Response of hostile individuals to stressful change in their working lives: test of a psychosocial vulnerability model

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ABSTRACT

Background. According to the psychosocial vulnerability model, the health of hostile individuals is at greater risk than that of non-hostile individuals, due partly to lesser ability of the former to cope with psychosocial stress situations. We examined whether hostile individuals were more vulnerable than others to health problems when faced with stressful changes in their working lives.

Methods. Hostility, sickness absence and psychosocial stressors in 866 local government employees over a 5-year period, which included severe economic decline, were investigated. Hostility was measured by a questionnaire. Data on medically certified sickness absence were obtained from the records of the local authority. Information about exposure to psychosocial stressors after assessment of hostility was also derived from these records, and from reports from the subjects.

Results. Exposure to stressors during the period of economic decline was related to increased rates of sickness absence. In men, hostility increased risk of sickness absence after exposure to stressors only in cases of absence because of trauma. In women, hostility increased risk of absence through sickness overall and absence because of musculoskeletal disorders in individuals facing stressors such as severe organizational downsizing, high or increased levels of job demands or negative change in work. Findings were adjusted for sickness absence at the beginning of the decline, socio-economic background and behavioural risk factors.

Conclusions. The psychosocial vulnerability model was partly supported. However, heightened vulnerability through hostility may differ between the sexes, since it was more evident in the women studied than in the men.

INTRODUCTION

It has been reported that hostility contributes to various health problems and diseases (Barefoot *et al.* 1983, 1989; Shekelle *et al.* 1983; Smith & Frohm, 1985; Dembroski *et al.* 1989; Romanov *et al.* 1994; Miller *et al.* 1996). Although findings are not wholly consistent, most research results suggest that hostile individuals are at greater risk of coronary heart disease (Ostfeld *et al.* 1964; Barefoot *et al.* 1983; Koskenvuo *et al.* 1988; Julkunen *et al.* 1994) and that hostility also causes minor health problems (Houston &

Kelly, 1989; Chen & Spector, 1992; Siegler *et al.* 1992; Kivimäki *et al.* 1996; Vahtera *et al.* 1997). For example, in a study of records of absence through sickness, covering a 4-year period, hostility was found to be associated with musculoskeletal disorders and trauma but not respiratory disease (Vahtera *et al.* 1997).

Despite evidence of an association between hostility and health, little is known of the mechanisms behind the relationship. Several theories have however been advanced (Williams *et al.* 1985; Leiker & Hailey, 1988; Smith, 1994; Miller *et al.* 1996). One involves a psychosocial vulnerability model. In this, the health of hostile individuals is assumed to be at greater risk than that of others, at least partly because the coping

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strategies the former employ in psychosocial stress situations are less effective. As a result, levels of social support in work and private life are lower than normal (Smith & Christensen, 1992; Smith, 1992, 1994; Miller *et al.* 1996). In support of this assumption, results of a recent study show that hostility in fact predicted psychosocial risks such as heavy drinking or breakdown of intimate relationships (Miller *et al.* 1995). In several studies (e.g. Smith & Frohm, 1985; Smith *et al.* 1988; Appelberg *et al.* 1991; Houston & Vavak, 1991), links between hostility, lack of social support, interpersonal conflicts at work, and experience of stress have been reported.

The value of the above-mentioned results is diminished by at least two limitations of the studies. The first is that the health of hostile and non-hostile people has not usually been measured before and after significant stressor change. To test the hypothesis of vulnerability, there is a need to determine whether the response of hostile individuals to stressors differs from that of others (Miller *et al.* 1995). The second limitation affecting studies is that hostility and exposure to psychosocial stressors have often been self-reported, making it difficult to decide whether relationships between them were genuine, or simply a reflection of common method variance.

To remove these limitations, a variety of sources of information and a prospective design were used in the study described below. Measurements were made at three times to investigate the vulnerabilities of hostile and non-hostile individuals to health problems in the context of stressful changes in their working lives. The hypothesis, on the basis of the psychosocial vulnerability model, was that an increase in exposure to occupational stressors such as organizational downsizing, and increased job insecurity and work demands was a greater risk to the health of hostile than of non-hostile workers.

METHOD

Subjects

In 1990, 1110 identifiable full-time employees of the town of Raisio, in south-western Finland, 95% of all 1168 Raisio local government personnel responded to a questionnaire designed to allow assessment of hostility, psychosocial stressors and behavioural risk factors. Eight hundred and ninety-two of those who responded were still working 3 years later, in 1993, when a second survey was conducted. Of these 892, 812 (91%) responded to the second survey.

Data on absence of the respondents through sickness covered two periods: the year 1991 and the years 1993–1995. Employees who responded to the first survey and who had worked for at least 6 months after the first and second surveys were included in the study reported here. They numbered 866 (230 men, 636 women).

Three hundred and fifty-six of the 1168 individuals employed by the town of Raisio in 1990 were therefore not covered by the study, because: (1) they did not return the questionnaire; or (2) they ceased to be employed by the town (e.g. because they retired, their contracts ended or they changed employers) during the period studied.

It was impossible to assess whether the 58 employees who did not return the questionnaire in the first survey differed in terms of hostility, or any other characteristic, from those who did. However, the 73 (23 men, 50 women) who did not return the questionnaire in the second survey did not differ significantly in terms of hostility (men: $t(266) = -1.27$, NS; women: $t(837) = 0.29$, NS) from those who did.

The 244 individuals who left or lost their jobs with the town during the study differed significantly from those who kept their jobs. The 39 men in this category were more hostile (mean = 10.33, s.d. ± 3.94) than those who kept their jobs (mean = 8.83, s.d. ± 3.51) ($t(266) = -2.42$, $P < 0.05$). The 205 women were slightly less hostile (mean = 8.78, s.d. ± 3.64) than those who kept their jobs (mean = 9.40, s.d. ± 3.93) ($t(837) = 1.98$, $P < 0.05$). Other characteristics of those who lost or left their jobs with the town as compared to those who did not included a greater frequency of non-permanent contract (37% $v.$ 5%, $\chi^2(1) = 171.7$, $P < 0.001$) and a greater number of days off work because of ill health (24.9 days/person-year $v.$ 9.9 days/person-year). These characteristics did not interact with sex.

Study design

From the beginning of 1990s, Finland faced its most severe economic decline since World War I.

The lengthy declining trend in unemployment reached its lowest point in 1990, at 3·4%. Unemployment subsequently increased rapidly, first in the private sector, then in the public. It reached its peak (17·9%) in 1993 (Statistic Finland, 1995). In comparison with the previous year, numbers of Finnish local government personnel fell by 1·4% in 1991, 2·7% in 1992, 7·8 in 1993 and 2·7% in 1994 (Statistics Finland, 1995). In Raisio, hours worked fell by 14·5% from 1991 to 1993, after which they gradually increased. However, hours worked in 1995 were still 10·7% fewer than before the decline. In addition to increasing unemployment, the economic decline led to increases in such psychosocial stressors as job insecurity, increased job demands, and negative changes in work (Hartley *et al.* 1991; Kets de Vries & Balazs, 1997).

In the study reported here, assessments were undertaken in relation to 1990–1991, i.e. the period before and at the beginning of the economic decline (Time 1), 1993, i.e. the worst year of the decline (Time 2) and 1993–1995, i.e. the period after the worst year (Time 3).

For Time 1, data included results of a survey conducted in November 1990 on hostility, baseline job stressors and behavioural risk factors, and records of absences through sickness of respondents to the survey from 1 January to 31 December 1991.

For Time 2, data consists of results from the second survey, in November 1993, and findings related to changes in staffing levels. The results of the surveys indicated that work-related stressors arose or changed after Time 1. Changes in staffing levels, in terms of reductions in hours worked between 1991 and 1993, were determined from employer's records.

For Time 3, data was drawn from records of absence through sickness from 1 January 1993 to 31 December 1995.

Measures

Hostility

We measured hostility using a 3-item scale derived from that of Koskenvuo *et al.* (1988). The items consist of self-ratings of anger-proneness ('do not get angry easily … get angry easily'), irritability ('get irritated easily … do not get irritated easily'), and argumentativeness ('not prone to get into arguments … prone to get into arguments'), reflecting particularly the affective and behavioural components of hostility (Miller *et al.* 1996). Item ratings were on a 7-point, Likert-type scale. The hostility measure has been shown to be reliable and valid, and has been successfully used in prospective studies to predict absence through sickness, hospitalization, coronary heart disease and mortality (Romanov *et al.* 1994; Strandberg *et al.* 1994; Vahtera *et al.* 1997). The internal consistency and long-term stability of the scale were satisfactory in our sample (coefficient alpha reliability 0·77, 3-year test–retest reliability 0·67). In illustrating interactions, hostile individuals were identified by application of the 30% *v.* 70% method (scores for low hostility 3–11; scores for high hostility 12–21).

Sickness absence

We collected data on absence through sickness from records kept by the occupational health-care unit in Raisio. These computer-based records list periods of sick leave for each employee, and include the dates on which sick leave began and ended, and diagnoses, in coded form. All sick-leave certificates, irrespective of place of issue, must be forwarded for recording. For absence through sickness of up to 3 days, employees may complete their own certificates. For absences of more than 3 days, medical certificates are required.

We grouped all periods of medically certified sickness absence that had occurred at the beginning of the period of economic decline (from 1 January to 31 December 1991) and those that occurred during and after the worst year of decline (between 1 January 1993 and 31 December 1995). We checked records for inconsistencies, and combined overlapping or consecutive periods of sickness above. The number of sick-leave periods in 1991 represented the baseline level of sickness absence, and was used as a dichotomized variable in analyses (no spells/ one or more spells). The number of sick-leave periods in 1993–1995 represented the level of sickness absence after the work-related stressors. Long periods of absences were combined and used as a general indicator of health. Musculoskeletal disorders and trauma as reasons for absence through sickness were also grouped separately (International Classification of Diseases, 1977 Revision, WHO, 1977). It has been reported that these categories of disease are

associated with hostility (Vahtera *et al.* 1997). They have also been found to be important causes of disability in the working population, and to relate to work stress (Office of Population Censuses and Surveys, 1988, Hemingway *et al.* 1997).

Organizational downsizing

To measure downsizing in staffing levels, we obtained information from the employers' records for all period of employment in Raisio. This information included dates for the start and end of employment, places of work, and the dates of when each period of absence began and ended. We calculated hours of work by sub-tracting the number of days absent from work, irrespective of cause, from the total working hours, for each place of work between 1 January and 31 December, 1991 (i.e. Time 1), and between 1 January and 31 December, 1993 (i.e. Time 2). Working hours in Time 1 and Time 2, expressed as person-years, were calculated for each place of work. The extent of downsizing was indicated by the percentage reduction in working hours in Time 2 compared with working hours in Time 1. The measure of downsizing was normally distributed.

Job insecurity

We assessed perceptions of job insecurity at Time 2 by means of five items, relating to threats of notice, lengthy lay-off, unemployment, re-dundancy and transfer to another job. The overall measure, derived from a national survey by Statistics Finland (Lehto, 1991), was the sum of the item scores (coefficient alpha $r = 0.87$).

Level of job demands and change in job demands

Job demands were measured at Times 1 and 2 by means of 5-item scale, relating to perceived psychological burden of work, amount of work, pace of work, and time pressure. The methods of measurement have been reported in detail elsewhere (Vahtera *et al.* 1996). We assessed change in job demands by comparing levels of job demands at Times 1 and 2.

Perceived overall change in work

Perception of overall change in work was measured at Time 2 by means of two items. One indicated the degree of change (minor to major), the other the nature of change (positive to negative). Responses were placed in one or other of two categories: negative, major change, and any other kind of change.

Potential confounding factors

We also investigated eight potential confounding factors. Absence through sickness at Time 1, age, sex and income level (as operationalization of socio-economic status) were determined from the employer's records. In these records, incomes of employees are grouped into 17 categories, each successive category corresponding to an increase of 12 000 FIM in annual income. In connection with the first survey, behavioural risk factors such as regular smoking (yes/no), body mass index (low, < 23 kg/m²; medium, 23–27 kg/m²; high, > 27 kg/m²), alcohol consumption (in men: low, < 40 g of absolute alcohol/ week, medium, 40–280 g/week, high, > 280 g/ week; in women: low, < 40 g of absolute alcohol/week, medium, 40–190 g/week, high, > 190 g/week) and physical activity (sedentary/ moderate/vigorous) were determined. A detailed description has been given elsewhere (see Vahtera *et al.* 1997).

Statistical analyses

We determined the number of periods of sick leave and the follow-up period in person-years for each employee. Number of sick leaves per 100 person-years and corresponding rate ratios were calculated. Because number of sick leaves is a form of count data, Poisson regression models were fitted to the data (McCullagh & Nelder, 1989; North *et al.* 1993). Use of the Poisson model implies that the between-employee variance in rates of sick leave is equal to the expected rate of sick leave. If rates of sick leave vary between individuals after taking account of predictors, dispersion may be greater than that predicted from the Poisson model. In such a case, the square-root of the variance divided by the number of degrees of freedom should be used to adjust for standard errors. In the study described here, the dispersion of rates of sick leave was, however, close to that predicted from the Poisson model.

We standardized continuous variables – i.e. age, income, organizational downsizing (reduction in person-years worked), perceived

job insecurity, job demands, change in job demands. Income, which was a skewed variable, was logarithmically transformed.

The first step of our analysis examined the associations between potential confounding factors at Time 1 and sickness absence at Time 3. When confounders were analysed separately, we adjusted absence rates for sickness absence at Time 1. To find out the block of confounders to be controlled in the test of vulnerability model, the combined effects of significant confounders on sickness absence was examined.

In the second step, were explored the relationships between hostility at Time 1, stressors at Time 2 and sickness absence at Time 3. The results were expressed as mean hostility scores and ratios of sickness absences rates and their 95% confidence intervals for different levels of stressors. We classified stressors indicated by continuous measures into three levels using −1s.D. and +1s.D. as cut-off points. The results were adjusted for age and sickness absence at Time 1. We used the cross-product term to analyse the interactions with gender, as suggested by Cohen & Cohen (1983).

To test the vulnerability model in relation to stressful changes in work life, we studied whether hostility at Time 1 affects the relationships between stressors at Time 2 and sickness absence at Time 3 by using crossproduct term hostility × stressor (Cohen & Cohen, 1983). We adjusted all interactions for sickness absence at Time 1 and the block of significant confounders found in the first step. We studied gender differences by using crossproduct term gender × hostility × stressor. Absence rates were estimated, and corresponding rate ratios and 95% CIs calculated, from the Poisson models, for different levels of stressors in hostile and non-hostile individuals.

For all analyses we used the SAS statistical program package. Poisson regression models were calculated by the GENMOD procedure (SAS, 1939).

RESULTS

The socio-economic factors and poor health habits which, in combination, increased risk of subsequent absence through sickness were high rate of sickness absence at baseline, low income, and high body mass (Table 1, see also Vahtera *et*

Table 1. *Socio-economic and behavioural risk factors variables at Time 1 and medically certified sickness absence at Time 3. Rate ratios (RR) and 95% confidence intervals*

	Separately*	Together
	RR (95% CI)	RR (95% CI)
Sickness absence at baseline		
No	1·00	
Yes	2·38 (2·14–2·66)	2·10 (1·88–2·36)
Sex		
Male	1·00	
Female	1·11 (0·98–1·27)	
Age		
−1 s.D.	1·00	
+1 s.D.	1·20 (1·07–1·35)	1·23 (1·09–1·40)
Income		
+1 s.D.	1·00	
−1 s.D.	1·56 (1·40–1·75)	1·57 (1·40–1·77)
Body mass index		
< 23 kg/m²	1·00	
23–27 kg/m²	1·40 (1·24–1·60)	1·36 (1·19–1·56)
> 27 kg/m²	1·59 (1·37–1·85)	1·52 (1·30–1·77)
Alcohol consumption		
Low	1·00	
Average	0·84 (0·75–0·95)	0·91 (0·80–1·02)
High	0·67 (0·55–0·83)	0·78 (0·63–0·96)
Smoking		
No	1·00	
Yes	1·04 (0·91–1·18)	
Physical activity		
Vigorous training	1·00	
Moderate	1·05 (0·82–1·34)	0·98 (0·76–1·26)
Sedentary lifestyle	1·33 (1·00–1·78)	1·26 (0·94–1·70)

* Adjusted for baseline sickness absence.

al. 1997). Adjustment was made for the effects of these variables, and age, in Poisson regression models. Regular smoking, a sedentary life-style and high alcohol consumption did not increase risk of sickness absence, after adjustment had been made for the rate of absence through sickness at Time 1.

Hostility at Time 1 was not associated with any stressor at Time 2. In regression models adjusted for rate of absence through sickness at Time 1 and age, all stressors except increased job demands were related to sickness absence at Time 3. Severe organizational downsizing, for example, increased risk of subsequent sickness absence in men 2·9 times. In women, high job insecurity and high job demands increased risk of sickness absence by 50–74% (Table 2).

Many of the stressor × hostility × sex interactions were statistically significant. Results are,

Table 2. *Relationships between psychosocial stressors, hostility before exposure to stressors, and sickness absence after exposure to stressors*

| | | | Sickness absence* | |
| | | | Men | Women |
Stressor	N	Hostility Mean	RR (95% CI)	RR (95% CI)
Reduction in person-years worked†				
Minor	138	9·61	1·00	1·00
Moderate	610	9·12	1·82 (1·23–2·70)	1·30 (1·05–1·61)
Severe	118	9·49	2·91 (1·84–4·61)	1·19 (0·76–1·54)
Job insecurity				
Low	113	8·98	1·00	1·00
Moderate	514	9·26	0·78 (0·58–1·07)	0·98 (0·80–1·20)
High	124	9·38	1·47 (0·95–2·28)	1·51 (1·21–1·89)
Job demands†				
Low	103	9·06	1·00	1·00
Moderate	545	9·19	1·34 (0·87–2·04)	1·25 (1·01–1·55)
High	108	9·66	1·32 (0·76–2·28)	1·74 (1·36–2·22)
Change in demands				
Decreased	94	9·38	1·00	1·00
No change	550	9·30	1·34 (0·85–2·14)	1·06 (0·87–1·29)
Increased	112	8·87	1·65 (0·97–2·80)	1·17 (0·94–1·51)
Negative job change†				
No	515	9·21	1·00	1·00
Yes	233	9·29	0·87 (0·66–1·14)	1·41 (1·23–1·62)

No significant association between hostility and stressors. No significant interaction with sex.
 * Rate ratios and 95% confidence intervals of medically certified sickness absences adjusted for age and sickness absence before exposure to stressors.
 † Interaction with sex in relation to sickness absence significant.

Table 3. *Joint effects of hostility and psychosocial stressors on subsequent sickness absence. Improvement in Poisson regression model after including interaction term*

| | Overall sickness absence | | Musculoskeletal disorders | | Trauma | |
| | Men χ^2 (df) | Women χ^2 (df) | Men χ^2 (df) | Women χ^2 (df) | Men χ^2 (df) | Women χ^2 (df) |
Model						
Hostility × downsizing†	5·0 (1)*	5·5 (1)*	4·6 (1)*	2·4 (1)	0·6 (1)	0·1 (1)
Hostility × job insecurity‡	0·0 (1)	9·5 (1)**	1·6 (1)	12·1 (1)***	9·2 (1)**	0·0 (1)
Hostility × job demands§	0·1 (1)	11·3 (1)***	0·8 (1)	15·8 (1)***	0·8 (2)	0·6 (2)
Hostility × change in demands§	0·0 (1)	12·8 (1)***	0·2 (1)	21·5 (1)***	3·4 (1)	0·2 (1)
Hostility × negative job change	0·8 (1)	4·5 (1)*	1·8 (1)	0·4 (1)	0·0 (1)	0·9 (1)

χ^2 values have been adjusted for age, sickness absence before exposure to stressor, income and health-risk behaviour.
 † Interaction with sex in relation to overall sickness absence significant.
 ‡ Interaction with sex in relation to trauma significant.
 § Interaction with sex in relation to musculoskeletal disorders significant.
 * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$.

therefore, reported separately for each sex. Results relating to adjusted Poisson regression models (Table 3) show that the stressor × hostility interaction for each sex was fairly similar in respect of absence through sickness of all kinds and absence because of musculo-skeletal disorder. In women, the effects of stressors such as high job insecurity, high and increased levels of job demands on absence through sickness of all kinds and absence because of musculoskeletal disorders were related to hostility. In men, and in cases of absence because of trauma, hostility was not related to the effects of stressors on health, with two exceptions. One was that the rate of absence because of trauma in hostile men who had

Men

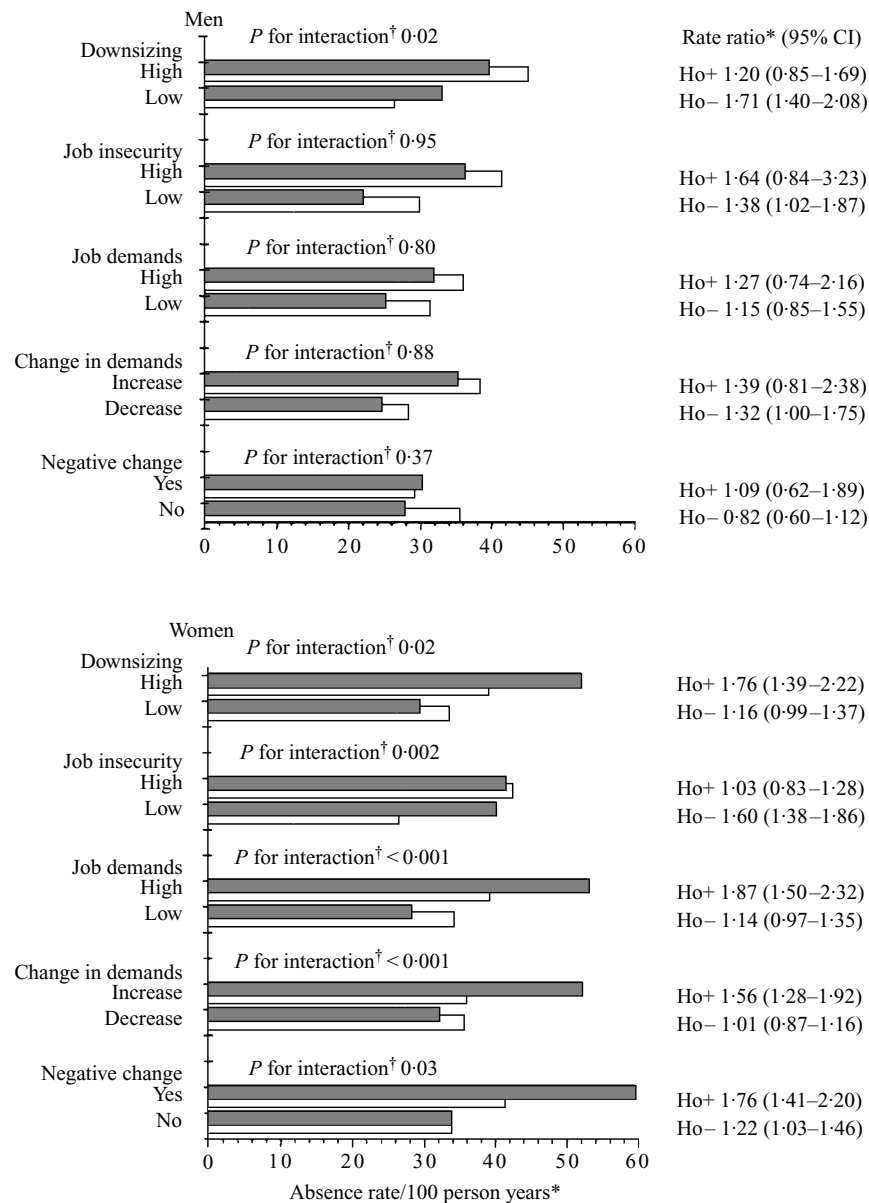

Women

Absence rate/100 person years*

FIG. 1. Interactions between hostility and exposure to psychosocial stressors on sickness absence. Rate ratios are ratios of absence through sickness at high *v.* low levels of exposure to stressors, in hostile (■, Ho+) and non-hostile (□, Ho−) individuals. * Absence rates and rate ratios adjusted for age and sickness absence before exposure to stressors. † *P* values for hostility × stressor interactions adjusted for age, sickness absence before exposure to stressors, income and health-risk behaviour.

experienced high job insecurity was 4·2 times higher than in hostile men who had experienced low levels of job insecurity. In non-hostile men, there was no relationship between job insecurity and absence because of trauma. The other exception was that hostile men were less affected

by organizational downsizing than non-hostile men (Fig. 1).

The result in Table 3 are based simply on classification of subjects as hostile or otherwise. Similar results were obtained when hostility was treated as a continuous variable.

As will be evident from Fig. 1, hostility in men did not increase risk of absence through sickness when stressors were operative. However, hostile women exposed to psychosocial stressors such as severe reductions in person-years worked, high or increased job demands, and negative changes in work were at 55–90 % greater risk of subsequent absence because of sickness than non-hostile women. Rates of absence through sickness were also high in hostile women, whether job security was regarded by them as high or low.

DISCUSSION

The aim of the study reported was to determine whether hostile individuals experienced more health problems than non-hostile individuals when exposed to stressors. The focus was on psychosocial stressors related to an economic decline that took place after hostility and baseline health had been assessed. Hostile women were found to be particularly vulnerable to most of the stressors studied. In men, adverse effects of the stressors on health were fairly independent of hostility.

Context for test of a psychosocial model of vulnerability

The stressors studied were not associated with hostility. In previous studies, however, it has sometimes been found that hostility was associated with higher exposure to various kinds of stress. Such associations have been considered to place hostile individuals at greater risk of health problems than non-hostile individuals (Scherwitz *et al.* 1991; Smith & Christensen, 1992). Differences between the findings reported here and those described previously could be explained by differences in extents to which the stressors studied related to personal attributes. In earlier studies, life events related to the individuals concerned may have been covered more extensively than in the present study, where the focus was on occupational stressors determined by major economic change affecting society but not significantly affected by characteristics of the subjects of the study. Absence of an association between hostility and stressors in the present study is, on this basis, not surprising.

Risk of health problems, as indicated by absence through sickness, seemed to increase after exposure to stressors such as organizational downsizing, job insecurity, high levels of job demands and overall negative changes in work. These results provided evidence that psychosocial work stressors are significant determinants of health, as already reported (e.g. Arsanault & Dolan, 1983; Beale & Nethercott, 1988; Mattiasson *et al.* 1990; Ferrie *et al.* 1995; North *et al.* 1996). Previous research in this field has predominantly been cross-sectional or prospective studies in which factors potentially predictive of health have been measured at only one time-point (Zapf *et al.* 1996). In the present study, at three-time points, it was possible to determine changes in health and exposure stressors with time. The relationship between health and exposure to stressors was investigated on the basis of data from a variety of sources, including the subjects themselves and organizational records. Problems relating to common-method variance were accordingly minimized. Thus, these findings fulfil an important precondition for a test of the psychosocial vulnerability model of hostility by giving evidence that the measured stressors indeed contributed to health problems.

There can be many causes for absence from work (Nicholson, 1993; North *et al.* 1993). Absence from work may, therefore, be of limited value as an indicator of health. This is especially true of short-term, uncertified absence. In contrast, long-term absence from work through sickness appears to reflect employee health fairly accurately (North *et al.* 1993; Marmot *et al.* 1995). In the present study, the reason for each long period of sickness absence had been verified by a physician, thus minimizing the effect of absence from work without a health-related reason. Data in the present study relating to absence through sickness also covered minor health problems. Information about these tends to be missing from the morbidity records often used.

Poor health habits are assumed to be an other mechanism underlying the relationship between hostility and health (Koskenvuo *et al.* 1988; Leiker & Hailey, 1988; Scherwitz *et al.* 1992; Siegler *et al.* 1992; Vahtera *et al.* 1997). In the present study, all main findings were adjusted for sociodemographic background and behavioural risk factors. Poor health habits

could not, therefore, have affected evidence relating to the psychosocial vulnerability model in this study.

Hostility, psychosocial vulnerability and sex

Consistent with the psychosocial vulnerability model, risk of sickness depended on hostility in women faced with severe downsizing of staffing levels, high or increased levels of job demands, or negative changes in work. Hostile women were at greater risk of absence through sickness of all kinds or absence of musculoskeletal problems, or both, than non-hostile women. In men, the situation was different. In a previous study in the same subjects it was shown that high levels of hostility predicted high numbers of periods of absence through sickness in men (Vahtera *et al.* 1997). The results of the present study suggest that this greater risk of sickness in hostile men cannot be explained by increased vulnerability to the adverse effects of occupational stressors. In men, hostility did not typically increase risk of health problems following exposure to studied stressors. Because an adjustment was made for baseline absence through sickness, no effect of hostility on subsequent absence through sickness was observable.

The differences between the men and the women could to some extent be attributable to the men who dropped out of the study, having been significantly more hostile than those who remained in the study. The male participants were, on average, less hostile than the female participants. If the level of hostility needed for an effect was high, the findings of differences between the sexes in this study could reflect limitations of the data rather than any real difference between men and women. This is, however, unlikely, because differences between the sexes were not observed not only when subjects were classed as hostile or non-hostile but also when hostility was treated as a continuous variable.

In general, the present findings relating to the measure of hostility of Koskenvuo *et al.* (1988) primarily reflect the roles played by the behavioural and emotional components of hostility in the development of health problems. Thus, the evidence from the present study relates to seldom studied components of hostility. Majority of prior research relates to cognitive and experienced aspects of hostility and their associations with health (Miller *et al.* 1996).

Conclusions and implications for future research

The results of the longitudinal study reported partly support the psychosocial vulnerability model but also suggest that heightened vulnerability associated with behavioural and emotional components of hostility may be sex-related. Hostility may increase an individual's risk of health problems in the face of certain occupational stressors, but this was evident in the study mainly in women. In hostile men it was observed to a lesser extent, suggesting that the mechanisms linking hostility with health problems may differ in men and women. Thus, several topics for future research remain.

Hostility was measured in this study by means of the simplest major hostility questionnaire used in the field (Barefoot, 1992; Miller *et al.* 1996). Repetition of the study using other hostility questionnaires (e.g. the Cook–Medley Hostility Scale (Cook & Medley, 1954) the Buss–Durkee Hostility Inventory (Buss & Durkee, 1957)) or complementary use of, for example, the Hostility Facet Scoring System (Dembroski *et al.* 1989), might prove more comprehensive. It would be desirable to supplement the evidence so far obtained with findings indicating extents to which, e.g. anger-in, cynicism, mistrust and resentment can affect the consequences of exposure to occupational stressors on health.

As the psychosocial vulnerability model argues that low levels of social support and high levels of social conflict and intrapersonal stress are responsible for the increased health risk among hostile individuals, it would also be useful to determine whether differences exist in social and other health resources between hostile and non-hostile individuals faced with occupational stressors, such as severe organizational downsizing, increased or high job demands, and negative changes in work.

The difference between the sexes when faced with the occupational stressors studied was striking and therefore also warrants further study. For example, it would be interesting to discover whether anger, irritability and argumentativeness are tolerated less in women than in men by other employees. It would also be interesting to determine whether similar

differences existed in relation to exposure to other psychosocial stressors at work and in private life.

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