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Hostility May Explain the Association between Depressive Mood and Mortality: Evidence from the French GAZEL Cohort Study

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Abstract

Background

Depressive mood is associated with mortality. Because personality has been found to be associated with depression and mortality as well, we aimed to test whether depressive mood could predict mortality when adjusting for several measures of personality.

Methods

20,625 employees of the French national gas and electricity companies gave consent to enter in the GAZEL cohort in 1989. Questionnaires were mailed in 1993 to assess depressive mood, Type A behaviour pattern, hostility, and the six personality types proposed by Grossarth-Maticek & Eysenck. Vital status and date of death were obtained annually for all participants. The association between psychological variables and mortality was measured by the Relative Index of Inequality (RII) computed through Cox regression.

Results

14,356 members of the GAZEL cohort (10,916 men, mean age: 49 years, 3,965 women, mean age: 46 years) completed the depressive mood scale and at least one personality scale. During a mean follow-up of 14.8 years, 687 participants had died. Depressive mood predicted mortality, even after adjustment for age, sex, education level, body mass index, alcohol consumption, and smoking [RII (95% CI) = 1.56 (1.16–2.11)]. However, this association was dramatically reduced (RII reduction: 78.9%) after further adjustment for cognitive hostility (i.e. hostile thoughts) [RII (95% CI) = 1.12 (0.80–1.57)]. Cognitive hostility was the only personality measure remaining associated with mortality after adjustment for depressive mood [RII (95% CI) = 1.97 (1.39–2.77)].

Conclusions

Cognitive hostility may either confound or mediate the association between depressive mood and mortality.

Author Keywords Cohort ; Depression ; Hostility ; Mood ; Mortality ; Personality

Introduction

Major depression is one of the leading causes of disability worldwide [1] and even subthreshold depressive symptoms, henceforth referred to as depressive mood, are associated with an increased mortality [2–7, but see also 8–11]. Some personality constructs, such as neuroticism, have been found to be associated with depression [12, 13] and others, such as hostility, with mortality [14–21]. Therefore, it is possible that personality (i.e. a person's characteristic pattern of behaviour, thoughts and feelings) may account for the association between depressive mood and mortality.

To address this issue, several measures of personality were selected regarding their putative association with mortality and assessed in the large-scale French GAZEL cohort [22, 23]: Type A behavior pattern, hostility, and the six personality types proposed by Grossarth-Maticek & Eysenck [24] (i.e. 'cancer-prone', 'coronary heart disease (CHD)-prone', 'ambivalent', 'healthy', 'rational', and 'antisocial'). Although the Type A behaviour pattern was found to predict CHD in early studies [25, 26], subsequent negative results failed

to provide compelling evidence linking the Type A with mortality and focused attention on hostility as the 'toxic' component of the Type A [18, 27]. Hostility was actually found to predict mortality [14–18], but null findings have also been reported [28]. Evidence supporting the personality-disease theory developed by Grossarth-Maticek and Eysenck [24] is more limited [19–21]. Because most of these personality constructs deal with emotional regulation, we expected that at least some of them would be associated with depressive mood.

The present study aimed to test whether depressive mood could predict mortality independently of personality measures. We assumed that if a personality measure explains or partially explains the association between depressive mood and mortality then this association should disappear or be attenuated when controlling for this measure.

Method

Participants

The GAZEL cohort study was established in 1989 and details of this study are available elsewhere [23]. The target population consisted of employees of the French national gas and electricity companies. At baseline, 20,625 employees (15,011 men aged 40–50, and 5,614 women aged 35–50) gave written informed consent to participate. In 1993, questionnaires were mailed to the 20,488 living members of the GAZEL cohort to assess depressive mood and personality [22]. Scores were interpolated whenever at least 70% of the items were completed.

Depressive mood

Depressive mood was assessed with the French version of the 20-item Center of Epidemiologic Studies Depression Scale (CES-D) [29, 30], which has been designed for use in community studies. The CES-D asks participants how often they have experienced specific symptoms during the previous week (e.g. "I felt depressed", "I felt everything I did was an effort", "My sleep was restless."). Responses range from 0 ("hardly ever") to 3 ("most of the time").

Personality measures

The personality scales used in this study, except for the Type A scale, were previously validated in French on 408 randomly selected participants of the GAZEL cohort [22].

The Bortner Type A Rating Scale

The Type A behaviour pattern (sense of time urgency, covert low self-esteem, and hostility) was assessed with the Bortner Type A Rating Scale [31]. It consists of 14 items each comprising two statements with a graded scale between the two statements (24-point scale in the original version, 6-point scale in the version adapted for the GAZEL cohort). Examples of statements include 'never late' versus 'casual about appointments'. High scores indicate Type A. This scale was translated and validated for the French population against the Friedman and Rosenman structured interview for assessing Type A, agreement observed 71.5% [25, 32].

The Buss and Durkee Hostility Inventory (BDHI)

The BDHI is a measure of general aggression and hostility, composed of 75 items with 'true-false' answers [33]. It has eight subscales, seven of which are designed to measure different components of hostility: assault, verbal aggression, indirect hostility, irritability, negativism, resentment and suspicion. The sum of these sub-scales leads to a 'total hostility' score ($\alpha=0.87$). Several factor analyses identified two overarching factors, namely 'reactive' (i.e. hostile behaviours) ($\alpha=0.78$) and 'cognitive' hostility (i.e. hostile thoughts) ($\alpha=0.77$), formed by the first three sub-scales and the last two sub-scales, respectively [22, 34]. The eighth scale, measuring the guilt tendency, does not contribute to the total score.

The Grossarth-Maticek and Eysenck Personal Style Inventory (PSI)

This scale assesses six personality types with different physical or psychological health liabilities [22, 24]: 'cancer-prone' ($\alpha=0.54$), 'CHD-prone' ($\alpha=0.79$), 'ambivalent' ($\alpha=0.60$), 'healthy' ($\alpha=0.73$), 'rational' ($\alpha=0.62$), and 'antisocial' ($\alpha=0.57$). The inventory is made up of 70-items with 'true-false' answers. Five of the personality scales are measured by 10 items each (sum of the true responses), and one (healthy type) is measured by 20 items (sum of the true responses, divided by 2). Here, we considered only the two personality types with a Cronbach's α coefficient ≥ 0.70 :

The 'CHD-prone' personality refers to individuals who show a lack of autonomy and are helplessly dependent in relationships. They experience anger, aggression and arousal when faced with relational problems. These characteristics are thought to lead to the development of cardiovascular problems, such as hypertension and CHD.

The 'Healthy' personality refers to individuals who exhibit autonomy and consider it to be important for their wellbeing and happiness. They are able to self-regulate their behaviour and are hypothesized to have a disposition towards being healthy as they avoid stress reactions such as those commonly experienced by 'CHD-prone' individuals.

Mortality

Dates of death were available from 1 January 1989 to 31 January 2008. Causes of death were available from 1 January 1989 to 31 December 2005.

Covariates

Age and sex were obtained from employer's human resources files. Education level (primary, lower secondary, higher secondary and tertiary) and behavioural factors in 1993 were self-reported. Alcohol consumption, as drinks per week, was categorized as non-drinkers, occasional drinkers (1–13 for men, 1–6 for women), moderate drinkers (14–27 for men, 7–20 for women) or heavy drinkers (≥ 28 for men, ≥ 21 for women). Smoking in the same period was categorized as non-smoker and as smoker of 1–10, 11–20 or ≥ 21 cigarettes per day. Body mass index (BMI) in 1993 was calculated by dividing weight in kilograms by height in meters squared and categorized as < 20 , 20–24.9, 25–29.9 or ≥ 30 kg/m².

Statistical analyses

All statistical analyses were computed with SPSS 16.0.1 software (SPSS Inc.).

The association between discrete variables and mortality was estimated with the Hazard Ratio computed in Cox regressions. Coefficients of correlation were computed to examine the relation between depressive mood and personality measures.

The association between continuous variables and mortality was modelled using the Relative Index of Inequality (RII) computed through Cox regression [18, 35]. The RII is computed by ranking the predictor on a scale from 0 to 1. For a given predictor, each score covers a range on this scale that is proportional to the number of participants who have that score and is given a value on the scale corresponding to the cumulative midpoint of its range. The RII resembles relative risk in that it compares the mortality at the extremes of the predictor but it is estimated using the data on all scores and is weighted to account for the distribution of the personality scores. An RII of 2 indicates a doubling of the risk of mortality for individuals at the extremes of the predictor.

For each personality measure, we first computed the RII of depressive mood adjusting for age and sex and including only participants that completed the personality measure (i.e. model 1). Then we computed the RII of the personality measure adjusting for age and sex and including only participants that completed the CES-D (i.e. model 2). Finally, whenever the personality measure predicted mortality with a P value < 0.10 in model 2, depressive mood and the personality measure were entered simultaneously, adjusting for age and sex (i.e. model 3). The percentage of change in the RII after mutual adjustment (i.e. model 3), was computed as follows: $100 \times \frac{(\text{RII}_{\text{not adjusted}} - \text{RII}_{\text{adjusted}})}{(\text{RII}_{\text{not adjusted}} - 1)}$. The whole procedure was repeated with further adjustment for BMI, alcohol consumption, smoking, and education level.

Results

A total of 14,356 (70.2%) members of the GAZEL cohort completed the CES-D and the entire personality inventory and 14,881 (72.8%) completed the CES-D and at least one personality scale. Compared with non participants, participants (10,916 men, mean age = 48.99 years, standard deviation = 2.87, and 3,965 women, mean age = 46.20 years, standard deviation = 4.18) were likely to be male, older, more educated, and to have lower mortality (all P < 0.005).

During a mean follow-up of 14.8 years, 687 (4.6%) participants had died, including 581 men (5.3%) and 106 women (2.7%). The main cause of death was available only for the 542 participants who died between January 1989 and December 2005: 297 (54.8%) participants died from a cancer, 103 (19.0%) from a cardiovascular disease, 84 (15.5%) from another disease, and 58 (10.7%) from an external cause (i.e. suicide or accident).

Self-reported covariates (i.e. education level, BMI, alcohol consumption, and smoking) were available for 12,120 (81%) participants. These participants were likely to be male, older, less depressed, less hostile, and less 'CHD-prone' (all P ≤ 0.001).

Regarding socio-demographic and behavioural variables, mortality was predicted by age [687 events/14,881 participants, RII (95% CI) = 2.79 (2.14–3.65), P < 0.001] and by sex, education level, BMI, alcohol consumption, and smoking (Table 1). Regarding discrete variables with more than 2 classes (i.e. education level, BMI, alcohol consumption, and smoking), their association with mortality did not demonstrate clear linearity (i.e. both P < 0.05 for linearity and P > 0.10 for deviation from linearity). Deviation from linearity was

particularly obvious for alcohol consumption, both non-drinkers and heavy drinkers showing an increased mortality compared with occasional drinkers (Table 1). Consequently, these discrete variables were considered as nominal covariates in subsequent multivariate analyses.

Regarding psychological variables, mortality was predicted by depressive mood, total and cognitive hostility, and negatively predicted by Type A (Table 2). Additionally, there was a trend for an association between mortality and 'CHD-prone' personality ($P = 0.054$). Depressive mood was positively correlated with Type A, hostility scores, and 'CHD-prone' personality, and negatively with 'healthy' personality (Table 3). Depressive mood was also associated with age ($r = -0.054$, $P < 0.001$), sex ($t = -23.34$, $P < 0.001$), education level ($F = 39.78$, $P < 0.001$), BMI ($F = 42.49$, $P < 0.001$), alcohol consumption ($F = 26.40$, $P < 0.001$), and smoking ($F = 3.56$, $P = 0.014$).

Table 4 displays the associations of depressive mood and personality with mortality before and after adjustment for each other, all models being adjusted for age and sex. Before mutual adjustment, mortality was predicted by depressive mood, total and cognitive hostility, and 'CHD-prone', and inversely predicted by 'healthy' personality. After mutual adjustment, the most important attenuation in the association between depressive mood and mortality was observed for cognitive hostility (RII change: 75.9%). After adjustment for cognitive hostility, depressive mood was no longer significantly associated with mortality. In all other models, depressive mood remained significantly associated with mortality. In contrast, 'CHD-prone' and 'healthy' personalities were no longer significantly associated with mortality after adjustment for depressive mood.

Further adjustment for the self-reported covariates (i.e. education level, BMI, alcohol consumption, and smoking) yielded similar results (Table 5). The attenuation of the association between cognitive hostility and mortality after adjustment for self-reported covariates was of 18.9 % (15.7 % when adjusting for depressive mood).

Regarding sex differences, when adjusting for age, mortality was predicted by depressive mood in men [574 events/10,768 participants, RII (95% CI) = 1.77 (1.32–2.38), $P < 0.001$], but not in women [105 event/3,923 participants, RII (95% CI) = 1.55 (0.80–3.00), $P = 0.203$]. There was no significant mood by sex interaction ($P = 0.704$). Likewise, mortality was predicted by cognitive hostility in men [574 events/10,768 participants, RII (95% CI) = 2.43 (1.83–3.24), $P < 0.001$], but not in women [105 event/3,923 participants, RII (95% CI) = 1.82 (0.91–3.61), $P = 0.090$]. There was no significant cognitive hostility by sex interaction ($P = 0.442$). After mutual adjustment in men, mortality was still predicted by cognitive hostility [574 events/10,768 participants, RII (95% CI) = 2.25 (1.62–3.13), $P < 0.001$], but no longer by depressive mood [574 events/10,768 participants, RII (95% CI) = 1.17 (0.84–1.64), $P = 0.353$] (RII change: 77.9%).

Regarding causes of death, when excluding external causes (i.e. suicides or accidents) and adjusting for the whole set of covariates, mortality from internal causes (i.e. diseases) remained predicted by depressive mood [403 events/11,987 participants, RII (95% CI) = 1.55 (1.10–2.19), $P = 0.013$] or cognitive hostility [403 events/11,987 participants, RII (95% CI) = 1.88 (1.33–2.65), $P < 0.001$]. After mutual adjustment, mortality was still predicted by cognitive hostility [403 events/11,987 participants, RII (95% CI) = 1.73 (1.16–2.57), $P = 0.001$], but no longer by depressive mood [403 events/11,987 participants, RII (95% CI) = 1.18 (0.80–1.76), $P = 0.409$] (RII change: 75.3%). Despite the nearly 15-year follow-up, the analysis was underpowered to allow more specific analyses regarding causes of death.

Discussion

This study aimed to examine the role of personality in explaining the association between depressive mood and mortality. Reciprocally, the design allowed us to examine the role of depressive mood in explaining the association between personality and mortality. We found that depressive mood predicted mortality even when excluding external causes of death and adjusting for age, sex, education level, BMI, alcohol consumption, and smoking. However, this association was dramatically reduced, and indeed disappeared, after adjustment for cognitive hostility. In contrast, cognitive hostility was the only personality measure that remained significantly associated with mortality when taking into account depressive mood and the whole set of covariates.

These results suggest that the association between depressive mood, such as measured by the CES-D, and subsequent mortality may be either confounded or mediated by cognitive hostility [36]. For instance, cognitive hostility may independently promote depressive mood and increase mortality, thus confounding their association. Alternatively, depressive mood may result in more hostile thoughts that may in turn increase mortality. Although these two hypotheses are not distinguishable on a statistical ground [36], both may have important implications for epidemiological research and clinical practice. First, the assessment of cognitive hostility should be included in longitudinal studies that examine health outcomes in relation to depressive mood [37]. Second, further studies should test whether targeting cognitive hostility through specific therapeutic interventions may alleviate the poor health outcome associated with depressive mood, not only in healthy subjects, but also in already ill individuals [2 –7].

The links between hostility and mortality remain poorly understood. Previous studies mainly focused on cardiovascular mortality [14 –17]. For instance, hostility may increase cardiac mortality associated with depressive mood through an increased risk of hypertension [37]. Closer to the construct of cognitive hostility, high levels of 'cynical distrust' may promote atherosclerosis through an increased inflammation [38]. Alternatively, baseline physical status or behavioural variables may explain the association between cognitive hostility

and mortality [15 , 38]. In the present study, cognitive hostility was assessed in a relatively young and working population, which is likely to contain a lower proportion of ill individuals compared with the general population. Regarding behavioural variables, the attenuation of the association between cognitive hostility and mortality after adjustment for education level, BMI, alcohol consumption, and smoking was marginal. The association between cognitive hostility and mortality is then unlikely to be primarily mediated by these baseline behavioural factors.

Additionally, we examined the role of depressive mood in explaining the association between personality and mortality. Multivariate analyses regarding the associations between mortality and personality measures in the GAZEL cohort, without adjustment for depressive mood, have been exposed elsewhere [18]. In the present study, cognitive hostility was the only personality measure that remained associated with mortality after adjustment for depressive mood and the whole set of covariates. These additional results of our study further challenge previous findings linking health with Type A [25 , 26] or with the personality types proposed by Grossarth-Maticek & Eysenck [19 –21]. Future research addressing the links between personality and mortality should include an assessment of depressive mood.

The following limitations should be considered. First, our study did not cover all personality constructs. Second, the GAZEL cohort is not representative of the general population as it does not include unemployed individuals. For instance, the magnitude of the association between hostility and mortality was found to be higher in relatively young populations, such as the GAZEL cohort [14 , 16]. Additionally, the response rate and the profile of the GAZEL cohort members who participated suggest that our study may have overlooked the role of cognitive hostility in those who had higher mortality. Third, given the relatively small number of events in women, our study was underpowered to allow specific analysis in women. It is noteworthy that the negative results in women were not explained by an interaction between sex and depressive mood or cognitive hostility. Fourth, the study was also underpowered to allow specific analyses regarding causes of death. However, cognitive hostility still explained the association between depressive mood and mortality when excluding external causes of death (i.e. suicides or accidents). Finally, a common caveat of most prospective studies addressing the links between psychosocial variables and mortality relates to the implicit assumption that these variables are stable over time. Although personality is considered to be stable through adulthood [39], life events may promote high levels of cognitive hostility, as illustrated by the clinical concept of 'posttraumatic embitterment disorder' [40]. Depressive mood is even more likely to encompass both state and trait components, which may be differentially linked to mortality. Additionally, depressive mood is only one feature of major depression [41] and its self-report measure by the CES-D is insufficient to decide therapeutic interventions. Although attenuated and chronic forms of depression, such as dysthymia, have been associated with poor health outcome [42], major depression, which requires a clinical diagnosis, may be linked to mortality through other mechanisms than depressive mood and cognitive hostility.

In summary, this study suggests that cognitive hostility may either confound or mediate the association between depressive mood and mortality. Further studies should explore the underlying mechanisms linking cognitive hostility, depressive mood and mortality in a biopsychosocial perspective [43]. A particular focus on modifiable mechanisms is warranted, as prevention and therapeutic strategies should address the processes through which personality is associated with health, rather than personality per se.

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Footnotes:

None of the authors have conflicts of interest to report.

References:

- 1 . Ustün TB , Ayuso-Mateos JL , Chatterji S , Mathers C , Murray CJ . Global burden of depressive disorders in the year 2000 . *Br J Psychiatry* . 2004 ; 184 : 386 - 392
- 2 . Zheng D , Macera CA , Croft JB , Giles WH , Davis D , Scott WK . Major depression and all-cause mortality among white adults in the United States . *Ann Epidemiol* . 1997 ; 7 : 213 - 218
- 3 . Everson SA , Roberts RE , Goldberg DE , Kaplan GA . Depressive symptoms and increased risk of stroke mortality over a 29-year period . *Arch Intern Med* . 1998 ; 158 : 1133 - 1138
- 4 . Whooley MA , Browner WS . Association between depressive symptoms and mortality in older women. Study of Osteoporotic Fractures Research Group . *Arch Intern Med* . 1998 ; 158 : 2129 - 2135
- 5 . Black SA , Markides KS . Depressive symptoms and mortality in older Mexican Americans . *Ann Epidemiol* . 1999 ; 9 : 45 - 52
- 6 . Schulz R , Beach SR , Ives DG , Martire LM , Ariyo AA , Kop WJ . Association between depression and mortality in older adults: the Cardiovascular Health Study . *Arch Intern Med* . 2000 ; 160 : 1761 - 1768
- 7 . Surtees PG , Wainwright NW , Luben RN , Wareham NJ , Bingham SA , Khaw KT . Depression and Ischemic Heart Disease Mortality: Evidence From the EPIC-Norfolk United Kingdom Prospective Cohort Study . *Am J Psychiatry* . 2008 ; 165 : 515 - 523
- 8 . Roberts RE , Kaplan GA , Camacho TC . Psychological distress and mortality: evidence from the Alameda County Study . *Soc Sci Med* . 1990 ; 31 : 527 - 536
- 9 . Coryell W , Turvey C , Leon A , Maser JD , Solomon D , Endicott J , Mueller T , Keller M . Persistence of depressive symptoms and cardiovascular death among patients with affective disorder . *Psychosom Med* . 1999 ; 61 : 755 - 761

- 10 . Fredman L , Magaziner J , Hebel JR , Hawkes W , Zimmerman SI . Depressive symptoms and 6-year mortality among elderly community-dwelling women . *Epidemiology* . 1999 ; 10 : 54 - 59
- 11 . Lane D , Carroll D , Ring C , Beevers DG , Lip GY . Mortality and quality of life 12 months after myocardial infarction: effects of depression and anxiety . *Psychosom Med* . 2001 ; 63 : 221 - 230
- 12 . Kendler KS , Neale MC , Kessler RC , Heath AC , Eaves LJ . A longitudinal twin study of personality and major depression in women . *Arch Gen Psychiatry* . 1993 ; 50 : 853 - 862
- 13 . Cloninger CR , Svrakic DM , Przybeck TR . Can personality assessment predict future depression? A twelve-month follow-up of 631 subjects . *J Affect Disorders* . 2006 ; 92 : 35 - 44
- 14 . Barefoot JC , Larsen S , von der Lieth L , Schroll M . Hostility, incidence of acute myocardial infarction, and mortality in a sample of older Danish men and women . *Am J Epidemiol* . 1995 ; 142 : 477 - 484
- 15 . Everson SA , Kauhanen J , Kaplan GA . Hostility and increased risk of mortality and acute myocardial infarction: the mediating role of behavioral risk factors . *Am J Epidemiol* . 1997 ; 146 : 142 - 152
- 16 . Boyle SH , Williams RB , Mark DB , Brummett BH , Siegler IC , Barefoot JC . Hostility, age, and Mortality in a Sample of Cardiac Patients . *Am J Cardiol* . 2005 ; 96 : 64 - 66
- 17 . Olson MB , Krantz DS , Kelsey SF , Pepine CJ , Sopko G , Handberg E , Rogers WJ , Gierach GL , McClure CK , Merz CNB . for the WISE Study Group . Hostility scores Are Associated With Increased Risk of Cardiovascular Events in Women Undergoing Coronary Angiography: A Report from the NHLBI-Sponsored WISE Study . *Psychosom Med* . 2005 ; 67 : 546 - 552
- 18 . Nabi H , Kivimäki M , Zins M , Elovainio M , Consoli SM , Cordier S , Ducimetière P , Goldberg M , Singh-Manoux A . Does personality predict mortality? Results from the GAZEL French prospective cohort study . *International Journal of Epidemiology* . 2008 ; 37 : 386 - 396
- 19 . Grossarth-Maticek R , Bastiaans J , Kanazir DT . Psychosocial factors as strong predictors of mortality from cancer, ischaemic heart disease and stroke: the Yugoslav prospective study . *J Psychosom Res* . 1985 ; 29 : 167 - 176
- 20 . Nagano J , Sudo N , Kubo C , Kono S . Lung cancer, myocardial infarction, and the Grossarth-Maticek personality types: a case-control study in Fukuoka, Japan . *J Epidemiol* . 2001 ; 11 : 281 - 287
- 21 . Nagano J , Ichinose Y , Asoh H . A prospective Japanese study of the association between personality and the progression of lung cancer . *Intern Med* . 2006 ; 45 : 57 - 63
- 22 . Consoli SM , Cordier S , Ducimetière P . Validation of a personality questionnaire designed for defining subgroups at risk for ischemic cardiopathy or cancer in the Gazel cohort . *Rev Epidemiol Sante Publique* . 1993 ; 41 : 315 - 326
- 23 . Goldberg M , Leclerc A , Bonenfant S , Chastang JF , Schmaus A , Kaniewski N , Zins M . Cohort profile: the GAZEL Cohort Study . *Int J Epidemiol* . 2007 ; 36 : 32 - 39
- 24 . Grossarth-Maticek R , Eysenck HJ . Personality, stress and disease: description and validation of a new inventory . *Psychol Rep* . 1990 ; 66 : 355 - 373
- 25 . Friedman M , Rosenman RH . Association of specific overt behavior pattern with blood and cardiovascular findings; blood cholesterol level, blood clotting time, incidence of arcus senilis, and clinical coronary artery disease . *J Am Med Assoc* . 1959 ; 169 : 1286 - 1296
- 26 . Haynes SG , Feinleib M , Kannel WB . The relationship of psychosocial factors to coronary heart disease in the Framingham Study. III. Eight-year incidence of coronary heart disease . *Am J Epidemiol* . 1980 ; 111 : 37 - 58
- 27 . Myrtek M . Meta-analyses of prospective studies on coronary heart disease, Type A personality, and hostility . *Int J Cardiol* . 2001 ; 79 : 245 - 251
- 28 . Surtees PG , Wainwright NW , Luben R , Day NE , Khaw KT . Prospective cohort study of hostility and the risk of cardiovascular disease mortality . *Int J Cardiol* . 2005 ; 100 : 155 - 161
- 29 . Radloff LS . The CES-D Scale: a self-report depression scale for research in the general population . *Appl Psychol Meas* . 1977 ; 1 : 385 - 401
- 30 . Fuhrer R , Rouillon F . The French version of the Center for Epidemiologic Studies–Depression Scale . *Psychiatry Psychobiol* . 1989 ; 4 : 163 - 166
- 31 . Bortner RW . A short rating scale as a potential measure of pattern A behavior . *J Chronic Dis* . 1969 ; 22 : 87 - 91
- 32 . The Belgian-French Pooling Project . Assessment of Type A behavior by the Bortner scale and ischaemic heart disease . *Eur Heart J* . 1984 ; 5 : 440 - 446
- 33 . Buss AH , Durkee A . An inventory for assessing different kinds of hostility . *J Consulting Psychol* . 1957 ; 21 : 343 - 349
- 34 . Suarez EC . The relationships between dimensions of hostility and cardiovascular reactivity as a function of task characteristics . *Psychosom Med* . 1990 ; 52 : 558 - 570
- 35 . Sergeant JC , Firth D . Relative index of inequality: definition, estimation and inference . *Biostatistics* . 2006 ; 7 : 213 - 224
- 36 . MacKinnon DP , Krull JL , Lockwood CM . Equivalence of the mediation, confounding and suppression effect . *Prev Sci* . 2000 ; 1 : 173 - 181
- 37 . Yan LL , Liu K , Matthews KA , Daviglius , Ferguson TF , Kiefe CI . Psychosocial factors and risk of hypertension: the Coronary Artery Risk Development in Young Adults (CARDIA) study . *JAMA* . 2003 ; 290 : 2138 - 2148
- 38 . Ranjit N , Diez-Roux AV , Shea S , Cushman M , Seeman T , Jackson SA , Ni H . Psychosocial factors and inflammation in the multi-ethnic study of atherosclerosis . *Arch Intern Med* . 2007 ; 167 : 174 - 181
- 39 . Roberts BW , DelVecchio WF . The rank-order consistency of personality traits from childhood to old age: a quantitative review of longitudinal studies . *Psychol Bull* . 2000 ; 126 : 3 - 25
- 40 . Linden M , Baumann K , Rotter M , Schippan B . Posttraumatic embitterment disorder in comparison to other mental disorders . *Psychother Psychosom* . 2008 ; 77 : 50 - 56
- 41 . Bech P . Fifty Years with the Hamilton Scales for Anxiety and Depression. A Tribute to Max Hamilton . *Psychother Psychosom* . 2009 ; 78 : 202 - 211
- 42 . Baune BT , Caniato RN , Arolt V , Berger K . The Effects of Dysthymic Disorder on Health-Related Quality of Life and Disability Days in Persons with Comorbid Medical Conditions in the General Population . *Psychother Psychosom* . 2009 ; 78 : 161 - 166
- 43 . Fava GA , Sonino N . The biopsychosocial model thirty years later . *Psychother Psychosom* . 2008 ; 77 : 1 - 2

Table 1

Associations between discrete socio-demographic and behavioural variables and mortality in univariate analyses.

	N events/N participants	Status at follow-up		Hazard Ratio (95% CI)
		Alive N (%)	Dead N (%)	
Sex	687/14,881			
0. Male		10,335 (72.8)	581 (84.6)	Reference
1. Female		3,859 (27.2)	106 (15.4)	0.50 (0.40–0.61)***
Education level	645/14,257			
0. Primary		765 (5.6)	59 (9.1)	Reference
1. Lower secondary		9,201 (67.6)	446 (69.1)	0.64 (0.49–0.84)***
2. Higher secondary and tertiary		3,646 (26.8)	140 (21.7)	0.51 (0.37–0.69)***
BMI	588/12,798			
0. <20		643 (5.3)	32 (5.4)	1.12 (0.78–1.62)
1. 20–24.9		5,894 (48.3)	262 (44.6)	Reference
2. 25–29.9		4,907 (40.2)	244 (41.5)	1.12 (0.94–1.33)
3. >30		7,66 (6.3)	50 (8.5)	1.45 (1.07–1.97)*
Alcohol consumption	634/13,813			
0. Non-drinkers		1,591 (12.1)	93 (14.7)	1.49 (1.17–1.88)***
1. Occasional drinkers		6,928 (52.6)	271 (42.7)	Reference
2. Moderate drinkers		3,036 (23.0)	138 (21.8)	1.16 (0.95–1.42)
3. Heavy drinkers		1,624 (12.3)	132 (20.8)	2.03 (1.65–2.50)***
Smoking	626/13,637			
0. Non-smokers		10,508 (80.8)	411 (65.7)	Reference
1. 1–10 cigarettes/day		1,175 (9.0)	54 (8.6)	1.17 (0.88–1.56)
2. 11–20 cigarettes/day		986 (7.6)	108 (17.3)	2.71 (2.19–3.35)***
3. >20 cigarettes/day		342 (2.6)	53 (8.5)	3.74 (2.81–4.97)***

* P ≤0.05;

*** P ≤0.001;

CI: Confidence Interval.

Table 2

Associations between psychological variables and mortality in univariate analyses.

	N events/N participants	Status at follow-up		
		Alive Mean (SD)	Dead Mean (SD)	RII (95% CI)
Depressive mood	687/14,881	13.10 (9.18)	13.96 (9.89)	1.45 (1.12–1.88)**
Type A behaviour pattern	686/14,840	53.21 (7.67)	52.63 (7.59)	0.73 (0.56–0.94)*
Total hostility	673/13,922	29.15 (9.81)	30.26 (10.36)	1.48 (1.14–1.92)**
Cognitive hostility	679/14,012	6.56 (3.52)	7.34 (3.71)	2.17 (1.66–2.83)***
Reactive hostility	680/14,752	14.47 (5.38)	14.77 (5.56)	1.22 (0.94–1.59)
'CHD-prone' personality	673/14,637	3.33 (2.59)	3.47 (2.59)	1.30 (1.00–1.69)
'Healthy' personality	673/14,656	6.97 (1.64)	6.88 (1.64)	0.86 (0.66–1.13)

* P ≤0.05;

** P ≤0.01;

*** P ≤0.001;

CI: Confidence Interval; SD: Standard Deviation; RII: Relative Index of Inequality.

Table 3

The correlations between depressive mood and personality measures.

	Depressive mood	1	2	3	4	5
1. Type A behaviour pattern	0.13					
2. Total hostility	0.41	0.31				
3. Cognitive hostility	0.52	0.15	0.71			
4. Reactive hostility	0.15	0.28	0.86	0.33		
5. 'CHD-prone' personality	0.58	0.13	0.50	0.62	0.23	
6. 'Healthy' personality	-0.57	-0.13	-0.34	-0.40	-0.12	-0.55

Note. P ≤0.01 for all coefficients.

Table 4

RII of depressive mood and each personality variable in predicting mortality before (models 1 & 2) and after (model 3) mutual adjustment, all models being adjusted for age and sex.

Predictive variables	N events/N participants	Model 1	Model 2	Model 3	Change in RII
Depressive mood	686/14,840	1.74 (1.33–2.27) ***			
Type A behaviour pattern	686/14,840		0.81 (0.63–1.05)		
Depressive mood	673/14,595	1.68 (1.28–2.21) ***		1.49 (1.11–2.00) **	28.6%
Total hostility	673/14,595		1.57 (1.21–2.04) ***	1.34 (1.00–1.78) *	40.4%
Depressive mood	679/14,691	1.73 (1.32–2.27) ***		1.18 (0.87–1.60)	75.9%
Cognitive hostility	679/14,691		2.33 (1.79–3.04) ***	2.15 (1.59–2.92) ***	13.4%
Depressive mood	680/14,752	1.73 (1.32–2.27) ***			
Reactive hostility	680/14,752		1.20 (0.92–1.55)		
Depressive mood	673/14,637	1.72 (1.31–2.26) ***		1.60 (1.16–2.21) **	16.8%
'CHD-prone' personality	673/14,637		1.47 (1.12–1.92) **	1.14 (0.83–1.57)	69.8%
Depressive mood	673/14,656	1.72 (1.31–2.26) ***		1.73 (1.26–2.38) ***	0.7%
'Healthy' personality	673/14,656		0.76 (0.58–0.99) *	1.01 (0.73–1.38)	102.1%

* P ≤0.05;

** P ≤0.01;

*** P ≤0.001;

RII: Relative Index of Inequality.

Table 5

RII of depressive mood and each personality variable in predicting mortality before (models 1 & 2) and after (model 3) mutual adjustment, all models being adjusted for age, sex, education level, BMI, alcohol consumption and smoking.

Predictive variables	N events/N participants	Model 1	Model 2	Model 3	Change in RII
Depressive mood	547/12,090	1.53 (1.14–2.06)**			
Type A behaviour pattern	547/12,090		0.85 (0.63–1.14)		
Depressive mood	541/11,905	1.52 (1.13–2.05)**		1.43 (1.03–1.98)*	17.3%
Total hostility	541/11,905		1.34 (1.00–1.79)†	1.16 (0.84–1.60)	52.9%
Depressive mood	545/11,987	1.56 (1.16–2.11)**		1.12 (0.80–1.57)	78.9%
Cognitive hostility	545/11,987		2.08 (1.54–2.80)***	1.97 (1.39–2.77)***	10.5%
Depressive mood	545/12,033	1.55 (1.15–2.10)**			
Reactive hostility	545/12,033		1.05 (0.79–1.40)		
Depressive mood	541/11,945	1.55 (1.15–2.10)**		1.51 (1.05–2.15)*	8.3%
'CHD-prone' personality	541/11,945		1.32 (0.98–1.79)†	1.06 (0.74–1.51)	81.3%
Depressive mood	540/11,959	1.55 (1.15–2.09)**		1.52 (1.07–2.16)*	5.6%
'Healthy' personality	540/11,959		0.77 (0.57–1.04)†	0.96 (0.68–1.37)	82.6%

† P ≤0.10;

* P ≤0.05;

** P ≤0.01;

*** P ≤0.001;

RII: Relative Index of Inequality.