Distribution of Psychological Instability Among Surgeons

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■ BACKGROUND: **High emotional instability (i.e., neuroticism) is associated with poor mental health. Conversely, traumatic experiences may increase neuroticism. Stressful experiences such as complications are common in the surgical profession, with neurosurgeons being particularly affected. We compared the personality trait neuroticism between physicians in a prospective cross-sectional study.**

■ METHODS: **We used an online survey using the Ten-Item Personality Inventory, an internationally validated measure of the 5-factor model of personality dimensions. It was distributed to board-certified physicians, residents, and medical students in several European countries and Canada (n = 5148). Multivariate linear regression was used to model differences between surgeons, nonsurgeons, and specialties with occasional surgical interventions with respect to neuroticism, adjusting for sex, age, age squared, and their interactions, then testing equality of parameters of adjusted predictions separately and jointly using Wald tests.**

■ RESULTS: **With an expected variability within disciplines, average levels of neuroticism are lower in surgeons than nonsurgeons, especially in the first part of their career. However, the course of neuroticism across age follows a quadratic pattern, that is, an increase after the initial decrease. The acceleration of neuroticism with age is specifically significant in surgeons. Levels of neuroticism are lowest towards mid-career, but exhibit a strong secondary increase towards the end of the surgeon's career. This pattern seems driven by neurosurgeons.**

■ CONCLUSIONS: **Despite initially lower levels of neuroticism, surgeons suffer a stronger increase of neuroticism together with age. Because, beyond well-being, neuroticism influences professional performance and health care systems costs, explanatory studies are mandatory to enlighten causes of this burden.**

INTRODUCTION

> "Every surgeon carries within himself a small cemetery, where from time to time he goes to pray—a place of bitterness and regret, where he must look for an explanation for his failures."
>
> René Leriche, *La philosophie de la chirurgie*, 1951[1]

Mental health differs between medical practitioners and the general population, and suicide risk is increased in physicians.[2-4] Emotional distress in practitioners not only has negative effects on the individual, it also weighs on patient care and even on the health care system.[5,6]

Distress can result from the occurrence of adverse clinical events, especially individual errors and surgical incidents, such as complications, with demonstrated negative impacts on health and wellbeing.[7-10] Emotional responses of health care professionals to adverse clinical events with intense professional suffering and possible long-term impact thus create a "second victim".[11,12] Health care professionals are exposed to such experiences over their careers,[6,13] especially in the surgical field,[12,14] and the

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- Medicine
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Abbreviations and Acronyms
FFM: Five-factor model

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impact of complications can be devastating, especially in neurosurgery.

Neuroticism, the opposite of emotional stability, is one of the "higher-order factors" used to describe personality in the classic Five-Factor Model (FFM).[15-17] It reflects a tendency to experience negative emotions such as irritability, anxiety, and sadness. It has been identified as a strong health predictor.[18,19] It is associated with depression and other psychopathologic states,[20-22] with burnout and psychological distress[23-25] as well as perceived job stress.[26] Generally, neuroticism appears to decrease somewhat with age,[27-29] even if the literature is not perfectly consistent on this subject.[30] Deteriorated quality of life and stressful life events may increase neuroticism.[31-35] Stressful life events might also alter the normative development trajectory, so that expected age-related reduction of neuroticism does not occur.[36-38]

We hypothesized that, contrary to the general population, in medical professionals, neuroticism increases with age, as adverse experiences accumulate over time. Second, we hypothesized that surgeons, and especially neurosurgeons, who face more adverse events that are directly causal to their actions, may be at a higher risk compared with physicians in nonsurgical specialties.

METHODS

Survey Design and Distribution

We used data collected by means of an online survey (prospective, cross-sectional study design; for details see Stienen et al.[39]). The survey was conducted in Austria, Belgium, Canada, Germany, and Switzerland, collecting respondents' age, sex, primary language, level of training (board-certified physician, resident, or medical student), as well as the (intended) medical specialty. Data was collected from February 12, 2016, to May 12, 2016. The study was submitted to the institutional review board of the Canton St. Gallen, Switzerland (EKSG 16/020) and the "Comité d'Ethique 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.

Study Variables

Our key outcome variable was neuroticism, measured by the Ten-Item Personality Inventory, an internationally validated short measure of the FFM.[40] The latter comprehensively describes personality using 5 higher-order factors: agreeableness, conscientiousness, openness to experience, neuroticism, and extraversion.[15] For assessing neuroticism, participants rate the extent to which they agree (1 = "Disagree strongly" to 7 = "Agree strongly") with the statements of being anxious and easily upset as well as being calm and emotionally stable (reversed item).[40] The score for neuroticism is the average of both items. 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-report, observer report and peer report, test–retest reliability, patterns of predicted external correlates, and convergence between self and observer ratings.[41]

We used raw and unstandardized test scores and included age and sex in our models to adjust for these factors. Respondents were categorized based on the discipline they stated to be: nonsurgeons (nonsurgical disciplines with clinical patient contact), surgeons, or "occasionals" (specialties with clinical patient contact and occasional invasive interventions). **Supplementary Table 1** provides an overview of the assignment of subspecialties to these 3 categories.

Statistical Analysis

Continuous data are reported as mean and standard deviation (SD) and were compared using 2-sample unpaired t tests. Potential bias due to unequal variances and unequal sample sizes was accounted for by the Satterthwaite approximation.

Multivariate linear regression was used to model differences between nonsurgeons, surgeons, neurosurgeons, and occasionals with respect to neuroticism. We adjusted for sex and age and included age squared to allow for a change in the association of age and levels of neuroticism as we expect. To analyze differences between nonsurgeons, surgeons, neurosurgeons, and occasionals, marginal effects were calculated, and their differences tested using Wald tests. All statistical tests were 2-sided and P values <0.05 were considered statistically significant. All analysis were performed in Stata, version 17.0 (StataCorp LP, College Station, TX).

Analysis Sample

A total of 5148 respondents completed the survey.[39] Excluding specialties without direct clinical contact to patients (as outlined under Study Variables), that is, clinical pathologists, forensic pathologists, microbiologists, pathologists, and radiologists, leaves us with a final analytical sample of 4678 cases, with 2200 nonsurgeons (age 35.4 ± 11.7 years; 55.7% female), 1035 surgeons (age 34.9 ± 11.2 years; 41.3% female), and 1443 occasionals (age 36.9 ± 13.1 years; 60.4% female).

RESULTS

On average, surgeons score lower on neuroticism (1.5) than nonsurgeons (1.9) and occasionals (1.9), yielding a statistically significant difference between groups as determined by one-way ANOVA ($F(2, 4{,}675) = 40.06$, $P < 0.001$). Multivariate linear regression suggests that these differences remain when adjusting for age and sex (Model 1, **Table 1**). Model 1 further provides evidence that male physicians score on average lower on neuroticism than female physicians do and that there is a negative association with age. Model 2 shows that these findings hold when allowing for an interaction between specialty and age. Model 3 further allows this interaction to vary over sex, Model 4 allows for a quadratic age pattern.

Overall, all models support a linear negative association of age with levels of neuroticism. Model 4 suggests that this decline is more pronounced for surgeons. Furthermore, Model 4 provides evidence that there is a significant quadratic pattern of age with respect to neuroticism for surgeons.

Plotting marginal effects derived from Model 4 (**Figure 1**) we see that overall levels of neuroticism decline with age, but increase again at some point following a U-shaped pattern. This pattern is most pronounced for surgeons, with the quadratic age terms

Table 1. Predicting Levels of Neuroticism for Nonsurgeons, Surgeons, and Occasionals

Specialty group (ref: Non-surgeons)	Model 1	Model 2	Model 3	Model 4
Surgeons	−0.330‡	−0.501‡	−0.651†	0.694
	(0.0470)	(0.151)	(0.242)	(0.618)
Occasionals	−0.00707	−0.155	−0.140	0.944
	(0.0420)	(0.128)	(0.177)	(0.554)
Age/100	−0.446†	−0.688†	−1.607‡	−5.950†
	(0.155)	(0.228)	(0.345)	(1.987)
Male (ref: Female)	−0.428‡	−0.429‡	−1.118‡	−1.056*
	(0.0380)	(0.0380)	(0.173)	(0.515)
Surgeons × Age/100		0.486	0.643	−7.102*
		(0.411)	(0.729)	(3.354)
Occasionals × Age/100		0.411	0.290	−5.735
		(0.335)	(0.504)	(3.025)
Surgeons × Male			0.494	−0.662
			(0.319)	(0.875)
Occasionals × Male			−0.0493	−0.990
			(0.269)	(0.836)
Male × Age/100			1.772‡	1.883
			(0.464)	(2.691)
Surgeons × Male × Age/100			−0.851	5.806
			(0.899)	(4.575)
Occasionals × Male × Age/100			0.244	5.616
			(0.695)	(4.310)
Age/100 × Age/100				5.673*
				(2.557)
Surgeons × Age/100 × Age/100				10.10*
				(4.275)
Occasionals × Age/100 × Age/100				7.418
				(3.824)
Male × Age/100 × Age/100				−0.738
				(3.299)
Surgeons × Male × Age/100 × Age/100				−8.643
				(5.622)
Occasionals × Male × Age/100 × Age/100				−6.802
				(5.168)
Constant	2.262‡	2.347‡	2.676‡	3.432‡
	(0.0592)	(0.0838)	(0.119)	(0.361)
Observations	4,678	4,678	4,678	4,678
Adjusted R^2	0.049	0.049	0.055	0.066

Standard errors in parentheses.
*$P < 0.05$.
†$P < 0.01$.
‡$P < 0.001$.

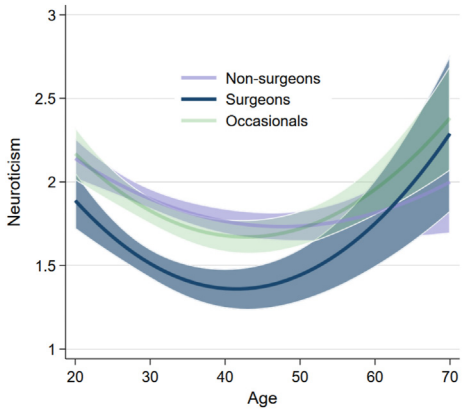

Figure 1. Linear predictions of levels of neuroticism across age for nonsurgeons, surgeons, and occasionals. Shaded areas are 95% confidence intervals. Estimates based on Model 4 (see **Table 1**), restricted to respondents aged 20 to 70 years and averaged over sex.

being jointly significantly different between nonsurgeons, surgeons, and occasionals ($F(2, 4{,}660) = 3.38$, $P = 0.034$).

In a subanalysis, we find that the prominent pattern for surgeons was particularly driven by neurosurgeons (see **Supplementary Table 2**) with the quadratic age pattern being jointly significantly different between neurosurgeons, surgeons, nonsurgeons, and occasionals ($F(3, 4{,}654) = 2.75$, $P = 0.041$).

DISCUSSION

The present cross-sectional observational study indicates a distinct pattern of the personality facet neuroticism within the medical field, across age and sex. It shows significant differences between surgical and other medical specialties.

As described before,[39,42] internists score, on average, higher on neuroticism than surgeons, including after adjustment for sex, especially in the first part of their career. It is plausible that relatively low baseline neuroticism helps surgeons to make incisive and irreversible decisions with less anxiety in critical situations. Lower neuroticism scores among surgeons are probably correlated with personality traits and non-technical skills inherent to the choice of pursuing a career in surgery.[43-45]

The current results also replicate findings that women score higher on neuroticism than men.[27] Furthermore, we found that both female and male internists' degree of neuroticism differs from that of female and male surgeons', respectively. This strengthens the notion of a personality trait difference, specifically neuroticism, in surgeons versus nonsurgeons, independently of sex differences.

To the best of our knowledge, no previous data about neuroticism in clinicians of different disciplines across age has been published. In the general population, mostly decreasing patterns were described in longitudinal,[28,29,46] as well as cross-sectional studies.[47,48] There are some previous data showing higher levels of neuroticism in older surgeons compared with younger surgeons.[49] We hypothesize that the impact of repeated adverse work-related events, accumulating over time in a surgical career, increase neuroticism in physicians with time.

Our results indeed provide evidence for a significant quadratic pattern of age with respect to neuroticism in all disciplines, with a clearer pronouncement in surgeons. This prominent pattern seems especially driven by neurosurgeons. While surgeons start with lower levels of neuroticism compared with other medical personnel, older surgeons show increased levels of neuroticism. This pattern is not statistically significant in physicians with occasional interventional tasks and nonsurgeons. This is possibly explained by the intensity of work-related negative impacts through directly experienced adverse events. Indeed, surgical incidents have been shown to generate significant negative personal and professional impact.[8,10,50] Surgeons must take greater individual risks and are thus more prone to concrete, immediate, and severe adverse work-related events.[51] They are mostly directly involved in adverse events and often attribute these to their own capabilities[50] and thus tend to feel responsible and blame themselves.[52] If, in addition to these general aspects, the extent of the damage caused by the operated organ is taken into account, neurosurgeons seem to be particularly affected. Balch and Shanafelt[53] reported that nearly 9% of surgeons perceive to have made a recent major medical error, and these surgeons score higher on suicide ideation, depression, and burnout.[53] According to Han and colleagues,[54] 80% of the studied surgeons reported at least 1 intraoperative adverse event in the past year, and intraoperative events only represent one, though very immediately apparent, type of surgical complication. An unwritten code of social norms and expectations—including the value attributed to "not complaining" or keeping emotions from interfering with one's work[53]—as well as convictions to be more resilient in comparison to nonsurgeons, reflect a unique overall surgical attitude. This might lead to silent suffering and not seeking adequate support.[10,55,56] Competitive and nonsupportive working cultures seem to hinder support seeking and might aggravate impacts of adverse events.[54] Thus, being more prone to, and possibly more affected by, these kinds of negative events adds strength to our hypothesis that negative work-related incidents affect well-being and performance not only directly,[10] but through progressively increasing neuroticism over a career, with further negative collateral impact.

Further longitudinal investigations could strengthen this hypothesis, help understand the impacts of negative incidents, and design strategies to lower these impacts. Indeed, in this perspective, neuroticism's significant economic burden[57] and personal negative effect,[58] as well as negative impact on job performance,[59] highlight the importance of further investigation of these findings. We concur with the assumption of Ullström et al.[60] that psychological and institutional support are likely to lower the negative impacts of adverse events. Additionally, a change of attitudes towards medical errors and incidents could evolve: Errors can be analyzed from an structural instead of an individual perspective[61]; learning from medical errors can be strengthened as a coping mechanism.[62] This type of changed attitude could improve not only the direct well-being of physicians, but also their performance and, ultimately, overall patient outcomes. In addition, complications are clearly underreported in

the medical literature at present. It is somewhat easier to publish a series of successful cases than to report complications. Upgrading the reporting of complications could be beneficial to the surgeon, the patients, and the entire health care system.[63] Previous work has already underlined the benefit of perceived social support on neuroticism[64] as well as favorable psychotherapeutic treatment effects on neuroticism.[65,66] In short, adequate support might lower perceived stress[12] and prevent increase of neuroticism with its associated negative implications.

Limitations

Our analytical strategy aims to provide a description of cross-sectional data but does not allow for a causal interpretation. For the limited number of recorded baseline variables, we were unable to adjust for other factors, for example, at the individual and job level. We could not consider possible changing personality characteristics of physicians or changing profiles concerning the chosen discipline over time. We also could not observe traumatic events during the professional career, as this information was not available. Another limitation is the self-selection of respondents into survey participation. This is also true for neurosurgeons, whose numbers might be considered too small to reliably determine their relative importance for some of the observed associations. All in all, the external validity stays unclear. Nevertheless, the findings of this study are of tremendous importance and give ground for further investigation with the ultimate aim to improve practitioners' wellbeing and patient care.

CONCLUSIONS

Surgeons show higher emotional stability than their medical colleagues and the general population at the beginning of their careers. First, emotional stability further increases, but then neuroticism rises above initial levels with advancing age. This finding is alarming, even if taking into account the current study limitations and its descriptive nature. Are surgeons not only carrying their "inner cemetery", as Leriche described, but also paying a high personal cost for their work? The hypothesis that traumatic or stressful work experiences contribute to this finding needs to be tested in further investigations. Meanwhile, we suggest that easily accessible and systematic psychological support throughout the career, as well as a change of attitudes towards medical errors and incidents, are likely to show benefits, without expected negative impacts, regarding physicians' mental health and work quality.

CONTRIBUTORS

Those persons listed as authors on the article have made substantial contributions to the conception or design of the work, and have been involved in acquiring, analyzing, or interpreting the data for the work. They all have been active in drafting or revising the manuscript for important intellectual content, which is the basis of the current article. Concept: ALK, RS, ES, WS. Data collection: MNS, FS, WS. Data analysis: RS, ALK, WS. Article drafting: ALK, WS, FS, RS, GR. Critical revision: all authors.

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SUPPLEMENTARY DATA

Supplementary Table 1. Participants in the Survey, Sorted by Subspecialty

	Specialists (n = 2345)	Residents (n = 1453)	Students (n = 1350)
Non-surgeons (n = 1892)			
Intensive care / Emergency medicine	40 (4.18%)	25 (3.75%)	51 (8.85%)
General internal medicine	116 (12.11%)	125 (18.77%)	59 (10.24%)
Angiologist	11 (1.15%)	3 (0.45%)	1 (0.17%)
Endocrinologist	32 (3.34%)	10 (1.50%)	10 (1.74%)
Gastroenterologist	51 (5.32%)	29 (4.35%)	30 (5.21%)
Hematologist / Oncologist	61 (6.37%)	42 (6.31%)	51 (8.85%)
Infectiologist	15 (1.57%)	13 (1.95%)	8 (1.39%)
Cardiologist	83 (8.66%)	61 (9.16%)	55 (9.55%)
Nephrologist	38 (3.97%)	31 (4.65%)	19 (3.30%)
Pulmonary specialist	30 (3.13%)	13 (1.95%)	6 (1.04%)
Rheumatologist	34 (3.55%)	13 (1.95%)	9 (1.56%)
Neurologist	109 (11.38%)	98 (14.71%)	76 (13.19%)
Pediatrician	187 (19.52%)	91 (13.66%)	130 (22.57%)
Geriatric medicine	18 (1.88%)	5 (0.75%)	3 (0.52%)
Child psychiatrist	23 (2.40%)	19 (2.85%)	10 (1.74%)
Physical-/Rehabilitational medicine	11 (1.15%)	7 (1.05%)	3 (0.52%)
Psychiatrist	99 (10.33%)	81 (12.16%)	55 (9.55%)
	n = 958 (100%)	n = 666 (100%)	n = 576 (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%)*
Occasionals (n = 2221)			
Anesthesiologist	222 (33.33%)	72 (20.17%)	100 (22.52%)
Dermatologist	60 (8.20%)	39 (10.92%)	24 (5.41%)
General physician	217 (29.64%)	120 (33.61%)	204 (45.95%)
Gynecologist	135 (18.44%)	56 (15.69%)	78 (17.57%)

Continues

Supplementary Table 1. Continued

	Specialists (n = 2345)	Residents (n = 1453)	Students (n = 1350)
Ophthalmologist	47 (6.42%)	40 (11.20%)	29 (6.53%)
Radiotherapist/Nuclear medicine	51 (6.97%)	30 (8.40%)	9 (2.03%)
	n = 732 (100%)	n = 357 (100%)	n = 444 (100%)
Excluded (n = 380)			
Clinical pathology	26 (13.68%)	4 (3.51%)	8 (10.53%)
Forensic pathologist	10 (5.26%)	9 (7.89%)	12 (15.79%)
Microbiologist	14 (7.37%)	7 (6.14%)	5 (6.58%)
Pathologist	35 (18.42%)	20 (17.54%)	8 (10.53%)
Radiologist	105 (55.26%)	74 (64.91%)	43 (56.58%)
	n = 190 (100%)	*n = 114 (100%)*	*n = 76 (100%)*

Values are provided as n (%). Subspecialties included in the analysis are those nonsurgical disciplines with clinical patient contact, surgeons from disciplines with regular surgical interventions, and "occasional surgical" specialties with clinical patient contact and occasional invasive or surgical interventions. Specialties without direct clinical contact to patients were excluded. ENT, ears, nose, and throat.

Supplementary Table 2. Predicting Levels of Neuroticism for Nonsurgeons, Surgeons, Occaisonals, and Neurosurgeons

Specialty group (ref: Non-surgeons)	Model 1	Model 2	Model 3	Model 4
Surgeons	−0.344*** (0.0506)	−0.495** (0.162)	−0.477 (0.263)	0.114 (0.785)
Occasionals	−0.00719 (0.0420)	−0.155 (0.128)	−0.140 (0.177)	0.944 (0.554)
Neurosurgeons	−0.273** (0.0909)	−0.560 (0.313)	−1.349** (0.499)	1.613 (1.112)
Age/100	−0.443** (0.155)	−0.687** (0.228)	−1.607*** (0.345)	−5.950** (1.988)
Male (ref: Female)	−0.430*** (0.0380)	−0.430*** (0.0380)	−1.118*** (0.173)	−1.056* (0.515)
Surgeons × Age/100		0.428 (0.439)	0.0873 (0.800)	−3.641 (4.470)
Occasionals × Age/100		0.411 (0.335)	0.290 (0.504)	−5.735 (3.027)
Neurosurgeons × Age/100		0.830 (0.875)	2.776 (1.454)	−11.83* (5.350)
Surgeons × Male			0.238 (0.346)	−0.0869 (1.029)
Occasionals × Male			−0.0493 (0.269)	−0.990 (0.836)
Neurosurgeons × Male			1.457* (0.641)	−1.710 (1.684)
Male × Age/100			«l yy2*** (0.464)	1.883 (2.692)
Surgeons × Male × Age/100			−0.143 (0.977)	2.130 (5.572)
Occasionals × Male × Age/100			0.244 (0.695)	5.616 (4.311)
Neurosurgeons × Male × Age/100			−3.516 (1.825)	11.96 (8.535)
Age/100 × Age/100				5.673* (2.558)
Surgeons × Age/100 × Age/100				5.431 (5.992)
Occasionals × Age/100 × Age/100				7.418 (3.825)
Neurosurgeons × Age/100 × Age/100				15.06** (5.805)
Male × Age/100 × Age/100				−0.738 (3.300)
Surgeons × Male × Age/100 × Age/100				−3.589 (7.139)
Occasionals × Male × Age/100 × Age/100				−6.802 (5.170)
Neurosurgeons × Male × Age/100 × Age/100				−15.71 (10.12)

Continues

Supplementary Table 2. Continued

Specialty group (ref: Non-surgeons)	Model 1	Model 2	Model 3	Model 4
Constant	2.261*** (0.0593)	2.348*** (0.0838)	2.676*** (0.119)	3.432*** (0.361)
Observations	4678	4678	4678	4678
Adjusted R^2	0.049	0.049	0.055	0.066

Standard errors in parentheses: * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$.