Personality Traits and Cancer Risk and Survival Based on Finnish and Swedish Registry Data

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Personality traits have been studied extensively as risk and prognostic factors for cancer; however, the association remains unclear. This prospective, population-based cohort study comprised 59,548 Swedish (1974–1999) and Finnish (1976–2004) participants who completed a questionnaire eliciting information for the Eysenck Personality Inventory and on health behavior at baseline. To analyze the association of personality traits extraversion and neuroticism with risk of cancer, the authors identified 4,631 cancer cases for a maximum 30 years of follow-up. To assess the association with cancer survival among the Finnish participants, they identified 2,733 cancer cases and, later, 1,548 deaths for a maximum 29 years of follow-up. Hazard ratios were estimated by treating the personality scales as continuous variables and are presented per one increase in score on each scale. In multivariate analyses, extraversion and neuroticism were not significantly associated with risk of cancers at all sites (extraversion: hazard ratio = 0.99, 95% confidence interval: 0.98, 1.01; neuroticism: hazard ratio = 1.00, 95% confidence interval: 0.99, 1.02). Results showed no significant association between these traits and the hazard ratio for death after cancers at all sites, and they do not support the hypothesis that extraversion and neuroticism are direct risk factors for cancer or survival after cancer.

extraversion (psychology); Finland; neoplasms; neurotic disorders; personality; personality inventory; survival; Sweden

Abbreviations: CI, confidence interval; EPI-Q, abbreviated version of the Eysenck Personality Inventory.

Editor's note: An invited commentary on this article is published on page 386.

Personality has long been hypothesized to play a causal role in the development and progression of cancer. In 1962, Kissen and Eysenck (1) conducted one of the first modern studies of the association between personality and cancer and reported that, compared with hospital controls, patients with lung cancer were more likely to be extraverted and less likely to be neurotic. Their theory could be interpreted to suggest that extraverts are at increased risk of cancer because they seek stimulation and thus experience high levels of stress, whereas individuals with low levels of neuroticism could be at increased risk of cancer because they tend to have a reduced emotional outlet and thus accumulate emotional stress (2). The higher exposure to stress could influence cancer risk by influencing immune and endocrine function (3, 4). Supporting this theory, Morris et al. (5) reported that persons with lower levels of neuroticism and trait anxiety scores were at increased risk of breast cancer.

Since then, the results of several well-conducted prospective studies have not confirmed an association between personality traits (e.g., extraversion (6–8), neuroticism (6–9), and trait anxiety (10)) and cancer risk; however, the majority of these studies had methodological limitations, including a small number of cancer incidents (ranging from 113 (6) to 1,898 (8)), which has not provided sufficient statistical power to analyze individual cancer sites. Because combined analyses across cancer sites may produce diluted effects,
site-specific analyses are needed. With a stress interpretation of the personality theory, we would expect an increased risk of, especially, immune- and endocrine-related cancers, but there has also been a layman expectation of an overall relation between personality and cancer.

Personality has also been suggested to play a role in cancer progression. Temoshok et al. (11) observed that tumor thickness in patients with malignant melanoma was positively associated with “type C” personality, which they described as cooperative, unassertive, patient, suppressive of negative emotions, and accepting/compliant with external authorities. Persons with low levels of extraversion and high levels of neuroticism are thought to repress their emotions, which is considered to be one of the most important aspects of type C personality (12). The hypothesis related to cancer survival could also be interpreted as being related to stress. Accumulated repression of emotions may cause stress, which could influence cancer progression by influencing immune and endocrine function (3, 4).

The role of personality traits in survival after cancer has been addressed in 8 known prospective studies, but no conclusion has been reached (13–20), and the evidence is still limited (21). Three studies found statistically significant associations between low extraversion levels and shorter breast cancer survival (13), between high scores on the lie scale (indicating rigid adherence to social norms, which has been suggested to be a characteristic of the cancer-prone personality) and non-Hodgkin lymphoma (14), and between high levels of neuroticism and all cancer sites combined for women (15). Still, 5 studies found no association between personality and cancer survival (16–20). These studies had several limitations, however, including small samples. Five of them had fewer than 200 participants (13–17) and lacked sufficient statistical power to analyze individual cancer sites.

We conducted a population-based, prospective cohort study to examine the associations between personality traits and cancer risk and survival. On the basis of previous studies, we expected that a number of factors may play a role in the causal pathway between personality traits and cancer risk and survival. In particular, we expected that a number of lifestyle factors (e.g., smoking and alcohol consumption) may function as mediators and thus that the effect of personality traits works through these factors and not independently. To the best of our knowledge, ours is the largest study of the association between personality traits and cancer risk and survival.

MATERIALS AND METHODS

Study population

The current study was based on combined data from Finnish and Swedish twin cohorts. These data include information on personality traits and details on lifestyle factors; most importantly, the data for both countries can be linked with registry information on cancer and vital status. This compilation of data thus offers a unique opportunity for investigating personality traits and cancer risk and survival.

The Finnish twin cohort has been investigated in a large, prospective, population-based study (22). The cohort consists of all Finnish same-sex twin pairs born before 1958, of which both members were alive in 1975. The cohort members were sent questionnaires including items on personality traits in 1975 and 1981, but we used only one-time measurement of personality traits (1975 questionnaire) because they are viewed as stable in adulthood (23). We included twins and singletons who satisfied the selection criteria and who responded to the baseline questionnaire in 1975 (n = 31,145).

The Swedish twin cohort was identified from the population-based Swedish Twin Registry, the largest of its kind in the world, which has information on more than 140,000 twins (24). The registry contains data for 3 cohorts, comprising twins born between 1886 and 1925, twins born between 1926 and 1958, and twins born between 1959 and 1990. We used data on 36,536 persons in the middle cohort who responded to a baseline questionnaire sent in 1973.

Eysenck Personality Inventory

We used an abbreviated version of the Eysenck Personality Inventory (EPI-Q), which is a short form of the Eysenck Personality Inventory (EPI Form B). When a previous study developed the 2 dimensions, all items were selected from the large pool of EPI items depending on the ability to differentiate between the upper and lower inventory score quartiles for 400 nontwins (25). EPI-Q allows measurement of 2 dimensions of personality: extraversion and neuroticism (23, 26). In both the Finnish and Swedish versions, extraversion was assessed with 9 items (possible score range, 0–9); neuroticism was assessed with 10 items (possible score range, 0–10) in the Finnish version and with 9 items (possible range, 0–9) in the Swedish version. The neuroticism item, Do you have difficulties in falling asleep?, was not included in the Swedish version. On both scales, higher scores indicate a greater tendency to have the personality trait. Extraversion represents sociability and liveliness, whereas neuroticism represents emotional instability and anxiousness (27).

Health behavior and demographic factors

We obtained one-time measures of known or suspected cancer risk factors at baseline assessments in 1973 in Sweden and 1975 in Finland. Considered were education, parity, weight, height, and lifestyle factors, including smoking status and alcohol consumption.

Linkage to national registries

Information on cancer diagnoses was obtained by record linkage to the national cancer registries in Finland and Sweden using the unique identification numbers assigned to everyone residing in those countries. The Finnish Cancer Registry holds information on all cases of cancer diagnosed in Finland since 1953 (28); the Swedish Cancer Registry holds information on cancers diagnosed in Sweden since 1958 (29). For the current study, tumor morphology was based on the International Classification of Diseases, Seventh Revision. Data on emigration and death were obtained in Finland by record linkage to the Population Register.
Centre and in Sweden by record linkage to the National Population Register.

**Follow-up**

Separate follow-up periods were constructed for the analyses of personality traits and risk of cancer and of personality traits and survival after cancer. To analyze personality traits and risk of cancer, we identified 67,681 people. We excluded 383 in whom cancer (other than nonmelanoma skin cancer) was diagnosed between establishment of the cancer registries and the beginning of follow-up (Finnish cohort: January 1, 1976; Swedish cohort: January 1, 1974), 51 people who died before the beginning of follow-up, 164 people who emigrated before the beginning of follow-up (Finnish cohort only), 7,359 people who did not respond sufficiently to the questions on personality traits (fewer than 6 items on each scale), leaving 59,548 people (88%) for the analyses.

For the analyses of cancer risk, people were followed up for cancer from the date of entry (Finnish cohort: January 1, 1976; Swedish cohort: January 1, 1974) until the date of first cancer diagnosis (other than nonmelanoma skin cancer), death, emigration (Finnish cohort only), or end of follow-up (Swedish cohort: December 31, 2004; Swedish cohort: December 31, 1999), whichever occurred first. A total of 4,631 cases of cancer were identified, 1,898 in Sweden and 2,733 in Finland (Figure 1).

Previous studies have suggested that personality traits affect the stage of cancer at the time of diagnosis (30), perhaps because certain traits affect motivation to seek medical assistance (31). Because cancer stage has been shown to be strongly associated with survival after cancer, it is an important potential mediator of analyses of personality and cancer survival. Since this information was not available in the Swedish data, we used only the Finnish data in the analyses of personality traits and survival after cancer. People were followed up for death from the date of cancer diagnosis until death, emigration, or December 31, 2004, whichever occurred first. A total of 1,548 deaths were identified in this period (Figure 1).

**Statistical analyses**

A Cox proportional hazards model, with standard errors and 95% confidence intervals estimated robustly to adjust for possible dependence among twins by using the COVSANDWICH option (32), was used to estimate hazard ratios for extraversion and neuroticism, separately and as a joint effect. The assumption of proportional hazards was verified graphically per each score, and linear associations...
between personality traits and outcomes were estimated and expressed as hazard ratios per one increase in score. In the analyses of the joint effect of extraversion and neuroticism, we used dichotomous versions of the 2 scales (low: ≤4; high: ≥5), which were also used in previous studies (6, 8).

To assess cancer risk, we conducted separate analyses for cancers at all sites and for cancers at 13 specific sites, and there were more than 100 incident cases. Age was used as the underlying time scale, and all analyses were stratified by study cohort and gender in the Cox model, which allowed for separate baseline hazard functions for men and women and in Sweden and Finland. The analyses were corrected for delayed entry so that individuals were considered at risk from age at entry into the cohort. To adjust for possible effects of time since baseline examination, time was included in the model as a time-dependent step function to jump to 3 years and to 10 years after baseline.

To analyze cancer survival, we conducted separate analyses for cancers at all sites and at 7 specific sites, and there were more than 100 cases. Time since cancer diagnosis was used as the underlying time scale. All analyses were stratified according to gender in the Cox model.

Previous studies have not found gender differences when examining the association between personality traits and cancer risk, but a previous study found an effect on cancer survival for women only (15). We thus also conducted separate analyses of cancer survival by gender.

We performed unadjusted analyses and multivariate analyses to estimate the risk of cancer and the risk of death after cancer. On the basis of previous studies, we selected and included a number of covariates. Smoking status (33–35), alcohol consumption in grams per month (15, 34, 35), body mass index in kilograms/meters squared (35–37), length of education in years (34, 38, 39), cancer stage (analyses of cancer survival only) (30, 31), and parity (40, 41) (analyses of risks of cancers of only the breast, cervix uteri, and corpus uteri and analyses of survival after breast cancer) were associated with both exposures (extraversion or neuroticism) and outcomes (risk of cancer or risk of death after cancer) in previous studies as well as in the current study. These factors are all considered potential mediators and thus as intermediate steps in the causal pathway: we expect that personality affects these factors, and we expect that these factors affect cancer risk and survival (42). These factors were adjusted for in the analyses to estimate a direct effect of personality on cancer risk and cancer survival. Zygosity was not found to be associated with either exposures or outcomes, and separate analyses by zygosity showed only small differences in results. Thus, we did not include zygosity as a covariate.

All data handling and statistical analyses were performed with the SAS version 9.1 statistical software package (SAS Institute, Inc., Cary, North Carolina). All statistical tests were 2-sided.

**RESULTS**

The distributions of personality traits and other risk factors for cancer are shown according to cohort (Finnish or Swedish) in Table 1. The Finnish were younger than the Swedish participants at baseline. The score distribution was more skewed for neuroticism than for extraversion in both cohorts. Some differences were found between the cohorts, particularly regarding unknown alcohol consumption, body mass index, length of education, and parity.

### Personality traits and risk of cancer

In unadjusted analyses of Cox proportional hazards regression analyses, neither extraversion nor neuroticism was...
Personality traits and the risk of death after cancer

We found no significant association between the 2 personality traits and risk of death after cancers at all sites or at specific cancer sites, in either unadjusted or multivariate analyses (Table 3). Unadjusted analysis of the joint effect of extraversion and neuroticism also showed no significant associations; the hazard ratios for persons with levels of low extraversion and high neuroticism, high extraversion and low neuroticism, and high extraversion and high neuroticism compared with persons with levels of low extraversion and low neuroticism were 1.02, 1.03, and 0.94, respectively. These results remained basically unchanged after adjustment for covariates.

We also examined gender difference. However, extraversion or neuroticism was not associated with the risk of death after cancer for either men or women (data not shown).

DISCUSSION

To the best of our knowledge, this is the largest study of associations between personality traits and cancer risks (>4,500 incident cases) and survival (>1,500 cancer patients who died during follow-up). Our findings are in line with those of recent prospective studies, which provide no support for the hypothesis that personality traits are direct risk factors for cancers at all sites (6–10), although both extraversion and neuroticism were significantly associated with risks of cancers at a few specific sites.

In the current study, significant positive associations were observed between extraversion and neuroticism and risk of lung cancer. An association of extraversion and neuroticism with smoking has been found in previous studies (33), with personality affecting smoking status, and smoking has been shown to be associated with an increased risk of lung cancer (34), suggesting a mediating role of smoking. The significant association between personality traits and the risk of lung cancer in the current study may be related to the fact that we were not able to adjust very precisely for the mediating effect of smoking.

We investigated this issue further in the Swedish cohort, where we had access to more detailed information on number of cigarettes smoked. When we used a dichotomous measure of smoking (never vs. ever), the unadjusted hazard ratio for extraversion and lung cancer was 1.16 (95% CI: 1.07, 1.26), and the adjusted hazard ratio for extraversion and lung cancer was 1.15 (95% CI: 1.06, 1.25). When a smoking measure with 4 ordinal levels (never, previous, current 1–19 cigarettes/day, current ≥20 cigarettes/day) was used, the adjusted hazard ratio was 1.12 (95% CI: 1.03, 1.21). A dichotomous measure of smoking (never vs. ever) produced an unadjusted hazard ratio of 1.10 (95% CI: 1.02, 1.18) for neuroticism and lung cancer and an adjusted hazard ratio of 1.08 (95% CI: 1.01, 1.16). When a smoking measure with 4 ordinal levels (never, previous, current 1–19 cigarettes/day, current ≥20 cigarettes/day) was considered, the adjusted hazard ratio was 1.04 (95% CI: 0.97, 1.11).

These results indicate that the strength of the association between extraversion and neuroticism and the risk of lung cancer gradually decreased, especially for neuroticism. This finding supports a mediating effect of smoking on the association between personality and lung cancer that explains most of the observed effect in the unadjusted analyses. With a perfect measure of smoking, we would expect no independent effect of the personality traits. We interpret these results to suggest that people with a certain set of personality traits are more likely to smoke and, by smoking, would have a higher risk of lung cancer. Furthermore, the personality traits cannot be characterized as causes of lung cancer because they do not work directly on lung cancer but only through smoking.

To our knowledge, the significant negative association we observed between neuroticism and risk of liver cancer has not been documented previously. This association was not significantly mediated by alcohol consumption; however, the number of cases of liver cancer was small, and further studies are needed to confirm these results, which may be a chance finding. Overall, the results showed no significant associations between personality and risk of immune- and endocrine-related cancers, such as those of the breast, corpus uteri, ovary, and prostate (6, 8). In addition, the only significant associations with cancer risk we observed were likely due to chance (liver) or were highly influenced by mediating factors (lung), and only small effects of extraversion on lung cancer are left when taking this into account. Thus, our findings do not support the hypothesis of an association between personality traits and cancer risk.

We found no significant association between the 2 personality traits and risk of death after cancer at any site. The role of personality traits in survival after cancer has been addressed in several prospective studies, but no conclusion has been reached (13–20). Three of these studies reported...
<table>
<thead>
<tr>
<th>Cancer Site (Cancer Cases)</th>
<th>Extraversion</th>
<th></th>
<th></th>
<th>Neuroticism</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unadjusted HR</td>
<td>95% CI</td>
<td>P Value</td>
<td>Multivariate HR</td>
<td>95% CI</td>
<td>P Value</td>
</tr>
<tr>
<td>All sites (n = 4,631)</td>
<td>1.00</td>
<td>0.99, 1.01</td>
<td>0.66</td>
<td>0.98, 1.01</td>
<td>0.23</td>
<td>1.01</td>
</tr>
<tr>
<td>Specific sites</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stomach (n = 180)</td>
<td>1.01</td>
<td>0.95, 1.07</td>
<td>0.77</td>
<td>1.01</td>
<td>0.95, 1.07</td>
<td>0.78</td>
</tr>
<tr>
<td>Colorectum (n = 376)</td>
<td>0.99</td>
<td>0.95, 1.03</td>
<td>0.54</td>
<td>0.98</td>
<td>0.94, 1.03</td>
<td>0.43</td>
</tr>
<tr>
<td>Liver (n = 115)</td>
<td>0.98</td>
<td>0.90, 1.06</td>
<td>0.55</td>
<td>0.98</td>
<td>0.91, 1.06</td>
<td>0.57</td>
</tr>
<tr>
<td>Pancreas (n = 140)</td>
<td>0.97</td>
<td>0.91, 1.04</td>
<td>0.46</td>
<td>0.97</td>
<td>0.90, 1.04</td>
<td>0.32</td>
</tr>
<tr>
<td>Lung (n = 364)</td>
<td>1.08</td>
<td>1.03, 1.13</td>
<td>&lt;0.01</td>
<td>1.06</td>
<td>1.01, 1.10</td>
<td>0.01</td>
</tr>
<tr>
<td>Breast (n = 908)</td>
<td>0.97</td>
<td>0.92, 0.98</td>
<td>0.06</td>
<td>0.97</td>
<td>0.95, 1.00</td>
<td>0.05</td>
</tr>
<tr>
<td>Cervix uteri (n = 113)</td>
<td>0.98</td>
<td>0.91, 1.06</td>
<td>0.61</td>
<td>0.99</td>
<td>0.91, 1.07</td>
<td>0.71</td>
</tr>
<tr>
<td>Corpus uteri (n = 138)</td>
<td>0.97</td>
<td>0.91, 1.04</td>
<td>0.41</td>
<td>1.00</td>
<td>0.93, 1.07</td>
<td>0.89</td>
</tr>
<tr>
<td>Prostate (n = 479)</td>
<td>1.03</td>
<td>0.99, 1.17</td>
<td>0.11</td>
<td>1.00</td>
<td>0.96, 1.04</td>
<td>0.81</td>
</tr>
<tr>
<td>Kidney (n = 122)</td>
<td>0.94</td>
<td>0.87, 1.02</td>
<td>0.12</td>
<td>0.94</td>
<td>0.87, 1.02</td>
<td>0.12</td>
</tr>
<tr>
<td>Urinary organs (excluding kidney) (n = 172)</td>
<td>1.01</td>
<td>0.95, 1.08</td>
<td>0.73</td>
<td>1.01</td>
<td>0.95, 1.08</td>
<td>0.76</td>
</tr>
<tr>
<td>Melanoma of the skin (n = 170)</td>
<td>1.01</td>
<td>0.95, 1.07</td>
<td>0.87</td>
<td>1.01</td>
<td>0.95, 1.08</td>
<td>0.72</td>
</tr>
<tr>
<td>Nervous system (n = 220)</td>
<td>0.98</td>
<td>0.92, 1.03</td>
<td>0.39</td>
<td>0.98</td>
<td>0.92, 1.03</td>
<td>0.43</td>
</tr>
</tbody>
</table>

Abbreviations: CI, confidence interval; HR, hazard ratio.

*a* Age was used as the underlying time scale, and all analyses were stratified by study cohort and gender that allowed for separate baseline hazard functions for men and women and in Sweden and Finland. The analyses were corrected for delayed entry; individuals were considered at risk from age at entry into the cohort. To adjust for possible effects of time since baseline examination, time was included in the model as a time-dependent step function to jump to 3 years and to 10 years after baseline.

*b* Obtained by linear trend tests.

*c* Adjusted for smoking status (ever, never, unknown), alcohol consumption in g/month (none, 1–250, 251–500, ≥501, unknown), body mass index in kg/m² (<18.5, 18.5–24.9, ≥25.0, unknown), and length of education in years (<9, ≥10, unknown).

*d* The analysis included only women, and multivariate HRs were further adjusted for parity (nulliparity or parity).

*e* The analysis included only men.
### Table 3. Hazard Ratios and 95% Confidence Intervals for Death After Cancer According to Cancer Site, per a One-Score Increase in Extraversion and Neuroticism, in 2,733 Finnish (1976–2004) Persons

<table>
<thead>
<tr>
<th>Cancer Site (Cancer Cases/Deaths)</th>
<th>Extraversion</th>
<th>Neuroticism</th>
<th>Extraversion</th>
<th>Neuroticism</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unadjusted</td>
<td>95% CI</td>
<td>P Value</td>
<td>Multivariate</td>
</tr>
<tr>
<td>All sites ($n = 2,733$/$n = 1,548$)</td>
<td>0.99</td>
<td>0.97, 1.01</td>
<td>0.34</td>
<td>1.00</td>
</tr>
<tr>
<td>Specific sites</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stomach ($n = 137$/$n = 110$)</td>
<td>1.00</td>
<td>0.94, 1.08</td>
<td>0.95</td>
<td>1.00</td>
</tr>
<tr>
<td>Colorectum ($n = 217$/$n = 131$)</td>
<td>0.96</td>
<td>0.90, 1.03</td>
<td>0.26</td>
<td>0.97</td>
</tr>
<tr>
<td>Lung ($n = 263$/$n = 238$)</td>
<td>1.05</td>
<td>1.00, 1.11</td>
<td>0.06</td>
<td>1.05</td>
</tr>
<tr>
<td>Breast* ($n = 474$/$n = 154$)</td>
<td>0.95</td>
<td>0.89, 1.02</td>
<td>0.13</td>
<td>0.98</td>
</tr>
<tr>
<td>Prostate* ($n = 327$/$n = 143$)</td>
<td>1.01</td>
<td>0.95, 1.07</td>
<td>0.83</td>
<td>1.02</td>
</tr>
<tr>
<td>Urinary organs (excluding kidney) ($n = 102$/$n = 61$)</td>
<td>1.03</td>
<td>0.92, 1.14</td>
<td>0.63</td>
<td>1.01</td>
</tr>
<tr>
<td>Nervous system ($n = 120$)</td>
<td>1.04</td>
<td>0.95, 1.15</td>
<td>0.40</td>
<td>1.05</td>
</tr>
</tbody>
</table>

**Abbreviations:** CI, confidence interval; HR, hazard ratio.
- a Obtained by linear trend tests.
- b Adjusted for age at cancer diagnosis (continuous variable), information on cancer stage (non-localized, localized, unknown), smoking status (ever, never, unknown), alcohol consumption in g/month (none, 1–250, 251–500, ≥501, unknown), body mass index in kg/m² (<18.5, 18.5–24.9, ≥25.0, unknown), and length of education in years (<9, ≥10, unknown).
- c The analysis included only men.
- d The analysis included only women, and multivariate HRs were further adjusted for parity (nulliparity or parity).

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Conflict of interest: none declared.

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