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NEUROTICISM, EDUCATION AND SELF-ASSESSED
HEALTH IN THE GENERAL POPULATION OF THE
UNITED STATES. CAN SMOKING BEHAVIOUR
EXPLAIN THE ASSOCIATIONS?

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ABSTRACT. In this study we investigate the interrelation between neuroticism, education, smoking and health. Two lines of research are brought together: one studying the relationship between neuroticism and health and the other studying the association between education and health. As lower educated people more often score high on neuroticism, we study the relationships of education and neuroticism with health simultaneously. Moreover, we hypothesize that smoking behaviour is a common explanatory factor in these associations. A 1996 US general population sample is employed to test the hypotheses. The associations between education and neuroticism on the one hand and self-assessed health on the other hand proved to be substantially smaller when education and neuroticism are mutually controlled for. Yet, the hypothesis that smoking behaviour provides an explanation for educational differences in health was only supported for men.

KEY WORDS: education, inequality, neuroticism, self-assessed health, smoking

INTRODUCTION

In this study, we bring together two lines of research in order to examine the relationship between neuroticism, education, smoking and self-assessed health. In psychological studies, the association between neuroticism and perceived health is examined and questions about explanations for this relationship have been addressed (e.g. Costa and McCrae, 1987; Goodwin and Engstrom, 2002; Smith and Spiro, 2002; Williams et al., 2004). Social epidemiological and sociological studies frequently describe and try to explain the association between education and health (Ross and Wu, 1995). Why is it important to bring these lines of research together? First, there is the assessed association between education and neuroticism

and this calls for a simultaneous study of the associations between education, neuroticism and health. Second, both lines of research might have an important explanatory (or intermediating) factor in common, namely smoking behaviour.

In the psychological literature, the association between neuroticism¹ and health has often been studied, although mostly in restricted samples such as patients or students (for instance, Vollrath et al., 1999; Williams et al., 2004). Goodwin and Engstrom (2002) were the first to describe the relationship between the five-factor personality model and health perception in a community-based sample for the United States. They found that among respondents without self-reported medical problems, openness, extraversion and conscientiousness were associated with the perception of good health, while neuroticism was associated with the perception of poor health. Among respondents with self-reported medical problems, agreeableness, openness, extraversion and conscientiousness were positively associated with good health, whereas neuroticism again was negatively associated with perception of good health. In Goodwin and Engstrom's study the associations were strongest for neuroticism.

Although there are inconsistent findings and arguments with regard to the degree to which neuroticism affects objective health or only perceived health (Costa and McCrae, 1987), it is clear that neuroticism is empirically associated with self-assessed health (Goodwin and Engstrom, 2002), which in itself is a predictor of mortality. However, neuroticism, as well as a number of other personality factors, cannot explain the effect of self-assessed health on mortality in follow-up studies (Mackenbach et al., 2002). The exact way neuroticism affects self-assessed physical health therefore is still rather unclear. Some studies have showed that there are substantial associations between neuroticism and health-related behaviours (Lemos-Giraldez and Fidalgo-Aliste, 1997; Bermudez, 1999). People who score high on neuroticism have a higher chance of starting to smoke and lower cessation rates (Eysenck and Eaves, 1980; Breslau et al., 1993; Droomers et al., 2002). Given the strong negative health effects of smoking, this might provide a partial explanation for the association between neuroticism and self-assessed health (Williams et al., 2004, p. 90). Testing this hypothesis is one way of advancing our knowledge about the relationship of neuroticism and health. The second line of research that is important in this study deals with the

relationship between education and health. One of the most robust findings in sociology and social medicine is that lower educated people more often report bad health (Adler et al., 1994; Kaplan and Lynch, 1997). Three groups of explanations have been proposed: differences in material living conditions, differences in health behaviour, and psychosocial differences. The second explanation focuses on the fact that lower educated people smoke more, exercise less, have unhealthier diets, etc. In this respect, smoking seems to be the most important factor. The third group of mediators points, among other things, at the higher prevalence of neuroticism among lower educated (Stronks et al., 1997a; Elstad, 1998; see also Chamorro-Premuzic and Furnham, 2003). According to this hypothesis, the link between education and self-assessed health is partly caused by differences in neuroticism. Previous studies have found some support for this hypothesis (Stronks et al., 1997a). Because the causality of the association between education and neuroticism is not straightforward, one might also state that the relationship between neuroticism and self-assessed health is biased by education, or that it can partly be interpreted by educational differences.

Here the two lines of research meet. The relationship between neuroticism and health on the one hand and education and health on the other hand should be studied simultaneously. Moreover, as stated above, neuroticism has frequently been associated with one of the most health-damaging behaviours, smoking (Stronks et al., 1997b; Droomers, 1999). Smoking behaviour thus might be an interpretation for both the relationship between neuroticism and health and the association between education and health.

In sum, in this study, we examine the link between neuroticism and self-assessed health for a general population sample. In particular, we want to introduce education as a possible confounder and smoking as an interpretation of the association between neuroticism and self-assessed health (and *vice versa*). Thus, we address the following research questions: (1) to what extent do neuroticism and education have an independent and significant association with perceived health in the general population and (2) to what extent can the associations of neuroticism and education with perceived health be explained by smoking behaviour?

In all countries for which data is available, women are more likely to report poor health than men are (Arber, 1997). And also levels of

smoking, educational attainment and neuroticism seem to differ between men and women (Cavelaars et al., 2000; Williams and Wiebe, 2000). Consequently, we study men and women separately.

METHODS

Sample

We use cross-sectional data from the MacArthur Foundation Midlife Development in the United States survey (MIDUS) (Brim et al., 2003). This is a national telephone and mail survey carried out in 1995–1996 under the auspices of the John D. and Catherine T. MacArthur Foundation Network on Successful Midlife Development (ICPSR 2760). A sample ranging in age from 25 to 74 years, was recruited from a random-digit-dial sampling frame of the coterminous United States and oversampling in five metropolitan areas. Only one respondent was selected from each eligible household. The survey was carried out in two phases: a telephone interview followed by a self-administered mail questionnaire. The first phase had a response rate of 70.0%, and the conditional phase 2 response rate was 86.8%, resulting in an overall response rate of 60.8%. In total, there are 4242 cases in the sample.

Measures

Neuroticism

The MIDUS questionnaire includes a 30-item list to measure the five factor model of personality traits. This item-list was derived from a much larger item-bank (Lachman and Weaver, 1997; John and Srivastava, 1999). For each personality dimension, a list of all adjectives appearing in the literature was compiled. The adjectives that appeared most consistently as markers and had the highest item to total correlations or factor loadings were identified. A pilot study was conducted in 1994 with a probability sample of 1000 men and women between the ages of 30 and 70. Again, items with the highest item to total correlations and factor loadings were selected. Forward regressions were run to determine the smallest number of items needed to account for over 90% of the total scale variance (Lachman and Weaver, 1997). Generally, it is acknowledged that short item

batteries represent the five factor model of personality very well (John and Srivastava, 1999). Here, we only use the factor for neuroticism. Exploratory and confirmatory factor analysis showed that the six items form one dimension. The reliability of the scale is 0.81 (Cronbach's α). Levels of neuroticism differ between men and women and therefore we constructed quartile scores of neuroticism for men and women separately.

Education

Educational attainment is categorized in three groups. The first group comprises of respondents with a high school diploma or less. The second group are high school graduates who have a 1 or 2-year college degree or have attended a 3–4 year college without obtaining a diploma. The highest group consists of 3–4 year college graduates and all respondents with education above that level.

Self-assessed Health

The questionnaire contains a frequently used question concerning physical health. This question reads: how would you say your physical health is in general? Excellent, very good, good, fair or poor. Such measures of self-assessed health predict mortality and correlate with more objective health measures (Lundberg and Manderbacka, 1996; Idler and Benyamini, 1997; Ferraro and Farmer, 1999). In addition, respondents were presented a list of 29 chronic health problems and were asked if they had experienced or were treated for any of them in the previous 12 months. This variable is highly skewed and the scale is ordinal (the difference between 0 or 1 condition is not comparable to the difference between 5 or 6 conditions). Therefore, we constructed a variable that is categorical and indicates whether respondents reported no chronic health problem, one chronic health problem or more than one. Respondents were also asked to rate their physical health when they were 16 years of age. A similar question as for current health was used.

Smoking

Respondents reported age of smoking initiation and the timing and duration of periods (of more than 6 months) during which they were regular smokers. The absolute years of smoking was calculated as the number of years that a respondent was a regular smoker. Although

some misclassifications cannot be ruled out, previous research has shown self-reported smoking data to be accurate (Wagenknecht et al., 1992; Monden et al., 2003). Krall et al. (1989) found valid recall of smoking statuses over 20 years. Moreover, the main issue in using retrospective data, at least in correlational analyses, is not whether there is no measurement error at all, but rather whether there is a systematic measurement error associated with independent or outcome variables that might lead to seemingly false conclusions. There are no reasons to assume such systematic errors in this sample. Random errors, on the other hand, will make it more difficult to find confirmation for the hypotheses. Retrospective measurements of smoking intensity seem less accurate than measurements of smoking status (Krall et al., 1989) and therefore smoking intensity is not used in this study. Previous research has showed that education is negatively associated with quantity smoked (Osler et al., 2000). Therefore, the current study might have underestimated the educational differences in total lifetime smoking.

Statistical Analyses

We apply ANOVA to test differences in health between respondents with high and low education and high and low levels of neuroticism. We control for age in all models. Adjusted mean health scores by educational level and neuroticism are calculated with ANOVA's multiple classification analysis (MCA) in SPSS. In addition, two-way interactions were added to the models.

RESULTS

Neuroticism and Health

In Table I, self-assessed health by level of neuroticism is presented for men and women. The first column shows that there are substantial associations between health and neuroticism for both sexes. Respondents with a high score on neuroticism report worse health than respondents with lower levels of neuroticism. Notice also that, overall, women report worse health than men. Among men the average health scores in the two highest quartiles are much higher than among women. For both sexes self-assessed health increases

TABLE I

ANOVA models of self-assessed health by level of neuroticism for men and women

Neuroticism		Self-assessed health (1 = poor, 5 = excellent)		
		Model 1	Model 2	Model 3
Men	Highest quartile	3.28	3.29	3.34
	50–75%	3.52	3.54	3.54
	25–50%	3.53	3.53	3.52
	Lowest quartile	3.74	3.72	3.67
		$F = 15.11^{***}$	$F = 13.94^{***}$	$F = 8.69^{***}$
Women	Highest quartile	3.09	3.12	3.22
	50–75%	3.37	3.40	3.43
	25–50%	3.55	3.53	3.51
	Lowest quartile	3.74	3.72	3.62
		$F = 32.59^{***}$	$F = 27.57^{***}$	$F = 13.05^{***}$

ANOVA Models; Model 1 adjusts for age only; Model 2 additionally adjusts for self-assessed health at age 16; Model 3 additionally adjusts for chronic conditions. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

with increasing neuroticism, but the association is not strictly linear.

As stated-above, the causality of the relationship between neuroticism and self-assessed health is not straightforward. In order to, at least partly, control for the effect of poor health on neuroticism, we add the respondent's evaluation of his or her physical health at the age of 16 and a variable indicating whether the respondent has chronic health problems. Respondents who report chronic conditions or poor health at age 16 score higher on the neuroticism scale.

Men who reported poor health at age 16 did not differ in levels of neuroticism from men who reported a good, very good or excellent health ($F = 0.285$; $p = 0.593$). Among women, those who indicated that their health at age 16 was poor or fair score slightly higher on neuroticism ($F = 4.993$; $p = 0.026$). Only one in twenty respondents assess their health at age 16 as less than good. Model 2 in Table I shows that the relationship between neuroticism and self-assessed current health is only slightly weaker after controlling for self-assessed health at age 16.

The change is more dramatic however, if chronic conditions are taken into account in Model 3. Men without chronic conditions had

a mean neuroticism score of 2.02 (1–4 scale), whereas this was 2.14 for men who reported one health problem and 2.25 for men reporting two or more health problems ($F=31.02$; $p<0.001$). Among women the mean scores were 2.13, 2.21 and 2.43 respectively ($F=52.941$; $p<0.001$). There are substantial differences between the first and third model in Table I. However, even after controlling for self-assessed health at age 16 and chronic health conditions, neuroticism and self-assessed health are significantly associated.

Education and Health

Next, we examine the relationship between education and health. Table II presents self-assessed health by educational level, again separately for men and women. Here too, we observe significant health differences by educational level for both sexes. Among women 21.6% of those with high school or less report poor health, whereas this is only 7.5% among women with at least 2 years of college. For men the percentages are 20.5% and 8% respectively.

TABLE II

ANOVA models for self-assessed health by educational level for men and women

Educational level		Self-assessed health (1 = poor, 5 = excellent)		
		Model 1	Model 2	Model 3
Men	High school (or less)	3.28	3.29	3.30
	2-year college degree	3.45	3.45	3.47
	>2-year college degree	3.76	3.76	3.73
		$F=43.17^{***}$	$F=41.53^{***}$	$F=36.96^{***}$
Women	High school (or less)	3.23	3.25	3.27
	2-year college degree	3.49	3.49	3.49
	>2-year college degree	3.74	3.72	3.70
		$F=39.54^{***}$	$F=34.35^{***}$	$F=32.30^{***}$

ANOVA Models; Model 1 adjusts for age only; Model 2 additionally adjusts for self-assessed health at age 16; Model 3 additionally adjusts for chronic conditions. * $p<0.05$, ** $p<0.01$, *** $p<0.001$.

Again, there might be a problem of selection. Individuals who have experienced serious health problems in their youth or as young adults might not be able to attain higher education. Their health situation might also have affected their personality, although this is less likely. Therefore, we again adjust the model for self-assessed health at age 16 and chronic health problems. Both chronic conditions and health at the age of 16 are independently associated with educational attainment. Respondents who report their health at age 16 was less than average, have lower educational attainment than respondents who report a better health status at age 16 ($F=3.697$, $p=0.005$ for women and $F=3.048$, $p=0.016$ for men). As can be observed from the second column in Table II, adjusting for self-assessed health at age 16 does not affect the results for men. The results for women change only a little. After taking health at age 16 and chronic conditions in to account (Model 3) the educational differences in health are somewhat smaller. The small change between Models 1 and 3 suggests that health selection does not play a major role in bringing about educational differences in self-assessed health.

Multivariate Results: Mutually Adjusted and Adjusted for Smoking

In the multivariate analyses, we first examine the association between health on the one hand and education and neuroticism on the other hand while mutually adjusting for the last two. The first and third model in Table III present the mutually adjusted health scores for men and women by educational level and neuroticism. In comparison to Tables I and II, the differences between high and low educated subjects and those with high and low scores of neuroticism are somewhat smaller, but both education and neuroticism still have independent and significant effects. The association of education with self-assessed health is hardly explained by neuroticism, and the association between neuroticism and self-assessed is hardly explained (or biased) by educational attainment. Not shown in the table is the interaction effect between education and neuroticism. This interaction was tested, but proved non-significant for either sex ($F=0.94$; $p=0.47$ and $F=1.33$; $p=0.24$, for men and women respectively).

The second step in the multivariate analyses is to adjust for years of smoking. Comparing Models 1–2 shows that the association

TABLE III

ANOVA models for self-assessed health by educational level and level neuroticism for men and women, mutually adjusted (Model 1) and controlled for years of smoking (Model 2)

Neuroticism	Self-assessed health (1 = poor, 5 = excellent)			
	Men		Women	
	Model 1	Model 2	Model 1	Model 2
Highest quartile	3.35	3.36	3.24	3.25
50–75%	3.55	3.55	3.45	3.45
25–50%	3.51	3.51	3.51	3.50
Lowest quartile	3.65	3.65	3.60	3.59
	<i>F</i> = 7.36***	<i>F</i> = 6.92***	<i>F</i> = 10.69***	<i>F</i> = 9.94***
Educational level				
High school (or less)	3.31	3.35	3.28	3.28
2-year college degree	3.47	3.48	3.48	3.49
>2-year college degree	3.73	3.69	3.68	3.68
	<i>F</i> = 34.92***	<i>F</i> = 21.74***	<i>F</i> = 28.62***	<i>F</i> = 26.34***

ANOVA Models; Model 1 includes both education and neuroticism and also adjusts for age, chronic conditions and health age 16; Model 2 additionally adjusts for years of smoking. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

between education and health can partly be interpreted by differences in smoking history. However, for men and women no substantial changes can be observed in the association between neuroticism and health. The health difference between high and low educated men is almost a fifth smaller after adjusting for the number of years that the respondent was a regular smoker. The change in *F*-value also shows that adding smoking behaviour only matters for educational differences in health among males. This also holds true if a simple dichotomous variable is used indicating whether the respondent currently smokes or not.

DISCUSSION

In this study, we examined the associations between neuroticism and educational attainment on the one hand and self-assessed health on the other hand for a general population sample. We tested the extent to which these associations are independent and whether they can be partly explained by smoking behaviour. Neuroticism and educational attainment both have significant independent effects on self-assessed physical health. We found no evidence for the hypothesis that the health effect of education runs through neuroticism or *vice versa*. Education and neuroticism are independently associated with self-assessed health. Besides, no interaction effects were found.

Smoking was tested as an explanatory factor for the association between education, neuroticism and health. However, educational differences in health can only partly be explained by smoking behaviour among men. Among women smoking behaviour did not explain educational differences in health at all. Moreover, controlling for smoking does not attenuate the association between neuroticism and health. However, years of smoking is significantly associated with health among both men ($F=28.4$; $p<0.001$) and women ($F=7.19$; $p<0.01$). Controlled for age, years of smoking has a significant negative correlation with years of education ($r=-0.27$ and $r=-0.16$, for men and women respectively) as well as neuroticism ($r=0.05$ and $r=0.13$, for men and women respectively).

The cross-sectional nature of the MIDUS-data do not allow for strong conclusions with regard to causality. Life course data would be needed to fully take into account selection effects. However, by excluding respondents younger than 25 and taking into account the occurrence of serious health problems and an evaluation of one's health at age 16, we have controlled for selection effects to a large degree. If health selection was very important, it might be expected that controlling for health during adolescence and chronic conditions would make a difference. We found relatively small differences between models that do and do not take into account health at age 16 and chronic conditions. This seems to suggest that health selection does not play a major role in bringing about educational differences in health. This is an important finding for the analysis of social inequalities in health. With regard to neuroticism the problem of

causality may be less problematic from the start, because psychologists assume that personality traits are quite stable in adulthood. Although there is empirical support for this assumption (Conley, 1984; Costa and McCrae, 1994) prospective studies are needed to provide more insight in the causal relationships. Another limitation of the current study is that we did not have more objective health measures in addition to the self-reports. Although the self-reports provide important information, it is important that future studies also examine the associations for other measures of illness and specific health problems.

The overall response rate of the MIDUS-survey was 60.8%. In general, cooperation rates are lower for the seriously ill and for lower educated people. This may have led to a slight under-representation of people in poor health. We, however, are not aware of studies that show an effect of neuroticism or smoking on response rates. Moreover, our interest lies in the associations between education, health, smoking and neuroticism. It is hard to come up with a plausible reason why those associations should differ between responders and non-responders. We therefore, argue that it is unlikely that a selective response has biased our results in a systematic way.

Future research should further unravel the relationship between education and neuroticism on the one hand and self-assessed health on the other. The current study has showed, for a general population sample, that education as well as neuroticism is associated with self-assessed physical health even after controlling for chronic conditions, earlier health and smoking history. Smoking does not seem to bias or explain the relationship between neuroticism and self-assessed physical health. A logical next step would be to examine whether other health-related behaviours, such as (lack of) physical exercise, food habits or alcohol use, can explain part of the association.

NOTES

¹ It should be noted that the cited studies all use very similar concepts and measurement of neuroticism although none of them explicitly reflects on the definition of neuroticism. Neuroticism is widely accepted as one of the (3 or 5) basic personality traits (Digman, 1990; Costa and McCrae, 1995) and is some times referred to as emotional instability. People who score high on this trait are characterized as anxious and nervous and experiencing feelings of loneliness and depression. They

experience over-reactivity of negative emotions and are more susceptible to neurotic problems. Neurotic people react quite emotional to all sorts of events and find it less easy to adapt to new situations. On the other end of the scale are emotionally stable people.

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