e. neither in models presented in Table 4 nor in models presented in Table 5. In each model examining sex differences in the effect of life events considered generically (Table 4), the main effect of life events was significant. In both models examining sex differences in the effects of more specific types of life events (Table 5), main effects were significant for death of spouse or child, and for divorce or marital/love problem. The main effect for death of friend or relative was significant only in the model including the covariates. The main effects of personal financial or family financial/legal problem, and also change of residence, physical attack or life threatening illness/injury were not statistically significant in either model.

Consistent with a recent study of Kendler *et al*. (2000), the risk ratio for depression associated with life events, considered generically, was significantly lower for those reporting a prior history of severely depressed mood (interaction with any event, adjusted risk ratio (95% CI) = 0·28 (0·13, 0·61), $P = 0{\cdot}001$). As a further examination of this issue, we found that prior depression modified only certain relationships between specific types of severe stressful life events and depression. Risk ratios for depression associated with death of a spouse/child, and change of residence, physical attack or life threatening illness/injury were significantly lower for those reporting prior depression (interaction with death of spouse/child, adjusted risk ratio (95% CI) = 0·08 (0·02, 0·32), $P <$ 0·001; interaction with change of residence,

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Table 5. *Risk for major depression associated with sex, specific categories of life events, and the interactions between sex and specific categories of life events* (N = 2824)

Risk factor	Hazard (risk) ratio for major depression			
	Unadjusted estimates		Adjusted estimates†	
	Risk ratio (95% CI)	*P*	Risk ratio (95% CI)	*P*
Sex	1·22 (0·89, 1·68)	NS	1·12 (0·81, 1·56)	NS
Death of spouse or child	43·11 (10·37, 179·25)	***	214·55 (43·49, 1058·39)	***
Death of spouse or child × Sex	0·87 (0·18, 4·24)	NS	1·38 (0·28, 6·94)	NS
Death of friend or relative (including parent)	2·55 (0·93, 7·05)	+	5·08 (1·43, 18·00)	*
Death of friend or relative (including parent) × Sex	3·43 (1·15, 10·26)	*	3·22 (1·06, 9·76)	*
Divorce or marital/love problem	14·55 (3·34, 63·26)	***	22·34 (2·43, 204·97)	**
Divorce or marital/love problem × Sex	2·86 (0·53, 15·44)	NS	0·79 (0·13, 4·71)	NS
Personal financial or family financial/legal problem	4·21 (0·97, 18·31)	+	3·52 (0·36, 34·35)	NS
Personal financial or family financial/legal problem × Sex	0·88 (0·17, 4·52)	NS	0·53 (0·10, 2·74)	NS
Change of residence, attack or illness/injury	1·05 (0·15, 7·62)	NS	2·71 (0·31, 23·63)	NS
Change of residence, attack or illness/injury × Sex	7·94 (1·02, 61·67)	*	6·13 (0·78, 48·18)	+

+ $P < 0·10$; * $P < 0·05$; ** $P < 0·01$; *** $P < 0·001$.

All estimates are adjusted for other risk factors listed in table.

† Adjusted for age, race, socio-economic status, marital status, history of severely depressed mood, interactions between history of severely depressed mood and specific categories of life events, number of chronic health conditions, functional impairment, chronic financial stress, social support and self-efficacy.

physical attack or life threatening illness/injury, adjusted risk ratio (95% CI) = 0·20 (0·06, 0·70), $P < 0·012$). Interactions between prior depression and: (*i*) death of a friend or relative (including parent); (*ii*) divorce or marital/love problem; and (*iii*) personal financial or family financial/legal problem were not statistically significant. The possibility that the influence of prior depression on the relationship between stress and depression is restricted to certain types of events, an issue beyond the scope of the present paper, may warrant further investigation.

The results presented in Table 4 and Table 5 are based on analyses of survival times defined from 12 months prior to the month of the follow-up interview until the month of the most recent episode of depression, ignoring the potential influence of unreported, intervening episodes of depression. In order to restrict the potential influence of unreported, intervening episodes of depression, those reporting a recurrent episode of depression who averaged more than one episode of depression every 4 years or reported prior episodes lasting more than 2 years were excluded from the full sample. Using this restricted sample, sex differences in risk associated with life events considered generically (unadjusted risk ratio (95% CI) = 2·71 (1·07, 6·91), $P = 0·036$; adjusted risk ratio (95% CI) = 2·75 (1·07, 7·01), $P = 0·035$) were essentially the same as those derived from the full sample (Table 4). When the classes of specific events for which women were found to be more vulnerable to depression than men were combined into a single class, the estimated sex difference in risk for depression for these events evaluated in restricted sample (adjusted risk ratio (95% CI) = 3·65 (1·18, 11·23), $P = 0·024$) was essentially no different from a corresponding estimate derived from the full sample (adjusted risk ratio (95% CI) = 4·00 (1·49, 10·74), $P = 0·006$). These results would suggest that unreported, intervening episodes of depression had little effect on our estimates of sex differences in event-related risk for depression.

According to Table 5, the unadjusted estimate of the effect of a sex difference in event-related risk for depression associated with change of residence, physical attack or life-threatening illness/injury was statistically significant ($P = 0·048$), but the estimate of the same effect adjusted for covariates was marginally non-significant ($P = 0·085$). While it is reasonable to assume that this modest difference in the level of significance of this effect between these estimates is simply due to the confounding influences of the covariates, the nature of the relationships

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between certain of these specific life events and certain covariates is worth further consideration. For example, number of chronic health conditions at baseline is a significant risk factor for experiencing the event of a life-threatening illness/injury (unadjusted RR (95% CI) = 1·32 (1·17, 1·49), $P < 0·001$). In addition, the event of a life-threatening illness/injury is significantly predictive of the number of chronic health conditions at follow-up, adjusting for number of chronic health conditions at baseline ($t = 9·34$, df = 2821, $P < 0·001$). These types of potentially causal relationships between certain event variables and certain covariates would suggest that, to some degree, the model including covariates presented in Table 5 unduly constrains the estimate of the sex difference in risk for depression associated with change of residence, physical attack, or life-threatening illness/injury. If the list of covariates is reduced to include only age, prior depression, and interactions between prior depression and life events, then the effect of a sex difference in risk for depression associated with change of residence, physical attack, or life-threatening illness/injury is significant (adjusted risk ratio (95% CI) = 7·87 (1·01, 61·48), $P = 0·049$).

DISCUSSION

Consistent with many other prior studies, we found that stressful life events pose a significant risk for depression for both women and men (i.e. main effects for life events in Table 4 and Table 5), and that women are at greater risk for depression than men (i.e. Table 3, full sample). However, neither the incidence of life events nor sex differences in our control variables appear to explain fully the observed sex difference in the rate of major depression. Consistent with the observation of Paykel (1991), we found no significant difference between women and men in reporting each of the life events examined in this report (Table 2). The difference in observed rates of depression between women and men cannot be attributed to differences in the frequency of these life events. Although women and men differed on each of the control variables included in our models (Table 1), several of these variables (race, marital status, chronic financial stress and social support) were not significantly related to the onset of major depression within the context of any of our multiple regression analyses. The control variables that were significantly related to depression in at least some of these analyses included age, history of extended periods of depressed mood, number of chronic health conditions, functional impairment and self-efficacy. While the advanced age of women in the sample would tend to reduce their likelihood of becoming depressed, differences between women and men with respect to each of the other factors significantly related to depression would be expected to increase the risk for women. However, these factors alone do not fully explain sex differences in rates of major depression. Sex remains a significant risk factor for depression adjusting for these potentially confounding factors (Table 3, full sample), demonstrating that the sex differences in the control variables (Table 1) do not in themselves explain sex differences in risk for major depression.

Our analyses of sex differences in incidence of depression in subsamples stratified by the occurrence of any examined life event (Table 3) suggest that differences in the manner in which women and men respond to severe stressful life events may well explain overall sex differences in risk for major depression. Among those not reporting a severe stressful life event, there is no difference between women and men in 12-month incidence of depression. However, among those reporting a severe stressful life event, women as compared to men are approximately twice as likely to have become depressed. Results associated with our models that explicitly examine sex differences in risk for depression associated with stressful life events (Table 4 and Table 5) are also consistent with the notion that these differences explain overall sex differences in risk for depression. In these models that include terms representing sex differences in response to stressful life events (i.e. interactions between sex and life events), sex alone (i.e. the main effect of sex) is not a significant risk factor for depression.

Women who experience life events, as compared to men who experience life events, are at greater risk for major depression. We found this to be the case whether we viewed the examined severe life events generically (Table 4) or, with certain qualifications, more specifically

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(Table 5). Indeed, broadly consistent with the perspective of Kessler & McLeod (1984) and Nazroo *et al*. (1997), our current findings lead us to conclude that sex differences in response to life events may be restricted to sex differences in response to certain kinds of life events. Losses or interpersonal problems involving their immediate loved-ones (death of spouse or child, divorce and marital/lover related problems) pose a risk for depression for both women and men. In particular, among these events, those relating to a spouse or significant other (i.e. death of a spouse, divorce and marital/love problems) pose no sex differences in risk for depression. This finding is similar to those of Kessler & McLeod (1984), who found no sex differences in psychological distress associated with separation/divorce and 'other love loss', and Nazroo *et al*. (1997), who found within couples no sex differences in risk for depression associated with marital crises. However, we also found that the death of a close friend or relative (including parent) poses a significantly greater risk for depression for women as compared to men. Greater risk for depression in women in relation to the death of a parent is consistent with the recent bereavement study of Moss *et al*. (1997), which found that women are more adversely affected by the loss of a parent than are men. Women's greater risk for depression in relation to more distant interpersonal losses would appear to lend support to Kessler & McLeod's (1984) 'cost of caring' hypothesis. Finally, we found some evidence that other types of events (change of residence, physical attack, or life-threatening illness or injury) pose risks for depression in women only. Risk for depression in women associated with change of residence echoes Nazroo *et al*.'s (1997) finding that women were at greater risk for depression associated with housing crises. Risk for depression in women associated with life-threatening illness or injury is consistent with Kessler & McLeod (1984), who present some evidence of sex differences in psychological distress associated with ill health. However, events like physical attack and life-threatening illness or injury do not fit nearly into explanatory schemes that associate elevated event-related risk for depression in women with events that reflect social roles typically assumed by women.

The findings of the present study should be understood in the context of four methodological limitations. First, episodes of major depression were determined retrospectively according to DSM-IV symptom criteria alone. Because the ACL survey was administered to a large community sample by trained interviewers who were not clinicians, other criteria relevant to clinical diagnoses of major depression (e.g. clinically significant impairment in important areas of functioning) were not assessed.

Secondly, stressful life events were assessed using a simple inventory approach, without regard for explicit contextual factors as advocated by Brown & Harris (1978) and Dohrenwend *et al*. (1993). However, the majority of the events employed in the present study would be considered by many to be severe. Furthermore, the omission of explicit contextual information in the assessment of life events would be more likely to dampen rather than to amplify estimates of risk for depression associated with life events (Brugha *et al*. 1985).

Thirdly, when a stressful life event and an episode of depression occurred in the same month, we assumed that the stressful life event precipitated the episode of depression rather than vice versa. The validity of this assumption could not be examined in the present data. Suppose, following other studies (Kendler *et al*. 1999; Maciejewski *et al*. 2000), we divide the events considered in the current report into two categories. One category would represent those events expected to have occurred independently of the respondent's mood and behaviour (e.g. death of a loved one), and another category would represent those events that might have been dependent on the respondent's mood and behaviour (e.g. marital/love problems). Given such a classification of events, we would conclude from the current analyses that there are sex differences in event-related risk for depression for events that occur independently of the respondent's mood and behaviour, for example, the death of a close friend or relative.

Fourthly, our survival analyses were implemented under the assumption that each respondent had no more than one episode of depression within the 12-month period prior to his/her follow-up interview. Additional analyses were conducted to assess the potential influence of this tacit assumption on the main results of this study. As described above, results for sex

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differences in risk for depression derived from a subsample restricted to those for whom prior depression was either nonexistent or infrequent were consistent with results derived from the full sample. Respondents in this subsample are unlikely to have had more than one episode of depression within 12 months prior to the follow-up interview. Furthermore, one possible way in which unreported, intervening prior episodes of depression might influence the results of the current study is if events somehow were the results of these earlier episodes. However, the results of this study are not restricted to life events that might be categorized as 'dependent'. Indeed, sex differences in event-related risk for depression for 'independent' events (i.e. death of a spouse, child, parent, of friend/relative) alone are significant (unadjusted risk ratio (95% CI) = 2·61 (1·04, 6·51), $P = 0{\cdot}040$; adjusted risk ratio (95% CI) = 2·70 (1·08, 6·77), $P = 0{\cdot}034$) and comparable to those for all events (Table 4). Moreover, one would expect that, for those reporting a prior history of depression, the later the month in which a depressive episode occurs in relation to 12 months prior to the follow-up interview, the more likely it is to be preceded by an earlier, unreported, intervening episode. Therefore, one might expect estimates of sex differences in event-related risk for depression based on recurrent episodes reported later to be influenced by the effects of preceding episodes of depression to a great extent than estimates based on recurrent episodes reported earlier. However, we found little difference in estimates of sex differences in event-related risk for depression based on samples examining recurrent depression reported in months 1–6 (adjusted risk ratio (95% CI) = 3·44 (0·85, 13·92), $P = 0{\cdot}083$) and recurrent depression reported in months 7–12 (adjusted risk ratio (95% CI) = 3·57 (1·02, 12·57), $P = 0{\cdot}047$). Each of these considerations would suggest that unreported, intervening episodes of depression had little influence on estimates of sex differences in event-related risk for depression reported in this study.

Each of these four methodological limitations would appear to apply equally to women and men. That is, these limitations might be expected to have less influence on our estimates of sex differences in event-related risk for depression than they would have on overall estimates of risk. However, despite these limitations, our findings clearly indicate sex differences in event-related risk for depression. These differences may be rooted ultimately in genetic, biological, psychological and/or social factors that may influence reactivity to stressful events. The present results suggest that future studies examining sex-specific causal mechanisms through which life events influence depression are likely to advance our understanding of the sexual dimorphism in rates of depression.

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