



Classification of personality traits using the Big Five Inventory-10 in esophageal adenocarcinoma patients

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Background: During the last decades the number of patients suffering from Barrett's esophagus and esophageal adenocarcinoma (EAC) were rising in the western hemisphere. The association of patient's personality traits, depression, stressors and cancer development is a controversial issue and there are no data available, correlating personality traits in EAC patients.

Methods: In a multi-center survey, the Big Five Inventory-10 (BFI-10; neuroticism, extraversion, openness, conscientiousness and agreeableness) was investigated in patients with EAC between 01/2013 and 12/2015. The questionnaires were sent to 1,247 EAC patients and were answered by 839 (females: 13.8%, males: 86.2%; 66.7±9.7 years) patients (67.3%). The results were compared with healthy controls from two Big Five inventories representing the German resident population for gender and age.

Results: Patients with EAC showed differences in their personality traits regarding to the Big Five compared to the German resident population with lower values in extraversion and openness and higher values in neuroticism, conscientiousness and agreeableness in the study group. Gender specific differences were observed for agreeableness (P=0.04) and neuroticism (P=0.000). In EAC patients, age was associated with a decrease in neuroticism, while in the reference group higher age was associated with higher values for neuroticism.

Conclusions: We were able to show gender and age specific characteristics in a large EAC patient cohort. Personality traits, especially neuroticism, might be a useful tool to increase the awareness to support also cancer survivors by psycho-oncologists, as neuroticism is associated with depression and anxiety.

Keywords: Barrett's carcinoma; esophageal adenocarcinoma (EAC); Big Five Inventory-10 (BFI-10); neuroticism; cancer survivor

Received: 30 April 2020. Accepted: 23 June 2020; Published: 25 September 2020.

doi: 10.21037/aoe-20-38

View this article at: <http://dx.doi.org/10.21037/aoe-20-38>

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Introduction

The incidence for esophageal adenocarcinoma (EAC) was rising during the last decades (1). Mostly, EAC is arising from Barrett's metaplasia due to chronic gastroesophageal reflux disease (GERD), while the physiological squamous epithelium is replaced by the metaplastic epithelium (2). However, the risk of EAC development is highly associated with the length of Barrett's segment, with the highest association for long Barrett's esophagus (BE) ≥ 3 cm with an annual cancer transition rate of 0.22% (3). Despite BE, nicotine abuse (4,5), obesity (6,7), and positive familiar history (8) are known risk factors for EAC development.

Psychological and social factors can be associated with tumor development, progression and convalescence. Also, the daily clinical praxis is characterized and dependent to patient's personality traits and psychological stress factors. However, there is a discussion about the association of personality traits, depression, stressors and cancer development. Livelong personality stability is a long-term predictor for health conservation. The evidence of psychosocial risk factors in cancer development is controversial (9,10), as chronically stress is associated with impaired immunological functions, which might lead to cancer development (11). The Big Five Inventory-10 (BFI-10) cumulate the five main personality traits, neuroticism, extraversion, openness, conscientiousness and agreeableness (12). Persons with higher conscientiousness were associated with a healthier life style and a longer life time (13). Thereby, the BFI-10 consists of only 10 items and according to this the BFI-10 promises an easy and efficient processing by patients, e.g., cancer patients (14).

There are no studies available investigated EAC patients for their personality traits. Therefore, we present a large multi-center survey, characterizing EAC patients for the BFI-10, neuroticism, extraversion, openness, conscientiousness and agreeableness and we implemented this inventory for a large disease-defined cancer population.

We present the following article in accordance with the STROBE reporting checklist (available at <http://dx.doi.org/10.21037/aoe-20-38>).

Methods

Patient characteristics

Patients gave their written and informed consent to participate in this survey. The local ethic committee of the "Landesärztekammer Rheinland-Pfalz" approved this study

in accordance with the Helsinki declaration (reference number: 837.095.11-7637) and informed consent was taken from all the patients. Patients with endoscopically and histologically confirmed EAC, at the age ≥ 18 years were eligible for this study. A total of 1,247 patients with EAC were found eligible for the study between 01/2013-12/2015, from which 839 (67.3%) completed the questionnaires. Reference groups (RG) with 1,134 individuals for gender and 2,116 individuals for age were used, which reflect the German general population (15-17).

Survey questionnaire

The BFI-10 was answered by EAC patients "paper-pencil-based" in a multi-center survey retrospectively in a 10-item questionnaire (two for each item), which reflects the personality traits, neuroticism, extraversion, openness, conscientiousness and agreeableness (12). The questionnaire was developed from an original 44-item inventory. However, the 10-item inventory was introduced because of its higher acceptance and respondent's time needed to conduct the questionnaire (14). The BFI-10 questionnaire is published open-access and can be used for any non-commercial research (14). Data were documented in a Redcap system (<https://www.project-redcap.org>). To consider age-specific personality traits, both cohorts were separated in 2 groups, representing individuals between the age of 30 to 60 years and older than 60 years (17).

Statistical methods

Statistical analyses were performed using the Statistical Packages for the Social Sciences (SPSS v.24). Both, the study and the reference collectives were described descriptively. The five dimensions were calculated and expressed as mean \pm standard deviation (SD). Differences between females and males as well as for age were analyzed by the Mann-Whitney test for the EAC-cohort. Reliability analyses were conducted through Cronbach's alpha, because of the limited sample size and retrospective character in the EAC collective and through retest and follow-ups in the reference group. Both RG cohorts were compared with the EAC-cohort by analyzing the means, standard deviation and sample size (www.medcalc.org). A multivariate analysis was performed by a linear model for age, with personality traits as dependent and age as independent variables. P values less than 0.05 were considered as being statistically significant. Statistical correlations were calculated using the Person's

Table 1 Comparison of the Big Five in the EAC-cohort and the RG

| Dimension | EAC-cohort (n=839) | RG (Rammstedt <i>et al.</i> 2014; n=1,134) | P |
|-------------------|--------------------|--|---------|
| Extraversion | 3.23±0.97 | 3.35±1.1 | 0.019 |
| Agreeableness | 3.16±0.80 | 3.00±1.1 | 0.0004 |
| Conscientiousness | 4.10±0.68 | 3.15±0.97 | <0.0001 |
| Neuroticism | 2.94±0.88 | 2.82±1.07 | 0.0081 |
| Openness | 3.25±0.92 | 3.40±1.1 | 0.001 |

EAC, esophageal adenocarcinoma; RG, reference group.

and Spearman's correlation coefficient (R). Spearman's R is a nonparametric measure of rank correlation. It analyzes how the relationship between two variables can be described. Because correlation coefficients like Pearson are sensible to very high/very low values, therefore robust coefficients like Spearman's R can be used. It utilizes ranks instead of observed values.

Results

The study group (EAC-cohort) consisted of 723 (86.2%) males and 116 (13.8%) females. Patient's average age was 66.7 years (SD 9.7 years).

In the RG (gender) 503 (44.4%) individuals were males and 631 (55.6%) females. Average age was 53.3 years (SD 18.4 years) (15). In the RG (age) 1,272 individuals were males and 1,295 (50.4%) were females. Average age was 47.5 years (SD 17.3 years) (17).

Patients with EAC showed significantly higher values for neuroticism (2.94 in EAC-cohort *vs.* 2.82 in the RG), but lower values for openness (3.25 in EAC-cohort *vs.* 3.40 in the RG) and extraversion (3.2 in EAC-cohort *vs.* 3.35 in the RG) (Table 1).

Gender-specific personality traits

Investigating neuroticism, the mean value of males was 2.89 (SD 0.87), while females had a mean value of 3.21 (SD 0.88) in the EAC-cohort. The RG had a mean value of 2.22 (SD 0.79) for neuroticism in males and 2.58 (SD 0.92) in females, which was significantly different between the two collectives (P=0.00).

The EAC-cohort showed a mean value for agreeableness of 3.13 (SD 0.79) for males and 3.32 (SD 0.80) for women, while the RG had a mean value of 3.39 (SD 0.78) for males and 3.49 (SD 0.81) for females. The differences between

the two collectives were significant (P=0.04) (Table 2).

Age-specific personality traits

Neuroticism was affected by age in the study collective. The mean value for the age-group 36–65 years was 3.08 (SD 0.88) and 3.37 (SD 0.83) in the reference group. In the age-group >65 years, the mean value was 2.89 (SD 0.88) in the EAC-group and 3.56 (SD 0.89) for the reference group. The reference group was characterized by increased values for neuroticism with age; the EAC-group was not.

While also extraversion, agreeableness, conscientiousness, and openness were significantly affected by age in the reference group, the EAC-cohort did not show significant differences for these personality traits (Table 3), which was confirmed by multivariate analyses, showing neuroticism significantly (P=0.006) decreased by age (Table 4).

Statistical correlations of personality traits in EAC patients

To investigate the robustness and the reliability of the raised Big Five values in the EAC-cohort, the values of the single dimensions were correlated by Spearman's correlation (Table 5). The reliability could be obtained, as specific correlations between items, e.g., neuroticism and extraversion, which were found to correlate.

Personality traits in regard to the EAC diagnosis

From 753 patients, who answered the questionnaire, the time point of the first diagnosis of EAC was documented. The median time between EAC diagnosis and the survey was 56 months (range, 1–227 months). Therefore, these patients represented a long-term survival EAC-cohort. The cohort was stratified in 88 patients (11.7%), who answered the questionnaire less than 18 months and in 665 patients

Table 2 Big Five in a gender-specific analysis

| Dimensions | Gender | EAC-cohort (n=839) | | | | RG (Rammstedt <i>et al.</i> 2014; n=1,134) | | | |
|-------------------|--------|--------------------|------|------|---------|--|------|------|---------|
| | | Number | Mean | SD | P | Number | Mean | SD | P |
| Extraversion | Male | 723 | 3.20 | 0.97 | 0.126 | 503 | 3.43 | 0.90 | 0.157 |
| | Female | 116 | 3.34 | 0.94 | | 631 | 3.51 | 0.98 | |
| Agreeableness | Male | 723 | 3.13 | 0.79 | 0.040 | 503 | 3.39 | 0.78 | 0.036 |
| | Female | 116 | 3.32 | 0.80 | | 631 | 3.49 | 0.81 | |
| Conscientiousness | Male | 723 | 4.07 | 0.68 | 0.763 | 503 | 4.05 | 0.82 | 0.0001 |
| | Female | 116 | 4.11 | 0.61 | | 631 | 4.24 | 0.76 | |
| Neuroticism | Male | 723 | 2.89 | 0.87 | <0.0001 | 503 | 2.22 | 0.79 | <0.0001 |
| | Female | 116 | 3.21 | 0.88 | | 631 | 2.58 | 0.92 | |
| Openness | Male | 723 | 3.24 | 0.91 | 0.548 | 503 | 3.31 | 0.89 | 0.0012 |
| | Female | 116 | 3.31 | 0.95 | | 631 | 3.49 | 0.96 | |

EAC, esophageal adenocarcinoma; RG, reference group; SD, standard deviation.

Table 3 Big Five in an age-specific analysis

| Dimensions | Age, years | EAC-cohort (n=839) | | | | RG (Rammstedt <i>et al.</i> 2007; n=2,116) | | | |
|-------------------|------------|--------------------|-------|-------|-------|--|------|------|---------|
| | | Number | Mean | SD | P | Number | Mean | SD | P |
| Extraversion | 30–59 | 207 | 3.268 | 1.078 | 0.305 | 1,375 | 3.26 | 0.86 | <0.0001 |
| | >60 | 627 | 3.215 | 0.924 | | 741 | 3.09 | 0.90 | |
| Agreeableness | 30–59 | 207 | 3.135 | 0.781 | 0.527 | 1,375 | 3.18 | 0.79 | 0.0005 |
| | >60 | 627 | 3.177 | 0.807 | | 741 | 3.31 | 0.86 | |
| Conscientiousness | 30–59 | 207 | 4.027 | 0.744 | 0.421 | 1,375 | 4.08 | 0.67 | <0.0001 |
| | >60 | 627 | 4.095 | 0.657 | | 741 | 4.29 | 0.66 | |
| Neuroticism | 30–59 | 207 | 3.080 | 0.877 | 0.006 | 1,375 | 3.37 | 0.83 | <0.0001 |
| | >60 | 627 | 2.887 | 0.879 | | 741 | 3.56 | 0.89 | |
| Openness | 30–59 | 207 | 3.188 | 0.899 | 0.183 | 1,375 | 3.43 | 0.87 | 0.0128 |
| | >60 | 627 | 3.277 | 0.930 | | 741 | 3.33 | 0.90 | |

EAC, esophageal adenocarcinoma; RG, reference group; SD, standard deviation.

Table 4 Multivariate analyses for age in the EAC-cohort

| Dimension | F value | df | P |
|-------------------|---------|----|-------|
| Extraversion | 0.480 | 1 | 0.488 |
| Agreeableness | 0.424 | 1 | 0.515 |
| Conscientiousness | 0.571 | 1 | 0.210 |
| Neuroticism | 7.504 | 1 | 0.006 |
| Openness | 1.426 | 1 | 0.233 |

df, degrees of freedom; EAC, esophageal adenocarcinoma.

Table 5 Pearson and Spearman's r in the single dimensions of the EAC-cohort

| Dimension | Mean | SD | Extraversion | Agreeableness | Conscientiousness | Neuroticism | Openness |
|-------------------|------|------|--------------|---------------|-------------------|-------------|----------|
| Extraversion | 3.23 | 0.97 | 1.000 | -0.023 | 0.151** | -0.192** | 0.164** |
| Agreeableness | 3.16 | 0.80 | 0.023 | 1.000 | -0.003 | -0.069* | 0.056 |
| Conscientiousness | 4.10 | 0.68 | 0.151** | -0.003 | 1.000 | -0.087* | 0.123 |
| Neuroticism | 2.94 | 0.88 | -0.192** | -0.069* | -0.087* | 1.000 | -0.136** |
| Openness | 3.25 | 0.92 | 0.164** | 0.056 | 0.123** | -0.136** | 1.000 |

*, $P < 0.05$; **, $P < 0.01$. EAC, esophageal adenocarcinoma; SD, standard deviation.

Table 6 Comparison of the Big Five in regard to the time between EAC diagnosis and the survey

| Dimension | ≤ 18 months (n=88) | > 18 months (n=665) | P |
|-------------------|-------------------------|-----------------------|-------|
| Extraversion | 3.15 \pm 1.01 | 3.24 \pm 0.95 | 0.420 |
| Agreeableness | 3.26 \pm 0.74 | 3.16 \pm 0.81 | 0.344 |
| Conscientiousness | 4.18 \pm 0.67 | 4.06 \pm 0.68 | 0.096 |
| Neuroticism | 2.97 \pm 0.96 | 2.93 \pm 0.88 | 0.974 |
| Openness | 3.26 \pm 0.99 | 3.25 \pm 0.92 | 0.977 |

(88.3%), who answered the questionnaire more than 18 months after their EAC diagnosis. The majority of the questioned patients had a relatively long-time interval of more than 18 months between their first tumor diagnosis and the time point of the survey. However, there were no significant differences between the personality traits of patients with a short time interval compared to patients with a long-time interval between EAC diagnosis and the survey (Table 6).

Discussion

A survey, investigating the personality traits of a large EAC patient cohort was conducted for the first time, using the BFI-10. Thereby, individuals with EAC showed significantly higher values for neuroticism and significantly lower values for the items openness and extraversion. Limitations of this study were the fewer females in the EAC-cohort (13.8%) compared to RG (55.6% and 50.4%), which was due to the specification of this tumor entity, which is predominant in males. Personality traits are dependent on cultural behavior and community habits and therefore only valid in a specific geographic region, e.g., the German population. Concerning the reliability, the RG used a retest setting, which was not performed in the EAC-cohort. Therefore, the robustness and the reliability were

calculated by Spearman's-R. The patients investigated in this survey displayed a long-time interval between EAC diagnosis and the time point of the survey. As personality traits are assumed to be unstable during life time and are affected by life threatening events, like cancer diagnosis, the investigated cohort is mostly homogeneous, as 88.3% of all patients had the survey more than 18 months after EAC diagnosis. Nevertheless, higher levels in neuroticism were still present in long-term survivors, assuming a long-lasting limitation of these patients.

The connection between personality and predisposition for a malignant disease has been discussed for decades. A correlation between personality traits and cancer development was described first in the 1960s (18). The majority of publications have not indicated a significant correlation between the development of malignant disease and certain personality traits. One of the largest studies, analyzing 29,595 Swedish twins, between 15 and 48 years, did not find a correlation between the items neuroticism and extraversion and a certain type of cancer (19). However, most recent studies, focused at the association between neuroticism, extraversion and the development of malignant disease (20-22).

In patients with cancer in general, severe psychological issues and problems, might arise in the course of diagnosis, therapy and stigmatization with associated uncertainty

regarding the therapeutic success. However, there are studies that suggest a correlation between compliance and personality traits, especially neuroticism (23-25).

The implementation of a psycho-oncological co-treatment is important for cancer patients as almost a third suffer from considerable psychological issues, especially of anxiousness and/or depression associated with cancer (26). A Danish prospective study had shown that higher levels of neuroticism were associated with higher distress in female patients with breast cancer, and therefore, associated with higher rates of depression in these patients (27). Nevertheless, psycho-oncological care is not offered sufficiently to the majority of cancer patients and need to be implemented in ambulant and hospital therapy settings (28). Comprehensive concepts need to be conducted to cover patients regardless of gender, age, socio-economic status, and comorbidities. A sufficient psycho-oncologic care will result in a better therapy adherence and quality of life, as well as in a reduced morbidity and mortality rate. Lung cancer patients with a psychological comorbidity were shown to have a decreased overall survival than mentally healthy patients (29). Quality of life related outcome is a powerful tool in survival prediction. In esophageal cancer (T2 and T3), an increased quality of life was associated with better cancer related survival (30). As surgery is the only curative therapy in EAC patients, quality of life will drop off after esophagectomy (31). However, quality of life will rise after operation, but physical and role functioning are still impaired 6 and 12 months after operation (31,32). This is in accordance with our results for personality traits, which still differed from normal values 56 months after EAC diagnosis.

Hengarnter *et al.* assessed the BFI-10 in a short questionnaire, to investigate, whether the outcome was beneficial for prevention purposes and came to the conclusion, that higher scores in neuroticism and conscientiousness were significantly associated with lower socioeconomic status and social resources, leading to an unhealthier behavior of the prospects (33,34). However, in our study no data were available to predict, whether the socioeconomic status, educational level, personal relationships, and employment status confound the results between the EAC and the German general population cohort.

In a large meta-analysis of 11 studies with a total of 19,941 individuals, brought evidence that greater openness was associated with lower all-cause mortality risk with an odds ratio of 0.88 (35). However, other large epidemiological studies did not find any association between

cancer risk, cancer prognosis and personality traits (36,37). Elevated values for neuroticism were correlated negatively, while higher values for extraversion were correlated positively with patients' compliance (25). In older cancer survivors, neuroticism might be associated with increased depression and anxiety. In general, neuroticism is associated with common mental disorders, as neurotic persons react more intensively to stressors and tends to be moody, have depression mood, and are self-conscious (38,39). Therefore, increased neuroticism should be targeted, to overcome the increased depression rates in these patients (40). However, Chow *et al.* included a heterogeneous cancer patient cohort and did not focus to a disease-defined cancer population than our study. Whereas, age was associated with increased values for neuroticism in the reference cohort, it was associated with decreased values in the EAC-cohort, which was confirmed in a multivariate analysis (17). The EAC-cohort is shaped by increasing age and the disease itself. Both, age and the disease impair alterations in personality traits and potentially overlay these developments.

Conclusions

Cancer patients show altered personality traits, than the healthy general population. The implementation of the BFI-10 in clinical diagnostics, like a nutritional risk score evaluation, could be a useful tool. Personality traits covered by the BFI-10 survey might identify patients with a risk of lower therapy adherence, aftercare or for intensive psychological co-treatment. These patients could benefit from a closer implementation of psycho-oncological care right after their cancer diagnosis. Additionally, the divergence in personality traits in late aftercare patients reflect the responsibility of the health care system, to figure out, which special patient group still need support by an ongoing psycho-oncological advice or by almoner. Whether personality traits changes during cancer diagnosis and long-time care, and whether the BFI-10 is suitable to identify healthcare gaps and drawing definitive causal conclusions, needs to be investigated in a longitudinal design in the future.

Acknowledgments

Funding: None.

Footnote

Reporting Checklist: The authors have completed the

STROBE reporting checklist. Available at <http://dx.doi.org/10.21037/aoe-20-38>

Data Sharing Statement: Available at <http://dx.doi.org/10.21037/aoe-20-38>

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at <http://dx.doi.org/10.21037/aoe-20-38>). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All participants provided their written informed consent to participate in this study. The local ethic committee of the “Landesärztekammer Rheinland-Pfalz” approved this study in accordance with the Declaration of Helsinki (as revised in 2013) (reference number: 837.095.11-7637) and informed consent was taken from all the patients.

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doi: 10.21037/aoe-20-38

Cite this article as: Gaisendrees C, Kreuser N, Lyros O, Becker J, Schumacher J, Gockel I, Kersting A, Thieme R. Classification of personality traits using the Big Five Inventory-10 in esophageal adenocarcinoma patients. *Ann Esophagus* 2020;3:22.