



HAL
open science

Does personality explain social inequalities in mortality? The French GAZEL cohort study.

Hermann Nabi, Mika Kivimäki, Michael G. Marmot, Jane E. Ferrie, Marie Zins, Pierre Ducimetière, Silla M. Consoli, Archana Singh-Manoux

► To cite this version:

Hermann Nabi, Mika Kivimäki, Michael G. Marmot, Jane E. Ferrie, Marie Zins, et al.. Does personality explain social inequalities in mortality? The French GAZEL cohort study.. International Journal of Epidemiology, 2008, 37 (3), pp.591-602. 10.1093/ije/dyn021 . inserm-00256973

HAL Id: inserm-00256973

<https://inserm.hal.science/inserm-00256973>

Submitted on 18 Feb 2009

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Does personality explain social inequalities in mortality? The French GAZEL cohort study

Nabi Hermann^{1*}, Kivimäki Mika², Marmot Michael G.², Ferrie Jane², Zins Marie^{1,3}, Ducimetière Pierre⁴, Consoli Silla M.⁵, Singh-Manoux Archana^{1,2,6}

¹ Santé publique et épidémiologie des déterminants professionnels et sociaux de la santé INSERM : U687, IFR69, Université Paris Sud - Paris XI, Université de Versailles-Saint Quentin en Yvelines, Hôpital Paul Brousse 16, av Paul Vaillant Couturier 94807 VILLEJUIF,FR

² ICHS, Department of Epidemiology and Public Health University College London, International Centre for Health and Society, 1-19 Torrington Place, London WC1E 6BT,GB

³ Equipe RPPC CETAF, Hôpital Paul Brousse Bat 15/16 16 av Paul Vaillant Couturier 94807 Villejuif,FR

⁴ Epidémiologie cardiovasculaire et métabolique INSERM : U258, INSERM : IFR69, Université Paris Sud - Paris XI, Hôpital Paul Brousse 16, Avenue Paul Vaillant-Couturier 94807 VILLEJUIF CEDEX,FR

⁵ Service de Psychologie Clinique et de Psychiatrie de Liaison AP-HP, Hôpital européen Georges Pompidou, FR

⁶ Centre de Gériatrie AP-HP, Hôpital Sainte-Perine, FR

* Correspondence should be addressed to: Hermann Nabi <hermann.nabi@inserm.fr>

Abstract

Background

The “indirect-selection” hypothesis proposes that some quality of the individual, a personality characteristic or intelligence, leads to both socioeconomic position (SEP) and health. We aim to quantify the contribution of personality measures to the associations between SEP and mortality.

Methods

14 445 participants of the GAZEL cohort, aged 39–54 years in 1993 and followed-up over 12.7 years, completed the Bortner-Type-A-scale, the Buss-Durkee-Hostility-Inventory, and the Grossarth-Maticek and Eysenck-Personality-Stress-Inventory. Indicators of SEP, such as father's social class, education, occupational grade and income, were assessed at baseline. Relative indices of inequality in Cox regression models were used to estimate associations.

Results

In age-adjusted-analyses, risk of death was inversely associated with SEP among men and women. Among men, the attenuation in this association depended on the measures of SEP and was 28–29% for “neurotic-hostility”, 13–22% for “anti-social” and 13–16% for “CHD-prone” personality. In women, the attenuation was evident only for type-A-behaviour, by 11%. After controlling simultaneously for all personality factors that predicted mortality, associations between SEP and mortality were attenuated in men: by 34% for education, 29% for occupational position and 28% for income; but were only attenuated by 11% for income in women. For cardiovascular mortality, the corresponding percentages of reduction were 42%, 31% and 44% after adjustment for “CHD-prone” personality in men.

Conclusions

Personality measures explained some of the mortality gradients observed for measures of adult socioeconomic position in men, but had little explanatory power in women. Whether personality represents a predictor or an outcome of social circumstances needs further research.

MESH Keywords Adult ; Cardiovascular Diseases ; mortality ; Cohort Studies ; Educational Status ; Female ; France ; epidemiology ; Health Status ; Humans ; Income ; Life Style ; Linear Models ; Male ; Middle Aged ; Mortality ; Personality ; Risk ; Sex Factors ; Social Mobility ; Socioeconomic Factors

KEY MESSAGES

The “indirect-selection” hypothesis proposes that some quality of the individual, a personality characteristic or intelligence, may explain part of the social inequalities in health.

However, few studies have examined the contribution of personality factors to social inequalities in health.

Our results show personality factors to explain some of the all-cause and cardiovascular mortality gradients observed for three measures of adult socioeconomic position in men, but had little explanatory power in women.

A considerable proportion of the association between socioeconomic position indicators and mortality remained unexplained by personality factors.

INTRODUCTION

Socioeconomic inequalities in morbidity and mortality have been widely documented(1–3). The Black Report identified four explanations for social inequalities: artefact, selection, materialist, and cultura/behavioural (4). Artefact as an explanation has received little support, leading research efforts to be directed at the three other explanations. The material and behavioural explanations (5) have been shown to explain only part of the social gradient in health (6, 7). The “indirect selection hypothesis” proposes that some quality of the individual - a personality characteristic or intelligence - leads to both socioeconomic position (SEP) and health (8). Two sets of evidence support this hypothesis. First, personality attributes are associated with an increased risk of hypertension (9, 10), coronary heart disease (CHD) (11, 12), subclinical atherosclerosis (13), myocardial infarction (14, 15), and all-cause mortality (11, 14). Second, personality factors such as hostility have been found to be associated with lower socioeconomic status (occupation, income and education) among adult men and women (16–20). Furthermore, personality factors have also been shown to be associated with social mobility (21). Recent studies have examined the role of intelligence (22, 23) but the extent to which personality factors explain social inequalities in health remains little explored.

Personality is defined as the “distinctive and characteristic patterns of thought, emotion and behaviour that define an individual’s personal style and influence his or her interaction with the environment” (21). Friedman and Rosenman’s seminal work (24) in the late 1950s showing Type-A behaviour pattern (TABP) to be a risk factor for coronary heart disease (CHD) renewed interest in the relationship between personality and health. They found cardiovascular diseases, the leading cause of mortality in Western countries, to be more common among time-pressured, competitive, aggressive and hostile persons: individuals with what they labelled Type-A behaviour pattern (TABP). The association between TABP and CHD has been replicated in many studies (12, 25–27).

To date, TABP and hostility, the ‘toxic’ component of TABP, have been by far the most extensively studied personality constructs in health research, but other conceptualisations have also been developed. The personality-disease theory proposed by Grossarth-Maticek and Eysenck (28–31) in the 1980s seems important as it aims to cover a more comprehensive set of health outcomes than TABP and hostility. The theory proposes six personality types, i.e. cancer-prone, CHD prone, ambivalent, healthy, rational and antisocial, that are each hypothesised to predict a particular disease or long-term health outcome. However, empirical evidence to support the theory is still relatively limited, consisting mostly of the original studies by Grossarth-Maticek and Eysenck (28, 31,32) and a few other studies (33, 34).

The association between SEP, personality and health remains little explored. We found only two smaller-scale studies that examined the role of personality in explaining educational differences in perceived general health (35) and risky health behaviours (36). In this study of a large cohort of French employees followed-up over a thirteen years (GAZEL cohort), we used three different personality models to quantify their contribution to the associations between SEP in childhood and adulthood and mortality from all causes and cardiovascular diseases.

MATERIALS & METHODS

The GAZEL cohort was established in 1989, on employees of France’s national gas and electricity companies: Electricité de France (EDF) and Gaz de France (GDF) (GAZEL stands for “GAZ” and “ELectricité”). Further details of this study can be found elsewhere (37). At baseline, 20 624 (15 010 men and 5 614 women), aged 35–50, gave consent to participate in this study. The study design consists of an annual questionnaire used to collect data on health, lifestyle, individual, familial, social and occupational factors and life events. Various sources within EDF-GDF provide additional data about GAZEL participants. Occupational and personal data are updated through human resources department files (38).

Socioeconomic position

SEP indicators including educational level (primary, secondary, and tertiary) and occupation grade (unskilled workers, skilled workers, and managers) were obtained from employer’s human resources files in 1989. Income (<1 600€, 1 600€ to 2 592€, and >2 592€) and father’s social class (low, intermediate, and high), derived using the occupational classification by the French National Institute for Statistics and Economic Studies, INSEE, were reported by participants in the 1989 GAZEL cohort annual questionnaire.

Personality

The personality test battery was first validated on a sub-sample of the GAZEL study (39) and was then administered between 1st February and 31st July 1993. It was composed of the following scales:

The Bortner Rating Scale (Cronbach's $\alpha=0.56$) for behaviour type (type A/type B) consists of 14 items (40) each comprising 2 statements with a 6-point Likert scale in between the 2 statements. Examples include "never late" on one end of the scale and "casual about appointments" on the other end of the scale. High score suggests Type-A behaviour. 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% (24, 41, 42).

The Buss-Durkee Hostility Inventory (BDHI)

The BDHI is a standardized measure of general aggression and hostility (43), composed of 66 items with "true-false" answers (44) that make up seven subscales: assault, verbal aggression, indirect hostility, irritability, negativism, resentment, and suspicion. A validation study (39) identified two overarching factors, involving an "emotional" component and a "motor" component, roughly corresponding to the affective and behavioural dimensions. Subsequent studies (44, 45) have also derived a similar 2-factor solution, described as "reactive hostility" formed by the first four sub-scales and "neurotic" hostility" formed by the last two sub-scales, respectively. Cronbach's α was 0.67 for "reactive hostility" and 0.71 for "neurotic hostility".

The Grossarth-Maticsek and Eysenck Personality-Stress Inventory (PSI)

This inventory assesses six personality types with different physical and/or psychological health liabilities. The inventory is made up of 70-items which have true-false as responses. (29) Five of the personality scales are measured by 10 items each and one (healthy type) is measured by 20 items. As suggested by Grossarth-Maticsek and Eysenck, a total score is computed on each personality type for each participant (46). Evidence to support the validity of this inventory, described below, is mixed (47–49).

"Cancer-prone" or Type 1 personality (Cronbach's $\alpha=0.54$) refers to individuals who show harmony seeking and a lack of autonomy in relationships. These individuals have a tendency to suppress their emotions and be unassertive; these characteristics are thought to lead to the development of chronic perceived stress, and depressive and helpless tendencies, chronic hormonal elevations (cortisol), immunosuppression, and possible cancer development; (29).

"CHD-prone" or Type 2 personality (Cronbach's $\alpha=0.60$) refers to individuals who also show a lack of autonomy, but are helplessly dependent in relationships. They experience anger, aggression, and arousal when faced with relational problems (50). These characteristics are thought to lead to the development of cardiovascular problems (elevated blood pressure, heart rate, and cholesterol), atherosclerosis, and coronary heart disease and related cardiovascular diseases(29).

"Ambivalent" or Type 3 personality (Cronbach's $\alpha=0.60$) refers to individuals who constantly shift from typical Type 1 to typical Type 2 reactions. These individuals vacillate between feelings of helplessness and anger when faced with relational problems (29)

"Healthy" or Type 4 personality (Cronbach's $\alpha=0.73$) 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 hypothesised to have a disposition towards being healthy as they avoid the stress reactions commonly experienced by Type 1 and Type 2 individuals (29)

"Rational" or Type 5 personality (Cronbach's $\alpha=0.62$) is thought to be prone to depressive disorders and possibly cancer (29). While Type 5 individuals share the feature of emotional suppression with Type 1 individuals, they are different in their non-emotional and rational tendencies.

"Anti-social" or Type 6 personality (Cronbach's $\alpha=0.57$) refers to individuals who exhibit psychopathic, impulsive, rebellious and hostile behaviours. These individuals are considered to have dispositions towards criminal behaviour and drug addiction (29).

Mortality

Mortality data on all participants are obtained from EDF-GDF. We used all-cause mortality data from 1st August 1993 to 5th October 2006. Cardiovascular disease (CVD) deaths (100–199), recorded by the French national cause-of-death registry, were available only till 31st December 2003 and coded using the International classification of diseases, 10th Revision (51).

Covariates

Data on age and sex were obtained from employer's human resources files. Depressive symptoms were assessed in 1993 using the validated French version of the Center for Epidemiologic Studies Depression Scale (CES-D) (39).

Statistical analysis

Differences in personality scores as a function of SEP indicators were assessed using one way-ANOVA, with a linear trend fitted across hierarchical variables. The intercorrelations between personality factors were calculated using Pearson correlation. We first calculated a relative index of inequality (RII) (52) to examine the association between personality measures and mortality (RII). The RII is a regression-based measure that summarises the association between two variables (52). It is computed by ranking each personality measure on a scale from the lowest, which is 0, to the highest, which is 1. Each participant is given a score on the scale equal to the cumulative midpoint of the number of participants who had the each same personality score. For the purposes of interpretation, the RII should be regarded as the relative risk of mortality among individuals with the highest personality score relative to those with the lowest personality score. An advantage of using the RII is that it is estimated using data on all individuals and is weighted to account for the distribution of the personality scores. Here the RII was fitted using Cox regression adjusted for age and CES-D to take into account the influence of mood variations on personality measures. A RII of 2, for example, indicates a doubling of the risk of mortality for individuals with the highest personality score compared to those with the lowest score.

We modelled associations between the indicators of SEP and mortality using the RII in Cox regression. Linearity in the association between SEP indicators and mortality was checked using ANOVA test for linearity. This assumption was satisfied for all indicators ($p \leq 0.002$). We assumed that if personality explains or partially explains SEP differences in mortality then the association between SEP and mortality should disappear or be attenuated after statistical control for personality. Thus, in a first step, each personality measure was introduced in the age-adjusted model as a continuous variable, its contribution being quantified by the percentage of reduction in RII $[(RII_{\text{age adjusted}} - RII_{\text{age and personality adjusted}}) / (RII_{\text{age adjusted}} - 1)] * 100$. In a Second Step, personality measures that were associated with mortality outcomes were simultaneously entered in a model already including age in order to quantify the cumulative percentage reduction in the RII. Despite small number of deaths in women, all analyses were performed separately for men and women due to gender differences in the association between SEP and mortality. Analyses for CVD mortality as an outcome were conducted only for men as only two women died from CVD during the follow-up.

This study was approved by the French Data Protection Authority (Commission Nationale Informatique et Liberté (CNIL)).

RESULTS

Sample selection is described in Figure 1. Mean age in 1993 was 49.0 years for men and 46.2 years for women. During a mean follow-up of 12.7 years subsequent to the completion of the personality questionnaires, there were 932 deaths from all causes and 115 deaths of these were from cardiovascular diseases. At best, the analysis is based on 603 all-cause deaths and 74 cardiovascular deaths. Missing data are essentially due to non-response on the personality questionnaire. These data were more likely to be missing among participants with low father's social class ($p=0.02$), lower education ($p<0.001$), employment grade and income ($p<0.001$). Missing data were not influenced by sex ($p=0.701$) and age ($p=0.922$).

Table 1 shows the associations between SEP indicators and personality scores in men. In general terms, out of the four SEP indicators it was father's social class that was least associated with personality measures. "Rational" personality type showed no association with the measures of SEP. Table 2 shows the same associations in women. Even though there was more of an association between father's social class and personality; overall the association between SEP and personality was less consistent in women. Table 3 shows that the bivariate correlations between personality measures in men and women were similar, low or moderate overall with the highest correlation coefficient being $r=0.63$.

The associations between the measures of personality and mortality outcomes in age- and CES-D adjusted models in men and women are presented in Table 4. Among men, "neurotic hostility" (RII = 2.22; 95 % CI: 1.59–3.11), "CHD-prone" (RII= 1.42; 95 % CI: 1.01–2.01), "ambivalent" (RII= 1.37; 95 % CI: 1.00–1.88), and "anti-social" (RII= 1.68; 95 % CI: 1.22–2.31) personality types were associated with all cause mortality. In women, unexpectedly, Type-A behaviour pattern (RII= 0.40; 95 % CI: 0.19–0.84) and "CHD-prone" (RII= 0.31; 95 % CI: 0.13–0.72) were inversely and "healthy" personality type was positively associated (RII= 2.27; 95 % CI: 1.00–5.13) with all-cause mortality. Analysis on CVD mortality, in men alone, shows an association with "CHD-prone" personality (RII= 2.81; 95 % CI: 1.13–7.03).

Table 5 shows the associations between indicators of SEP and mortality in men. Father's social class was not associated with mortality (RII =0.98; 95% CI 0.68–1.40), leading us not to analyse this association any further. Education (RII=1.85; 95% CI 1.27–2.70), occupational grade (RII=2.52; 95% CI 1.79–3.55) and income (RII=2.19; 95% CI 1.57–3.00) were inversely associated with mortality. Adjustment for personality measures was carried out only if these measures were themselves associated with mortality (see Table 4). The most important attenuation in the association between SEP and mortality was observed for neurotic hostility (28–29%), “CHD-prone” (13–16%) and “anti-social” (12–22%) personality types. Adjustment for “ambivalent” personality type attenuated associations only by 3–5%. Simultaneous adjustment for all these four personality measures reduced the association between SEP and mortality by 34% for education, 29% for occupational grade and 28% for income.

In men, only occupational grade was clearly and inversely related to CVD mortality. Education level and income were also inversely related to this mortality outcome, but with wide confidence intervals (table 5). Adjustment for “CHD-prone” personality type reduced the association between SEP and CVD mortality by 42% for education, 31% for occupational grade, and 44% for income.

In women, there was no evidence of a consistent association of education (RII=1.48; 95% CI 0.56–3.89) or occupational position (RII=2.11; 95% CI 0.78–5.69) with mortality. Thus, the analysis to examine the role of personality in explaining social inequalities in mortality were pursued for father's social class (RII=3.58; 95% CI=1.51–8.53) and income (RII=2.97; 95% CI=1.30 to 6.82) which were inversely associated with mortality (table 6). Controlling for type-A behaviour reduced the RIIs for father's social class and income by 3–11%. In contrast, controlling for CHD-prone personality type increased the association by 10% for father's social class and by 11% for income. Adjustment for “healthy” personality type increased the association between father's social class and mortality by 4%. Adjusting for all three personality measures increased the association by 6 % for father's social class and by 2 % for income.

DISCUSSION

We quantified the contribution of personality measures to the association between different indicators of SEP and mortality in a large cohort of French employees followed-up over a 13-year period. First, there was a social gradient in mortality among men for the measures of education, occupational position and income; and among women for father's social class and income. Second, based on hazard ratio reductions after adjustments, personality partly explained some of these associations, although the exact proportion explained varied depending mainly on the dimension of personality adjusted for, gender and somewhat on the indicator of SEP under consideration. Third, controlling for all personality predictors considerably attenuated the association between SEP and all-cause mortality in men, i.e., 34% for education, 29% for occupational position and 28% for income. The corresponding percentages of reduction for CVD mortality in men were 42%, 31% and 44%. For all-cause mortality in women, the attenuation was 11% at best. In both genders, strong associations with mortality remained for all measures of SEP after simultaneous adjustment for all the personality measures.

To our knowledge, this is the first prospective cohort study that has examined effects of personality on social inequalities in mortality using various personality measures and indicators of SEP from different stages of the lifecourse. To test the robustness of our findings, we repeated the analyses excluding deaths (all-cause) that occurred in the first five years of follow-up. These analyses provided very similar results as those for all-cause mortality presented in Table 5 for men. Our findings are in agreement with smaller-scale studies that examined the role of personality in explaining educational differences in perceived general health (35) and risky health behaviours (36). In those studies, adjustment for hostility reduced educational differences in perceived general health and adjustments for type A behaviour components, such as impatience and lack of hard driving, attenuated educational gradients in smoking. The average percentage of attenuation in these associations was higher in men (from 24% to 28%) than women (from 11% to 16%), consistent with our results for the social gradient in mortality.

There were clear gender differences in the results of our study. First, the associations between SEP and personality are less consistent among women; even though father's social class appears more important. The different personality measures are associated with each other in a similar manner in men and women even though their associations with mortality are quite different in the two sexes. Type-A behaviour and CHD-prone personality are protective for mortality among women whereas “healthy” personality type is a risk factor. The mortality rate among women in this cohort is lower than among men, partly because women in our study are somewhat younger than men (women aged 35–50 years versus 40–50 years for men) and because of the generally longer life expectancy in women (53). Nevertheless, these results are intriguing, particularly as the gender differences in the association between personality and mortality in our analysis was strengthened after adjustment for depressive symptoms. This was particularly true for the “healthy” personality type (table 4) which was inversely correlated with depressive symptoms in both men and women. However, the change in the association between “healthy” personality type and mortality when adding depressive symptoms to the age-adjusted model was considerable in women only, suggesting gender-differentiated associations between personality, mental health and mortality.

The association between the measures of socioeconomic position and mortality also differed in the two sexes. Among men, father's social class whereas in women education and own occupational position was not associated with mortality. Thus, comparisons between men and women on the attenuation effects associated with personality measures can only be made for the measure of income and clearly personality explains less of the association between SEP and mortality in women. No firm conclusions can be drawn from these analyses as there are few deaths among women. Nevertheless, these results suggest that the association between SEP, personality and health is different in men and women.

In this study, personality was measured in adulthood, making it difficult to ascertain the causal nature of the association between personality and SEP. In line with the "indirect selection" hypothesis, a Finnish study found that components of type A behaviour in childhood, such as high impatience and low hard-driving, predicted drift to a lower educational level, which in turn was associated with smoking (54). The authors of that study suggested that "personality earlier in life may affect adulthood health behaviours through its impact on adult social circumstances" (36). Other studies have shown associations between personality and career success and job satisfaction (55, 56). However, the relationship between personality and SEP may be bi-directional. Although personality is often seen as a relatively stable individual attribute, it is likely that socioeconomic circumstances also affect personality, both in childhood and adulthood (57). It has been shown in previous studies (58, 59) that psychological attributes, including personality, are partially rooted in environmental conditions in childhood, (learning) experiences, and rearing styles and that the development of hostility could be explained by factors such as parental behaviour that is overly strict, critical and demanding of conformity.

It is also plausible that adult circumstances, such as work-related stressors act as possible contributors to the development or promotion of personality traits, such as hostility. The parental behaviour pattern described above (i.e., overly strict, critical and demanding of conformity) is more common in low SEP households, and may be viewed as a reflection of the parents' occupational and other life experiences, which are characterized by job-strain for example (17). Given the evidence on job strain as a risk factor for CHD (60, 61), psychological distress (62), and depression (63, 64), it would be of great public health importance to get insight into the direction of causality in the association between SEP and personality.

Interpretation of these findings should be considered within the context of the study objectives and the measures of personality used. First, all comparisons in the predictive strength between personality traits should be interpreted with caution, as the operationalization of these concepts may not be equally successful in every case (65, 66), for example the internal consistency of some scores of the Grossarth-Maticek and Eysenck personality was lower than the accepted cutoff of 0.70. Imprecision in the measurement of personality types may contribute to underestimation of both their predictive power and role in socioeconomic differences in mortality. Second, while this study included various measures of personality, it did not cover recent personality constructs, including the big five factors of personality (57). However, the advantage of using older measures is that there is sufficient follow-up to allow mortality analysis. The problem with using current measures is that the mortality analysis will necessarily be on high risk population (already sick for instance) to allow enough events for analysis. Thus, the longitudinal analysis using mortality outcomes necessarily has a time lag with the current literature. Nevertheless, our analysis is useful in identifying aspects of personality that are linked both to mortality and SEP indicators and will contribute to improve understanding of the considerable variability in morbidity and mortality between individuals and subgroups. A further caveat relates to the fact that the GAZEL cohort is not representative of the general population. The EDF-GDF employees have security of employment and certain categories of the population (agricultural workers, self-employed, foreigners) are not represented. However, it is important to note that the social gradient in mortality in EDF-GDF is similar to that in the French general population (67). Although occupational records ensure the completeness of mortality data, at least 35% of mortality cases were not included in the study, mainly due to non-response on the personality measures. Missing data were more likely to be associated with lower SEP, suggesting that the social gradient in mortality may be underestimated in the present study. Finally, due to the small number of deaths (n=75), findings among women may suffer from lack of power in the analyses.

In conclusion, these results show the importance of personality traits in explaining part of the social gradient in mortality, particularly in men, and encourage further research on the developmental origins of personality traits and the processes by which these traits influence diverse life outcomes, i.e. whether personality is a predictor of SEP or an outcome of social circumstances

Acknowledgements:

HN and MK are supported by the Academy of Finland (grant 117604). ASM is supported by a 'EURYI' award from the European Science Foundation and a "Chaire d'excellence" award from the French Ministry of Research. The GAZEL cohort is supported by Electricité de France-Gaz de France (EDF-GDF). We would like to thank all the staff of the Équipe Risques Postprofessionnels – Cohortes de l'Unité mixte 687

INSERM -CNAMTS. The personality data collection was funded by the “Caisse Nationale d'Assurance Maladie” and by the “Ligue Nationale contre le Cancer”, our thanks to Sylvaine Cordier for access to these data and Pr Marcel Goldberg for critical comments on the manuscript. Very special thanks to the participants of the GAZEL cohort.

References:

1. Adler NE , Boyce WT , Chesney MA , Folkman S , Syme SL Socioeconomic inequalities in health. No easy solution. *Jama*. 1993; Jun 23–30 269: (24) 3140- 5
2. Marmot MG , Smith GD , Stansfeld S Health inequalities among British civil servants: the Whitehall II study. *Lancet*. 1991; Jun 8 337: (8754) 1387- 93
3. Pappas G , Queen S , Hadden W , Fisher G The increasing disparity in mortality between socioeconomic groups in the United States, 1960 and 1986. *N Engl J Med*. 1993; Jul 8 329: (2) 103- 9
4. Black DS , Townsend P , Davidson N Inequalities in health: The Black Report; The health divide. Harmondsworth; Penguin 1988;
5. Schrijvers CT , Stronks K , van de Mheen HD , Mackenbach JP Explaining educational differences in mortality: the role of behavioral and material factors. *Am J Public Health*. 1999; Apr 89: (4) 535- 40
6. Lantz PM , House JS , Lepkowski JM , Williams DR , Mero RP , Chen J Socioeconomic factors, health behaviors, and mortality: results from a nationally representative prospective study of US adults. *Jama*. 1998; Jun 3 279: (21) 1703- 8
7. van Oort FV , van Lenthe FJ , Mackenbach JP Material, psychosocial, and behavioural factors in the explanation of educational inequalities in mortality in The Netherlands. *J Epidemiol Community Health*. 2005; Mar 59: (3) 214- 20
8. Marmot M , Ryff CD , Bumpass LL , Shipley M , Marks NF Social inequalities in health: next questions and converging evidence. *Soc Sci Med*. 1997; Mar 44: (6) 901- 10
9. Barefoot JC , Dahlstrom WG , Williams RB Jr Hostility, CHD incidence, and total mortality: a 25-year follow-up study of 255 physicians. *Psychosom Med*. 1983; Mar 45: (1) 59 - 63
10. Shekelle RB , Gale M , Ostfeld AM , Paul O Hostility, risk of coronary heart disease, and mortality. *Psychosom Med*. 1983; May 45: (2) 109- 14
11. 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; Sep 1 142: (5) 477- 84
12. Rosenman RH , Brand RJ , Sholtz RI , Friedman M Multivariate prediction of coronary heart disease during 8.5 year follow-up in the Western Collaborative Group Study. *Am J Cardiol*. 1976; May 37: (6) 903- 10
13. Matthews KA , Owens JF , Kuller LH , Sutton-Tyrrell K , Jansen-McWilliams L Are hostility and anxiety associated with carotid atherosclerosis in healthy postmenopausal women?. *Psychosom Med*. 1998; Sep-Oct 60: (5) 633- 8
14. 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; Jul 15 146: (2) 142- 52
15. Helmers KF , Krantz DS , Howell RH , Klein J , Bairey CN , Rozanski A Hostility and myocardial ischemia in coronary artery disease patients: evaluation by gender and ischemic index. *Psychosom Med*. 1993; Jan-Feb 55: (1) 29- 36
16. Marmot MG , Shipley MJ , Rose G Inequalities in death--specific explanations of a general pattern?. *Lancet*. 1984; May 5 1: (8384) 1003- 6
17. Kivimaki M , Elovainio M , Kokko K , Pulkkinen L , Kortteinen M , Tuomikoski H Hostility, unemployment and health status: testing three theoretical models. *Social science & medicine* (1982). 2003; May 56: (10) 2139- 52
18. Christensen U , Lund R , Damsgaard MT Cynical hostility, socioeconomic position, health behaviors, and symptom load: a cross-sectional analysis in a Danish population-based study. *Psychosomatic medicine*. 2004; Jul-Aug 66: (4) 572- 7
19. Carroll D , Davey Smith G , Sheffield D , Shipley MJ , Marmot MG The relationship between socioeconomic status, hostility, and blood pressure reactions to mental stress in men: data from the Whitehall II study. *Health Psychol*. 1997; Mar 16: (2) 131- 6
20. Barefoot JC , Peterson BL , Dahlstrom WG , Siegler IC , Anderson NB , Williams RB Jr Hostility patterns and health implications: correlates of Cook-Medley Hostility Scale scores in a national survey. *Health Psychol*. 1991; 10: (1) 18- 24
21. Mackenbach JP Genetics and health inequalities: hypotheses and controversies. *Journal of epidemiology and community health*. 2005; Apr 59: (4) 268- 73
22. Batty GD , Der G , Macintyre S , Deary IJ Does IQ explain socioeconomic inequalities in health? Evidence from a population based cohort study in the west of Scotland. *Bmj*. 2006; Mar 11 332: (7541) 580- 4
23. Singh-Manoux A , Ferrie JE , Lynch JW , Marmot M The role of cognitive ability (intelligence) in explaining the association between socioeconomic position and health: evidence from the Whitehall II prospective cohort study. *Am J Epidemiol*. 2005; May 1 161: (9) 831- 9
24. 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; Mar 21 169: (12) 1286- 96
25. Rosenman RH , Brand RJ , Jenkins D , Friedman M , Straus R , Wurm M Coronary heart disease in Western Collaborative Group Study. Final follow-up experience of 8 1/2 years. *Jama*. 1975; Aug 25 233: (8) 872- 7
26. Eaker ED , Sullivan LM , Kelly-Hayes M , D'Agostino RB Sr , Benjamin EJ Anger and hostility predict the development of atrial fibrillation in men in the Framingham Offspring Study. *Circulation*. 2004; Mar 16 109: (10) 1267- 71
27. Gallacher JE , Sweetnam PM , Yarnell JW , Elwood PC , Stansfeld SA Is type A behavior really a trigger for coronary heart disease events?. *Psychosomatic medicine*. 2003; May-Jun 65: (3) 339- 46
28. Grossarth-Maticke 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: (2) 167- 76
29. Grossarth-Maticke R , Eysenck HJ Personality, stress and disease: description and validation of a new inventory. *Psychol Rep*. 1990; 66: (2) 355- 73
30. Grossarth-Maticke R , Eysenck HJ Personality, stress, and motivational factors in drinking as determinants of risk for cancer and coronary heart disease. *Psychol Rep*. 1991; Dec 69: (3 Pt 1) 1027- 43
31. Grossarth-Maticke R , Vetter H , Frentzel-Beyme R , Heller WD Precursor lesions of the GI tract and psychosocial risk factors for prediction and prevention of gastric cancer. *Cancer Detect Prev*. 1988; 13: (1) 23- 9
32. Eysenck HJ , Grossarth-Maticke R , Everitt B Personality, stress, smoking, and genetic predisposition as synergistic risk factors for cancer and coronary heart disease. *Integr Physiol Behav Sci*. 1991; Oct-Dec 26: (4) 309- 22
33. 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: (2) 57- 63
34. Nagano J , Sudo N , Kubo C , Kono S Lung cancer, myocardial infarction, and the Grossarth-Maticke personality types: a case-control study in Fukuoka, Japan. *J Epidemiol*. 2001; Nov 11: (6) 281- 7
35. Schrijvers CT , Bosma H , Mackenbach JP Hostility and the educational gradient in health. The mediating role of health-related behaviours. *Eur J Public Health*. 2002; Jun 12: (2) 110- 6
36. Pulkki L , Kivimaki M , Keltikangas-Jarvinen L , Elovainio M , Leino M , Viikari J Contribution of adolescent and early adult personality to the inverse association between education and cardiovascular risk behaviours: prospective population-based cohort study. *Int J Epidemiol*. 2003; Dec 32: (6) 968- 75
37. Goldberg M , Leclerc A , Bonenfant S Cohort profile: the GAZEL Cohort Study. *Int J Epidemiol*. 2006; Nov 12

- 38. Goldberg M , Chevalier A , Imbernon E , Coing F , Pons H The epidemiological information system of the French national electricity and gas company: the SI-EPI project. *Med Lav.* 1996; Jan-Feb 87: (1) 16- 28
- 39. Consoli SM , Cordier S , Ducimetiere P [Validation of a personality questionnaire designed for defining sub-groups at risk for ischemic cardiopathy or cancer in the Gazel cohort]. *Rev Epidemiol Sante Publique.* 1993; 41: (4) 315- 26
- 40. Bortner RW A short rating scale as a potential measure of pattern A behavior. *Journal of chronic diseases.* 1969; Jul 22: (2) 87- 91
- 41. Assessment of type A behaviour by the Bortner scale and ischaemic heart disease. The Belgian-French Pooling Project *European heart journal.* 1984; Jun 5: (6) 440- 6
- 42. Neumann P [The psychological approach in cardiovascular epidemiology]. *La Nouvelle presse medicale.* 1977; May 28 6: (22) 1955- 8
- 43. Felsten G Five-factor analysis of Buss-Durkee hostility inventory neurotic hostility and expressive hostility factors: implications for health psychology. *Journal of personality assessment.* 1996; Aug 67: (1) 179- 94
- 44. Buss AH , Durkee A An inventory for assessing different kinds of hostility. *Journal of consulting psychology.* 1957; Aug 21: (4) 343- 9
- 45. Suarez EC , Williams RB Jr The relationships between dimensions of hostility and cardiovascular reactivity as a function of task characteristics. *Psychosomatic medicine.* 1990; Sep-Oct 52: (5) 558- 70
- 46. Grossarth-Maticek R , Eysenck HJ , Boyle GJ Method of test administration as a factor in test validity: the use of a personality questionnaire in the prediction of cancer and coronary heart disease. *Behaviour research and therapy.* 1995; Jul 33: (6) 705- 10
- 47. Nagano J , Nagase S , Sudo N , Kubo C Psychosocial stress, personality, and the severity of chronic hepatitis C. *Psychosomatics.* 2004; Mar-Apr 45: (2) 100- 6
- 48. Espnes GA The type 2 construct and its relation to coronary heart disease. *Psychological reports.* 1995; Feb 76: (1) 3- 13
- 49. Cooper CL , Payne R Personality and stress individual differences in the stress process. Chichester Wiley; 1991;
- 50. Grossarth-Maticek R , Kanazir DT Smoking as a risk factor for lung cancer and stroke: the Yugoslav prospective study. *J Psychosom.* 1983; 39: (2) 94- 105
- 51. Pavilion G , Maguin P The 10th revision of the International Classification of Diseases. *Rev Epidemiol Sante Publique.* 1993; 41: (3) 253- 5
- 52. Mackenbach JP , Kunst AE Measuring the magnitude of socio-economic inequalities in health: an overview of available measures illustrated with two examples from Europe. *Soc Sci Med.* 1997; Mar 44: (6) 757- 71
- 53. Barer BM Men and women aging differently. *International journal of aging & human development.* 1994; 38: (1) 29- 40
- 54. Pulkki L, Costa PT, Jr.
- 55. Judge TA , Heller D , Mount MK Five-factor model of personality and job satisfaction: a meta-analysis. *J Appl Psychol.* 2002; Jun 87: (3) 530- 41
- 56. Judge TA , Ilies R Relationship of personality to performance motivation: a meta-analytic review. *J Appl Psychol.* 2002; Aug 87: (4) 797- 807
- 57. McCrae RR , Costa PT Jr Validation of the five-factor model of personality across instruments and observers. *J Pers Soc Psychol.* 1987; Jan 52: (1) 81- 90
- 58. Shaffer DR Social and personality development. 3 Monterey, Calif Brooks/Cole;
- 59. Schwartz JE , Friedman HS , Tucker JS , Tomlinson-Keasey C , Wingard DL , Criqui MH Sociodemographic and psychosocial factors in childhood as predictors of adult mortality. *American journal of public health.* 1995; Sep 85: (9) 1237- 45
- 60. Kivimaki M , Virtanen M , Elovainio M , Kouvonen A , Vaananen A , Vahtera J Work stress in the etiology of coronary heart disease--a meta-analysis. *Scandinavian journal of work, environment & health.* 2006; Dec 32: (6) 431- 42
- 61. Hemingway H , Marmot M Evidence based cardiology: psychosocial factors in the aetiology and prognosis of coronary heart disease. Systematic review of prospective cohort studies. *BMJ (Clinical research ed.)* 1999; May 29 318: (7196) 1460- 7
- 62. Virtanen M , Vahtera J , Pentti J , Honkonen T , Elovainio M , Kivimaki M Job strain and psychologic distress influence on sickness absence among Finnish employees. *American journal of preventive medicine.* 2007; Sep 33: (3) 182- 7
- 63. Williams RB , Barefoot JC , Blumenthal JA Psychosocial correlates of job strain in a sample of working women. *Archives of general psychiatry.* 1997; Jun 54: (6) 543- 8
- 64. Virtanen M , Honkonen T , Kivimaki M Work stress, mental health and antidepressant medication findings from the Health 2000 Study. *J Affect Disord.* 2007; Mar 98: (3) 189- 97
- 65. Kiecolt-Glaser JK , Chee M Personality, Stress, and Cancer: A Re-Examination. *Psychological Inquiry.* 1991; 2: (3) 249- 51
- 66. Derogatis LR Personality, Stress, Disease, and Bias in Epidemiologic Research. *Psychological Inquiry.* 1991; 2: (3) 238- 42
- 67. Poncet M , Chevalier A , Bumsel F , Lahon G [Mortality among active workers at EDG-GDF: social and occupational disparities and evolution]. *Revue d'epidemiologie et de sante publique.* 2003; Oct 51: (5) 481- 91

FIGURE 1

Flow chart of sample selection.

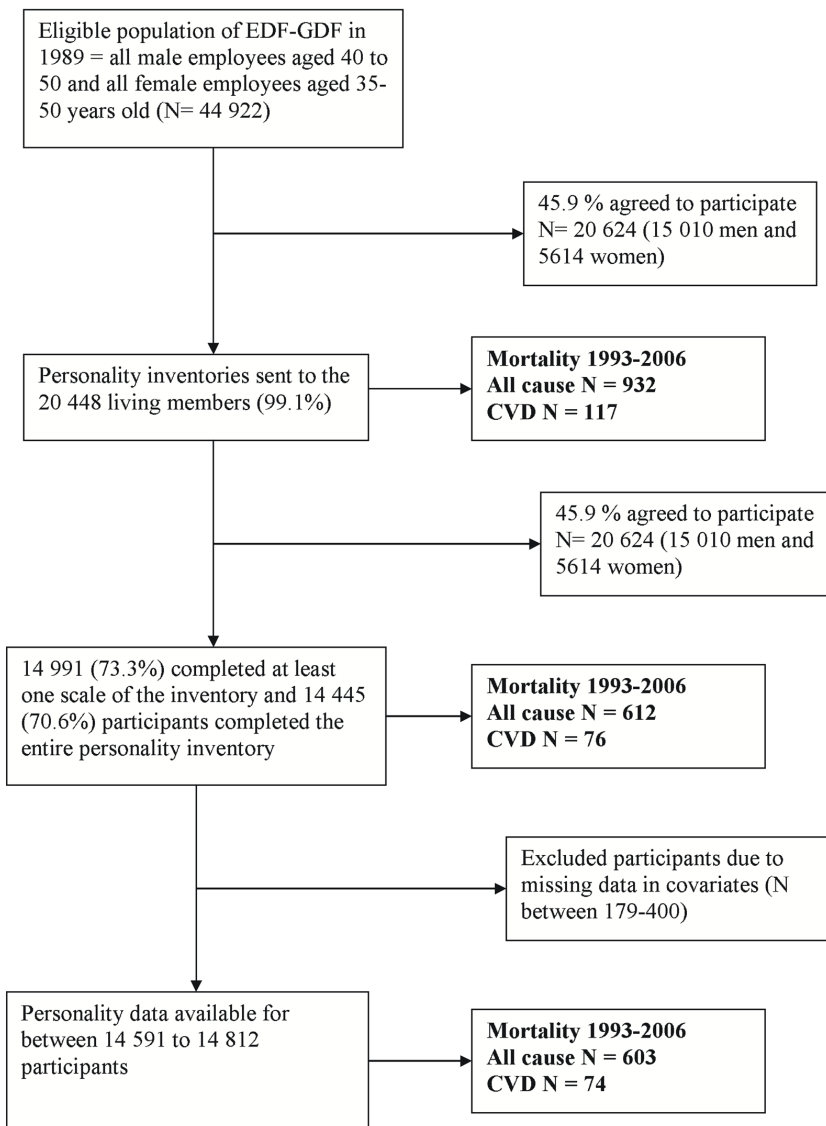


TABLE 1

Personality as a function of socioeconomic position in men

	N**	Bortner*	BDHI*	Grossarth-Maticek & Eysenck PSI*										
		Type-A M(SD)	pattern M(SD)	Neurotic M(SD)	hostility M(SD)	Reactive M(SD)	hostility (Type1) M(SD)	Cancer prone M(SD)	CHD prone M(SD)	(Type 3) M (SD)	Ambivalent (Type 4) M(SD)	Healthy M(SD)	Rational M (SD)	(Type 5) Anti-socia M (SD)
Father's social class	10806													
High	82	53.9 (6.9)	6.7 (3.7)	20.3 (7.7)	4.1(1.9)	3.3 (2.7)	2.2 (1.7)	6.8(1.8)	6.3 (2.2)	2.0 (1.6)				
Intermediate	5629	52.9 (7.5)	6.3 (3.5)	20.0 (7.2)	3.7 (2.0)	3.0 (2.5)	2.2 (1.7)	7.1(1.6)	6.3 (2.0)	2.1(1.7)				
Low	5095	52.5 (7.8)	6.6 (3.6)	20.5(7.1)	3.7(2.1)	3.2 (2.5)	2.2 (1.8)	7.0 (1.7)	6.3 (1.9)	2.2 (1.8)				
p value		0.006	<0.001	<0.001	0.600	<0.001	0.772	<0.001	0.474	0.001				
Education level	10704													
Primary	2370	51.4(7.9)	7.5 (3.8)	20.8 (7.6)	4.0 (2.2)	3.7 (2.6)	2.4(1.9)	7.0 (1.6)	6.4(1.8)	2.7 (1.9)				
Secondary	5060	52.4 (7.7)	6.7 (3.5)	20.4 (7.2)	3.7(2.1)	3.3 (2.5)	2.2 (1.8)	7.1(1.5)	6.3 (1.9)	2.3 (1.8)				
Higher secondary & tertiary	3274	53.6 (7.4)	5.7 (3.3)	19.8 (7.2)	3.6(2.1)	2.6(2.4)	2.1(1.7)	7.2 (1.6)	6.3 (2.1)	1.8(1.6)				
p for trend		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.177	<0.001				
Occupational grade	10985													
Unskilled workers	1304	50.8 (7.8)	7.7 (3.7)	21.0 (7.5)	3.9(2.1)	4.0 (2.1)	2.5 (1.9)	6.8(1.5)	6.2 (1.9)	2.7 (1.9)				
Skilled workers	6062	52.3 (7.7)	6.8 (3.5)	20.4 (7.2)	3.7(2.1)	3.7(2.1)	2.2 (1.8)	7.0 (1.6)	6.3 (1.9)	2.3 (1.8)				
Managers	3619	54.2 (6.7)	5.4(3.1)	19.7 (7.0)	3.5 (2.0)	2.5 (2.0)	2.1(1.6)	7.3 (1.6)	6.3 (2.1)	1.9(1.6)				
p for trend		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.149	<0.001				
Income in €	10704													
< 1600	2370	51.7(7.7)	7.4 (3.7)	20.4 (7.4)	4.0 (2.1)	3.8 (2.6)	2.3 (1.8)	6.9 (1.6)	6.3 (1.9)	2.4(1.8)				
1 600–2 592	5060	52.5 (7.7)	6.6 (3.5)	20.2(7.1)	3.7 (2.0)	3.2 (2.5)	2.2 (1.7)	7.1(1.6)	6.3 (1.9)	2.2 (1.7)				
>2 592	3274	53.9 (7.5)	5.6 (3.4)	20.1 (7.2)	3.5 (2.0)	2.5 (2.3)	2.2 (1.7)	7.2 (1.6)	6.3 (2.1)	1.9(1.7)				
p value		<0.001	<0.001	0.063	0.001	0.001	0.001	0.001	0.289	0.001				

* M: Mean; SD: Standard Deviation

** N = Varies somewhat as a function of the personality measures.

TABLE 2
Personality as a function of socioeconomic position in women

	Bortner*		BDHI*		Grossarth-Maticek & Eysenck PSI*						
	N**	Type-A pattern M(SD)	Neurotic hostility M(SD)	Reactive hostility M(SD)	Cancer (Type1) M(SD)	prone CHD prone (Type 2) M(SD)	(Type 3) M(SD)	Ambivalent (Type 4) M(SD)	Healthy (Type 5) M(SD)	Rational (Type 5) M(SD)	Anti-social M(SD)
Father's social class	3873										
High	56	56.0 (7.3)	5.5 (2.9)	19.4 (6.2)	3.6(2.1)	3.4(2.7)	2.6 (1.8)	6.8(1.9)	5.1(1.9)	1.7(1.8)	
Intermediate	2096	54.4 (7.3)	6.8 (6.9)	20.5 (6.9)	3.9 (2.2)	3.8 (2.7)	2.5 (1.4)	6.7 (1.7)	5.6 (2.1)	2.0 (1.7)	
Low	1721	54.3 (7.7)	7.2 (3.6)	20.7 (6.9)	4.1(2.2)	4.2 (2.6)	2.6 (1.8)	6.5 (1.7)	5.6 (2.1)	2.2 (1.7)	
p value		0.305	<0.001	0.235	0.018	<0.001	<0.208	0.001	0.174	0.001	
Education level	3906										
Primary	254	53.7 (7.6)	7.7 (3.6)	20.5 (6.8)	4.6 (2.2)	4.6 (2.6)	2.5 (1.9)	6.3 (1.7)	5.8(1.8)	2.4(1.7)	
Secondary	2640	53.2 (7.7)	7.2 (3.6)	20.4 (7.2)	3.7(2.1)	3.3 (2.6)	2.3 (1.8)	6.9 (1.6)	5.6 (2.0)	2.2 (1.8)	
Higher secondary & tertiary	1012	52.8 (7.7)	6.2 (3.4)	20.1(7.1)	3.8(2.1)	3.3 (2.6)	2.2 (1.7)	7.0 (1.6)	5.4 (2.2)	1.8(1.6)	
p for trend		0.0481	<0.001	0.331	<0.001	<0.001	0.202	<0.001	0.001	<0.001	
Occupational grade	3990										
Unskilled workers	971	53.5 (7.8)	7.7 (3.7)	20.8 (7.2)	4.2 (2.3)	4.5 (2.7)	2.7 (1.8)	6.4(1.7)	5.6 (2.0)	2.3 (1.9)	
Skilled workers	2655	54.5 (7.5)	6.9 (3.5)	20.5 (6.9)	3.9 (2.2)	4.0 (2.6)	2.5 (1.8)	6.6 (1.7)	5.6 (2.1)	2.1(1.7)	
Managers	364	55.6 (6.7)	5.4(3.1)	20.6 (6.6)	3.6 (2.2)	2.7 (2.2)	2.2(1.5)	7.0 (1.7)	5.5 (2.3)	1.5 (1.7)	
p for trend		<0.001	<0.001	0.293	<0.001	<0.001	<0.001	<0.001	0.815	<0.001	
Income in €	3804										
< 1600	791	53.2 (8.0)	7.4 (3.6)	20.3 (6.9)	4.1(2.1)	4.2 (2.8)	2.6 (1.7)	6.7 (1.8)	5.5 (2.1)	2.2 (1.8)	
1 600–2 592	1676	54.3 (7.4)	7.2 (3.5)	20.8 (6.9)	4.1(2.2)	4.2 (2.6)	2.6 (1.8)	6.5 (1.8)	5.7 (2.1)	2.2 (1.8)	
>2 592	1337	55.3 (7.4)	6.3 (3.4)	20.4 (6.9)	3.8 (2.2)	3.5 (2.6)	2.5 (1.7)	6.8 (2.1)	5.5 (2.1)	2.0 (1.7)	
p value		<0.001	<0.001	0.995	0.008	<0.001	0.056	0.083	0.433	0.004	

* M: Mean; SD: Standard Deviation

** N = Varies somewhat as a function of the personality measures.

TABLE 3

The correlations between personality measures in men (below the diagonal) and women (above the diagonal)

		1	2	3	4	5	6	7	8	9
Bortner Type-A behaviour	(1)	--	0.18**	0.35**	-0.12**	0.17**	0.13**	-0.16**	-0.06**	0.19**
BDHI: Neurotic hostility	(2)	0.13**	--	0.42**	0.33**	0.63**	0.32**	-0.43**	0.16**	0.41**
BDHI: Reactive hostility	(3)	0.34**	0.44**	--	-0.07**	0.34**	0.34**	-0.27**	-0.08**	0.45**
Cancer-prone-Type 1	(4)	-0.16**	0.28**	-0.06**	--	0.42**	0.17**	-0.39**	0.21**	0.11**
CHD-prone-Type 2	(5)	0.10**	0.61**	0.34**	0.40**	--	0.34**	-0.57**	0.09**	0.37**
Ambivalent-Type 3	(6)	0.12**	0.36**	0.34**	0.22**	0.35**	--	-0.20**	0.05**	0.51**
Healthy-Type 4	(7)	-0.10**	-0.38**	-0.24**	-0.37**	-0.53**	-0.22**	--	0.06**	-0.21*
Rational-Type 5	(8)	-0.06**	0.12**	-0.06**	0.20**	0.06**	0.06**	0.09**	--	0.03
Anti-social-Type 6	(9)	0.16**	0.42**	0.46**	0.11**	0.35**	0.50**	-0.16**	0.01	--

** p <0.001 two-tailed

TABLE 4

Associations between personality measures and mortality among men and women adjusted for age and depressive symptoms.

	MEN		WOMEN	
	N events/N participants	RII (95% CI)	N events/N participants	RII (95% CI)
Mortality from all causes				
Bortner Type- A	514/10848	0.77(0.57–1.04)	89/3946	0.40 (0.19–0.84)*
BDHI: Neurotic hostility	508/10727	2.22(1.59–3.11)***	88/3918	1.15 (0.50–2.64)
BDHI: Reactive hostility	507/10729	1.00(0.73–1.36)	88/3910	1.07 (0.50–2.29)
Cancer prone-Type 1	504/10715	1.11(0.80–1.54)	87/3912	0.49 (0.23–1.03)
CHD-prone-Type 2	503/10700	1.42(1.01–2.01)*	87/3891	0.31 (0.13–0.72)**
Ambivalent-Type 3	502/10711	1.37(1.00–1.88)*	85/3896	1.30 (0.57–3.01)
Healthy-Type 4	504/10715	0.90(0.63–1.28)	86/3895	2.27 (1.00–5.13)*
Rational-Type 5	501/10705	0.93 (0.68–1.27)	87/3899	1.34 (0.64–2.81)
Anti-social-Type 6	502/10737	1.68(1.22–2.31)*	87/3911	0.71 (0.33–1.51)
Mortality form cardiovascular disease †				
Bortner Type- A	74/10408	0.62(0.24–1.39)	-	-
BDHI: Neurotic hostility	73/10292	2.03 (0.84 –4.90)	-	-
BDHI: Reactive hostility	73/10293	0.63 (0.28 –1.42)	-	-
Cancer prone-Type 1	73/10310	1.09(0.46–2.55)	-	-
CHD-prone-Type 2	73/10270	2.81 (1.13–7.03)*	-	-
Ambivalent-Type 3	73/10282	0.93(0.41–2.15)	-	-
Healthy-Type 4	73/10284	0.57(0.23–1.43)	-	-
Rational-Type 5	73/10270	0.92 (0.41–2.07)	-	-
Anti-social-Type 6	73/10308	0.97 (0.42–2.21)	-	-

Note RII provides the relative risk of mortality outcomes in the highest personality score relative to the lowest

personality score.

* P < 0.05

** p<0.01

*** p< 0.001

† Restricted to men due to small number of CVD deaths (n=7) in women

TABLE 5

Role of personality in explaining the association between SEP indicators and mortality in men.

	Education		Occupational grade		Income	
	N events/N participants	RII 95% CI	N events/N participants	RII 95% CI	N events/N participants	RII 95% CI
Adjusted for :	All-cause mortality					
Age (reference)	498/10681	.85 (1.27–2.70)**	513/10836	2.52 (1.79–3.55)***	497/10560	2.19 (1.57–3.00)
Age + BDHI-Neurotic hostility		11.60 (1.09–2.35)*		2.10 (1.48–3.00)***		1.85 (1.32–2.60)
% change		-29		-28		-29
Age (reference)	493/10663	1.83 (1.25–2.68)**	507/10814	2.52 (1.79–3.55)***	491/10539	2.21 0(1.58–3.1
Age + CHD-prone-Type 2		.70 (1.16–2.50)**		2.30 (1.62–3.55)***		2.02 (1.43–2.84)
% change		-13		-15		-16
Age (reference)	492/10179	1.83 (1.25–2.68)**	506/10821	2.52 (1.79–3.56)***	490/10546	2.19 (1.56–3.06)
Age + Ambivalent-Type 3		1.80 (1.23–2.63)**		2.45 (1.73–3.45)**		2.16 (1.54–3.02)
% change		-4		-5		-3
Age (reference)	492/10698	1.82 (1.24–2.66)**	506/10850	2.48 (1.76–3.49)***	490/10576	2.16 (1.54–3.02)
Age + Anti-social-Type 6		1.64 (1.12–2.41)**		2.26 (1.60–3.21)***		2.02 (1.44–2.83)
% change		-22		-15		-12
Age (reference)	490/10559	1.82 (1.24–2.65)**	504/10709	2.50 (1.77–3.52)***	488/10438	2.18 (1.56–3.05)
Age + All personality measures		1.54 (1.04–2.26)*		2.07 (1.45–2.97)***		1.85 (1.31–2.62)
% change		-34		-29		-28
	Cardiovascular disease mortality					
Age (reference)	70/10240	1.64 (0.60–4.40)	73/10380	2.59 (1.05–6.40)*	69/10117	1.97 (0.81–4.80)
Age + CHD-prone-Type 2		1.35 (0.49–3.72)		2.09 (0.83–5.29)		1.54 (0.62–3.83)
% change		-42	-31			-44

* p< 0.05

** p<0.01

*** p< 0.00

Table 6

Role of personality in explaining the association between SEP indicators and mortality in women.

	Father's social class		Income	
	N events/N participants	RII 95% CI	N events/N participants	RII 95% CI
Adjusted for :	All-cause mortality			
Age (reference)	85/3873	3.58 (1.51–8.53)**	81/3804	2.97 (1.30 to 6.82)*
Age + Type-A behaviour pattern		3.51 (1.47–8.35)**		2.76 (1.20 to 6.35)*
% change		-3		-11
Age (reference)	83/3820	3.65 (1.52–8.78)**	79/3753	2.82 (1.26–6.32)*
Age+ CHD-prone-Type 2		3.92 (1.62–9.46)**		3.02 (1.35–6.73)**
% change		+10		+11
Age (reference)	82/3824	3.51 (1.45–8.47)**	78/3755	2.66 (1.18–6.00)*
Age+ Healthy-Type 4		3.62 (1.50–8.75)**		2.66 (1.18–5.99)*
% change		+4		0
Age (reference)	82/3792	3.48 (1.44–8.40)**	78/3725	2.67 (1.19–6.01)*
Age + All personality measures		3.63 (1.50–8.80)**		2.70 (1.19–6.09)*
% change		+6		+2

* p< 0.05

** p<0.01

*** p< 0.001