

ORIGINAL ARTICLE

The personality trait of neuroticism is strongly associated with long-term morbidity in testicular cancer survivors

ELLEN KARINE GROV^{1*}, SOPHIE D. FOSSÅ^{1,2}, ROY M. BREMNES³, OLAV DAHL⁴,
OLBJØRN KLEPP⁵, ERIK WIST⁶ & ALV A. DAHL^{1,2}

¹Department of Clinical Cancer Research, The Norwegian Radium Hospital, Oslo University Hospital, Oslo, Norway,

²Faculty Division, The Norwegian Radium Hospital, University of Oslo, Oslo, Norway, ³Department of Oncology, University Hospital of Northern Norway, University of Tromsø, Tromsø, Norway, ⁴Department of Oncology, Haukeland University Hospital, University of Bergen, Bergen, Norway, ⁵Department of Oncology, Ålesund Hospital, Ålesund/Saint Olav's Hospital, National University for Science and Technology, Trondheim, Norway and ⁶Department of Oncology, Ullevaal, Oslo University Hospital, University of Oslo, Oslo, Norway

Abstract

Background. Neuroticism is a personality trait expressing nervousness and insecurity. Associations between neuroticism and morbidity in long-term cancer survivors have hardly been explored. The aim of this study was to explore associations between neuroticism and somatic and mental morbidity and lifestyle issues in long-term survivors of testicular cancer (TCSs). **Material and methods.** All Norwegian TCSs treated between 1980 and 1994 ($n = 1\,814$) were invited to this cross-sectional study. Among them 1 428 (79% response rate) delivered valid data. Neuroticism was self-rated on an abridged version of the Eysenck Personality Inventory. Information was collected by mailed questionnaires. The associations of neuroticism and self-reported variables were tested with multivariate logistic regression analyses. **Results.** Neuroticism was significantly associated with presence of somatic complaints, reduced physical function, neurotoxic side-effects (tinnitus, hearing impairment, peripheral neuropathy, and Raynaud's Phenomenon), self-esteem, concerns about not being able to father children, sexual problems, hazardous alcohol use, daily use of medication, use of sedatives and hypnotics, recent visits to a general practitioner, and seeing a psychologist/ psychiatrist after ended cancer treatment. Poor self-rated health, higher number of negative life events, economical problems and problems getting loans granted showed significant associations with neuroticism. **Discussion.** Neuroticism in TCSs at long-term follow-up is significantly associated with somatic and mental morbidities, and several aspects of unhealthy lifestyle. High levels of neuroticism should be considered in TCSs expressing multiple complaints and concerns at follow-up consultations. Assessment of neuroticism may be clinically important in order to offer appropriate interventions to prevent and manage morbidity in TCSs.

Key Words: Neuroticism, somatic and mental morbidity, testicular cancer survivors

The concept of personality describes “enduring patterns of perceiving, relating to, and thinking about the environment and oneself. Personality traits are prominent aspects of personality that are exhibited in a wide range of important social and personal contexts.” [1]. Personality traits are considered to be relatively stable over long time [2]. Empirical studies have identified a small number of basic personality traits. Based on a combination of knowledge from physiology, genetics, and learned behavior, Eysenck defined three such traits: neuroticism, extraversion,

and psychoticism [3]. The trait of ‘neuroticism’ represents the person’s tendency to feel nervous and worrying rather than feeling calm and safe. Other classification systems of personality traits label neuroticism as ‘nervousness’ [4] or ‘harm avoidance’ [5].

Many studies have shown that aspects of neuroticism such as negative affective states (depression, anxiety, hopelessness) [6], and exhaustion [7] have a strong association with somatic morbidity particularly cardiovascular diseases. Survival and risk of recurrence have also been linked to negative psychological

Correspondence: Ellen Karine Grov, Department of Clinical Cancer Research, The Norwegian Radium Hospital, Montebello, N-0310 Oslo, Norway. Tel: +47 22934000. Fax: +47 22934553. E-mail: ellen.karine.grov@radiumhospitalet.no

(Received 17 July 2008; accepted 2 February 2009)

ISSN 0284-186X print/ISSN 1651-226X online © 2009 Informa UK Ltd. (Informa Healthcare, Taylor & Francis AS)
DOI: 10.1080/02841860902795232

aspects, however Nakaya et al. [8] did not confirm such association in a sample of lung cancer patients, neither did Petticrew et al. [9] in a review including several cancer types, and different follow-up time spans. A large population-based study confirmed the association between neuroticism, and common somatic symptoms, defined as mainly psychosomatic/somatoform ones (e.g. nausea, fatigue, and enteralgia), or infectious/allergic ones (e.g. symptoms related to having a cold) [10]. Goodwin et al. [11] examined adults in the USA (the National Comorbidity Survey), a study which showed strong association between neuroticism and several physical diseases, e.g. diabetes, arthritis, ulcer, and kidney/liver- and stomach/gallbladder diseases. Neeleman et al. (2004) [12] also showed significant associations between neuroticism and somatic and mental morbidity in a population based Dutch sample. Causal links between neuroticism and mental disorders mainly anxiety and depression have also been observed [13–15].

The association between personality and psychopathology has been described in different ways, e.g. considering neuroticism as a predisposition or vulnerability factor for mental health disorders. Another way of explaining this association is considering neuroticism and anxiety to have a shared etiology. Craske et al. [16] presents several etiological and pathogenetic factors for anxiety disorders, e.g. genetic and physiological causes, parental influence, cognitive impact, and direct and indirect traumatic exposure. Some of these factors are also described for Eysenck's conceptualization of personality traits [3], which support the idea of a common conceptual framework between neuroticism and mental health disorders. Thus, neuroticism has both mediating and moderating effects on somatic and mental morbidity, and the effects could be either direct or through unhealthy lifestyle [6].

These associations between neuroticism and somatic and mental morbidity, and lifestyle have hardly been examined in cancer survivors. A study of head and neck cancer patients showed significantly higher level of neuroticism than in control patients [17]. Since neuroticism is associated with somatic and mental morbidity as well as lifestyle factors, studies of this personality trait in cancer survivors is highly relevant for secondary prevention.

We have earlier on reported on mental distress [18], quality of life [19], fatigue [20] and sexual functioning [21] in a large Norwegian sample of long-term testicular cancer survivors (TCSs). Neuroticism, as an independent variable, was regularly significant associated with these outcome variables. We, therefore, wanted to examine neuroticism in more detail in our sample of TCSs. This study examines the

associations between neuroticism and somatic and mental morbidity, health behavior as well as lifestyle issues.

Besides making the personality trait of neuroticism more familiar to the oncologist, the aim of this study was to explore two research questions: 1) What are the associations between neuroticism and self-reported somatic and mental morbidity, and lifestyle in TCSs?; 2) Do somatic and mental morbidity and lifestyle show significant associations with neuroticism in multivariable analyses also including age, level of education and treatment modalities as independent variables? For question 1) we held the hypothesis that many significant associations would be found, and for question 2) we held the hypothesis that neuroticism would show more significant association than the background factors of age, level of education and treatment modalities.

Material and methods

Patient recruitment

In 1998 the five Norwegian university oncologic departments started a collaborative cross-sectional study of unilaterally orchiectomized TCSs addressing their somatic and psychosocial health and long-term quality of life. Patients treated for testicular cancer (TC) between 1980 and 1994 were identified by the Cancer Registry of Norway and crosschecked with the patient registries of the five departments. Eligibility criteria for the study were age between 18 and 75 years at the time of invitation and no evidence of TC. Patients with extra-gonadal germ cell malignancy, bilateral TC, a second non-germ cell malignancy (except skin cancer), and those, in whom the non-affected testicle had been removed previously due to a benign condition, were excluded. The sample consisted of TCSs that all were tumour-free, but previously had been registered with mainly stage I testicular cancer. The distribution of cancer stages at treatment were as follows: 1 013 (71%) with stage I, 278 (20%) had stage II, 32 (2%) had stage III, and 105 (7%) were registered with stage IV.

By mail 1 814 eligible TCSs were invited to fill in a questionnaire and to have an outpatient follow-up examination. Non-compliers had emigrated, were without permanent address, deceased, did not respond, or refused to participate, resulting in a study-sample of 1 438 TCSs (compliance rate 79%). Ten TCSs delivered invalid forms in relation to the measurements relevant for this study, and the sample examined, therefore, consists of 1 428 evaluable TCSs.

Treatment principles

The treatment principles of this sample have been presented elsewhere [18]. Post-orchidectomy treatment was preferably given according to the specified protocols defined by the Swedish-Norwegian testicular cancer project (SWENOTECA), the EORTC Genito-Urinary Group, or the MRC Testicular Cancer Working Party.

Measures

Neuroticism was self-rated by an 18-items version of The Eysenck Personality Questionnaire (EPQ-18) [22]. EPQ-18 was derived from the EPQ-90 in which each personality trait (neuroticism, extraversion and psychoticism) was examined with 30 items [23]. Several brief versions of the EPQ-90 have been published [24], and our version was based on EPQ findings from a Norwegian twin sample [22,25]. The analyses concerned neuroticism since only that trait has shown strong association with psychological distress [15]. In EPQ-18 six items cover neuroticism, and each item is scored as present (1) or absent (0). Adding up the six item scores on neuroticism, the sum score ranges from 0 to 6. For some of our analyses high levels of neuroticism were defined by a sum score of ≥ 5 ('high neuroticism') in contrast to lower scores ('low neuroticism'). The correlation between neuroticism rated by the EPQ 90 and the EPQ-18 was $r = 0.89$. Internal consistency of EPQ-18 neuroticism was $\alpha = 0.72$ in the TCSs group.

Questionnaire issues. The questionnaire covered demographic, morbidity, illness behaviour and lifestyle issues as well as several assessment instruments. *Civil status* was dichotomized into paired (married and cohabiting), and not-paired [single, separated, divorced, widow(er)] relationships, *education* was divided into two levels: <13 school years and ≥ 13 school years. *Work status* was classified into currently employed/self-employed or not so. *Concerns about fertility* was present in those who scored "quite a bit" or "very much" and absent in those scoring "not at all" or "a little". Data on *Problems getting loan and insurance* was gathered by one question "Have you, after the diagnosis of testicular cancer, experienced problems getting loan and insurance?" with dichotomous rating of the answer (yes/no). *Problems getting loan or insurance* were present in those with a positive rating. In addition the respondents were given the possibility to describe these specific problems, and the impact on the person's life.

Self-rated health was based on the question: "Overall, how would you define your health right now?" and dichotomized into "Poor" ("Poor" or "Fairly

good"), and "Good" ("Excellent", "Very good", and "Good"). The formulation: "Have a medical doctor ever told you that you had any of the following diseases...?" was used for self-report of the following *somatic* diseases: myocardial infarction, angina pectoris, stroke, diabetes, hypertension, osteoporosis, rheumatoid arthritis, arthrosis, ankylosing spondylitis, and other long-standing musculo-skeletal diseases. These diagnoses were not confirmed by medical doctors or hospitals. *Somatic symptoms/complaints* were present if "considerable distress" last year were due to nausea, heartburn, diarrhea, constipation, tachycardia, or dyspnoea.

Daily smoking concerned daily consumption of any number of cigarettes. *Alcohol problems* were screened with a four items version of Alcohol Use Disorders Identification Test (AUDIT) used in Norway rated on five point Likert scale from 1 (never) to 5 (daily), and the sum score ≥ 6 defined alcohol problems. Internal consistency of AUDIT was $\alpha = 0.67$ in this study.

The level of *physical activity* was dichotomized as "minimal" or "at least moderate" based on published procedures [26]. Assessment on the use of daily medication was performed by means of the question "Have you, during the last year, used any kind of medication as a daily practice?" with the answering possibilities "yes" or "no". Additionally *daily use of sedatives or hypnotics* last month was reported. Daily use of *analgesics*, and use of medication for *anxiety and depression*, and *hypertension* were assessed. *Health consultations* was defined as seeing a medical doctor last year, and seeing a psychologist/psychiatrist after treatment. Data regarding 'life events' were collected by ten questions containing options from the experience of own disease, divorce, bereavement in the family or among close friends, being out of work or unemployed, serious financial problems in the family, to problems with domestic life and breaking the laws. All questions was to be answered with a "yes" or "no" rating. The variable *negative life events* was constructed as a continuous variable, defined as the sum of these ten defined events [27].

Rating scales. *Neurotoxic side-effects* like peripheral neuropathy, Raynaud's phenomena, tinnitus, and reduced hearing were assessed by the six items of the Scale for Chemotherapy-Induced long-term neurotoxicity (SCIN)-form [28] on 4-items Likert scales, dichotomized into not present ("not at all" or "a little") and present ("quite a bit" or "very much") according to published procedures [18].

Sexual problems were defined by the total score on the ten functional items of the Brief Male Sexual

Function Inventory (BSFI) [29]. Internal consistency was $\alpha = 0.91$ in this study. In the logistic regression analysis *sexual problems* was dichotomized according to cut-off levels for caseness, and defined as *overall sexual problems* present or absent [21].

Anxiety and *depression* were self-rated by The Hospital Anxiety and Depression Scale (HADS) [30] in which both the anxiety and depression sub-scales include seven items. Scores for the sub-scales range from 0 (low) to 21 (high). Internal consistency was $\alpha = 0.84$ for HADS-A, and for HADS-D $\alpha = 0.82$ in this study.

Physical, and mental function was assessed by means of the Physical (PCS), and the Mental Component Summary Score (MCS), of Short Form-36 (SF-36) [31]. PCS and MCS are based on T-transformation so that the population mean is 50 points and one standard deviation (SD) 10 points. In the logistic regression analysis PCS was dichotomized with the values ≥ 40 representing "good physical quality of life", and < 40 indicating "poor physical quality of life".

Fatigue was self-rated by the Fatigue Questionnaire (FQ) [32] of which 11 items assess the prevalence and intensity of fatigue symptoms compared to the last time the respondent felt well. Seven items concern Physical Fatigue (PF), and four contain Mental Fatigue (MF) and their sum score represents Total Fatigue Score (TF). Higher scores imply more fatigue. Internal consistency for TF was $\alpha = 0.99$ in this study.

The Impact of Event Scale (IES) [33] assesses the *psychological response to cancer related distress*. The IES consists of two sub scales: intrusion (IES-I), and avoidance (IES-A) rated on a six point Likert scale from 1 ("Never") to 6 ("To a high degree"), which is an adjusted scoring compared to the original one [34]. Internal consistency was $\alpha = 0.90$ for IES-I and $\alpha = 0.84$ for IES-A in this study.

The Brief Approach/Avoidance Coping Questionnaire (BACQ) was used to assess coping strategies. The BACQ consists of 12 items covering the "approach"/"avoidance" strategies [35], that are scored on a 5-point ordinal scale from 1 ("Disagree completely") to 5 ("Agree completely"). Higher score denotes a more adaptive coping style in terms of an active approach rather than avoidance. Internal consistency was $\alpha = 0.64$ for BACQ in this study.

Statistics

Data were analysed by the SPSS, PC version 13.0, using standard descriptive statistics. Associations between continuous variables were assessed by

Spearman's correlation coefficient due to skewed distributions. TCSs with high and low levels of neuroticism were compared, and continuous variables were examined by t-tests and categorical variables by Pearson's χ^2 -test. Significant differences on continuous variables and 2×2 contingency tables were also expressed as effects sizes (ES), and clinical significance was set at $ES = 0.40$ [36].

Multivariate logistic regression analyses were used to examine the associations between neuroticism, age, level of education, and treatment modalities and various demographic, morbidity and lifestyle-factors as dependent variables. By this approach the four independent variables were controlled for each other in the models. The strength of associations was expressed by odds ratios (ORs), and p-values in the logistic regression analyses.

Due to multiple comparisons the significance level was set at $p < 0.01$, and all significance tests were two-sided.

Ethics

The study was approved by the Ethical Committee of the Southern Health Region of Norway and the Norwegian Data Inspectorate. All participants gave written informed consent.

Results

Comparison of TCSs with high and low levels of neuroticism

Among TCSs 176 (12%) were identified with 'high neuroticism' and compared to the 1 252 (88%) ones with 'low neuroticism'. Significant differences were observed between the 'high' and 'low' neuroticism groups for nearly all variables examined (Table I). The exception were coping styles (BACQ), not being in paired relationship, fathered no children, and having had hypertension, diabetes or myocardial infarction. Clinically significant poorer results in the 'high neuroticism' group were observed for sexual problems, fatigue, physical functioning, psychological distress, and negative life events last year, economical problems last year, tinnitus, peripheral neuropathy, somatic complaints, consultations with psychiatrists/psychologist, self-rated health and self-image was found in the 'high neuroticism' group.

Correlation of neuroticism with other measures

Table II shows moderate correlations between neuroticism, and established measures of psychological distress such as the HADS-A, the HADS-D, the

Table I. Comparison of independent variables in relation to high and low neuroticism in TCSs.

Variables	NEUROTICISM		P	ES
	Low	High		
	(n = 1 252)	(n = 176)		
	Mean (SD)	Mean (SD)		
Age at survey	44.9 (10.3)	43.1 (10.1)	0.03	
Sexual functioning (BFSI)	30.9 (8.5)	27.1 (9.9)	<0.001	0.44
Current hazardous alcohol use	0.9 (1.4)	1.4 (2.2)	<0.001	0.33
Fatigue (FQ)	12.3 (3.9)	16.6 (5.0)	<0.001	1.06
SF-36 PCS	51.2 (9.0)	45.4 (11.8)	<0.001	0.62
SF-36 MCS	52.6 (7.8)	42.0 (11.5)	<0.001	1.27
HADS-Anxiety	4.0 (3.1)	9.4 (4.0)	<0.001	1.67
HADS-Depression	2.4 (2.7)	6.0 (4.0)	<0.001	1.25
IES-Avoidance	5.9 (6.9)	13.9 (9.4)	<0.001	1.10
IES-Intrusion	3.9 (4.7)	10.4 (7.9)	<0.001	1.25
Coping style (BACQ)	36.4 (5.4)	37.0 (5.1)	0.15	-
Number of negative life events	1.1 (1.2)	1.8 (1.7)	<0.001	0.55
<i>Neurotoxic side-effects (SCIN)</i>	n (%)	n (%)		
Tinnitus	182 (15)	46 (26)	<0.001	0.43
Hearing impairment	177 (14)	36 (21)	0.003	0.25
Paresthesias fingers	147 (12)	42 (24)	<0.001	0.36
Paresthesias toes	184 (15)	54 (31)	<0.001	0.59
Raynaud's fingers	239 (19)	49 (28)	0.008	0.30
Raynaud's toes	207 (17)	57 (33)	<0.001	0.43
<i>Demography and life-style</i>				
Non-paired relationship	286 (23)	48 (27)	0.19	
Low education <13 years	740 (60)	134 (76)	<0.001	0.35
Currently not working	166 (13)	43 (25)	<0.001	0.31
Concerns being able to father children	133 (11)	38 (22)	<0.001	0.64
Daily smoker	408 (33)	81 (46)	0.003	0.27
Low level of physical activity	186 (15)	43 (24)	0.001	0.23
Disease-influenced self-image	77 (6)	42 (24)	<0.001	0.53
Poor self-rated health	225 (18)	91 (53)	<0.001	0.76
Problems to grant loan/ insurance, or to continue working after treatment	377 (31)	73 (44)	0.001	0.37
<i>Disease issues</i>				
Somatic co-morbidity	266 (21)	58 (34)	<0.001	0.29
Somatic complaints	163 (13)	51 (30)	<0.001	0.42
Seen a medical doctor last year	1 023 (83)	161 (92)	0.004	0.28
Seen a psychologist/psychiatrist after treatment	120 (10)	49 (28)	<0.001	0.47
Daily use of medication	492 (40)	86 (51)	0.01	0.24
Daily use of sedatives or hypnotics	43 (4)	22 (13)	<0.001	0.34
Hypertension	103 (9)	19 (13)	0.14	
Diabetes	27 (3)	7 (5)	0.22	
Myocardial infarction	24 (2)	6 (4)	0.16	

IES-I, the IES-A, the TF, and the MCS with neuroticism explaining 19 to 41% of the variance in these measures.

Associations with neuroticism and other independent variables. In multivariate logistic regression analyses with neuroticism, age, lower education level and treatment modalities as independent variables, neuroticism was significantly associated with: hazardous alcohol use, concerns about not being able to father

children, overall sexual problems, poor physical quality of life, reduced self-image due to TC, consulting a psychiatrist/psychologist after TC treatment, seeing a doctor last year, presence of somatic complaints and all types of neurotoxic side effects, daily use of any medication and of sedatives/hypnotics, poor self-rated health, and problems to grant a loan or insurance (Table III).

When the logistic regression analyses are studied closer, neuroticism showed significant associations with 20 variables of 22 (91%). In contrast, age was

Table II. Correlations between neuroticism and established measures of psychological distress*.

	Neuroticism	HADS-A	HADS-D	MCS	IES-A	IES-I	TF
Neuroticism	–	0.64	0.50	–0.50	0.43	0.44	0.48
HADS-A	0.64	–	0.64	–0.65	0.46	0.49	0.50
HADS-D	0.50	0.64	–	–0.60	0.41	0.37	0.56
MCS	–0.50	–0.65	–0.60	–	–0.33	–0.36	–0.51
IES-A	0.43	0.46	0.41	–0.33	–	0.56	0.37
IES-I	0.44	0.49	0.37	–0.36	0.56	–	0.44
TF	0.48	0.50	0.56	–0.51	0.37	0.44	–

*Abbreviations: HADS-A: The Hospital Anxiety and Depression Scale, anxiety subscale, HADS-D: The Hospital Anxiety and Depression Scale, depression subscale, MCS: Mental Component Summary Scale of the Short Form-36, IES-A: Impact of Event Scale, avoidance subscale, IES-I: Impact of Event Scale, intrusion subscale, TF: Fatigue Questionnaire, Total Fatigue scale.

significantly associated with 12/22 (55%), lower level of education with 9/22 (41%) and treatment modalities with 7/22 (32%).

Discussion

We confirmed our hypotheses of strong associations between neuroticism and self-reported somatic and mental morbidity, unhealthy lifestyle and more health care consumption in TCSs at long-term follow-up. Neuroticism showed significant associations with 20/22 variables examined which was clearly more than for age, lower education and treatment modalities.

In our TCSs sample neuroticism showed moderate correlations with established measures of psychological distress. These moderate correlations confirm previous studies showing significant associations between neuroticism and negative affects (anxiety and depression, and cancer-specific anxiety) mental quality of life, fatigue, and somatic and mental morbidity [12].

The significant associations between neuroticism and somatic complaints and somatic comorbidity found in TCSs are in line with large population studies confirming the link between common somatic symptoms and neuroticism [10]. Comparison between these studies seems reasonable since the

Table III. Logistic regression analyses of associations between age, level of education, treatment modalities and neuroticism, and relevant dependent variables.

	Age		<13 years education		Treatment		Neuroticism	
	OR	p	OR	p	OR	p	OR	p
Low level of physical activity	1.01	.14	2.48	<.001	1.06	.48	1.11	.01
Daily smoking	.99	.13	2.23	<.001	1.19	.01	1.08	.02
Hazardous alcohol use	.99	.09	1.28	.18	1.08	.42	1.19	<.001
Concerns about not being able to father children	.92	<.001	.90	.54	1.03	.72	1.32	<.001
Sexual problems (BSFI defined)	1.05	<.001	1.10	.57	1.17	.03	1.36	<.001
Disease influenced self-image	1.03	.001	1.66	.03	1.12	.35	1.75	<.001
Daily use of medication	1.05	<.001	1.32	.02	.94	.33	1.18	<.001
Daily use of sedatives/ hypnotics	1.04	.003	1.64	.11	.84	.22	1.40	<.001
Seen a medical doctor last year	1.02	.01	1.31	.07	.95	.53	1.13	.004
Seen a psychologist/ psychiatrist after treatment	.98	.04	.59	.003	1.11	.28	1.54	<.001
Physical functioning (PCS <40)	.95	<.001	.34	<.001	.96	.36	.68	<.001
Somatic co-morbidity	1.08	<.001	1.52	.004	1.11	.17	1.13	.001
Somatic symptoms/complaints	1.00	.58	1.73	.002	1.09	.33	1.33	<.001
Problems to grant loan or insurance	.98	<.001	1.00	.99	1.26	.001	1.16	<.001
Number of negative life events	1.00	.54	1.06	.65	1.09	.17	1.23	<.001
Poor self-rated health	1.03	<.001	1.55	.006	1.22	.02	1.59	<.001
Paresthesias fingers	1.02	.01	1.85	.001	1.35	.003	1.30	<.001
Paresthesias toes	1.04	<.001	1.51	.01	1.53	<.001	1.30	<.001
Raynaud's Phenomenon fingers	1.00	.22	1.38	.03	2.14	<.001	1.23	<.001
Raynaud's Phenomenon toes	1.02	.002	1.39	.03	1.91	<.001	1.27	<.001
Tinnitus	1.02	.02	1.35	.06	1.39	.001	1.28	<.001
Hearing impairment	1.04	<.001	1.94	<.001	1.39	.001	1.16	<.001

*Brief Sexual Function Inventory (BSFI).

**Physical Component Summary Scale of the Short Form 36 (SF-36, PCS).

definition of somatic complaints in our study has the same content as the factor “psychosomatic/somatoform” in the study of Rosmalen et al. [10].

In this study we used self-reporting of medical diseases and complaints, which might give inaccurate results due to possible over-reporting of painful, persistent bodily disorder or under-reporting of asymptomatic diseases. Costa & McCrae (1987) [4] suggested cases with ‘high’ neuroticism, could have a tendency to over-report all kind of negative health conditions. This aspect should therefore be taken into consideration. However, the study by Rosmalen et al. [10] was also based on self-report.

In long-term TCSs we have documented association between neuroticism and somatic and mental morbidity, health, and lifestyle, all factors that might have an impact on morbidity after cancer. In order to prevent and manage morbidity in TCSs, assessment of neuroticism may be clinically important since neuroticism may be amenable to prophylactic interventions.

Personality traits like neuroticism may be new concepts for most oncologists, but our findings convincingly demonstrate the strong impact of neuroticism on somatic and mental morbidity. Patients with high neuroticism could be identified by clinicians with the six neuroticism items in TCSs with multiple chronic complaints. If TCSs are found positive on neuroticism and particularly if signs of unhealthy lifestyle are identified, counseling should be strongly recommended.

The EPQ is moderately correlated with substantiate instruments frequently used within the oncology setting, made for the purpose of assessing latent concepts as fatigue (FQ), cancer related distress (IES), anxiety and depression (HADS), and mental quality of life (MCS). These findings indicate the necessity of a separate instrument for measuring neuroticism.

Strengths and limitations

Our study has several strengths. A large population-based sample allowed for subgroup analyses and was adequately powered for comparisons between two groups. The study mostly used validated questionnaires on various psycho-social variables.

The results need to be interpreted in light of several limitations, however. Since the data are cross-sectional, we cannot demonstrate causal relationships, but rather present associations for further examination in prospective studies. Multiple analyses in studies like this could present false positive results by chance, and we have taken several actions to meet this problem. We have supplemented p-values with effect sizes, and we have set the

p-values at <0.01 , and limited the number of independent variables in the regression analyses.

Our use of an abridged version of the EPQ-18 could be criticized due to reduced variance of only seven summary score alternatives. However, the psychometric properties of the abridged form, EPQ-18, is good, and its utilization is recommended [22]. Self-report of morbidity can always be criticized as to lack of confirmation by medial records, medical doctors or at hospitals.

Finally, the survey was sampled some years ago. However, we cannot see that this delay influences the aims and results of the study, which illustrate general principles.

Conclusion

This study found many significant associations between self-reported somatic and mental morbidity, lifestyle, and health care consumption and neuroticism in TCSs. Neuroticism is a personality trait that should be considered in TCSs who at long-term have chronic and multiple somatic and mental complaints in spite of being cured of their cancer. Neuroticism as measured by the EPQ-18 is only moderately correlated with more established questionnaire measures used in oncology.

Declaration of interest: The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

References

- [1] American Psychiatric Association. Diagnostic and statistical manual of mental disorders [DSM-IV]. Washington D.C.: American Psychiatric Association; 1994.
- [2] Bazana PG, Stelmack RM. Stability of personality across the life span: A meta-analysis. In: On the psychobiology of personality: Essays in honor of Marvin Zuckerman. Stelmack RM, editor. 1st ed. Ottawa, Canada/Oxford, UK: Elsevier Ltd; 2004. p 113–44.
- [3] Eysenck HJ. Dimensions of personality. London: Routledge & Kegan Paul; 1948.
- [4] Costa PT, Jr, McCrae RR. Neuroticism, somatic complaints, and disease: Is the bark worse than the bite? *J Pers* 1987;55: 299–316.
- [5] Cloninger CR. A systematic method for clinical description and classification of personality variants. *Arch Gen Psychiatry* 1987;44:573–88.
- [6] Anda R, Williamson D, Jones D, Macera C, Eaker E, Glassman A, et al. Depressed affect, hopelessness, and the risk of ischemic heart disease in a cohort of U.S. adults. *Epidemiology* 1993;4:285–94.
- [7] Appels A, Mulder P. Fatigue and heart disease. The association between ‘vital exhaustion’ and past, present and future coronary heart disease. *J Psychosom Res* 1989; 33:727–38.
- [8] Nakaya N, Saito-Nakaya K, Akechi T, Kuriyama S, Inagaki M, Kikuchi N, et al. Negative psychological aspects and

- survival in lung cancer patients. *Psychooncology* 2008;17:466–73.
- [9] Petticrew M, Bell R, Hunter D. Influence of psychological coping on survival and recurrence in people with cancer: Systematic review. *BMJ* 2002;325:1066.
 - [10] Rosmalen JG, Neeleman J, Gans RO, de JP. The association between neuroticism and self-reported common somatic symptoms in a population cohort. *J Psychosom Res* 2007;62:305–11.
 - [11] Goodwin RD, Cox BJ, Clara I. Neuroticism and physical disorders among adults in the community: Results from the National Comorbidity Survey. *J Behav Med* 2006;29:229–38.
 - [12] Neeleman J, Bijl R, Ormel J. Neuroticism, a central link between somatic and psychiatric morbidity: Path analysis of prospective data. *Psychol Med* 2004;34:521–31.
 - [13] Jorm AF, Christensen H, Henderson AS, Jacomb PA, Korten AE, Rodgers B. Predicting anxiety and depression from personality: Is there a synergistic effect of neuroticism and extraversion? *J Abnorm Psychol* 2000;109:145–9.
 - [14] Neeleman J, Sytema S, Wadsworth M. Propensity to psychiatric and somatic ill-health: Evidence from a birth cohort. *Psychol Med* 2002;32:793–803.
 - [15] Weinstock LM, Whisman MA. Neuroticism as a common feature of the depressive and anxiety disorders: A test of the revised integrative hierarchical model in a national sample. *J Abnorm Psychol* 2006;115:68–74.
 - [16] Craske MG, Waters AM. Panic disorder, phobias, and generalized anxiety disorder. *Annu Rev Clin Psychol* 2005;1:197–225.
 - [17] Aarstad HJ, Heimdal JH, Aarstad AK, Olofsson J. Personality traits in head and neck squamous cell carcinoma patients in relation to the disease state, disease extent and prognosis. *Acta Otolaryngol* 2002;122:892–9.
 - [18] Dahl AA, Haaland CF, Mykletun A, Bremnes R, Dahl O, Klepp O, et al. Study of anxiety disorder and depression in long-term survivors of testicular cancer. *J Clin Oncol* 2005;23:2389–95.
 - [19] Mykletun A, Dahl AA, Haaland CF, Bremnes R, Dahl O, Klepp O, et al. Side effects and cancer-related stress determine quality of life in long-term survivors of testicular cancer. *J Clin Oncol* 2005;23:3061–8.
 - [20] Orre IJ, Fossa SD, Murison R, Bremnes R, Dahl O, Klepp O, et al. Chronic cancer-related fatigue in long-term survivors of testicular cancer. *J Psychosom Res* 2008;64:363–71.
 - [21] Dahl AA, Bremnes R, Dahl O, Klepp O, Wist E, Fossa SD. Is the sexual function compromised in long-term testicular cancer survivors? *Eur Urol* 2007;52:1438–47.
 - [22] Tambs K, Sundet JM, Eaves L, Solaas MH, Berg K. Pedigree analysis of Eysenck Personality Questionnaire (EPQ) scores in monozygotic (MZ) twin families. *Behav Genet* 1991;21:369–82.
 - [23] Eysenck HJ, Eysenck SBG. *Manual of the Eysenck Personality Inventory*. London: Hodder and Stoughton; 1975.
 - [24] Eysenck SBG, Eysenck HJ, Barrett P. A revised version of The Psychoticism Scale. *Personality and individual differences* 1985;6:21–9.
 - [25] Eysenck SBG, Tambs K. Cross-cultural comparison of personality: Norway and England. *Scand J Psychol* 1990;31:191–7.
 - [26] Thorsen L, Nystad W, Dahl O, Klepp O, Bremnes RM, Wist E, Fossa SD. The level of physical activity in long-term survivors of testicular cancer. *Eur J Cancer* 2003;39:1216–21.
 - [27] Brugha T, Bebbington P, Tennant C, Hurry J. The list of threatening experiences: A subset of 12 life event categories with considerable long-term contextual threat. *Psychol Med* 1985;15:189–94.
 - [28] Oldenburg J, Fossa SD, Dahl AA. Scale for chemotherapy-induced long-term neurotoxicity (SCIN): Psychometrics, validation, and findings in a large sample of testicular cancer survivors. *Qual Life Res* 2006;15:791–800.
 - [29] O'Leary MP, Fowler FJ, Lenderking WR, Barber B, Sagnier PP, Guess HA, Barry MJ. A brief male sexual function inventory for urology. *Urology* 1995;46:697–706.
 - [30] Zigmond AS, Snaith RP. The hospital anxiety and depression scale. *Acta Psychiatrica Scand* 1983;67:361–70.
 - [31] Ware JE, Jr, Kosinski M, Dewey JE. How to score version 2 of the SF-36 health survey (standard & acute forms). Lincoln, RI: Quality Metric Inc; 2000.
 - [32] Chalder T, Berelowitz G, Pawlikowska T, Watts L, Wessely S, Wright D, Wallace EP. Development of a fatigue scale. *J Psychosom Res* 1993;37:147–53.
 - [33] Horowitz M, Wilner N, Alvarez W. Impact of event scale: A measure of subjective stress. *Psychosom Med* 1979;41:209–18.
 - [34] Sundin EC, Horowitz MJ. Impact of event scale: Psychometric properties. *Br J Psychiatry* 2002;180:205–9.
 - [35] Finset A, Steine S, Haugli L, Steen E, Lærum E. The brief approach/avoidance coping questionnaire: Development and validation. *Psychol Health Med* 2002;7:75–85.
 - [36] Lipsey MW, Wilson DB. *Practical meta-analysis*. Thousand Oaks, CA: SAGE; 2001.