BMJ Open

Different but Similar: Personality Traits of Surgeons and Internists

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2017-021310
Article Type:	Research
Date Submitted by the Author:	03-Jan-2018
Complete List of Authors:	Stienen, MN; University Hospital Zurich, Neurosurgery Scholtes, Felix; University Hospital of Liège, Department of Neurosurgery Samuel, Robin; University of Luxembourg, Research Unit INSIDE Weil, Alexander; University Hospital of Montréal, Department of Neurosurgery Weyerbrock, Astrid; Cantonal Hospital St.Gallen, Department of Neurosurgery Surbeck, Werner; Psychiatric Hospital of the University of Zurich,
Keywords:	Five Factor Model, personality traits, physician, difference, surgeon, internist

Different but Similar: Personality Traits of Surgeons and Internists

Martin N. Stienen*[1], MD; Felix Scholtes*[2], PhD; Robin Samuel[3], PhD; Alexander Weil[4], MD; Astrid Weyerbrock[5], MD; Werner Surbeck[5,6], MD

*These authors contributed equally to the manuscript.

[1]Department of Neurosurgery, University Hospital Zurich, Zurich, Switzerland
[2]Department of Neurosurgery, University Hospital of Liège, Liège, Belgium & Department of Neuroanatomy, Faculty of Medicine, University of Liège, Liège, Belgium
[3]Research Unit INSIDE, University of Luxembourg, Luxembourg
[4]Department of Neurosurgery, University Hospital of Montréal, Montréal, Canada
[5]Department of Neurosurgery, Cantonal Hospital St.Gallen, St.Gallen, Switzerland
[6]Department of Psychiatry, Psychotherapy and Psychosomatics, Psychiatric Hospital of the University of Zurich, Zurich, Switzerland

Correspondence to:
Martin N. Stienen, MD
Department of Neurosurgery
University Hospital Zurich
Clinical Neuroscience Center
University of Zurich
Frauenklinikstrasse 10
8091 Zurich, Switzerland
Tel: +41 (0)44-255-1111
Email: mnstienen@gmail.com

Abstract word count: 235
Manuscript text word count: 3196
Number of references: 30
Number of total figures: 3
Number of color figures: 1
Number of Tables: 2
Number of Supplemental Tables: 1

Running head: Different but Similar: Personality Traits of Surgeons and Internists

Research support: None

Conflict of Interest: None

Previous presentation: None

Author contributions: Those persons listed as authors on the manuscript have made substantial contributions to the conception or design of the work, have been involved in acquiring, analysing, or interpreting the data for the work. They all have been active in drafting or revising the manuscript for important intellectual content, which is basis of the current article. All authors have approved the final version to be published. They agree to be 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. In detail: Concept: MNS, FS, WS. Data collection: MNS, FS, AW, WS. Data analysis: MNS, RS, FS, WS. Article drafting: MNS, FS, RS, WS. Critical revision: all authors.

Abstract

Objectives: Medical practice may attract and possibly enhance distinct personality profiles. We set out to describe the personality profiles of surgical and medical specialties focusing on board-certified physicians.

Design: Prospective, observational.

Setting: Online survey containing the Ten-Item Personality Inventory (TIPI), an internationally validated measure of the Five Factor Model of personality dimensions, distributed to board-certified physicians, residents and medical students in several European countries and Canada. Differences in personality profiles were analyzed using MANOVA and Canonical Linear Discriminant Analysis on age- and sex-standardized z-scores of the personality traits. Single personality traits were analyzed using robust t-tests.

Participants: The TIPI was completed by 2345 board-certified physicians, 1453 residents and 1350 medical students, who also provided demographic information.

Interventions: None.

Results: Normal population and board-certified physicians' personality profiles differed. The latter scored higher on conscientiousness, extraversion, and agreeableness, but lower on neuroticism. There was no difference in openness to experience. Board-certified surgical and medical doctors' personality profiles were also different. Surgeons scored higher on extraversion and openness to experience, but lower on neuroticism. There was no difference in agreeableness and conscientiousness. These differences in personality profiles were reproduced at other levels of training, i.e., in students and training physicians engaging in surgical versus medical practice.

Conclusion: These results indicate the existence of a distinct and consistent average "physician personality". Despite high variability within disciplines, there are moderate, but solid and reproducible differences between surgical and medical specialties.

Key words: Five Factor Model; personality traits; physician; difference; doctor; surgeon; internist

Strengths and limitations:

- This study applied a validated instrument to determine the Five Factor Model personality traits among a multinational sample of > 5000 physicians
- The results clearly demonstrate that physicians share a common personality profile that differs from the normal population and is stable across levels of training
- Physicians scored higher in conscientiousness, agreeableness, and extraversion but lower on neuroticism

- Between specialties, moderate differences exist: compared to medical doctors, on average, surgeons show lower levels of neuroticism, extraversion and openness to experience
- However, no inferences from the general average personality profiles reported here to the individual physician can be made

Funding statement:

No funding was received for this research.

Competing interests statement:

All authors declare that they have nothing to disclose and no conflicts of interest.

Data sharing statement:

Once the study results have been published, the dataset will be distributed to other researchers upon request. Final decision is made by the corresponding author (Dr. Stienen) and the last author (Dr. Surbeck).

Introduction

A key factor for success in a professional career is how personality traits fit the characteristics of the chosen profession.[1] Thus, personality has attracted growing research interest in various professional fields, including medical training, with the aim to improve career counseling, selection processes and training strategies.[2]

Between different academic fields, personality traits differ.[3] Within the medical field, personality structures appear to differ in students depending on the intended specialty,[2-7] in trainees of different specialties after graduation from medical school,[8-12] as well as in board certified specialists of different disciplines.[12-20] These conclusions of previous investigations in the medical field remain however limited by somewhat inconsistent results which were difficult to compare, due to small sample sizes and the use of various ways of operationalizing and measuring personality traits.

Personality can be comprehensively described using five higher order factors, according to the Five Factor Model (FFM):[21 22] agreeableness, conscientiousness, openness to experience, neuroticism, and extraversion (Figure 1). The present investigation assesses a large, multinational sample of trained or training physicians, using the FFM to describe the profiles of surgical and medical specialties across levels of training.

Methods

Study Population and Data Collection

An online survey was distributed among physicians and medical students in Austria, Belgium, France, Canada, Germany and Switzerland via the management of larger public hospitals offering a variety of ≥10 sub-specializations, official associations of general physicians, official medical journals (Deutsches Ärzteblatt, Germany; Schweizer Ärztezeitung, Switzerland; Le Quotidien du Médecin, France), and students' councils of the German, Swiss, Austrian and Belgian medical faculties. Data was collected from February 12, 2016 to May 12, 2016. The survey collected the respondent age, sex, primary language, educational level (board certified physician, resident, or medical student), as well as the (intended) medical specialty. 5660 responses were received, of which 512 were incomplete and discarded. Complete answers were provided by 1350 medical students, 1453 residents and 2345 board-certified physicians (Table 1).

Measurement of Personality Traits

All respondents completed the Ten Item Personality Inventory (TIPI),[23] a validated measure of the FFM. This concise instrument was developed for the use in larger samples.[23 24] It is available in English, German and French among other languages. Despite less precise estimation of the FFM than with more complex and time consuming tools, its results have been shown to converge with other widely used FFM measures in self-, observer-, and peer reports, test-retest reliability, patterns of predicted external correlates, and convergence between self and observer ratings.[23 25 26] To allow for better comparison, z-scores were calculated, adjusted for age-categories and sex using normative population data available for 155,433 females and 122,567 males.[25]

Hypotheses, Statistical Analysis and Sample Size Calculation

The first hypothesis was that the personality profiles of physicians differ from those of the normal population. The second hypothesis was that personality profiles of surgeons differ from those of medical doctors. The dependent variables of interest were the age- and sex-adjusted z-scores of each of the FFM personality traits. The independent variables were being a physician or not (H1) and being a surgically or medically orientated physician (H2). In line with other research on how personality profiles between two or more groups differ, we assumed that the linear combinations between single personality traits have to be taken into account. Not doing so would imply to discard the multivariate information present in the data. Therefore, we used MANOVA to test H1 and H2. To gauge what personality traits discriminate physicians and normal population (H1) as well as surgeons and medical doctors (H2), we then ran Canonical Linear Discriminant Analysis. Post-hoc two-sample unpaired t-tests

served to illustrate differences in single personality traits between those groups. We further used Bonferroni correction to account for multiple comparisons and Satterthwaite approximation to correct for unequal variances and unequal sample sizes. All statistical tests were two-sided and p values <0.05 were considered statistically significant. Power calculations revealed that to detect a substantially meaningful difference of half a standard deviation between surgeons and internists,[20] 30 participants per group were required ($\beta = 0.9$, $\alpha = 0.001$; two-sided). The group sizes present in the sample exceed this number, indicating that the statistical power afforded by the data collected was sufficient to detect meaningful group differences. The software used for statistical analysis was Stata v14.2 (StataCorp LP, College Station, Texas, USA).

Analysis Samples

We restricted our primary analysis sample to board-certified specialists, because disciplinary specialization cannot be considered fixed until board certification. We included students and residents in a secondary analysis sample. Two further amendments were required. To run MANOVA for our first hypothesis, we had to augment our primary analysis sample by a sample of people form the normal population. The authors of TIPI kindly provided means, standard deviations, and correlation matrix of all relevant variables for a sample of 305,830 respondents.[25] To test our second hypothesis, that surgeon and medical doctors differ with respect to their personality profiles, we excluded medical specialties as well as diagnostic specialties that did not fit into one of the two categories, (Supplementary table 1).

Ethical Considerations

The study was submitted to the institutional review board of the Canton St.Gallen, Switzerland (EKSG 16/020) and the “Comité d’Éthique Hospitalo-Facultaire Universitaire de Liège” (2016/74). Both estimated that it did not fall under the legislation for research involving human beings and that the collected anonymous data did not require any consent beyond the deliberate participation.

Results

Personality Traits of Physicians versus (vs.) Normal Population

Compared to normative data (n=305,830), board-certified physicians' personality profile (n=2,345) differed significantly, as established by MANOVA (Table 2). The subsequent Canonical Linear Discriminant Analysis suggested that a main driver of this global difference in personality profiles was the comparably high level of conscientiousness present in our sample of board-certified physicians (Table 2). All but one personality trait were significantly different as well, according to unpaired t-tests with Bonferroni correction and Satterthwaite approximation (all $P < 0.001$): physicians scored higher on conscientiousness, agreeableness, and extraversion, but lower on neuroticism (Table 2 and Figure 2). Normal population and board-certified physicians did not differ in openness to experience (Table 2). The same analyses performed on our secondary analysis sample, including residents and medical students, replicated the findings with respect to personality profiles across board-certified specialists, residents and medical students (all $P < 0.001$).

Personality Traits of Surgeons vs. Medical Doctors

Personality profiles of board-certified surgical doctors (n=465) and medical doctors (n=825) differed significantly (Table 2). Canonical Linear Discriminant Analysis revealed that differences in neuroticism mainly drive the global difference in personality profiles (Table 2). Turning to single personality traits and using robust t-tests as above, board-certified surgeons' mean z-scores compared to medical doctors', were significantly lower for neuroticism, but significantly higher for openness to experience and extraversion (Table 2). However, differences in agreeableness and conscientiousness were not significant using a conservative correction for multiple comparisons (Table 2 & Figure 3). The differences in personality profiles between surgical and medical doctors replicate fully in surgically and medically orientated residents and students.

Discussion

The result of this FFM based personality self-evaluation by more than 5000 trained and training physicians using a web-based questionnaire (Figure 1) indicate that physicians share a common personality profile. It is distinct from that of the normal population and stable across levels of training (Figure 2). Physicians score higher in conscientiousness, agreeableness, and extraversion but lower on neuroticism. The difference in personality profiles is mainly driven by conscientiousness. Between specialties, moderate differences exist: compared to medical doctors, on average, surgeons show lower levels of neuroticism, extraversion and openness to experience, while there is no significant difference in agreeableness and conscientiousness (Figure 3). These differences replicate across residents as well as medical students.

Conscientiousness

This trait was previously found to be a significant predictor of success in different professional and academic settings [27 28] including medical training.[4 10] Qualities associated with the trait conscientiousness, such as efficiency, reliability, responsibility and thoroughness, respond to requirements of medical practice. Low levels of conscientiousness, which may lead to disastrous consequences in some settings, have even been proposed as potential exclusion criterion in the assessment process of applicants to medical school.[2] The recent finding that conscientiousness positively predicted the choice of a surgical specialty in medical students [7] can, however, not be explicitly supported by our data.

Neuroticism

Although generally low in medical practitioners, surgeons' scores were particularly low, at 0.7 SD below the population norm, and a quarter SD lower than in internists (Figure 3). Emotional stability can be seen as adaptive to the challenges of medical decision-making, particularly surgical indications and operative practice. Previous studies had already indicated at least equal,[8 16] sometimes lower scores [29] in surgeons compared to other disciplines.

Agreeableness

As previously shown,[20] this trait is prevalent in all physicians. Previous studies reported lower agreeableness in surgeons than internists,[7 8] reflecting a generally perceived difference between the two disciplines.[20] In the present cohort, differences in agreeableness were not significant among board-certified surgical and medical physicians.

Extraversion

Extraversion is above normal (Figure 2) in physicians, and more significantly so in surgical than medical specialties (Figure 3). This is in line with the majority of previous studies.[6 16 17 20 29] Agreeableness and extraversion are the only traits within the FFM directly related to interpersonal interactions. The prevalence of these traits in the medical population intuitively appears appropriate, not only for the physician-patient relationship, but also for functional interdisciplinary teamwork.

Openness to Experience

There were only slight non-significant deviations from the population norm, positive for surgeons and negative for medical doctors. However, the difference between the two types of discipline is approximately in line with empirical experience and previous data (Figure 3).[8 16]

These findings indicate that, although differences between medical specialties exist, average personality traits are shared between surgeons and medical doctors, as well as students aiming for these specializations. This large sample therefore highlights with robust estimates that a “physician personality” predominates over “specialty-specific personalities”. Although the present data is limited due to its cross-sectional character, the results were stable across the three analyzed levels of training.

Since personality profiles predispose towards consistent patterns of behavior, the consideration of relevant personality traits could facilitate career counseling or even selection processes of applicants to medical school beyond purely intellectual qualifications.[2] In addition, in established medical practitioners, a better understanding of predominant personality traits within different disciplines could be helpful for interdisciplinary teamwork and patient care by stimulating self-reflection and professional development.

This is by far the largest study applying a validated measure of the FFM to a multinational and -cultural sample of physicians. The assessment tool (TIPI) is the only existing sufficiently concise instrument to realistically obtain a sample as large as the present one.[23 24] Potential biases in the interpretation of the results include age and sex-differences, e.g., male-female proportions at different levels of training. In the comparative analysis of surgical and medical specialties, these biases were accounted for by adjusted z-scores. Primary language was unbalanced and could theoretically bias the results through differences of mentality and practice patterns. No specific norms for each of the three language areas exist, however. Furthermore, the possibility of producing an intentional favorable image on personality testing

should always be borne in mind when interpreting this kind of study. However, social desirability response bias may not substantially distort the results when the questionnaires are administered under ‘‘non-penalizing’’ circumstances.[2] Another limitation pertains to the comparison of our sample with the norm population data sample, which comprises sixty times as many cases. To assess this potential source of bias, we repeated the analyses on 1000 size-matched random sub samples. These analyses did not lead to substantially different results.

One critical aspect of the interpretation is the assignment of various specialties to the “surgical” and “medical” fields. When the analyses of our study including various specialties, resulting in larger groups, were repeated on very strictly selected but small samples of unequivocal surgical and medical specialties (Supplementary table 1), the findings were reproduced despite the concurrent loss of power. This corroborates the reported findings in the larger groups. Given the scope of this study, it was not possible to draw a random sample from the population of all board-certified and training physicians as well as medical students. Hence, selection bias might limit the generalizability of our findings to, e.g., the full population of surgical and medical specialties. Furthermore, it goes without saying that no inferences from the general average personality profiles reported in the present study to individual physicians can be made.

Conclusion

This study suggests the existence of a distinct “physician personality profile”. In addition, despite high variability within disciplines, our findings provide evidence for moderate but robust differences in personality profiles between surgical and medical specialties.

Tables

Table 1:

Demographic data and personality traits of board-certified physicians (specialists), residents and medical students.

	All (n=5148)	Specialists (n=2345)	Residents (n=1453)	Students (n=1350)
Age in years	35·9 ± 12·1	46·1 ± 10·2	30·5 ± 3·4	23·9 ± 3·6
Sex				
Male	2427 (47·1%)	1358 (57·9%)	618 (42·5%)	451 (33·4%)
Female	2721 (52·9%)	987 (42·1%)	835 (57·5%)	899 (66·6%)
Language				
German	3374 (65·5%)	1482 (63·2%)	951 (65·4%)	941 (69·7%)
French	1434 (27·9%)	791 (33·7%)	283 (19·5%)	360 (26·7%)
English	340 (6·6%)	72 (3·1%)	219 (15·1%)	49 (3·6%)
Personality Traits				
(mean z-score ± standard deviation)				
Agreeableness	0·37 ± 0·88	0·25 ± 0·89	0·45 ± 0·89	0·47 ± 0·85
Conscientiousness	0·83 ± 0·68	0·80 ± 0·66	0·87 ± 0·70	0·85 ± 0·71
Extraversion	0·35 ± 0·90	0·33 ± 0·90	0·38 ± 0·92	0·34 ± 0·87
Neuroticism	−0·49 ± 0·90	−0·47 ± 0·91	−0·57 ± 0·84	−0·42 ± 0·87
Openness to Experience	−0·11 ± 0·95	−0·01 ± 0·92	−0·16 ± 0·97	−0·23 ± 0·96

Table 2:

Differences in personality profiles (i.e., the individual combination of single personality traits) and personality traits between (1) physicians and normal population and (2) surgeons and medical doctors.

	(1) Physicians (n=2,345) vs. normal population (n=305,830)	(2) Surgeons (n=465) vs. medical doctors (n=825)
Personality profiles	MANOVA: Wilks' lambda = 0.99 $F(5; 308{,}169) = 384.99$, P < 0.001	MANOVA: Wilks' lambda = 0.94 $F(5; 1{,}284) = 9.39$, P < 0.001
Standardized canonical discriminant function coefficients[a]		
Agreeableness	−0.10	0.52
Conscientiousness	−0.79	−0.24
Extraversion	−0.33	−0.34
Neuroticism	0.30	0.62
Openness to Experience	0.12	−0.37
Personality traits (95% CI)		
Agreeableness	0.25 (0.22 to 0.29) vs. 0.00 (−0.00 to 0.00)[b] P < 0.001[c]	0.19 (0.10 to 0.27) vs. 0.30 (0.24 to 0.36) P = 0.16[c]
Conscientiousness	0.80 (0.77 to 0.83) vs. 0.00 (−0.00 to 0.00)[b] P < 0.001[c]	0.87 (0.81 to 0.93) vs. 0.80 (0.75 to 0.84) P = 0.22[c]
Extraversion	0.33 (0.29 to 0.37) vs. 0.00 (−0.00 to 0.00)[b] P < 0.001[c]	0.50 (0.42 to 0.59) vs. 0.32 (0.26 to 0.39) P = 0.003[c]
Neuroticism	−0.47 (−0.51 to −0.44) vs. 0.00 (−0.00 to 0.00)[b] P < 0.001[c]	−0.67 (−0.75 to −0.59) vs. −0.45 (−0.51 to −0.39) P < 0.001[c]
Openness to Experience	−0.12 (−0.05 to −0.03) vs. 0.00 (−0.00 to 0.00)[b] P = 1[c]	0.17 (0.09 to 0.25) vs. −0.01 (−0.07 to −0.05) P = 0.002[c]

a. Standardized canonical discriminant function coefficients obtained from canonical linear discriminant analysis with $F(5; 308{,}169) = 384.99$, P < 0.001 and $F(5; 1{,}284) = 9.39$, P < 0.001 for (1) and (2), respectively.
b. Means and confidence intervals in normal population are not equal zero, but very small due to standardization (mean) and high number of cases (confidence intervals).
c. P values obtained from unpaired t-tests with Bonferroni correction to account for multiple comparisons and Satterthwaite approximation to account for unequal variances.

Supplementary table 1:

Medical and surgical subspecialties of board-certified physicians (specialists) and residents in training, or intended specialties of medical students included in the analysis. “Other” specialties refer to those not included in the analysis comparing medical doctors to surgeons. ENT = Ears, Nose and Throat. * Indicates the medical specialties that were compared to surgical specialties (°) in a subgroup analysis.

Figures

Figure 1:

Personality dimensions of the Five Factor Model (FFM) and their descriptors according to McCrae and John.[30]

Figure 2:

Mean z-scores and 95% confidence intervals (CI) for each of the Five Factor Model personality traits in board-certified physicians. Y-axis: z-score; X-axis: Personality item. A z-score of 0 corresponds to the population mean for the corresponding personality trait in the normative data. All reported P values are from post-hoc two-sample unpaired t-tests with Bonferroni correction to account for multiple comparisons and Satterthwaite approximation to correct for unequal variances and unequal sample sizes.

Figure 3:

Mean z-scores and 95% confidence intervals (CI) for each of the Five Factor Model personality traits in board-certified surgeons or medical doctors. Y-axis: z-score; X-axis: Personality item. A z-score of 0 corresponds to the population mean for the corresponding personality trait in the normative data. All reported P values are from post-hoc two-sample unpaired t-tests with Bonferroni correction to account for multiple comparisons and Satterthwaite approximation to correct for unequal variances and unequal sample sizes.

Acknowledgements

The authors thank the journals “Deutsches Ärzteblatt, Germany”, “Schweizer Ärztezeitung, Switzerland”, and “Le Quotidien du Médecin, France” to help distribute the survey among their readership. We thank all participating specialists, residents and medical students for their time and trust.

References

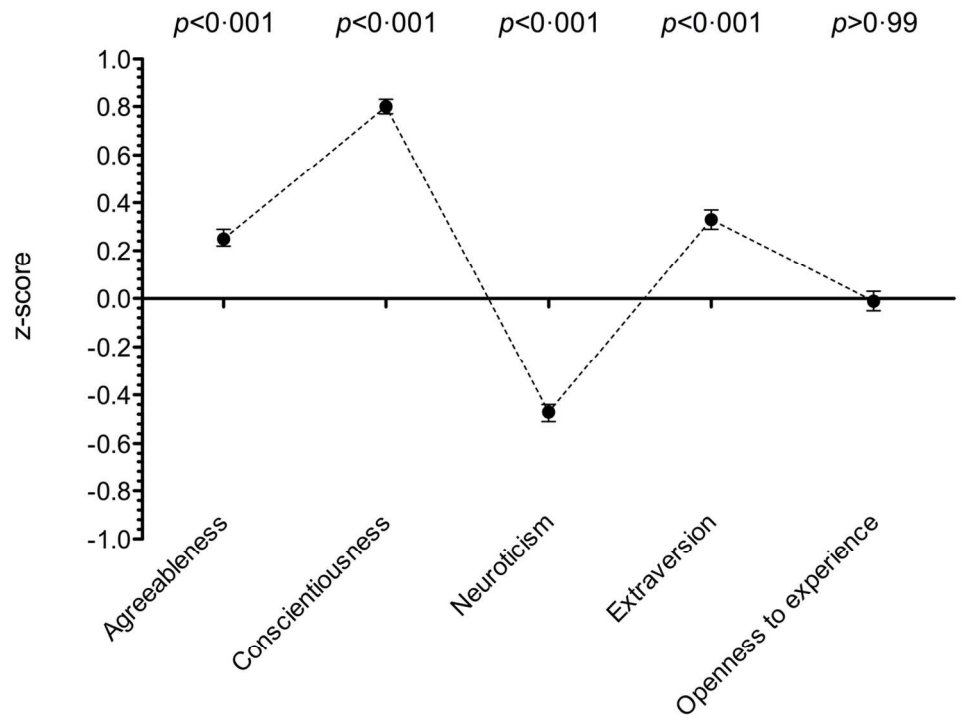
1. Holland JL. *Making vocational choices. A theory of vocational personalities and work environments*. Odessa, FL: Psychological Assessment Resources, 1997.
2. Hojat M, Erdmann JB, Gonnella JS. Personality assessments and outcomes in medical education and the practice of medicine: AMEE Guide No. 79. Medical teacher 2013;**35**(7):e1267-301 doi: 10.3109/0142159X.2013.785654[published Online First: Epub Date]|.
3. Lievens F, Coetsier P, De Fruyt F, et al. Medical students' personality characteristics and academic performance: a five-factor model perspective. Medical education 2002;**36**(11):1050-6
4. Ferguson E, James D, Madeley L. Factors associated with success in medical school: systematic review of the literature. Bmj 2002;**324**(7343):952-7
5. Linn BS, Zeppa R. Does surgery attract students who are more resistant to stress? Annals of surgery 1984;**200**(5):638-43
6. Stilwell NA, Wallick MM, Thal SE, et al. Myers-Briggs type and medical specialty choice: a new look at an old question. Teaching and learning in medicine 2000;**12**(1):14-20 doi: 10.1207/S15328015TLM1201_3[published Online First: Epub Date]|.
7. Turska D, Skrzypek M, Tychmanowicz A, et al. Concept of distinct surgical personality revisited. Personality traits and personal values as surgical specialty choice predictors. European Journal of Medical Technologies 2016;**1**((10)):54-59
8. Bexelius TS, Olsson C, Jarnbert-Pettersson H, et al. Association between personality traits and future choice of specialisation among Swedish doctors: a cross-sectional study. Postgraduate medical journal 2016 doi: 10.1136/postgradmedj-2015-133478[published Online First: Epub Date]|.
9. Buddeberg-Fischer B, Klaghofer R, Abel T, et al. Swiss residents' speciality choices--impact of gender, personality traits, career motivation and life goals. BMC health services research 2006;**6**:137 doi: 10.1186/1472-6963-6-137[published Online First: Epub Date]|.
10. Doherty EM, Nugent E. Personality factors and medical training: a review of the literature. Medical education 2011;**45**(2):132-40 doi: 10.1111/j.1365-2923.2010.03760.x[published Online First: Epub Date]|.
11. Hojat M, Nasca TJ, Magee M, et al. A comparison of the personality profiles of internal medicine residents, physician role models, and the general population. Academic medicine : journal of the Association of American Medical Colleges 1999;**74**(12):1327-33

12. King SH, McArthur CG, Norman JC. The Surgical Personality: A Comparison of Medical and Surgical Residents with the Rorschach. Cardiovascular diseases 1975;**2**(2):117-28
13. Gilligan JH, Treasure T, Watts C. Incorporating psychometric measures in selecting and developing surgeons. Journal of management in medicine 1996;**10**(6):5-16, 2
14. Gilligan JH, Welsh FK, Watts C, et al. Square pegs in round holes: has psychometric testing a place in choosing a surgical career? A preliminary report of work in progress. Annals of the Royal College of Surgeons of England 1999;**81**(2):73-9
15. Greenburg AG, McClure DK, Penn NE. Personality traits of surgical house officers: faculty and resident views. Surgery 1982;**92**(2):368-72
16. Macneily AE, Alden L, Webber E, et al. The surgical personality: comparisons between urologists, non-urologists and non-surgeons. Canadian Urological Association journal = Journal de l'Association des urologues du Canada 2011;**5**(3):182-5 doi: 10.5489/cuaj.10142[published Online First: Epub Date]|.
17. McGreevy J, Wiebe D. A preliminary measurement of the surgical personality. American journal of surgery 2002;**184**(2):121-5
18. Schwartz RW, Barclay JR, Harrell PL, et al. Defining the surgical personality: a preliminary study. Surgery 1994;**115**(1):62-8
19. Subramanian P, Kantharuban S, Subramanian V, et al. Orthopaedic surgeons: as strong as an ox and almost twice as clever? Multicentre prospective comparative study. Bmj 2011;**343**:d7506 doi: 10.1136/bmj.d7506[published Online First: Epub Date]|.
20. Warschkow R, Steffen T, Spillmann M, et al. A comparative cross-sectional study of personality traits in internists and surgeons. Surgery 2010;**148**(5):901-7 doi: 10.1016/j.surg.2010.03.001[published Online First: Epub Date]|.
21. Digman JM. Personality Structure: Emergence of the Five-Factor Model. Annu. Rev. Psychol. 1990;**41**:417-40
22. Tupes EC, Christal RE. *Recurrent personality factors based on trait ratings.* USAF ASD Tech. Re. No. 61-97. Lackland Air Force Base, Tx: U.S. Air Force, 1961.
23. Gosling SD, Rentfrow PJ, Swann WB. A very brief measure of the Big-Five personality domains. Journal of Research in Personality 2003;**37**:504-28
24. Foulkrod KH, Field C, Brown CV. Trauma surgeon personality and job satisfaction: results from a national survey. The American surgeon 2010;**76**(4):422-7
25. Gosling SD, Rentfrow PJ, Potter J. Norms for the Ten Item Personality Inventory: Personal Communication. Unpublished Data, 2014.
26. Muck PM, Hell B, Gosling SD. Construct validation of a short five-factor model instrument. European Journal of Psychological Assessment 2007;**23**(3):166-75

27. Hurtz GM, Donovan JJ. Personality and job performance: the Big Five revisited. The Journal of applied psychology 2000;**85**(6):869-79
28. Poropat AE. A meta-analysis of the five-factor model of personality and academic performance. Psychological bulletin 2009;**135**(2):322-38 doi: 10.1037/a0014996[published Online First: Epub Date]|.
29. McCulloch P, Kaul A, Wagstaff GF, et al. Tolerance of uncertainty, extroversion, neuroticism and attitudes to randomized controlled trials among surgeons and physicians. The British journal of surgery 2005;**92**(10):1293-7 doi: 10.1002/bjs.4930[published Online First: Epub Date]|.
30. McCrae RR, John OP. An introduction to the five-factor model and its applications. Journal of personality 1992;**60**(2):175-215

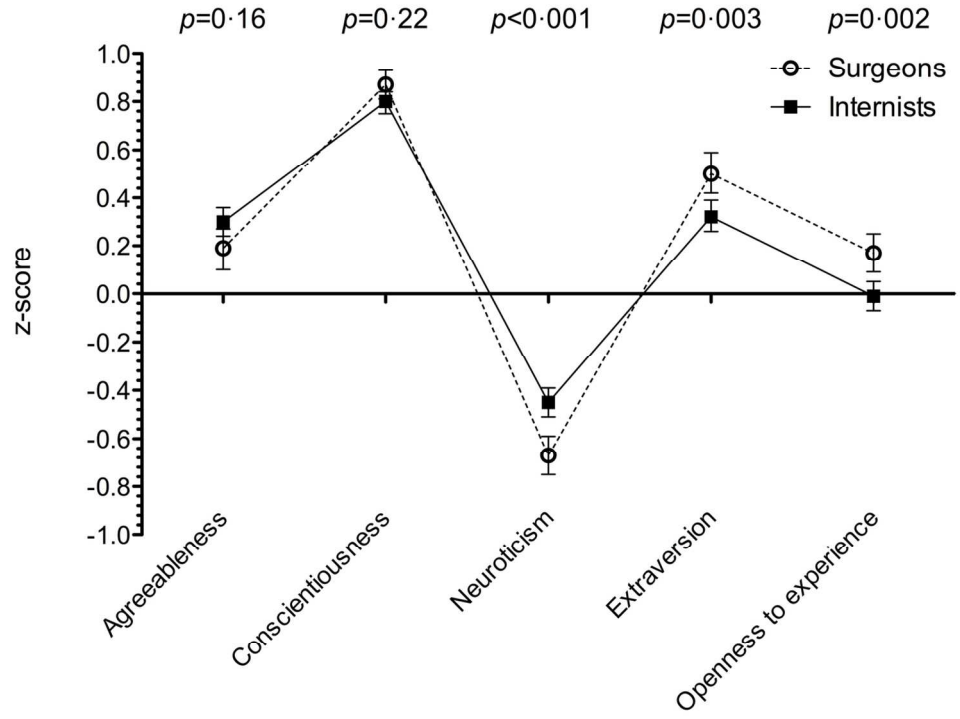
Personality dimensions of the Five Factor Model (FFM) and their descriptors according to McCrae and John.[30]

71x30mm (300 x 300 DPI)



Mean z-scores and 95% confidence intervals (CI) for each of the Five Factor Model personality traits in board-certified physicians. Y-axis: z-score; X-axis: Personality item. A z-score of 0 corresponds to the population mean for the corresponding personality trait in the normative data. All reported P values are from post-hoc two-sample unpaired t-tests with Bonferroni correction to account for multiple comparisons and Satterthwaite approximation to correct for unequal variances and unequal sample sizes.

64x49mm (600 x 600 DPI)



Mean z-scores and 95% confidence intervals (CI) for each of the Five Factor Model personality traits in board-certified surgeons or medical doctors. Y-axis: z-score; X-axis: Personality item. A z-score of 0 corresponds to the population mean for the corresponding personality trait in the normative data. All reported P values are from post-hoc two-sample unpaired t-tests with Bonferroni correction to account for multiple comparisons and Satterthwaite approximation to correct for unequal variances and unequal sample sizes.

64x49mm (600 x 600 DPI)

Supplementary table 1:

Medical and surgical subspecialties of board-certified physicians (specialists) and residents in training, or intended specialties of medical students included in the analysis. "Other" specialties refer to those not included in the analysis comparing medical doctors to surgeons. ENT = Ears, Nose and Throat. * Indicates the medical specialties that were compared to surgical specialties (°) in a subgroup analysis.

	Specialists (n=2345)	Residents (n=1453)	Students (n=1350)
Medical doctors (n=1892)			
Intensive care / Emergency medicine	40 (4.85%)	25 (4.47%)	51 (10.04%)
General internal medicine*	116 (14.06%)	125 (22.36%)	59 (11.61%)
Angiologist*	11 (1.33%)	3 (0.54%)	1 (0.20%)
Endocrinologist*	32 (3.88%)	10 (1.79%)	10 (1.97%)
Gastroenterologist*	51 (6.18%)	29 (5.19%)	30 (5.91%)
Hematologist / Oncologist*	61 (7.39%)	42 (7.51%)	51 (10.04%)
Infectiologist*	15 (1.82%)	13 (2.33%)	8 (1.57%)
Cardiologist*	83 (10.06%)	61 (10.91%)	55 (10.83%)
Nephrologist*	38 (4.61%)	31 (5.55%)	19 (3.74%)
Pulmonary specialist*	30 (3.64%)	13 (2.33%)	6 (1.18%)
Rheumatologist*	34 (4.12%)	13 (2.33%)	9 (1.77%)
Neurologist	109 (13.21%)	98 (17.53%)	76 (14.96%)
Pediatrician	187 (22.67%)	91 (16.28%)	130 (25.59%)
Geriatric medicine	18 (2.18%)	5 (0.89%)	3 (0.59%)
	n=825 (100%)	n=559 (100%)	n=508 (100%)
Surgeons (n=1035)			
ENT surgeon	31 (6.67%)	15 (4.75%)	18 (7.09%)
General surgeon°	35 (7.53%)	44 (13.92%)	38 (14.96%)
Heart surgeon°	21 (4.52%)	19 (6.01%)	17 (6.69%)
Maxillofacial surgeon	23 (4.95%)	21 (6.65%)	8 (3.15%)
Neurosurgeon	84 (18.06%)	87 (27.53%)	34 (13.39%)
Orthopedic surgeon°	74 (15.91%)	46 (14.56%)	69 (27.17%)
Pediatric surgeon	39 (8.39%)	14 (4.43%)	12 (4.72%)
Plastic surgeon	14 (3.01%)	15 (4.75%)	21 (8.27%)
Thoracic surgeon°	10 (2.15%)	1 (0.32%)	4 (1.57%)

Vascular surgeon°	29 (6.24%)	8 (2.53%)	4 (1.57%)
Visceral surgeon°	74 (15.91%)	26 (8.23%)	14 (5.51%)
Urologist	31 (6.67%)	20 (6.33%)	15 (5.91%)
	n=465 (100%)	*n=316 (100%)*	*n=254 (100%)*
Other (n=2221)			
Anesthesiologist	222 (21.04%)	72 (12.46%)	100 (17.01%)
Child psychiatrist	23 (2.18%)	19 (3.29%)	10 (1.70%)
Clinical pathology	26 (2.46%)	4 (0.69%)	8 (1.36%)
Dermatologist	60 (5.69%)	39 (6.75%)	24 (4.08%)
Forensic pathologist	10 (0.95%)	9 (1.56%)	12 (2.04%)
General physician	217 (20.57%)	120 (20.76%)	204 (34.69%)
Gynecologist	135 (12.80%)	56 (9.69%)	78 (13.27%)
Microbiologist	14 (1.33%)	7 (1.21%)	5 (0.85%)
Ophthalmologist	47 (4.45%)	40 (6.92%)	29 (4.93%)
Pathologist	35 (3.32%)	20 (3.46%)	8 (1.36%)
Physical-/rehabilitational medicine	11 (1.04%)	7 (1.21%)	3 (0.51%)
Psychiatrist	99 (9.38%)	81 (14.01%)	55 (9.35%)
Radiologist	105 (9.95%)	74 (12.80%)	43 (7.31%)
Radiotherapist/Nuclear medicine	51 (4.83%)	30 (5.19%)	9 (1.53%)
	n=1055 (100%)	*n=578 (100%)*	*n=588 (100%)*

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	3
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	5
Bias	9	Describe any efforts to address potential sources of bias	*5*
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	6
		(*b*) Describe any methods used to examine subgroups and interactions	6
		(*c*) Explain how missing data were addressed	6
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	6
		(*e*) Describe any sensitivity analyses	6
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7
		(b) Give reasons for non-participation at each stage	7
		(c) Consider use of a flow diagram	7
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7
		(b) Indicate number of participants with missing data for each variable of interest	7
Outcome data	15*	Report numbers of outcome events or summary measures	7
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	7
		(*b*) Report category boundaries when continuous variables were categorized	7
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	7
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	7
Discussion			
Key results	18	Summarise key results with reference to study objectives	8
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	9/10
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	9/10
Generalisability	21	Discuss the generalisability (external validity) of the study results	9/10
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	2

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Different but Similar: Personality Traits of Surgeons and Internists - Results of a Cross-Sectional Observational Study

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2017-021310.R1
Article Type:	Research
Date Submitted by the Author:	13-Mar-2018
Complete List of Authors:	Stienen, MN; University Hospital Zurich, Neurosurgery Scholtes, Felix; University Hospital of Liège, Department of Neurosurgery Samuel, Robin; University of Luxembourg, Research Unit INSIDE Weil, Alexander; University Hospital of Montréal, Department of Neurosurgery Weyerbrock, Astrid; Cantonal Hospital St.Gallen, Department of Neurosurgery Surbeck, Werner; Psychiatric Hospital of the University of Zurich,
Primary Subject Heading:	Health services research
Secondary Subject Heading:	Epidemiology, Global health, Medical education and training, Mental health, Public health
Keywords:	Five Factor Model, personality traits, physician, difference, surgeon, internist

Different but Similar: Personality Traits of Surgeons and Internists - Results of a Cross-Sectional Observational Study

Martin N. Stienen*[1], MD; Felix Scholtes*[2], PhD; Robin Samuel[3], PhD; Alexander Weil[4], MD; Astrid Weyerbrock[5], MD; Werner Surbeck[5,6], MD

*These authors contributed equally to the manuscript.

[1]Department of Neurosurgery, University Hospital Zurich, Zurich, Switzerland
[2]Department of Neurosurgery, University Hospital of Liège, Liège, Belgium & Department of Neuroanatomy, Faculty of Medicine, University of Liège, Liège, Belgium
[3]Research Unit INSIDE, University of Luxembourg, Luxembourg
[4]Department of Neurosurgery, University Hospital of Montréal, Montréal, Canada
[5]Department of Neurosurgery, Cantonal Hospital St.Gallen, St.Gallen, Switzerland
[6]Department of Psychiatry, Psychotherapy and Psychosomatics, Psychiatric Hospital of the University of Zurich, Zurich, Switzerland

Correspondence to:
Martin N. Stienen, MD
Department of Neurosurgery
University Hospital Zurich
Clinical Neuroscience Center
University of Zurich
Frauenklinikstrasse 10
8091 Zurich, Switzerland
Tel: +41 (0)44-255-1111
Email: mnstienen@gmail.com

Abstract word count: 235
Manuscript text word count: 3196
Number of references: 29
Number of total figures: 3
Number of color figures: 1
Number of Tables: 2

Number of Supplemental Tables: 1

Running head: Different but Similar: Personality Traits of Surgeons and Internists

Research support: None

Conflict of Interest: None

Previous presentation: None

Author contributions: Those persons listed as authors on the manuscript have made substantial contributions to the conception or design of the work, have been involved in acquiring, analysing, or interpreting the data for the work. They all have been active in drafting or revising the manuscript for important intellectual content, which is basis of the current article. All authors have approved the final version to be published. They agree to be 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. In detail: Concept: MNS, FS, WS. Data collection: MNS, FS, AlWe, WS. Data analysis: MNS, RS, FS, WS. Article drafting: MNS, FS, RS, WS. Critical revision: all authors.

Abstract

Objectives: Medical practice may attract and possibly enhance distinct personality profiles. We set out to describe the personality profiles of surgical and medical specialties focusing on board-certified physicians.

Design: Prospective, observational.

Setting: Online survey containing the Ten-Item Personality Inventory (TIPI), an internationally validated measure of the Five Factor Model of personality dimensions, distributed to board-certified physicians, residents and medical students in several European countries and Canada. Differences in personality profiles were analyzed using MANOVA and Canonical Linear Discriminant Analysis on age- and sex-standardized z-scores of the personality traits. Single personality traits were analyzed using robust t-tests.

Participants: The TIPI was completed by 2345 board-certified physicians, 1453 residents and 1350 medical students, who also provided demographic information.

Interventions: None.

Results: Normal population and board-certified physicians' personality profiles differed ($P<0.001$). The latter scored higher on conscientiousness, extraversion, and agreeableness, but lower on neuroticism (all $P<0.001$). There was no difference in openness to experience. Board-certified surgical and medical doctors' personality profiles were also different ($P<0.001$). Surgeons scored higher on extraversion ($P=0.003$) and openness to experience ($P=0.002$), but lower on neuroticism ($P<0.001$). There was no difference in agreeableness and conscientiousness. These differences in personality profiles were reproduced at other levels of training, i.e., in students and training physicians engaging in surgical versus medical practice.

Conclusion: These results indicate the existence of a distinct and consistent average "physician personality". Despite high variability within disciplines, there are moderate, but solid and reproducible differences between surgical and medical specialties.

Key words: Five Factor Model; personality traits; physician; difference; doctor; surgeon; internist

Strengths and limitations:

- This study applied a validated instrument to determine the Five Factor Model personality traits among a multinational sample of > 5000 physicians
- The results clearly demonstrate that physicians share a common personality profile that differs from the normal population and is stable across levels of training
- Physicians scored higher in conscientiousness, agreeableness, and extraversion but lower on neuroticism

- Between specialties, moderate differences exist: compared to medical doctors, on average, surgeons show lower levels of neuroticism, extraversion and openness to experience
- However, no inferences from the general average personality profiles reported here to the individual physician can be made

Funding statement:

No funding was received for this research.

Competing interests statement:

All authors declare that they have nothing to disclose and no conflicts of interest.

Data sharing statement:

Once the study results have been published, the dataset will be distributed to other researchers upon request. Final decision is made by the corresponding author (Dr. Stienen) and the last author (Dr. Surbeck).

Introduction

A key factor for success in a professional career is how personality traits fit the characteristics of the chosen profession.[1] Thus, personality has attracted growing research interest in various professional fields, including medical training, with the aim to improve career counseling, selection processes and training strategies.[2]

Between different academic fields, personality traits differ.[3] Whether or not personality traits of physicians differ from those of the general population remains unclear. But also within the medical field, personality structures appear to differ in students depending on the intended specialty,[2-7] in trainees of different specialties after graduation from medical school,[8-12] as well as in board certified specialists of different disciplines.[12-20] These conclusions of previous investigations in the medical field remain however limited by somewhat inconsistent results which were difficult to compare, due to small sample sizes and the use of various ways of operationalizing and measuring personality traits.

Personality can be comprehensively described using five higher order factors, according to the Five Factor Model (FFM):[21 22] agreeableness, conscientiousness, openness to experience, neuroticism, and extraversion (Figure 1). The present investigation assesses a large, multinational sample of trained or training physicians, using the FFM to describe the profiles of surgical and medical specialties across levels of training.

Methods

Study Population and Data Collection

An online survey was distributed among physicians and medical students in Austria, Belgium, France, Canada, Germany and Switzerland via the management of larger public hospitals offering a variety of ≥10 sub-specializations, official associations of general physicians, official medical journals (Deutsches Ärzteblatt, Germany; Schweizer Ärztezeitung, Switzerland; Le Quotidien du Médecin, France), and students' councils of the German, Swiss, Austrian and Belgian medical faculties. Data was collected from February 12, 2016 to May 12, 2016. The survey collected the respondent age, sex, primary language, educational level (board certified physician, resident, or medical student), as well as the (intended) medical specialty. 5660 responses were received, of which 512 were incomplete and discarded. Complete answers were provided by 1350 medical students, 1453 residents and 2345 board-certified physicians (Table 1).

Measurement of Personality Traits

All respondents completed the Ten Item Personality Inventory (TIPI),[23] a validated measure of the FFM. This concise instrument employs ten items to measure the five personality traits, employing a 7-point rating scale ranging from 1 (disagree strongly) to 7 (agree strongly). The set of items is introduced with "I see myself as:", followed by two descriptors per item (e.g., "extraverted, enthusiastic"; "sympathetic, warm"; etc.) [23]. TIPI was specifically developed for the use in larger samples.[23 24] It is available in English, German and French among other languages. Despite less precise estimation of the FFM than with more complex and time consuming tools, its results have been shown to converge with other widely used FFM measures in self-, observer-, and peer reports, test-retest reliability, patterns of predicted external correlates, and convergence between self and observer ratings.[23 25] To allow for better comparison, z-scores were calculated, adjusted for age-categories and sex using normative population data available for 155,433 females and 122,567 males (Gosling SD, Rentfrow PJ, Potter J. Norms for the Ten Item Personality Inventory, Personal Communication. Unpublished Data, 2014).

Hypotheses, Statistical Analysis and Sample Size Calculation

The first hypothesis was that the personality profiles of physicians differ from those of the normal population. The second hypothesis was that personality profiles of surgeons differ from those of medical doctors. The outcome variables of interest were the age- and sex-adjusted z-scores of each of the FFM personality traits. The grouping variables were being a physician or not (H1) and being a surgically or medically orientated physician (H2). In line with other research on how personality profiles between two or more groups differ, we as-

sumed that the linear combinations between single personality traits have to be taken into account. Not doing so would imply to discard the multivariate information present in the data. Therefore, we used MANOVA to test H1 and H2. To gauge what personality traits discriminate physicians and normal population (H1) as well as surgeons and medical doctors (H2), we then ran Canonical Linear Discriminant Analysis. Post-hoc two-sample unpaired t-tests served to illustrate differences in single personality traits between those groups. We further used Bonferroni correction to account for multiple comparisons and Satterthwaite approximation to correct for unequal variances and unequal sample sizes. All statistical tests were two-sided and p values <0.05 were considered statistically significant. Power calculations revealed that to detect a substantially meaningful difference of half a standard deviation between surgeons and internists,[20] 30 participants per group were required ($\beta = 0.9$, $\alpha = 0.001$; two-sided). The group sizes present in the sample exceed this number, indicating that the statistical power afforded by the data collected was sufficient to detect meaningful group differences. The software used for statistical analysis was Stata v14.2 (StataCorp LP, College Station, Texas, USA).

Analysis Samples

We restricted our primary analysis sample to board-certified specialists, because disciplinary specialization cannot be considered fixed until board certification. We included students and residents in a secondary analysis sample. Two further amendments were required. To run MANOVA for our first hypothesis, we had to augment our primary analysis sample by a sample of people form the normal population. The authors of TIPI kindly provided means, standard deviations, and correlation matrix of all relevant variables for a sample of 305,830 respondents. To test our second hypothesis, that surgeon and medical doctors differ with respect to their personality profiles, we excluded medical specialties as well as diagnostic specialties that did not fit into one of the two categories, (Supplementary table 1).

Ethical Considerations

The study was submitted to the institutional review board of the Canton St.Gallen, Switzerland (EKSG 16/020) and the “Comité d’Éthique Hospitalo-Facultaire Universitaire de Liège” (2016/74). Both estimated that it did not fall under the legislation for research involving human beings and that the collected anonymous data did not require any consent beyond the deliberate participation.

Patient and Public Involvement

There were neither patients nor the public involved in this research, as the survey was specifically addressed to physicians and medical students. This article will be disseminated to participants of the survey that indicated being interested in the results.

Results

Personality Traits of Physicians versus (vs.) Normal Population

Compared to normative data (n=305,830), board-certified physicians' personality profile (n=2,345) differed significantly, as established by MANOVA (Table 2). The subsequent Canonical Linear Discriminant Analysis suggested that a main driver of this global difference in personality profiles was the comparably high level of conscientiousness present in our sample of board-certified physicians (Table 2). All but one personality trait were significantly different as well, according to unpaired t-tests with Bonferroni correction and Satterthwaite approximation (all $P < 0.001$): physicians scored higher on conscientiousness, agreeableness, and extraversion, but lower on neuroticism (Table 2 and Figure 2). Normal population and board-certified physicians did not differ in openness to experience (Table 2). The same analyses performed on our secondary analysis sample, including residents and medical students, replicated the findings with respect to personality profiles across board-certified specialists, residents and medical students (all $P < 0.001$).

Personality Traits of Surgeons vs. Medical Doctors

Personality profiles of board-certified surgical doctors (n=465) and medical doctors (n=825) differed significantly (Table 2). Canonical Linear Discriminant Analysis revealed that differences in neuroticism mainly drive the global difference in personality profiles (Table 2). Turning to single personality traits and using robust t-tests as above, board-certified surgeons' mean z-scores compared to medical doctors', were significantly lower for neuroticism, but significantly higher for openness to experience and extraversion (Table 2). However, differences in agreeableness and conscientiousness were not significant using a conservative correction for multiple comparisons (Table 2 & Figure 3). The differences in personality profiles between surgical and medical doctors replicate fully in surgically and medically orientated residents and students.

Discussion

The result of this FFM based personality self-evaluation by more than 5000 trained and training physicians using a web-based questionnaire (Figure 1) indicate that physicians share a common personality profile. It is distinct from that of the normal population and stable across levels of training (Figure 2). Physicians score higher in conscientiousness, agreeableness, and extraversion but lower on neuroticism. The difference in personality profiles is mainly driven by conscientiousness. Between specialties, moderate differences exist: compared to medical doctors, on average, surgeons show lower levels of neuroticism, extraversion and openness to experience, while there is no significant difference in agreeableness and conscientiousness (Figure 3). These differences replicate across residents as well as medical students.

Conscientiousness

This trait was previously found to be a significant predictor of success in different professional and academic settings [26 27] including medical training.[4 10] Qualities associated with the trait conscientiousness, such as efficiency, reliability, responsibility and thoroughness, respond to requirements of medical practice. Low levels of conscientiousness, which may lead to disastrous consequences in some settings, have even been proposed as potential exclusion criterion in the assessment process of applicants to medical school.[2] The recent finding that conscientiousness positively predicted the choice of a surgical specialty in medical students [7] can, however, not be explicitly supported by our data.

Neuroticism

Although generally low in medical practitioners, surgeons' scores were particularly low, at 0.7 SD below the population norm, and a quarter SD lower than in internists (Figure 3). Emotional stability can be seen as adaptive to the challenges of medical decision-making, particularly surgical indications and operative practice. Previous studies had already indicated at least equal,[8 16] sometimes lower scores [28] in surgeons compared to other disciplines.

Agreeableness

As previously shown,[20] this trait is prevalent in all physicians. Previous studies reported lower agreeableness in surgeons than internists,[7 8] reflecting a generally perceived difference between the two disciplines.[20] In the present cohort, differences in agreeableness were not significant among board-certified surgical and medical physicians.

Extraversion

Extraversion is above normal (Figure 2) in physicians, and more significantly so in surgical than medical specialties (Figure 3). This is in line with the majority of previous studies.[6 16 17 20 28] Agreeableness and extraversion are the only traits within the FFM directly related to interpersonal interactions. The prevalence of these traits in the medical population intuitively appears appropriate, not only for the physician-patient relationship, but also for functional interdisciplinary teamwork.

Openness to Experience

There were only slight non-significant deviations from the population norm, positive for surgeons and negative for medical doctors. However, the difference between the two types of discipline is approximately in line with empirical experience and previous data (Figure 3).[8 16]

These findings indicate that, although differences between medical specialties exist, average personality traits are shared between surgeons and medical doctors, as well as students aiming for these specializations. This large sample therefore highlights with robust estimates that a “physician personality” predominates over “specialty-specific personalities”. Although the present data is limited due to its cross-sectional character, the results were stable across the three analyzed levels of training.

Since personality profiles predispose towards consistent patterns of behavior, the consideration of relevant personality traits could facilitate career counseling or even selection processes of applicants to medical school beyond purely intellectual qualifications.[2] In addition, in established medical practitioners, a better understanding of predominant personality traits within different disciplines could be helpful for interdisciplinary teamwork and patient care by stimulating self-reflection and professional development.

This is by far the largest study applying a validated measure of the FFM to a multinational and -cultural sample of physicians. The assessment tool (TIPI) is the only existing sufficiently concise instrument to realistically obtain a sample as large as the present one.[23 24] Potential biases in the interpretation of the results include age and sex-differences, e.g., male-female proportions at different levels of training. In the comparative analysis of surgical and medical specialties, these biases were accounted for by adjusted z-scores. Primary language was unbalanced and could theoretically bias the results through differences of mentality and practice patterns. No specific norms for each of the three language areas exist, however. Furthermore, the possibility of producing an intentional favorable image on personality testing

should always be borne in mind when interpreting this kind of study. However, social desirability response bias may not substantially distort the results when the questionnaires are administered under ‘‘non-penalizing’’ circumstances.[2] Another limitation pertains to the comparison of our sample with the norm population data sample, which comprises sixty times as many cases. To assess this potential source of bias, we repeated the analyses on 1000 size-matched random sub samples. These analyses did not lead to substantially different results.

One critical aspect of the interpretation is the assignment of various specialties to the “surgical” and “medical” fields. When the analyses of our study including various specialties, resulting in larger groups, were repeated on very strictly selected but small samples of unequivocal surgical and medical specialties (Supplementary table 1), the findings were reproduced despite the concurrent loss of power. This corroborates the reported findings in the larger groups. Given the scope of this study, it was not possible to draw a random sample from the population of all board-certified and training physicians as well as medical students. Hence, selection bias might limit the generalizability of our findings to, e.g., the full population of surgical and medical specialties. Furthermore, it goes without saying that no inferences from the general average personality profiles reported in the present study to individual physicians can be made.

Conclusion

This study suggests the existence of a distinct “physician personality profile”. In addition, despite high variability within disciplines, our findings provide evidence for moderate but robust differences in personality profiles between surgical and medical specialties.

Tables

Table 1:

Demographic data and personality traits of board-certified physicians (specialists), residents and medical students.

	All (n=5148)	Specialists (n=2345)	Residents (n=1453)	Students (n=1350)
Age in years	35·9 ± 12·1	46·1 ± 10·2	30·5 ± 3·4	23·9 ± 3·6
Sex				
Male	2427 (47·1%)	1358 (57·9%)	618 (42·5%)	451 (33·4%)
Female	2721 (52·9%)	987 (42·1%)	835 (57·5%)	899 (66·6%)
Language				
German	3374 (65·5%)	1482 (63·2%)	951 (65·4%)	941 (69·7%)
French	1434 (27·9%)	791 (33·7%)	283 (19·5%)	360 (26·7%)
English	340 (6·6%)	72 (3·1%)	219 (15·1%)	49 (3·6%)
Personality Traits				
(mean z-score ± standard deviation)				
Agreeableness	0·37 ± 0·88	0·25 ± 0·89	0·45 ± 0·89	0·47 ± 0·85
Conscientiousness	0·83 ± 0·68	0·80 ± 0·66	0·87 ± 0·70	0·85 ± 0·71
Extraversion	0·35 ± 0·90	0·33 ± 0·90	0·38 ± 0·92	0·34 ± 0·87
Neuroticism	−0·49 ± 0·90	−0·47 ± 0·91	−0·57 ± 0·84	−0·42 ± 0·87
Openness to Experience	−0·11 ± 0·95	−0·01 ± 0·92	−0·16 ± 0·97	−0·23 ± 0·96

Table 2:

Differences in personality profiles (i.e., the individual combination of single personality traits) and personality traits between (1) physicians and normal population and (2) surgeons and medical doctors.

	(1) Physicians (n=2,345) vs. normal population (n=305,830)	(2) Surgeons (n=465) vs. medical doctors (n=825)
Personality profiles	MANOVA: Wilks' lambda = 0.99 $F(5; 308{,}169) = 384.99$, P < 0.001	MANOVA: Wilks' lambda = 0.94 $F(5; 1{,}284) = 9.39$, P < 0.001
Standardized canonical discriminant function coefficients[a]		
Agreeableness	−0.10	0.52
Conscientiousness	−0.79	−0.24
Extraversion	−0.33	−0.34
Neuroticism	0.30	0.62
Openness to Experience	0.12	−0.37
Personality traits (95% CI)		
Agreeableness	0.25 (0.22 to 0.29) vs. 0.00 (−0.00 to 0.00)[b] P < 0.001[c]	0.19 (0.10 to 0.27) vs. 0.30 (0.24 to 0.36) P = 0.16[c]
Conscientiousness	0.80 (0.77 to 0.83) vs. 0.00 (−0.00 to 0.00)[b] P < 0.001[c]	0.87 (0.81 to 0.93) vs. 0.80 (0.75 to 0.84) P = 0.22[c]
Extraversion	0.33 (0.29 to 0.37) vs. 0.00 (−0.00 to 0.00)[b] P < 0.001[c]	0.50 (0.42 to 0.59) vs. 0.32 (0.26 to 0.39) P = 0.003[c]
Neuroticism	−0.47 (−0.51 to −0.44) vs. 0.00 (−0.00 to 0.00)[b] P < 0.001[c]	−0.67 (−0.75 to −0.59) vs. −0.45 (−0.51 to −0.39) P < 0.001[c]
Openness to Experience	−0.12 (−0.05 to −0.03) vs. 0.00 (−0.00 to 0.00)[b] P = 1[c]	0.17 (0.09 to 0.25) vs. −0.01 (−0.07 to −0.05) P = 0.002[c]

a. Standardized canonical discriminant function coefficients obtained from canonical linear discriminant analysis with $F(5; 308{,}169) = 384.99$, P < 0.001 and $F(5; 1{,}284) = 9.39$, P < 0.001 for (1) and (2), respectively.
b. Means and confidence intervals in normal population are not equal zero, but very small due to standardization (mean) and high number of cases (confidence intervals).
c. P values obtained from unpaired t-tests with Bonferroni correction to account for multiple comparisons and Satterthwaite approximation to account for unequal variances.

Supplementary table 1:

Medical and surgical subspecialties of board-certified physicians (specialists) and residents in training, or intended specialties of medical students included in the analysis. “Other” specialties refer to those not included in the analysis comparing medical doctors to surgeons. ENT = Ears, Nose and Throat. * Indicates the medical specialties that were compared to surgical specialties (°) in a subgroup analysis.

Figures

Figure 1:

Personality dimensions of the Five Factor Model (FFM) and their descriptors according to McCrae and John.[29]

Figure 2:

Mean z-scores and 95% confidence intervals (CI) for each of the Five Factor Model personality traits in board-certified physicians. Y-axis: z-score; X-axis: Personality item. A z-score of 0 corresponds to the population mean for the corresponding personality trait in the normative data. All reported P values are from post-hoc two-sample unpaired t-tests with Bonferroni correction to account for multiple comparisons and Satterthwaite approximation to correct for unequal variances and unequal sample sizes.

Figure 3:

Mean z-scores and 95% confidence intervals (CI) for each of the Five Factor Model personality traits in board-certified surgeons or medical doctors. Y-axis: z-score; X-axis: Personality item. A z-score of 0 corresponds to the population mean for the corresponding personality trait in the normative data. All reported P values are from post-hoc two-sample unpaired t-tests with Bonferroni correction to account for multiple comparisons and Satterthwaite approximation to correct for unequal variances and unequal sample sizes.

Acknowledgements

The authors thank the journals “Deutsches Ärzteblatt, Germany”, “Schweizer Ärztezeitung, Switzerland”, and “Le Quotidien du Médecin, France” to help distribute the survey among their readership. We thank all participating specialists, residents and medical students for their time and trust.

References

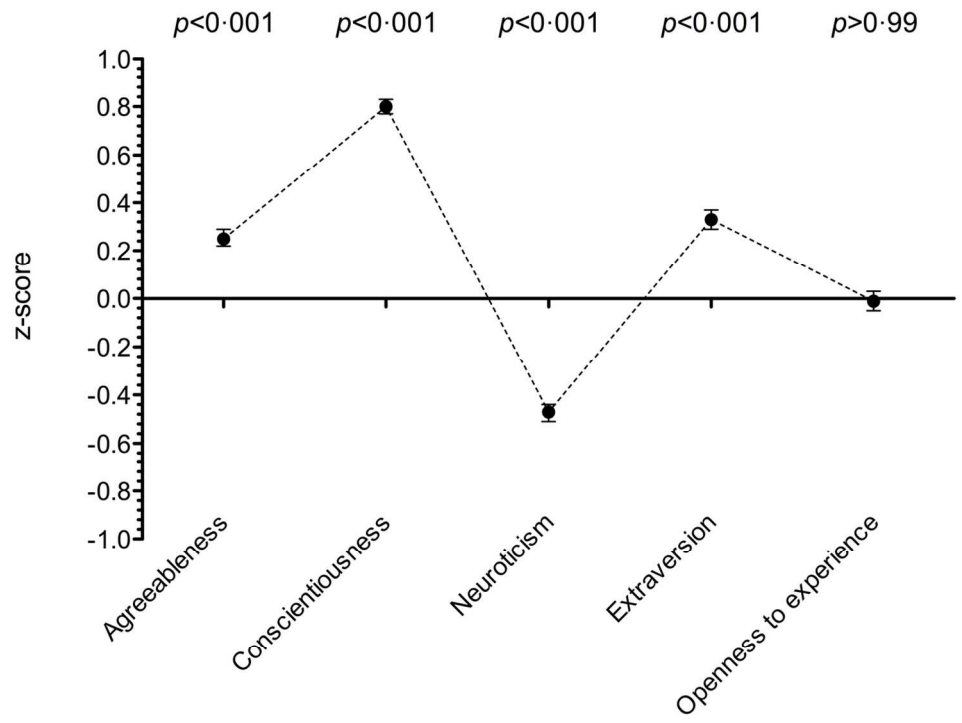
1. Holland JL. *Making vocational choices. A theory of vocational personalities and work environments*. Odessa, FL: Psychological Assessment Resources, 1997.
2. Hojat M, Erdmann JB, Gonnella JS. Personality assessments and outcomes in medical education and the practice of medicine: AMEE Guide No. 79. Medical teacher 2013;**35**(7):e1267-301 doi: 10.3109/0142159X.2013.785654[published Online First: Epub Date]|.
3. Lievens F, Coetsier P, De Fruyt F, et al. Medical students' personality characteristics and academic performance: a five-factor model perspective. Medical education 2002;**36**(11):1050-6
4. Ferguson E, James D, Madeley L. Factors associated with success in medical school: systematic review of the literature. Bmj 2002;**324**(7343):952-7
5. Linn BS, Zeppa R. Does surgery attract students who are more resistant to stress? Annals of surgery 1984;**200**(5):638-43
6. Stilwell NA, Wallick MM, Thal SE, et al. Myers-Briggs type and medical specialty choice: a new look at an old question. Teaching and learning in medicine 2000;**12**(1):14-20 doi: 10.1207/S15328015TLM1201_3[published Online First: Epub Date]|.
7. Turska D, Skrzypek M, Tychmanowicz A, et al. Concept of distinct surgical personality revisited. Personality traits and personal values as surgical specialty choice predictors. European Journal of Medical Technologies 2016;**1**((10)):54-59
8. Bexelius TS, Olsson C, Jarnbert-Pettersson H, et al. Association between personality traits and future choice of specialisation among Swedish doctors: a cross-sectional study. Postgraduate medical journal 2016 doi: 10.1136/postgradmedj-2015-133478[published Online First: Epub Date]|.
9. Buddeberg-Fischer B, Klaghofer R, Abel T, et al. Swiss residents' speciality choices--impact of gender, personality traits, career motivation and life goals. BMC health services research 2006;**6**:137 doi: 10.1186/1472-6963-6-137[published Online First: Epub Date]|.
10. Doherty EM, Nugent E. Personality factors and medical training: a review of the literature. Medical education 2011;**45**(2):132-40 doi: 10.1111/j.1365-2923.2010.03760.x[published Online First: Epub Date]|.
11. Hojat M, Nasca TJ, Magee M, et al. A comparison of the personality profiles of internal medicine residents, physician role models, and the general population. Academic medicine : journal of the Association of American Medical Colleges 1999;**74**(12):1327-33

12. King SH, McArthur CG, Norman JC. The Surgical Personality: A Comparison of Medical and Surgical Residents with the Rorschach. Cardiovascular diseases 1975;**2**(2):117-28
13. Gilligan JH, Treasure T, Watts C. Incorporating psychometric measures in selecting and developing surgeons. Journal of management in medicine 1996;**10**(6):5-16, 2
14. Gilligan JH, Welsh FK, Watts C, et al. Square pegs in round holes: has psychometric testing a place in choosing a surgical career? A preliminary report of work in progress. Annals of the Royal College of Surgeons of England 1999;**81**(2):73-9
15. Greenburg AG, McClure DK, Penn NE. Personality traits of surgical house officers: faculty and resident views. Surgery 1982;**92**(2):368-72
16. Macneily AE, Alden L, Webber E, et al. The surgical personality: comparisons between urologists, non-urologists and non-surgeons. Canadian Urological Association journal = Journal de l'Association des urologues du Canada 2011;**5**(3):182-5 doi: 10.5489/cuaj.10142[published Online First: Epub Date]|.
17. McGreevy J, Wiebe D. A preliminary measurement of the surgical personality. American journal of surgery 2002;**184**(2):121-5
18. Schwartz RW, Barclay JR, Harrell PL, et al. Defining the surgical personality: a preliminary study. Surgery 1994;**115**(1):62-8
19. Subramanian P, Kantharuban S, Subramanian V, et al. Orthopaedic surgeons: as strong as an ox and almost twice as clever? Multicentre prospective comparative study. Bmj 2011;**343**:d7506 doi: 10.1136/bmj.d7506[published Online First: Epub Date]|.
20. Warschkow R, Steffen T, Spillmann M, et al. A comparative cross-sectional study of personality traits in internists and surgeons. Surgery 2010;**148**(5):901-7 doi: 10.1016/j.surg.2010.03.001[published Online First: Epub Date]|.
21. Digman JM. Personality Structure: Emergence of the Five-Factor Model. Annu. Rev. Psychol. 1990;**41**:417-40
22. Tupes EC, Christal RE. *Recurrent personality factors based on trait ratings.* USAF ASD Tech. Re. No. 61-97. Lackland Air Force Base, Tx: U.S. Air Force, 1961.
23. Gosling SD, Rentfrow PJ, Swann WB. A very brief measure of the Big-Five personality domains. Journal of Research in Personality 2003;**37**:504-28
24. Foulkrod KH, Field C, Brown CV. Trauma surgeon personality and job satisfaction: results from a national survey. The American surgeon 2010;**76**(4):422-7
25. Muck PM, Hell B, Gosling SD. Construct validation of a short five-factor model instrument. European Journal of Psychological Assessment 2007;**23**(3):166-75
26. Hurtz GM, Donovan JJ. Personality and job performance: the Big Five revisited. The Journal of applied psychology 2000;**85**(6):869-79

27. Poropat AE. A meta-analysis of the five-factor model of personality and academic performance. Psychological bulletin 2009;**135**(2):322-38 doi: 10.1037/a0014996[published Online First: Epub Date]|.
28. McCulloch P, Kaul A, Wagstaff GF, et al. Tolerance of uncertainty, extroversion, neuroticism and attitudes to randomized controlled trials among surgeons and physicians. The British journal of surgery 2005;**92**(10):1293-7 doi: 10.1002/bjs.4930[published Online First: Epub Date]|.
29. McCrae RR, John OP. An introduction to the five-factor model and its applications. Journal of personality 1992;**60**(2):175-215

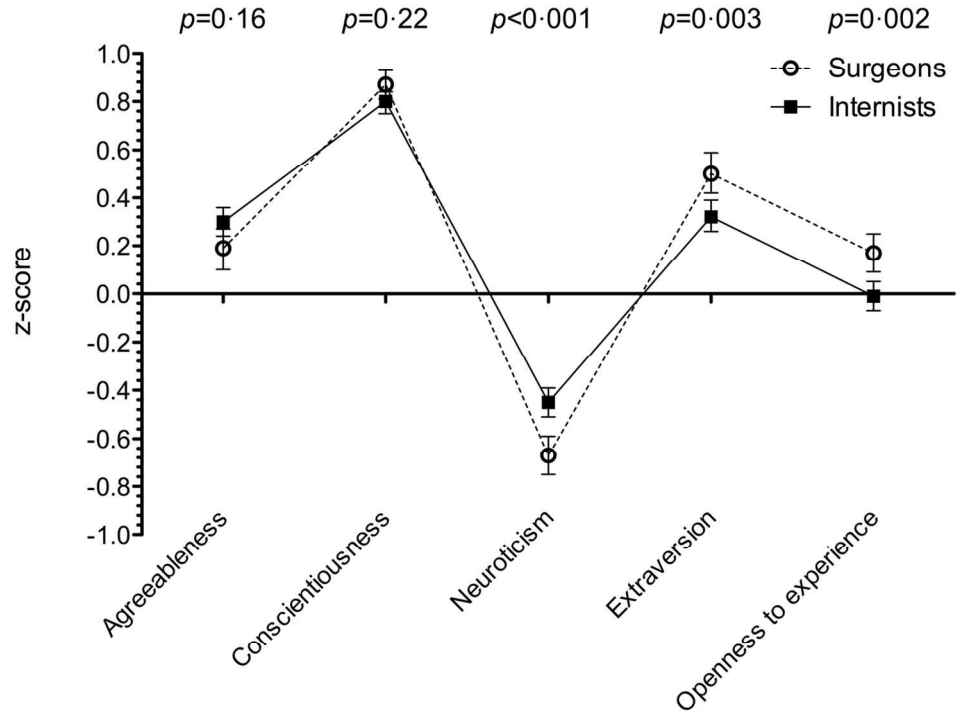
Personality dimensions of the Five Factor Model (FFM) and their descriptors according to McCrae and John.[30]

71x30mm (300 x 300 DPI)



Mean z-scores and 95% confidence intervals (CI) for each of the Five Factor Model personality traits in board-certified physicians. Y-axis: z-score; X-axis: Personality item. A z-score of 0 corresponds to the population mean for the corresponding personality trait in the normative data. All reported P values are from post-hoc two-sample unpaired t-tests with Bonferroni correction to account for multiple comparisons and Satterthwaite approximation to correct for unequal variances and unequal sample sizes.

64x49mm (600 x 600 DPI)



Mean z-scores and 95% confidence intervals (CI) for each of the Five Factor Model personality traits in board-certified surgeons or medical doctors. Y-axis: z-score; X-axis: Personality item. A z-score of 0 corresponds to the population mean for the corresponding personality trait in the normative data. All reported P values are from post-hoc two-sample unpaired t-tests with Bonferroni correction to account for multiple comparisons and Satterthwaite approximation to correct for unequal variances and unequal sample sizes.

64x49mm (600 x 600 DPI)

Supplementary table 1:

Medical and surgical subspecialties of board-certified physicians (specialists) and residents in training, or intended specialties of medical students included in the analysis. "Other" specialties refer to those not included in the analysis comparing medical doctors to surgeons. ENT = Ears, Nose and Throat. * Indicates the medical specialties that were compared to surgical specialties (°) in a subgroup analysis.

	Specialists (n=2345)	Residents (n=1453)	Students (n=1350)
Medical doctors (n=1892)			
Intensive care / Emergency medicine	40 (4.85%)	25 (4.47%)	51 (10.04%)
General internal medicine*	116 (14.06%)	125 (22.36%)	59 (11.61%)
Angiologist*	11 (1.33%)	3 (0.54%)	1 (0.20%)
Endocrinologist*	32 (3.88%)	10 (1.79%)	10 (1.97%)
Gastroenterologist*	51 (6.18%)	29 (5.19%)	30 (5.91%)
Hematologist / Oncologist*	61 (7.39%)	42 (7.51%)	51 (10.04%)
Infectiologist*	15 (1.82%)	13 (2.33%)	8 (1.57%)
Cardiologist*	83 (10.06%)	61 (10.91%)	55 (10.83%)
Nephrologist*	38 (4.61%)	31 (5.55%)	19 (3.74%)
Pulmonary specialist*	30 (3.64%)	13 (2.33%)	6 (1.18%)
Rheumatologist*	34 (4.12%)	13 (2.33%)	9 (1.77%)
Neurologist	109 (13.21%)	98 (17.53%)	76 (14.96%)
Pediatrician	187 (22.67%)	91 (16.28%)	130 (25.59%)
Geriatric medicine	18 (2.18%)	5 (0.89%)	3 (0.59%)
	n=825 (100%)	n=559 (100%)	n=508 (100%)
Surgeons (n=1035)			
ENT surgeon	31 (6.67%)	15 (4.75%)	18 (7.09%)
General surgeon°	35 (7.53%)	44 (13.92%)	38 (14.96%)
Heart surgeon°	21 (4.52%)	19 (6.01%)	17 (6.69%)
Maxillofacial surgeon	23 (4.95%)	21 (6.65%)	8 (3.15%)
Neurosurgeon	84 (18.06%)	87 (27.53%)	34 (13.39%)
Orthopedic surgeon°	74 (15.91%)	46 (14.56%)	69 (27.17%)
Pediatric surgeon	39 (8.39%)	14 (4.43%)	12 (4.72%)
Plastic surgeon	14 (3.01%)	15 (4.75%)	21 (8.27%)
Thoracic surgeon°	10 (2.15%)	1 (0.32%)	4 (1.57%)

Vascular surgeon°	29 (6.24%)	8 (2.53%)	4 (1.57%)
Visceral surgeon°	74 (15.91%)	26 (8.23%)	14 (5.51%)
Urologist	31 (6.67%)	20 (6.33%)	15 (5.91%)
	n=465 (100%)	*n=316 (100%)*	*n=254 (100%)*
Other (n=2221)			
Anesthesiologist	222 (21.04%)	72 (12.46%)	100 (17.01%)
Child psychiatrist	23 (2.18%)	19 (3.29%)	10 (1.70%)
Clinical pathology	26 (2.46%)	4 (0.69%)	8 (1.36%)
Dermatologist	60 (5.69%)	39 (6.75%)	24 (4.08%)
Forensic pathologist	10 (0.95%)	9 (1.56%)	12 (2.04%)
General physician	217 (20.57%)	120 (20.76%)	204 (34.69%)
Gynecologist	135 (12.80%)	56 (9.69%)	78 (13.27%)
Microbiologist	14 (1.33%)	7 (1.21%)	5 (0.85%)
Ophthalmologist	47 (4.45%)	40 (6.92%)	29 (4.93%)
Pathologist	35 (3.32%)	20 (3.46%)	8 (1.36%)
Physical-/rehabilitational medicine	11 (1.04%)	7 (1.21%)	3 (0.51%)
Psychiatrist	99 (9.38%)	81 (14.01%)	55 (9.35%)
Radiologist	105 (9.95%)	74 (12.80%)	43 (7.31%)
Radiotherapist/Nuclear medicine	51 (4.83%)	30 (5.19%)	9 (1.53%)
	n=1055 (100%)	*n=578 (100%)*	*n=588 (100%)*

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	3
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	5
Bias	9	Describe any efforts to address potential sources of bias	*5*
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	6
		(*b*) Describe any methods used to examine subgroups and interactions	6
		(*c*) Explain how missing data were addressed	6
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	6
		(*e*) Describe any sensitivity analyses	6
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7
		(b) Give reasons for non-participation at each stage	7
		(c) Consider use of a flow diagram	7
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7
		(b) Indicate number of participants with missing data for each variable of interest	7
Outcome data	15*	Report numbers of outcome events or summary measures	7
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	7
		(*b*) Report category boundaries when continuous variables were categorized	7
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	7
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	7
Discussion			
Key results	18	Summarise key results with reference to study objectives	8
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	9/10
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	9/10
Generalisability	21	Discuss the generalisability (external validity) of the study results	9/10
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	2

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Different but Similar: Personality Traits of Surgeons and Internists - Results of a Cross-Sectional Observational Study

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2017-021310.R2
Article Type:	Research
Date Submitted by the Author:	06-Jun-2018
Complete List of Authors:	Stienen, MN; University Hospital Zurich, Neurosurgery Scholtes, Felix; University Hospital of Liège, Department of Neurosurgery Samuel, Robin; University of Luxembourg, Research Unit INSIDE Weil, Alexander; University Hospital of Montréal, Department of Neurosurgery Weyerbrock, Astrid; Cantonal Hospital St.Gallen, Department of Neurosurgery Surbeck, Werner; Psychiatric Hospital of the University of Zurich,
Primary Subject Heading:	Health services research
Secondary Subject Heading:	Epidemiology, Global health, Medical education and training, Mental health, Public health
Keywords:	Five Factor Model, personality traits, physician, difference, surgeon, internist

Different but Similar: Personality Traits of Surgeons and Internists - Results of a Cross-Sectional Observational Study

Martin N. Stienen*[1], MD; Felix Scholtes*[2], PhD; Robin Samuel[3], PhD; Alexander Weil[4], MD; Astrid Weyerbrock[5], MD; Werner Surbeck[5,6], MD

*These authors contributed equally to the manuscript.

[1]Department of Neurosurgery, University Hospital Zurich, Zurich, Switzerland
[2]Department of Neurosurgery, University Hospital of Liège, Liège, Belgium & Department of Neuroanatomy, Faculty of Medicine, University of Liège, Liège, Belgium
[3]Research Unit INSIDE, University of Luxembourg, Luxembourg
[4]Department of Neurosurgery, University Hospital of Montréal, Montréal, Canada
[5]Department of Neurosurgery, Cantonal Hospital St.Gallen, St.Gallen, Switzerland
[6]Department of Psychiatry, Psychotherapy and Psychosomatics, Psychiatric Hospital of the University of Zurich, Zurich, Switzerland

Correspondence to:
Martin N. Stienen, MD
Department of Neurosurgery
University Hospital Zurich
Clinical Neuroscience Center
University of Zurich
Frauenklinikstrasse 10
8091 Zurich, Switzerland
Tel: +41 (0)44-255-1111
Email: mnstienen@gmail.com

Abstract word count: 235
Manuscript text word count: 3224
Number of references: 30
Number of total figures: 3
Number of color figures: 1
Number of Tables: 2

Number of Supplemental Tables: 1

Running head: Different but Similar: Personality Traits of Surgeons and Internists

Research support: None

Conflict of Interest: None

Previous presentation: None

Author contributions: Those persons listed as authors on the manuscript have made substantial contributions to the conception or design of the work, have been involved in acquiring, analysing, or interpreting the data for the work. They all have been active in drafting or revising the manuscript for important intellectual content, which is basis of the current article. All authors have approved the final version to be published. They agree to be 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. In detail: Concept: MNS, FS, WS. Data collection: MNS, FS, AlWe, WS. Data analysis: MNS, RS, FS, WS. Article drafting: MNS, FS, RS, WS. Critical revision: all authors.

Abstract

Objectives: Medical practice may attract and possibly enhance distinct personality profiles. We set out to describe the personality profiles of surgical and medical specialties focusing on board-certified physicians.

Design: Prospective, observational.

Setting: Online survey containing the Ten-Item Personality Inventory (TIPI), an internationally validated measure of the Five Factor Model of personality dimensions, distributed to board-certified physicians, residents and medical students in several European countries and Canada. Differences in personality profiles were analyzed using MANOVA and Canonical Linear Discriminant Analysis on age- and sex-standardized z-scores of the personality traits. Single personality traits were analyzed using robust t-tests.

Participants: The TIPI was completed by 2345 board-certified physicians, 1453 residents and 1350 medical students, who also provided demographic information.

Interventions: None.

Results: Normal population and board-certified physicians' personality profiles differed (P<0.001). The latter scored higher on conscientiousness, extraversion, and agreeableness, but lower on neuroticism (all P<0.001). There was no difference in openness to experience. Board-certified surgical and medical doctors' personality profiles were also different (P<0.001). Surgeons scored higher on extraversion (P=0.003) and openness to experience (P=0.002), but lower on neuroticism (P<0.001). There was no difference in agreeableness and conscientiousness. These differences in personality profiles were reproduced at other levels of training, i.e., in students and training physicians engaging in surgical versus medical practice.

Conclusion: These results indicate the existence of a distinct and consistent average "physician personality". Despite high variability within disciplines, there are moderate, but solid and reproducible differences between surgical and medical specialties.

Key words: Five Factor Model; personality traits; physician; difference; doctor; surgeon; internist

Strengths and limitations:

- This study applied a validated instrument to determine the Five Factor Model personality traits among a multinational sample of > 5000 physicians
- The results clearly demonstrate that physicians share a common personality profile that differs from the normal population and is stable across levels of training
- Physicians scored higher in conscientiousness, agreeableness, and extraversion but lower on neuroticism

- Between specialties, moderate differences exist: compared to medical doctors, on average, surgeons show lower levels of neuroticism, extraversion and openness to experience
- However, no inferences from the general average personality profiles reported here to the individual physician can be made

Funding statement:

No funding was received for this research.

Competing interests statement:

All authors declare that they have nothing to disclose and no conflicts of interest.

Data sharing statement:

Once the study results have been published, the dataset will be distributed to other researchers upon request. Final decision is made by the corresponding author (Dr. Stienen) and the last author (Dr. Surbeck).

Introduction

A key factor for success in a professional career is how personality traits fit the characteristics of the chosen profession.[1] Thus, personality has attracted growing research interest in various professional fields, including medical training, with the aim to improve career counseling, selection processes and training strategies.[2]

Between different academic fields, personality traits differ.[3] Whether or not personality traits of physicians differ from those of the general population remains poorly studied. As only limited data from single institutions is available today,[4 5] it is questionable how far the results can be generalized to the entire medical community. But also within the medical field, personality structures appear to differ in students depending on the intended specialty,[2 3 6-9] in trainees of different specialties after graduation from medical school,[10-14] as well as in board certified specialists of different disciplines.[4 14-21] These conclusions of previous investigations in the medical field remain however limited by somewhat inconsistent results which were difficult to compare, due to small sample sizes and the use of various ways of operationalizing and measuring personality traits.

Personality can be comprehensively described using five higher order factors, according to the Five Factor Model (FFM):[22 23] agreeableness, conscientiousness, openness to experience, neuroticism, and extraversion (Figure 1). The present investigation assesses a large, multinational sample of trained or training physicians, using the FFM to describe the profiles of surgical and medical specialties across levels of training.

Methods

Study Population and Data Collection

An online survey was distributed among physicians and medical students in Austria, Belgium, France, Canada, Germany and Switzerland via the management of larger public hospitals offering a variety of ≥10 sub-specializations, official associations of general physicians, official medical journals (Deutsches Ärzteblatt, Germany; Schweizer Ärztezeitung, Switzerland; Le Quotidien du Médecin, France), and students' councils of the German, Swiss, Austrian and Belgian medical faculties. Data was collected from February 12, 2016 to May 12, 2016. The survey collected the respondent age, sex, primary language, educational level (board certified physician, resident, or medical student), as well as the (intended) medical specialty. 5660 responses were received, of which 512 were incomplete and discarded. Complete answers were provided by 1350 medical students, 1453 residents and 2345 board-certified physicians (Table 1).

Measurement of Personality Traits

All respondents completed the Ten Item Personality Inventory (TIPI),[24] a validated measure of the FFM. This concise instrument employs ten items to measure the five personality traits, employing a 7-point rating scale ranging from 1 (disagree strongly) to 7 (agree strongly). The set of items is introduced with "I see myself as:", followed by two descriptors per item (e.g., "extraverted, enthusiastic"; "sympathetic, warm"; etc.) [23]. TIPI was specifically developed for the use in larger samples.[24 25] It is available in English, German and French among other languages. Despite less precise estimation of the FFM than with more complex and time consuming tools, its results have been shown to converge with other widely used FFM measures in self-, observer-, and peer reports, test-retest reliability, patterns of predicted external correlates, and convergence between self and observer ratings.[24 26] To allow for better comparison, z-scores were calculated, adjusted for age-categories and sex using normative population data available for 155,433 females and 122,567 males (Gosling SD, Rentfrow PJ, Potter J. Norms for the Ten Item Personality Inventory, Personal Communication. 2014).

Hypotheses, Statistical Analysis and Sample Size Calculation

The first hypothesis was that the personality profiles of physicians differ from those of the normal population. The second hypothesis was that personality profiles of surgeons differ from those of medical doctors. The outcome variables of interest were the age- and sex-adjusted z-scores of each of the FFM personality traits. The grouping variables were being a physician or not (H1) and being a surgically or medically orientated physician (H2). In line with other research on how personality profiles between two or more groups differ, we as-

sumed that the linear combinations between single personality traits have to be taken into account. Not doing so would imply to discard the multivariate information present in the data. Therefore, we used MANOVA to test H1 and H2. To gauge what personality traits discriminate physicians and normal population (H1) as well as surgeons and medical doctors (H2), we then ran Canonical Linear Discriminant Analysis. Post-hoc two-sample unpaired t-tests served to illustrate differences in single personality traits between those groups. We further used Bonferroni correction to account for multiple comparisons and Satterthwaite approximation to correct for unequal variances and unequal sample sizes. All statistical tests were two-sided and p values <0.05 were considered statistically significant. Power calculations revealed that to detect a substantially meaningful difference of half a standard deviation between surgeons and internists,[4] 30 participants per group were required ($\beta = 0.9$, $\alpha = 0.001$; two-sided). The group sizes present in the sample exceed this number, indicating that the statistical power afforded by the data collected was sufficient to detect meaningful group differences. The software used for statistical analysis was Stata v14.2 (StataCorp LP, College Station, Texas, USA).

Analysis Samples

We restricted our primary analysis sample to board-certified specialists, because disciplinary specialization cannot be considered fixed until board certification. We included students and residents in a secondary analysis sample. Two further amendments were required. To run MANOVA for our first hypothesis, we had to augment our primary analysis sample by a sample of people form the normal population. The authors of TIPI kindly provided means, standard deviations, and correlation matrix of all relevant variables for a sample of 305,830 respondents. To test our second hypothesis, that surgeon and medical doctors differ with respect to their personality profiles, we excluded medical specialties as well as diagnostic specialties that did not fit into one of the two categories, (Supplementary table 1).

Ethical Considerations

The study was submitted to the institutional review board of the Canton St.Gallen, Switzerland (EKSG 16/020) and the “Comité d’Éthique Hospitalo-Facultaire Universitaire de Liège” (2016/74). Both estimated that it did not fall under the legislation for research involving human beings and that the collected anonymous data did not require any consent beyond the deliberate participation.

Patient and Public Involvement

There were neither patients nor the public involved in this research, as the survey was specifically addressed to physicians and medical students. This article will be disseminated to participants of the survey that indicated being interested in the results.

Results

Personality Traits of Physicians versus (vs.) Normal Population

Compared to normative data (n=305,830), board-certified physicians' personality profile (n=2,345) differed significantly, as established by MANOVA (Table 2). The subsequent Canonical Linear Discriminant Analysis suggested that a main driver of this global difference in personality profiles was the comparably high level of conscientiousness present in our sample of board-certified physicians (Table 2). All but one personality trait were significantly different as well, according to unpaired t-tests with Bonferroni correction and Satterthwaite approximation (all $P < 0.001$): physicians scored higher on conscientiousness, agreeableness, and extraversion, but lower on neuroticism (Table 2 and Figure 2). Normal population and board-certified physicians did not differ in openness to experience (Table 2). The same analyses performed on our secondary analysis sample, including residents and medical students, replicated the findings with respect to personality profiles across board-certified specialists, residents and medical students (all $P < 0.001$).

Personality Traits of Surgeons vs. Medical Doctors

Personality profiles of board-certified surgical doctors (n=465) and medical doctors (n=825) differed significantly (Table 2). Canonical Linear Discriminant Analysis revealed that differences in neuroticism mainly drive the global difference in personality profiles (Table 2). Turning to single personality traits and using robust t-tests as above, board-certified surgeons' mean z-scores compared to medical doctors', were significantly lower for neuroticism, but significantly higher for openness to experience and extraversion (Table 2). However, differences in agreeableness and conscientiousness were not significant using a conservative correction for multiple comparisons (Table 2 & Figure 3). The differences in personality profiles between surgical and medical doctors replicate fully in surgically and medically orientated residents and students.

Discussion

The result of this FFM based personality self-evaluation by more than 5000 trained and training physicians using a web-based questionnaire (Figure 1) indicate that physicians share a common personality profile. It is distinct from that of the normal population and stable across levels of training (Figure 2). Physicians score higher in conscientiousness, agreeableness, and extraversion but lower on neuroticism. The difference in personality profiles is mainly driven by conscientiousness. Between specialties, moderate differences exist: compared to medical doctors, on average, surgeons show lower levels of neuroticism, extraversion and openness to experience, while there is no significant difference in agreeableness and conscientiousness (Figure 3). These differences replicate across residents as well as medical students.

Conscientiousness

This trait was previously found to be a significant predictor of success in different professional and academic settings [27 28] including medical training.[6 12] Qualities associated with the trait conscientiousness, such as efficiency, reliability, responsibility and thoroughness, respond to requirements of medical practice. Low levels of conscientiousness, which may lead to disastrous consequences in some settings, have even been proposed as potential exclusion criterion in the assessment process of applicants to medical school.[2] The recent finding that conscientiousness positively predicted the choice of a surgical specialty in medical students [9] can, however, not be explicitly supported by our data.

Neuroticism

Although generally low in medical practitioners, surgeons' scores were particularly low, at 0.7 SD below the population norm, and a quarter SD lower than in internists (Figure 3). Emotional stability can be seen as adaptive to the challenges of medical decision-making, particularly surgical indications and operative practice. Previous studies had already indicated at least equal,[10 18] sometimes lower scores [29] in surgeons compared to other disciplines.

Agreeableness

As previously shown,[4] this trait is prevalent in all physicians. Previous studies reported lower agreeableness in surgeons than internists,[9 10] reflecting a generally perceived difference between the two disciplines.[4] In the present cohort, differences in agreeableness were not significant among board-certified surgical and medical physicians.

Extraversion

Extraversion is above normal (Figure 2) in physicians, and more significantly so in surgical than medical specialties (Figure 3). This is in line with the majority of previous studies.[4 8 18 19 29] Agreeableness and extraversion are the only traits within the FFM directly related to interpersonal interactions. The prevalence of these traits in the medical population intuitively appears appropriate, not only for the physician-patient relationship, but also for functional interdisciplinary teamwork.

Openness to Experience

There were only slight non-significant deviations from the population norm, positive for surgeons and negative for medical doctors. However, the difference between the two types of discipline is approximately in line with empirical experience and previous data (Figure 3).[10 18]

These findings indicate that, although differences between medical specialties exist, average personality traits are shared between surgeons and medical doctors, as well as students aiming for these specializations. This large sample therefore highlights with robust estimates that a “physician personality” predominates over “specialty-specific personalities”. Although the present data is limited due to its cross-sectional character, the results were stable across the three analyzed levels of training.

Since personality profiles predispose towards consistent patterns of behavior, the consideration of relevant personality traits could facilitate career counseling or even selection processes of applicants to medical school beyond purely intellectual qualifications.[2] In addition, in established medical practitioners, a better understanding of predominant personality traits within different disciplines could be helpful for interdisciplinary teamwork and patient care by stimulating self-reflection and professional development.

This is by far the largest study applying a validated measure of the FFM to a multinational and -cultural sample of physicians. The assessment tool (TIPI) is the only existing sufficiently concise instrument to realistically obtain a sample as large as the present one.[24 25] Potential biases in the interpretation of the results include age and sex-differences, e.g., male-female proportions at different levels of training. In the comparative analysis of surgical and medical specialties, these biases were accounted for by adjusted z-scores. Primary language was unbalanced and could theoretically bias the results through differences of mentality and practice patterns. No specific norms for each of the three language areas exist, however. Furthermore, the possibility of producing an intentional favorable image on personality testing

should always be borne in mind when interpreting this kind of study. However, social desirability response bias may not substantially distort the results when the questionnaires are administered under ‘‘non-penalizing’’ circumstances.[2] Another limitation pertains to the comparison of our sample with the norm population data sample, which comprises sixty times as many cases. To assess this potential source of bias, we repeated the analyses on 1000 size-matched random sub samples. These analyses did not lead to substantially different results.

One critical aspect of the interpretation is the assignment of various specialties to the “surgical” and “medical” fields. When the analyses of our study including various specialties, resulting in larger groups, were repeated on very strictly selected but small samples of unequivocal surgical and medical specialties (Supplementary table 1), the findings were reproduced despite the concurrent loss of power. This corroborates the reported findings in the larger groups. Given the scope of this study, it was not possible to draw a random sample from the population of all board-certified and training physicians as well as medical students. Hence, selection bias might limit the generalizability of our findings to, e.g., the full population of surgical and medical specialties. Furthermore, it goes without saying that no inferences from the general average personality profiles reported in the present study to individual physicians can be made.

Conclusion

This study suggests the existence of a distinct “physician personality profile”. In addition, despite high variability within disciplines, our findings provide evidence for moderate but robust differences in personality profiles between surgical and medical specialties.

Tables

Table 1:

Demographic data and personality traits of board-certified physicians (specialists), residents and medical students.

	All (n=5148)	Specialists (n=2345)	Residents (n=1453)	Students (n=1350)
Age in years	35·9 ± 12·1	46·1 ± 10·2	30·5 ± 3·4	23·9 ± 3·6
Sex				
Male	2427 (47·1%)	1358 (57·9%)	618 (42·5%)	451 (33·4%)
Female	2721 (52·9%)	987 (42·1%)	835 (57·5%)	899 (66·6%)
Language				
German	3374 (65·5%)	1482 (63·2%)	951 (65·4%)	941 (69·7%)
French	1434 (27·9%)	791 (33·7%)	283 (19·5%)	360 (26·7%)
English	340 (6·6%)	72 (3·1%)	219 (15·1%)	49 (3·6%)
Personality Traits				
(mean z-score ± standard deviation)				
Agreeableness	0·37 ± 0·88	0·25 ± 0·89	0·45 ± 0·89	0·47 ± 0·85
Conscientiousness	0·83 ± 0·68	0·80 ± 0·66	0·87 ± 0·70	0·85 ± 0·71
Extraversion	0·35 ± 0·90	0·33 ± 0·90	0·38 ± 0·92	0·34 ± 0·87
Neuroticism	−0·49 ± 0·90	−0·47 ± 0·91	−0·57 ± 0·84	−0·42 ± 0·87
Openness to Experience	−0·11 ± 0·95	−0·01 ± 0·92	−0·16 ± 0·97	−0·23 ± 0·96

Table 2:

Differences in personality profiles (i.e., the individual combination of single personality traits) and personality traits between (1) physicians and normal population and (2) surgeons and medical doctors.

	(1) Physicians (n=2,345) vs. normal population (n=305,830)	(2) Surgeons (n=465) vs. medical doctors (n=825)
Personality profiles	MANOVA: Wilks' lambda = 0.99 $F(5; 308{,}169) = 384.99$, P < 0.001	MANOVA: Wilks' lambda = 0.94 $F(5; 1{,}284) = 9.39$, P < 0.001
Standardized canonical discriminant function coefficients[a]		
Agreeableness	−0.10	0.52
Conscientiousness	−0.79	−0.24
Extraversion	−0.33	−0.34
Neuroticism	0.30	0.62
Openness to Experience	0.12	−0.37
Personality traits (95% CI)		
Agreeableness	0.25 (0.22 to 0.29) vs. 0.00 (−0.00 to 0.00)[b] P < 0.001[c]	0.19 (0.10 to 0.27) vs. 0.30 (0.24 to 0.36) P = 0.16[c]
Conscientiousness	0.80 (0.77 to 0.83) vs. 0.00 (−0.00 to 0.00)[b] P < 0.001[c]	0.87 (0.81 to 0.93) vs. 0.80 (0.75 to 0.84) P = 0.22[c]
Extraversion	0.33 (0.29 to 0.37) vs. 0.00 (−0.00 to 0.00)[b] P < 0.001[c]	0.50 (0.42 to 0.59) vs. 0.32 (0.26 to 0.39) P = 0.003[c]
Neuroticism	−0.47 (−0.51 to −0.44) vs. 0.00 (−0.00 to 0.00)[b] P < 0.001[c]	−0.67 (−0.75 to −0.59) vs. −0.45 (−0.51 to −0.39) P < 0.001[c]
Openness to Experience	−0.12 (−0.05 to −0.03) vs. 0.00 (−0.00 to 0.00)[b] P = 1[c]	0.17 (0.09 to 0.25) vs. −0.01 (−0.07 to −0.05) P = 0.002[c]

a. Standardized canonical discriminant function coefficients obtained from canonical linear discriminant analysis with $F(5; 308{,}169) = 384.99$, P < 0.001 and $F(5; 1{,}284) = 9.39$, P < 0.001 for (1) and (2), respectively.
b. Means and confidence intervals in normal population are not equal zero, but very small due to standardization (mean) and high number of cases (confidence intervals).
c. P values obtained from unpaired t-tests with Bonferroni correction to account for multiple comparisons and Satterthwaite approximation to account for unequal variances.

Supplementary table 1:

Medical and surgical subspecialties of board-certified physicians (specialists) and residents in training, or intended specialties of medical students included in the analysis. “Other” specialties refer to those not included in the analysis comparing medical doctors to surgeons. ENT = Ears, Nose and Throat. * Indicates the medical specialties that were compared to surgical specialties (°) in a subgroup analysis.

Figures

Figure 1:

Personality dimensions of the Five Factor Model (FFM) and their descriptors according to McCrae and John.[30]

Figure 2:

Mean z-scores and 95% confidence intervals (CI) for each of the Five Factor Model personality traits in board-certified physicians. Y-axis: z-score; X-axis: Personality item. A z-score of 0 corresponds to the population mean for the corresponding personality trait in the normative data. All reported P values are from post-hoc two-sample unpaired t-tests with Bonferroni correction to account for multiple comparisons and Satterthwaite approximation to correct for unequal variances and unequal sample sizes.

Figure 3:

Mean z-scores and 95% confidence intervals (CI) for each of the Five Factor Model personality traits in board-certified surgeons or medical doctors. Y-axis: z-score; X-axis: Personality item. A z-score of 0 corresponds to the population mean for the corresponding personality trait in the normative data. All reported P values are from post-hoc two-sample unpaired t-tests with Bonferroni correction to account for multiple comparisons and Satterthwaite approximation to correct for unequal variances and unequal sample sizes.

Acknowledgements

The authors thank the journals “Deutsches Ärzteblatt, Germany”, “Schweizer Ärztezeitung, Switzerland”, and “Le Quotidien du Médecin, France” to help distribute the survey among their readership. We thank all participating specialists, residents and medical students for their time and trust.

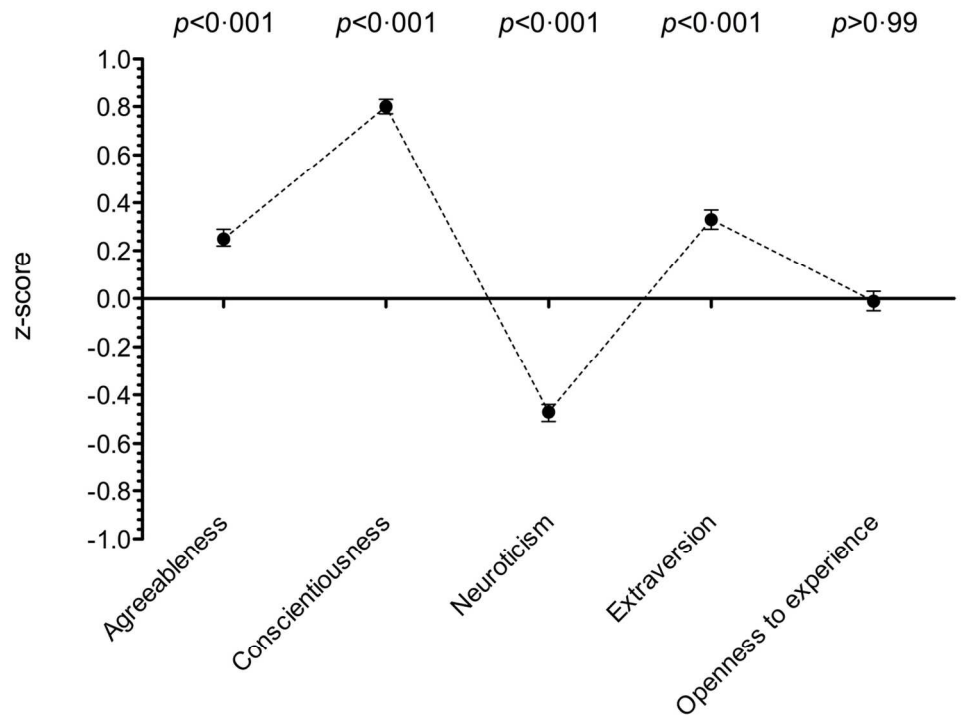
References

1. Holland JL. *Making vocational choices. A theory of vocational personalities and work environments*. Odessa, FL: Psychological Assessment Resources, 1997.
2. Hojat M, Erdmann JB, Gonnella JS. Personality assessments and outcomes in medical education and the practice of medicine: AMEE Guide No. 79. Medical teacher 2013;**35**(7):e1267-301 doi: 10.3109/0142159X.2013.785654[published Online First: Epub Date]|.
3. Lievens F, Coetsier P, De Fruyt F, et al. Medical students' personality characteristics and academic performance: a five-factor model perspective. Medical education 2002;**36**(11):1050-6
4. Warschkow R, Steffen T, Spillmann M, et al. A comparative cross-sectional study of personality traits in internists and surgeons. Surgery 2010;**148**(5):901-7 doi: 10.1016/j.surg.2010.03.001[published Online First: Epub Date]|.
5. Rosenthal R, Schafer J, Hoffmann H, et al. Personality traits and virtual reality performance. Surgical endoscopy 2013;**27**(1):222-30 doi: 10.1007/s00464-012-2424-z[published Online First: Epub Date]|.
6. Ferguson E, James D, Madeley L. Factors associated with success in medical school: systematic review of the literature. Bmj 2002;**324**(7343):952-7
7. Linn BS, Zeppa R. Does surgery attract students who are more resistant to stress? Annals of surgery 1984;**200**(5):638-43
8. Stilwell NA, Wallick MM, Thal SE, et al. Myers-Briggs type and medical specialty choice: a new look at an old question. Teaching and learning in medicine 2000;**12**(1):14-20 doi: 10.1207/S15328015TLM1201_3[published Online First: Epub Date]|.
9. Turska D, Skrzypek M, Tychmanowicz A, et al. Concept of distinct surgical personality revisited. Personality traits and personal values as surgical specialty choice predictors. European Journal of Medical Technologies 2016;**1**((10)):54-59
10. Bexelius TS, Olsson C, Jarnbert-Pettersson H, et al. Association between personality traits and future choice of specialisation among Swedish doctors: a cross-sectional study. Postgraduate medical journal 2016 doi: 10.1136/postgradmedj-2015-133478[published Online First: Epub Date]|.
11. Buddeberg-Fischer B, Klaghofer R, Abel T, et al. Swiss residents' speciality choices--impact of gender, personality traits, career motivation and life goals. BMC health services research 2006;**6**:137 doi: 10.1186/1472-6963-6-137[published Online First: Epub Date]|.
12. Doherty EM, Nugent E. Personality factors and medical training: a review of the literature. Medical education 2011;**45**(2):132-40 doi: 10.1111/j.1365-2923.2010.03760.x[published Online First: Epub Date]|.
13. Hojat M, Nasca TJ, Magee M, et al. A comparison of the personality profiles of internal medicine residents, physician role models, and the general population. Academic medicine : journal of the Association of American Medical Colleges 1999;**74**(12):1327-33
14. King SH, McArthur CG, Norman JC. The Surgical Personality: A Comparison of Medical and Surgical Residents with the Rorschach. Cardiovascular diseases 1975;**2**(2):117-28
15. Gilligan JH, Treasure T, Watts C. Incorporating psychometric measures in selecting and developing surgeons. Journal of management in medicine 1996;**10**(6):5-16, 2
16. Gilligan JH, Welsh FK, Watts C, et al. Square pegs in round holes: has psychometric testing a place in choosing a surgical career? A preliminary report of work in progress. Annals of the Royal College of Surgeons of England 1999;**81**(2):73-9
17. Greenburg AG, McClure DK, Penn NE. Personality traits of surgical house officers: faculty and resident views. Surgery 1982;**92**(2):368-72

18. Macneily AE, Alden L, Webber E, et al. The surgical personality: comparisons between urologists, non-urologists and non-surgeons. Canadian Urological Association journal = Journal de l'Association des urologues du Canada 2011;**5**(3):182-5 doi: 10.5489/cuaj.10142[published Online First: Epub Date]|.
19. McGreevy J, Wiebe D. A preliminary measurement of the surgical personality. American journal of surgery 2002;**184**(2):121-5
20. Schwartz RW, Barclay JR, Harrell PL, et al. Defining the surgical personality: a preliminary study. Surgery 1994;**115**(1):62-8
21. Subramanian P, Kantharuban S, Subramanian V, et al. Orthopaedic surgeons: as strong as an ox and almost twice as clever? Multicentre prospective comparative study. Bmj 2011;**343**:d7506 doi: 10.1136/bmj.d7506[published Online First: Epub Date]|.
22. Digman JM. Personality Structure: Emergence of the Five-Factor Model. Annu. Rev. Psychol. 1990;**41**:417-40
23. Tupes EC, Christal RE. *Recurrent personality factors based on trait ratings.* USAF ASD Tech. Re. No. 61-97. Lackland Air Force Base, Tx: U.S. Air Force, 1961.
24. Gosling SD, Rentfrow PJ, Swann WB. A very brief measure of the Big-Five personality domains. Journal of Research in Personality 2003;**37**:504-28
25. Foulkrod KH, Field C, Brown CV. Trauma surgeon personality and job satisfaction: results from a national survey. The American surgeon 2010;**76**(4):422-7
26. Muck PM, Hell B, Gosling SD. Construct validation of a short five-factor model instrument. European Journal of Psychological Assessment 2007;**23**(3):166-75
27. Hurtz GM, Donovan JJ. Personality and job performance: the Big Five revisited. The Journal of applied psychology 2000;**85**(6):869-79
28. Poropat AE. A meta-analysis of the five-factor model of personality and academic performance. Psychological bulletin 2009;**135**(2):322-38 doi: 10.1037/a0014996[published Online First: Epub Date]|.
29. McCulloch P, Kaul A, Wagstaff GF, et al. Tolerance of uncertainty, extroversion, neuroticism and attitudes to randomized controlled trials among surgeons and physicians. The British journal of surgery 2005;**92**(10):1293-7 doi: 10.1002/bjs.4930[published Online First: Epub Date]|.
30. McCrae RR, John OP. An introduction to the five-factor model and its applications. Journal of personality 1992;**60**(2):175-215

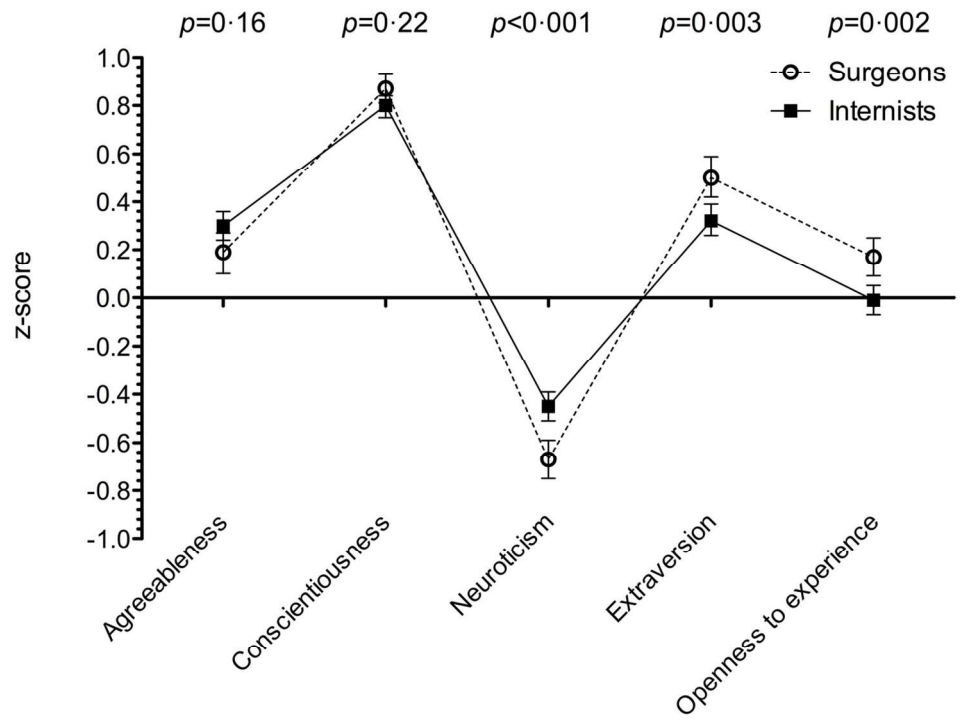
Personality dimensions of the Five Factor Model (FFM) and their descriptors according to McCrae and John.[30]

71x30mm (300 x 300 DPI)



Mean z-scores and 95% confidence intervals (CI) for each of the Five Factor Model personality traits in board-certified physicians. Y-axis: z-score; X-axis: Personality item. A z-score of 0 corresponds to the population mean for the corresponding personality trait in the normative data. All reported P values are from post-hoc two-sample unpaired t-tests with Bonferroni correction to account for multiple comparisons and Satterthwaite approximation to correct for unequal variances and unequal sample sizes.

64x49mm (600 x 600 DPI)



Mean z-scores and 95% confidence intervals (CI) for each of the Five Factor Model personality traits in board-certified surgeons or medical doctors. Y-axis: z-score; X-axis: Personality item. A z-score of 0 corresponds to the population mean for the corresponding personality trait in the normative data. All reported P values are from post-hoc two-sample unpaired t-tests with Bonferroni correction to account for multiple comparisons and Satterthwaite approximation to correct for unequal variances and unequal sample sizes.

64x49mm (600 x 600 DPI)

Supplementary table 1:

Medical and surgical subspecialties of board-certified physicians (specialists) and residents in training, or intended specialties of medical students included in the analysis. "Other" specialties refer to those not included in the analysis comparing medical doctors to surgeons. ENT = Ears, Nose and Throat. * Indicates the medical specialties that were compared to surgical specialties (°) in a subgroup analysis.

	Specialists (n=2345)	Residents (n=1453)	Students (n=1350)
Medical doctors (n=1892)			
Intensive care / Emergency medicine	40 (4.85%)	25 (4.47%)	51 (10.04%)
General internal medicine*	116 (14.06%)	125 (22.36%)	59 (11.61%)
Angiologist*	11 (1.33%)	3 (0.54%)	1 (0.20%)
Endocrinologist*	32 (3.88%)	10 (1.79%)	10 (1.97%)
Gastroenterologist*	51 (6.18%)	29 (5.19%)	30 (5.91%)
Hematologist / Oncologist*	61 (7.39%)	42 (7.51%)	51 (10.04%)
Infectiologist*	15 (1.82%)	13 (2.33%)	8 (1.57%)
Cardiologist*	83 (10.06%)	61 (10.91%)	55 (10.83%)
Nephrologist*	38 (4.61%)	31 (5.55%)	19 (3.74%)
Pulmonary specialist*	30 (3.64%)	13 (2.33%)	6 (1.18%)
Rheumatologist*	34 (4.12%)	13 (2.33%)	9 (1.77%)
Neurologist	109 (13.21%)	98 (17.53%)	76 (14.96%)
Pediatrician	187 (22.67%)	91 (16.28%)	130 (25.59%)
Geriatric medicine	18 (2.18%)	5 (0.89%)	3 (0.59%)
	n=825 (100%)	n=559 (100%)	n=508 (100%)
Surgeons (n=1035)			
ENT surgeon	31 (6.67%)	15 (4.75%)	18 (7.09%)
General surgeon°	35 (7.53%)	44 (13.92%)	38 (14.96%)
Heart surgeon°	21 (4.52%)	19 (6.01%)	17 (6.69%)
Maxillofacial surgeon	23 (4.95%)	21 (6.65%)	8 (3.15%)
Neurosurgeon	84 (18.06%)	87 (27.53%)	34 (13.39%)
Orthopedic surgeon°	74 (15.91%)	46 (14.56%)	69 (27.17%)
Pediatric surgeon	39 (8.39%)	14 (4.43%)	12 (4.72%)
Plastic surgeon	14 (3.01%)	15 (4.75%)	21 (8.27%)
Thoracic surgeon°	10 (2.15%)	1 (0.32%)	4 (1.57%)

Vascular surgeon°	29 (6.24%)	8 (2.53%)	4 (1.57%)
Visceral surgeon°	74 (15.91%)	26 (8.23%)	14 (5.51%)
Urologist	31 (6.67%)	20 (6.33%)	15 (5.91%)
	n=465 (100%)	*n=316 (100%)*	*n=254 (100%)*
Other (n=2221)			
Anesthesiologist	222 (21.04%)	72 (12.46%)	100 (17.01%)
Child psychiatrist	23 (2.18%)	19 (3.29%)	10 (1.70%)
Clinical pathology	26 (2.46%)	4 (0.69%)	8 (1.36%)
Dermatologist	60 (5.69%)	39 (6.75%)	24 (4.08%)
Forensic pathologist	10 (0.95%)	9 (1.56%)	12 (2.04%)
General physician	217 (20.57%)	120 (20.76%)	204 (34.69%)
Gynecologist	135 (12.80%)	56 (9.69%)	78 (13.27%)
Microbiologist	14 (1.33%)	7 (1.21%)	5 (0.85%)
Ophthalmologist	47 (4.45%)	40 (6.92%)	29 (4.93%)
Pathologist	35 (3.32%)	20 (3.46%)	8 (1.36%)
Physical-/rehabilitational medicine	11 (1.04%)	7 (1.21%)	3 (0.51%)
Psychiatrist	99 (9.38%)	81 (14.01%)	55 (9.35%)
Radiologist	105 (9.95%)	74 (12.80%)	43 (7.31%)
Radiotherapist/Nuclear medicine	51 (4.83%)	30 (5.19%)	9 (1.53%)
	n=1055 (100%)	*n=578 (100%)*	*n=588 (100%)*

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	3
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	5
Bias	9	Describe any efforts to address potential sources of bias	*5*
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	6
		(*b*) Describe any methods used to examine subgroups and interactions	6
		(*c*) Explain how missing data were addressed	6
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	6
		(*e*) Describe any sensitivity analyses	6
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7
		(b) Give reasons for non-participation at each stage	7
		(c) Consider use of a flow diagram	7
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7
		(b) Indicate number of participants with missing data for each variable of interest	7
Outcome data	15*	Report numbers of outcome events or summary measures	7
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	7
		(*b*) Report category boundaries when continuous variables were categorized	7
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	7
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	7
Discussion			
Key results	18	Summarise key results with reference to study objectives	8
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	9/10
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	9/10
Generalisability	21	Discuss the generalisability (external validity) of the study results	9/10
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	2

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.