

RESEARCH REPORT

Stress and suicide in the Nurses' Health Study

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Study objectives: Although stress is thought to be a risk factor for suicide, most research has been retrospective or has focused on attempted suicides or suicide ideation. This study examined prospectively the associations between self perceived stress, diazepam use, and death from suicide among adult women.

Design: A cohort study was conducted with 14 years of follow up. Stress at home and at work were assessed by questionnaire and scored on a four point scale: minimal, light, moderate, or severe.

Setting: Eleven states within the United States.

Participants: Female nurses (n=94 110) who were 36 to 61 years of age when they answered questions on stress and diazepam use in 1982.

Results: During 1 272 000 person years of observation 73 suicides were identified. After adjustment for age, smoking, coffee consumption, alcohol intake, and marital status, the relation between self reported stress and suicide remained U shaped. Compared with the light home and work stress categories, which had the lowest incidences of suicide, risks were increased among women reporting either severe (relative risk (RR) = 3.7, 95% confidence intervals (CI) 1.7 to 8.3) or minimal (RR=2.1, 95% CI 1.0 to 4.5) home stress and either severe (RR=1.9, 95% CI 0.8 to 4.7) or minimal (RR=2.4, 95% CI 0.9 to 6.1) work stress. When responses to home and work stress were combined, there was an almost fivefold increase in risk of suicide among women in the high stress category. Risk of suicide was over eightfold among women reporting high stress or diazepam use compared with those reporting low stress and no diazepam use.

Conclusions: The relation between self reported stress and suicide seems to be U shaped among adult women. The excess risk for those reporting minimal stress may reflect denial or undiagnosed depression or an association with some other unmeasured risk factor for suicide.

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Over 30 000 suicide deaths are recorded per year in the US,¹ contributing significantly to years of potential life lost.² However, few prospective studies of suicide have been reported. Studies of people who attempted suicide or who have suicidal thoughts are more common, though the factors associated with these situations may differ from those that characterise completed suicides.³ In the case of a completed suicide, information provided by family or friends may be subject to recall bias. Consequently, there is a need to study suicide in prospectively evaluated cohorts of persons systematically followed up for many years.

Stress is thought to be a major contributor to suicide. A stressful life event, such as the death of a spouse or loss of employment, may trigger the suicide.⁴ However, such events are more likely to act as triggers in already vulnerable people.⁵ High levels of perceived stress have been observed in people with early signs of suicidal thoughts.⁶

Physiological changes characteristic of chronic stress have been associated with suicide. One study reported significant enlargement of the adrenal cortex in suicide victims.⁷ Also, peripheral-type benzodiazepine receptors are decreased during exposure to chronic stressful conditions and were found to be decreased among patients with a history of at least three suicide attempts.⁸

In this study, we examined the association between self reports of stress at home and at work and regular use of diazepam, a minor tranquiliser for stress and anxiety, and subsequent risk of suicide over a 14 year period among women in the Nurses' Health Study.

METHODS

The Nurses' Health Study began in 1976 when 121 700 US married female registered nurses between the ages of 30 and 55 responded to a mailed questionnaire concerning their

medical history and health related behaviours, such as smoking and oral contraceptive use. Approximately 98% of the cohort is white. Every two years, a follow up questionnaire has been sent to ascertain incident diseases and to update lifestyle characteristics. If a participant does not respond after repeated mailings, a short form of the questionnaire is sent that includes only the disease reports and the most important behavioural information. A response rate of over 90% has been maintained throughout follow up. In 1980, a food frequency questionnaire was added to the mailing, and diet has been reassessed about every four years.

Questions on stress and diazepam use were included on the full questionnaires in 1980 and 1982. In 1980, participants were asked whether they were currently taking valium (diazepam) and if so, their duration of use. In 1982, current diazepam use was again included on the questionnaire. Participants were also asked to rate their experience of stress at home and at work as either minimal, light, moderate, or severe. Seventy six per cent of the participants were employed outside the home in 1982; among the employed women, 90% held jobs in the nursing profession.

Most deaths in this cohort are reported by relatives or by postal authorities. The National Death Index is also searched for records of death among the non-respondents. More than 98% of all deaths in the cohort are successfully identified.⁹ Death certificates are sought for all deaths and reviewed by a physician who is unaware of exposure information. As of June, 1996, 7% of the cohort (n=8505) had died and 166 deaths were attributable to suicide. One hundred and ten of the suicide deaths occurred after 1982 when the stress ratings were obtained. Of these, 73 (66%) responded to the full 1982 questionnaire with the stress and diazepam questions. This response rate was lower than the 78% rate for the full cohort and the 73% rate among those who died of other causes.

The study population for this analysis consisted of the 94 110 women who responded to the full 1982 questionnaire. Participants contributed person-time from the return date of this questionnaire (mailed June, 1982) until death from any cause or end of study follow up on 1 June 1996. Incidence rates were computed for each category of home stress, work stress, and diazepam use. Relative risks were calculated as the age adjusted incidence rate (within five year age groups) in a specific category divided by the age adjusted rate in the lowest category. Proportional hazards models¹⁰ were used to adjust simultaneously for possible confounding variables, including smoking status (never, past, current), quantity among current smokers (1–14, 15–24, 25+ cigarettes/day), coffee consumption (none, <0.7, 0.7–1, 2–3, 4+ cups/day), alcohol intake (none, <5, 5–14, 15–24, 25+ g/day), and marital status (married, widowed, divorced or separated). Although all participants were married in 1976 when the cohort was formed, 3% were widowed and 5% were divorced or separated by 1980. Covariate data were assessed at baseline; results were similar when covariate data were updated over follow up.

In previous research on suicide in this cohort, we reported independent and significant associations with smoking and coffee consumption. Women who drank two or more cups of coffee per day had a 70% lower risk of suicide compared with those who never drank coffee,¹¹ and women who smoked 25 or more cigarettes per day had four times the risk of committing suicide compared with those who had never smoked.¹²

RESULTS

The suicide death rate in the NHS was 6.8 per 100 000 person years, about the same as the US national rate for white women 40 to 64 years of age,¹ and the Nurses' Health Study showed a similar age related pattern of a peak in the 55–59 year age group (8.8 per 100,000 person years). Suicide cases in this analysis (n=73) ranged in age from 39 to 75 years (median=56 years).

The distributions of responses to levels of home and work stress and to diazepam use among suicide cases and non-cases in the Nurses' Health Study are shown in table 1. We expected cases to report higher levels of stress and more diazepam use. Indeed, 18% of cases reported severe home stress and 21% reported severe work stress compared with 8% and 14%, respectively, for non-cases. Diazepam use was also higher among the cases (14%) than among the non-cases (3%). An unexpected higher percentage of cases (17%) than non-cases (10%) reported minimal stress at work.

Characteristics of the Nurses' Health Study study population by level of stress and by diazepam use are listed in table 2. Older women were more likely to report a minimal amount of stress at home but were more likely to use diazepam. Age was not related to work stress. The percentage of women who were heavy smokers (25 or more cigarettes per day) was higher among those reporting severe stress at home (13%) or at work (11%) compared with those reporting minimal stress (6%), while high coffee consumption (two or more cups per day) was weakly associated with higher work stress and no diazepam use. Women consuming 25 or more grams of alcohol intake (about two drinks) were more likely to report a severe level of home stress and to use diazepam. Both divorce and diazepam use were associated with higher levels of home and work stress.

Associations between stress and suicide are presented in table 3. For both home and work stress, the light stress category had the lowest incidence of suicide and was the most reported selection among non-cases and was therefore used as the reference when calculating relative risks (RR). For home stress, the RR for suicide was significantly increased in all categories, even after adjusting for age, smoking, alcohol, coffee, and marital status. The highest risk was associated with reports of severe home stress (RR=3.7, 95% confidence intervals (CI) 1.7 to 8.3). Adjustments for smoking and marital status were primarily responsible for attenuation of the simple

Table 1 Responses to questions on home stress, work stress, and diazepam use at baseline in 1982 among suicide cases (n=73) and non-cases (n=94037) in the Nurses' Health Study

	Cases		Non-cases	
	Number	%	Number	%
Home stress				
Minimal	15	21	17462	19
Light	11	15	27417	29
Moderate	33	45	40797	43
Severe	13	18	7288	8
Missing	1	1	1073	1
Work stress*				
Minimal	10	17	7838	10
Light	8	14	15152	20
Moderate	25	43	40918	54
Severe	12	21	10275	14
Missing	3	5	1493	2
Diazepam use				
Yes	10	14	2489	3
No	63	86	91548	97

*Work stress was assessed among the 75734 women who reported that they worked outside the home or otherwise responded to the work stress question.

Table 2 Characteristics* of the study population (n=94110 women) by level of home and work stress and by diazepam use at baseline in 1982

Home stress	Minimal	Light	Moderate	Severe
Age (mean years)	51	49	48	49
25+ cigarettes/day (%)	6	7	9	13
2+ cups coffee/day (%)	58	57	57	58
25+ g alcohol/day (%)	7	7	7	9
Divorced or separated (%)	5	4	5	7
Diazepam user (%)	2	2	3	16
Work stress	Minimal	Light	Moderate	Severe
Age (mean years)	49	48	48	49
25+ cigarettes/day (%)	6	6	8	11
2+ cups coffee/day (%)	55	56	60	61
25+ g alcohol/day (%)	8	7	7	8
Divorced or separated (%)	3	4	6	9
Diazepam user (%)	2	2	3	5
Diazepam use	No	Yes		
Age (mean years)	49	51		
25+ cigarettes/day (%)	8	10		
2+ cups coffee/day (%)	58	51		
25+ g alcohol/day (%)	7	10		
Divorced or separated (%)	5	5		

*Mean value or per cent of the population within each response category.

age adjusted results. For work stress, the RR for suicide was increased in the minimal (RR=2.4, 95% CI 0.9 to 6.1) and severe (RR=1.9, 95% CI 0.8 to 4.7) categories.

The amount of stress in one's life is subject to change, so that a stress rating in 1982 may not pertain to suicide many years later. Therefore, we reanalysed our data using only eight years of follow up (1982–1990, 49 cases). For home stress, the results were stronger (RR=6.4, 95% CI 1.9 to 21 in the severe category) and exhibited the same pattern of high risk with both minimal and severe stress. For work stress, the results through 1990 were stronger only in the minimal category (RR=4.2, 95% CI 1.3 to 14).

Forty four per cent of the women reported the same stress level at home and at work. Incidence rates for suicide were highest among those who reported severe (24.8 per 100 000) or minimal (13.3 per 100 000) levels of stress both at home

and at work. However, 7% of the women placed themselves in the severe category for one stress measure but in the light or minimal category for the other measure. Therefore, we combined responses to the home and work stress questions to achieve maximal differentiation in suicide risk between low and high stress levels (table 3). We defined low combined stress to include those who reported light stress at home and light or minimal work stress, or light stress at work and light or minimal home stress. At the other end, we defined high combined stress as severe stress at home and severe or moderate work stress, or severe stress at work and severe or moderate home stress. The RR for suicide in the high combined stress category was 4.9 (95% CI 1.4 to 17), a more increased risk than either severe home or work stress alone.

Diazepam use was significantly predictive of suicide (RR=4.9, 95% CI 2.5 to 9.7) (table 3). The risk was somewhat higher among women taking diazepam for three or more years compared with a shorter length of use, but statistical power was limited for assessing a duration effect. Because of colinearity between diazepam use and high stress ratings (1.3% diazepam use in low combined home and work stress; 5.2% diazepam use in high combined stress), we created an index that labelled an individual as stressed if either diazepam use or high combined home and work stress were present. Thus, a person would be considered highly stressed even if diazepam effectively reduced her stress ratings. Compared with women with low combined home and work stress and not using diazepam, the RR for suicide in this high stressed group was over eightfold (RR=8.1, 95% CI 1.9 to 35).

When home stress, work stress, and diazepam use were analysed in the same multivariate model, each seemed to be an independent contributor to risk of suicide. Risk estimates from this model were as follows: severe home stress RR=3.1,

Key points

- Although stress is considered a risk factor for suicide, there has been no prospective research to associate self perceived stress with death from suicide. Previous studies have been retrospective or have examined attempted suicide or suicide ideation.
- The observed association between self reported stress and suicide was U shaped, with increased risks in the minimal and severe categories for both home and work stress. Risk estimates remained increased even after adjusting for smoking, coffee consumption, alcohol intake, and marital status.
- The increased risk of suicide among the women who reported minimal stress at home or at work may reflect denial or it may be associated with other risks for suicide, such as social isolation and depression.
- A simple assessment of self perceived stress at home and at work is predictive of future risk of suicide. A more extensive evaluation or repeated assessment over time may prove useful in targeting and preventing suicide deaths.

95% CI 1.4 to 7.0; severe work stress RR=1.5, 95% CI 0.6 to 3.5; diazepam use RR=4.4, 95% CI 2.2 to 8.8.

DISCUSSION

Suicide rates among middle aged women in the US have declined slightly over the past 20 years.¹ However, rates may be increased among women in certain professions, notably physicians¹³ and nurses,¹⁴ because of occupational stress and access to drugs. Though access to drugs may indeed have influenced the method of suicide in this cohort, it did not appear to induce suicide; the suicide rate in the Nurses' Health Study was very similar to the national rate among white middle aged women.

In this study, a severe level of stress at home or at work was associated with an increased risk of suicide. Our simple self ratings of stress differ from those that inquire about the number and severity of recent stressful life events, such as marriage, divorce, death of a close relative, or change in job. Self ratings of stress have an advantage in that some events, such as retirement or home purchase, cannot be assumed to be universally negative or positive, and the degree of stress caused by various events is highly variable. On the other hand, the stress ratings used in this study have three disadvantages. Firstly, single item questions inevitably have lower reliabilities than longer scales.¹⁵ A more extensive stress evaluation might enhance the validity of this predictor. Secondly, our stress ratings were unidimensional along a continuum of severity and did not attempt to assess other dimensions associated with perceptions of stress, such as controllability, predictability, and chronicity. Research suggests that a more multidimensional approach to stress measurement is a better predictor of health outcomes. Thirdly, participants may deny stress as a coping mechanism and provide lower ratings of self perceived stress.¹⁶ Denial may have been a factor in the increased suicide risk observed among those who reported minimal stress at home or at work. Alternatively, a minimal rating of stress may be associated with other risks for suicide, such as social isolation and depression. Social isolation has been implicated in the increasing suicide rates among elderly widowed men in the US.¹⁷ Though we had no psychosocial measures for the Nurses' Health Study women in 1982, participants did report whether they had been widowed or divorced since the cohort was established in 1976. Divorce was associated with an almost threefold risk of suicide, but divorced women were not more likely to report a minimal amount of home or work stress.

We observed an almost fivefold increase in risk of suicide among diazepam users in the Nurses' Health Study. Diazepam

Table 3 Incidence rates (IR) and relative risks (RR) of suicide by levels of home and work stress, by diazepam use and duration of use, and by combined measures of stress and diazepam use in the Nurses' Health Study, 1982–1996

	Suicide cases	IR*	RR†	Multivariate RR‡ (95% CI)
Home stress				
Minimal	15	6.4	2.1	2.1(1.0to4.5)
Light	11	3.0	1.0	1.0
Moderate	33	6.0	2.0	1.9(1.0to3.8)
Severe	13	13.3	4.4	3.7(1.7to8.3)
Work stress				
Minimal	10	9.4	2.3	2.4(0.9to6.1)
Light	8	3.9	1.0	1.0
Moderate	25	4.5	1.2	1.1(0.5to2.5)
Severe	12	8.6	2.1	1.9(0.8to4.7)
Combined stress§				
Low	3	2.0	1.0	1.0
High	14	10.9	5.7	4.9(1.4to 17)
Diazepam use				
No	63	5.1	1.0	1.0
Yes	10	30.0	6.0	4.9(2.5to9.7)
<3 years	4	24.4	4.7	4.1(1.5to 11)
3+ years	5	34.0	6.7	5.2(2.1to 13)
Stress + diazepam¶				
Neither	2	1.4	1.0	1.0
Either	19	12.9	9.7	8.1(1.9to 35)

*Crude incidence rates per 100 000 person years of follow up; †relative risks adjusted for age; ‡relative risks (with 95% confidence intervals) adjusted for age, smoking status and quantity, alcohol intake, coffee consumption, and marital status; §low combined stress = light home stress and light or minimal work stress, or light work stress and light or minimal home stress; high combined stress = severe home stress and severe or moderate work stress, or severe work stress and severe or moderate home stress; ¶neither stress nor diazepam = low combined home and work stress and no diazepam use; either stress or diazepam = high combined home and work stress or diazepam use.

is frequently prescribed for anxiety symptoms or during times of high stress, which are often accompanied or followed by depressive symptoms.¹⁸ Therefore, our assessment of diazepam use encompasses more than just an assessment of stress. Combining this with the self reported measures of stress at home and at work resulted in a eightfold increase in risk of suicide among those reporting either high stress or diazepam use. Despite this significantly increased relative risk, only 19 of the 73 suicides were identified based on these characteristics. Thus, the fraction of suicides whose deaths might be prevented by targeting those reporting high stress or diazepam use is small. Also, further information than what was collected in this study would be needed to identify those high stress responders who are likely to commit suicide.

The relative risk estimates for stress and diazepam use were adjusted for smoking, coffee consumption, alcohol intake, and marital status. Inclusion of these variables in a multivariate model attenuated the risk estimates that were only adjusted for age. One could argue that control for these covariates is not appropriate; smoking, coffee consumption, and alcohol intake may be influenced by stress and therefore in the causal pathway between stress and suicide, while marital status may be a predictor of stress. The age adjusted risk estimates may be more indicative of the full effect of stress on suicide.

This study focused solely on completed suicides. We had no data on attempted suicides or depressive symptoms, which may also be associated with perceived stress. Although this study is based on a large cohort, the number of events was small, resulting in imprecise risk estimates. Thus, the findings are suggestive but far from definitive. Also, only two thirds of the women who committed suicide during the follow up period provided baseline self ratings of stress and diazepam use. If these women had higher perceived stress levels and were more likely to use diazepam, the results of this study may be biased toward the null. Misclassification of a suicide (that is, classified as an accident) could also bias the results towards the null.

In summary, a simple self perceived assessment of stress at home and at work was predictive of suicide in middle aged women, even up to 14 years after the stress report. A more extensive evaluation of perceived stress or repeated assessment over time may increase the sensitivity of the measure and prove useful in targeting and preventing suicide deaths.

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