

## **European Medical Students' Views On Neurosurgery, With Emphasis On South-East Europe (Albania Greece, Serbia, And Turkey)**

### **Introduction**

Medical students tend to choose an area of specialization based on their experience in medical schools. Neurosurgery is an exciting and dynamic surgical specialty that embraces advanced technology. It is also extraordinarily multidirectional. Although neurosurgery should be a popular career choice among medical graduates, this is frequently not what we experience.<sup>1</sup>

Currently, there is a trend for medical students to move away from surgical specialties, including neurosurgery. Work-life balance, duration of education/training, and heavy workload seem to play a pivotal role.<sup>2,3</sup> As representatives of this challenging and most rewarding specialty, the authors are concerned that there will be a growing gap between the demand for board-certified neurosurgeons and the number of new, talented physicians entering the neurosurgery field in the near future, as has already been described in the literature.<sup>4</sup> This could potentially further increase the workload and consequently reduce further the number of doctors attracted to the field of neurosurgery. This phenomenon could also negatively affect diversity in neurosurgery. Our study aims to evaluate the medical student's perceptions of neurosurgery and shed light on how we can improve the appeal of our specialty.

Increasing awareness of neurosurgery career pathways in medical schools will provide potential neurosurgeons with a comprehensive understanding of the specialty's merits and demands, enabling the selection of the most able and suitable candidates. Equipping aspiring surgeons with informed insights into neurosurgical practice will help maintain the pursuit of excellence within the neurosurgery domain.<sup>5</sup>

### **Materials and Methods**

#### ***Study methodology***

A comprehensive, 33-question, digital survey in English was created using the Survey Monkey platform. The survey was distributed to medical students across Europe through European national neurosurgical societies, the European Association of Neurosurgical Societies (EANS), and the authors' Universities. The survey aimed to investigate European undergraduate student's perceptions of neurosurgery. The survey link was distributed to the target group via email as well as other social media platforms.

#### ***Survey Structure***

The survey was divided into three sections. The first section gathered demographic information from the participants. The second section contained questions regarding the choice of specialty after graduating from medical school. The third section aimed to explore general perceptions of neurosurgery and the factors influencing the decision-making process specifically looking at factors relating to the pursuit of neurosurgery as a career path. The majority of the questions were presented as 5-point Likert scale items, ranging from "Entirely agree" to "Strongly disagree," while open-ended and multiple-choice questions were also included to obtain detailed qualitative insights.

#### ***Data Collection***

Survey responses were collected anonymously to ensure participant privacy and confidentiality. Incomplete responses were omitted to ensure data accuracy and consistency. Participants were informed of the voluntary nature of their participation and given the option to withdraw without consequences. Each participant was assigned a unique identifier, preserving anonymity. Measures were taken to protect data against unauthorized access, with only research-team members involved in analysis allowed access. Data storage was secure, with physical and digital records stored in locked and password-protected locations.

### ***Statistical analysis***

The analysis was performed using the IBM SPSS (Statistical Package for the Social Sciences) version 22. Age was presented as a continuous variable using mean value and standard deviation. All survey responses were summarized using counts and proportions. Survey answers were analyzed based on the participants' gender and responses were compared using Pearson's chi-square or Fisher's exact test. The threshold for statistical significance was set at  $p < 0.05$ .

### **Results**

Over a period of nine months (September 2021 – May 2022), 1,115 medical students from 17 countries across Europe participated in the survey. A total of 834 (74.8%) responders completed the questionnaire. Incomplete responses were excluded from the analysis.

#### ***Demographics***

There were 565 (67.7%) female and 261 (31.3%) male responders. Eight (1%) participants chose not to disclose their gender. The mean age of our study population was  $22.08 \pm 3.18$  years (ranging from 17 to 41 years). The majority of responses were collected from south-east Europe, including Albania (33.7%), Turkey (31.2%), Serbia (12.0%) and Greece (10.2%) (Table 1).

Representation of each successive year of medical school was similar. There were 134 (16.1%) first-year students, 104 (12.4%) second-year, 134 (16.1%) third-year, 150 (18%) fourth-year, 118 (14.1%) fifth-year, and 149 (17.9%) sixth-year. Also, there were 45 (5.4%) seventh-year students (this grade exists only in some European countries). The majority of the participants (97.5%) reported that they speak at least one foreign language, while more than half (66.3%) speak two or more. The most common language was English. In terms of foreign language, 22 (2.6%) of respondents reported beginner's level, while the advanced level was reported by 217 students (26%). Over one-third (39.7%) of the students stated that they were studying abroad (Table 1).

#### ***Career considerations***

We found that most of the participants (88.8%) had decided upon a likely career path in a specialty after graduation, while a minority (10.1%) had not decided yet. In total, 360 students (43.2%) were considering a surgical career. In our study population, the most favoured surgical specialty was neurosurgery (220 participants, 26.37%) ( $p < 0.001$ ). When asked who encouraged them to consider a career in neurosurgery, the most common answer (32.2%) was "neurosurgeons and neurosurgery residents" (Fig. 1).

The majority of the participants (80.2%) reported that they did not have enough knowledge about pursuing a career in neurosurgery. Over two-thirds (67.1%) answered that they did not attend any presentations about neurosurgery as a career in their medical school.

According to the X<sup>2</sup> analysis conducted in our study, 477 (57.2%) students who reported deficient knowledge about the field of neurosurgery also indicated that they did not receive any presentations during their time at medical school. The relationship between insufficient knowledge and the absence of presentations is statistically significant ( $p < 0.001$ ).

Overall, we found that the student's main source of information about neurosurgery was non-neurosurgery, medical faculty (40.2%) (Fig. 2). Furthermore, we divided the period of medical education into 2 groups; the preclinical (first 3 years of medicine) and the clinical (last 3 to 4 years of medicine, including the 7th year). The preclinical group, with less exposure to neurosurgery, exhibited a lower level of knowledge compared to the clinical group. However, a lack of information was evident in both groups. Moreover, in the preclinical group, the preference for neurosurgery was found to be significantly higher compared to the clinical group ( $p < 0.001$ ).

Regarding their career plans, 23.6% responded that they would prioritize work-life balance, 16.8% would like a professional life where family is at the forefront, 14.3% would be more career-oriented, 10.1% would follow an academic career and 17.1% had not yet decided on this issue.

### ***Perceptions of Neurosurgery***

The majority of respondents (65.5%) "entirely agreed" that neurosurgery is a respected specialty. The idea that neurosurgery requires special skills is widely accepted among students (53.2% and 34.5% responded "Entirely Agree" and "Agree", respectively). A total of 40.8% of the students agreed that long surgical procedures and irregular working hours constitute a burden for physicians. It was predicted by 43.4% (Agree) of the students that neurosurgeons' private lives are adversely affected by their heavy and unpredictable workload. This was mostly recognized by male respondents, and this gender difference was statistically significant ( $p = 0.01$ ).

Many participants replied that the heavy workload in neurosurgery negatively affects the neurosurgeon's spare time for social activities (34% were Neutral / Neither agreed nor disagreed, while 32% Agreed). This belief was also supported by males (38.7% of males agreed, while 36.8% of females were "Neutral / Neither agreed nor disagreed") ( $p < 0.001$ ). Males felt that they would not have enough time for family life or for themselves (37.3% and 32.5% agreed, respectively).

Most of the participants (47.8% entirely and 41.6%) agreed that neurosurgery is a science characterized by innovation and advanced technology. It was generally accepted that neurosurgeons follow and contribute to scientific developments (47.8% entirely agreed and 44.4% agreed). Their common belief was that it is more difficult to pursue a career in neurosurgery compared to other specialties (18,6% entirely agreed and 40,5% agreed).

45.4% of the respondents felt that the hierarchical structure of neurosurgery departments may negatively affect working conditions in neurosurgery. Females expressed a belief that there are gender differences in the behavior of neurosurgeons in such a highly stressful and demanding environment, males do not support this idea ( $p = 0.02$ ). A majority of the students surveyed expressed a belief in gender equity, with 34.5% entirely agreeing and 25.3% agreeing. Notably, 36.5% of female respondents unequivocally support equal success for both male and female neurosurgeons, whereas 26.1% of male participants remain undecided on this matter ( $p = 0.006$ ).

The hypothesis that patients prefer to have a male neurosurgeon for their consultation and surgery is agreed by a total of 39.9% of our participants. We found a statistically significant difference between male and female respondents ( $p=0.01$ ). While 42.5% of female students believe that patients prefer male neurosurgeons, 36.8% of males are undecided on this issue.

When asked if more females are interested in neurosurgery nowadays compared to ten years ago, 41.5% of the participants answered positively, while 37.2% gave a neutral answer, “neither agree nor disagree”. There was a significant difference in the response of female students (43.5% agreed) compared to their male counterparts (45.2% were neutral / neither agreed nor disagreed) ( $p=0.007$ ). 43.6% of the participants stated that they were undecided whether neurosurgery is more or less preferred than it used to be, 26% of them agreed and 13.3% entirely agreed with this statement. The increase in medicolegal cases in neurosurgery was the most common reason for this uncertainty. 49.6% of the respondents felt that overall a career in neurosurgery is attractive and provides career satisfaction (Table 2).

## Discussion

### *Students' perception of neurosurgery*

There is limited literature exploring the perspectives of medical students on neurosurgery. A few recent national studies have tackled this matter, but, our study, encompassing mainly Southern Europe, represents, to the best of our knowledge, the first, published, international survey conducted across the region. Two national surveys, one conducted in Germany with a sample size of 210 medical students, and another in Nigeria with a study population of 256 medical students, were published in 2022 and 2019, respectively.<sup>2,6,7</sup> They found that 5% of females and 10% of males in Germany, and 4% of females and 11.8% of males in Nigeria, showed interest in pursuing a career in neurosurgery.<sup>2,6,7</sup> In the Nigerian survey, although surgery was the most preferred specialty among final-year medical students, only 7.8% of the respondents reported an interest in choosing neurosurgery as a career. Factors influencing the decision not to pursue neurosurgery were the unfriendly teaching environment (52.6%), continuous industrial action (strikes), as well as the prevalence of stress among trainers and residents (27.7%).<sup>6</sup>

According to the results of a survey conducted in Saudi Arabia, with 1,014 respondents, 40% of medical students and 26% of interns would consider or declare definite interest in pursuing a career in neurosurgery.<sup>8</sup> In Ireland, 80% of students expressed that their neurosurgery training was inadequate yet 78% of them were still considering neurosurgery as a potential career in the future.<sup>9</sup> According to the 2022 Report on Residents from the Association of American Medical Colleges, only 137 medical students expressed interest in neurosurgery among a total of 12,034 who participated in the graduation questionnaire.<sup>10</sup> Eventually, less than half of them pursued neurosurgery training, while 44.5% of those who were interested in neurosurgery opted for another residency program.<sup>10</sup> In our study, 42.7% of the participants expressed an interest in entering a neurosurgery residency program. This does not reflect the numbers actually entering or completing a residency program in neurosurgery.<sup>11</sup>

### *Factors influencing specialty choice*

A review of the literature reveals 69 pertinent articles, involving a total of 882,209 students evaluates the factors influencing medical students' specialty choices.<sup>12</sup> The authors found that the 12 most important factors were: academic interests (75.3%), competencies (55.1%), controllable lifestyles or flexible work schedules (53%), patient service orientation (50%), medical teachers or mentors (46.9%), career opportunities (44%), workload or working hours (38%), income (34.7%), length of education (32.3%), prestige (31.2%), advice

(28.2%), and student debt (15.3%). Notably, economic factors such as median income and student debt influenced half of the student's choices. In addition, differences were observed between developed and developing countries.<sup>13</sup> Academic interest was higher in developed compared with developing countries, while the opposite trend was noticed for the prestige associated with a career in neurosurgery.<sup>13</sup> In 2014, Akhigbe et al. reported that 90% of their study participants agreed that neurosurgery requires not only long working hours but also an extensive training period.<sup>9</sup> Despite that, 87% of their respondents noted that neurosurgery could negatively affect family life, and 92% of them claimed that neurosurgery is associated with high prestige and income.<sup>9</sup> These findings are in agreement with our results.

Work-life balance is a significant factor that deters students from pursuing a career in neurosurgery, irrespective of gender.<sup>7,8</sup> Based on the results of recently published studies, it has been identified that females are more likely to report that neurosurgery is not a family-friendly specialty, which could be a further barrier to their interest in this field.<sup>7,8</sup> On the other hand, males express concerns about the hierarchical and unpleasant work environment in neurosurgery.<sup>7,8</sup> In our study, 23.6% of the respondents preferred a good work-life balance, while only 14.3% would be more career-oriented. These findings highlight the need to address concerns related to work-life balance, as well as creating a more welcoming and supportive work environment, to attract and retain a diverse group of talented individuals in neurosurgery.

### ***Gender differences***

There is an increasing number of studies in the pertinent literature focused on gender inequity in neurosurgery. Renfrow et al. found that between 2000 and 2009 in the US, only 12%, of 240 residents who matched into neurosurgery, were women.<sup>14</sup> They found that annually, the number of women matching into neurosurgery ranged from 11 to 3, with a trend for that number to increase over time.<sup>14</sup> On the other hand, it has been reported that the overall attrition rate of residents starting neurosurgical residency is approximately 11%, with females having higher attrition rates compared to males (18.5% and 10.3%, respectively).<sup>11</sup> Among them, 56.3% transferred to a different medical specialty, while 8.4% left clinical medicine.<sup>11</sup>

In 2016, a survey was conducted to evaluate the current gender situation in neurosurgery across Europe.<sup>15</sup> The authors reported that male neurosurgeons were significantly more likely to be married, and have children compared to their female counterparts.<sup>15</sup> Similarly, a more recent study by Lambrianou et al. found that female neurosurgeons are more likely to be unmarried or childless, have fewer children, or postpone having children due to lack of support compared with their male counterparts.<sup>16</sup> Interestingly, the authors identified lifestyle and work-life balance as the main reasons neurosurgeons would not choose neurosurgery if starting over again (58.6%).<sup>16</sup> These findings suggest some gender-based disparities in neurosurgery training and practice, which should be addressed through targeted interventions to support the career advancement of women in the field.

### ***Neurosurgery teaching in undergraduate medical curriculum***

Unlike other specialties, there are no national or international specialty-specific guidelines or curricula for teaching neurosurgery in medical schools.<sup>12,17,18</sup> In addition, due to the intensive curricula in medical schools, exposure to neurosurgery is often extremely limited. A properly and comprehensively designed curriculum will guide candidates interested in neurosurgery to create specific practice modules (such as Special Study Modules/independent projects). It will also help programs to better identify the most talented candidates.<sup>12,19</sup> Students choose their careers based on the specialties to which they have been exposed, and therefore exposure to neurosurgery is important to maintain this interest.<sup>13,20</sup> It has been found that early and significant exposure to neurosurgery has a positive educational

impact.<sup>21</sup> It enhances neurosurgery knowledge and also debunks stereotypes that could potentially deter students from pursuing neurosurgical careers.<sup>19</sup>

Despite the inadequate neurosurgery teaching, a significant proportion of students do consider neurosurgery as a potential career path.<sup>14</sup> Similarly, we found that the majority of our participants (80.2%) reported insufficient neurosurgical teaching; over two-thirds (67.1%) did not attend any neurosurgical orientation/education events in their medical school. These findings highlight a potentially serious deficiency in medical schools in terms of their perception and approach to careers in neurosurgery. This highlights the need for increased efforts to improve the quality of neurosurgical education and encourage more diversity and inclusivity.

Undoubtedly, keeping abreast with technological changes in neurosurgery necessitates a strong academic background and sound knowledge base. Advanced knowledge is associated with increased student satisfaction, which is correlated with improved outcomes. On the other hand, neurophobia is the syndrome of difficulties that medical students and young doctors face with neurology and clinical neuroscience.<sup>22</sup> The inclusion of neurosurgery in the undergraduate curriculum could reduce neurophobia and improve their neurological orientation and skills base.

Neurosurgical teaching could make a valuable contribution to the undergraduate medical curriculum. Although few medical students will pursue a career in neurosurgery, many will be exposed to managing the presenting stages of neurosurgical conditions and emergencies. Moreover, exposure to neurosurgery could be beneficial for learning and better understanding general neurology and neuroimaging by improving their general neuroscience education.<sup>21,23</sup>

Development of specific neurosurgery projects in medical school, aiming to create opportunities for all medical students to extend their studies further (beyond the core curriculum). This could support and promote innovation and research skills, and to create opportunities for professional development, could significantly contribute to their contact and familiarity with neurosurgery.<sup>24</sup>

### ***Innovation in neurosurgery***

Neurosurgery is a field that demands innovative thinking, as novel developments and advances in technology have become increasingly important. The significance and recognition of both simulation-based training and newly developed surgical instruments (such as robotic surgery and endoscopy) are growing day by day. In our study, 89.4% of the participants acknowledged that neurosurgery is a discipline characterized by innovation and technological advancements, while 92.2% believed that neurosurgeons follow and potentially contribute to scientific developments.<sup>25,26</sup>

### ***Study limitations***

Our study has some limitations; The aim of this survey was to investigate European medical student's perception of neurosurgery. We disseminated our survey across Europe and waited until a sufficient number of responses were obtained. Although medical students from 17 European countries have participated to the survey, it was not possible to avoid the underrepresentation of certain countries. Therefore, we are unable to conduct a subgroup analysis based on nationality. Since there is a predominant participation from Albania and Turkey, followed by Serbia and Greece, our results reflect mostly Southeast European students views. This is the main limitation of our study. On the other hand, to the best of our knowledge, it represents the first study incorporating data from multiple countries that

evaluates how medical students in Europe perceive neurosurgery and emphasizes the factors influencing their perspectives. A further limitation is that we were unable to report the response rate due to the distribution of our survey via social media.

Another bias in our study is the disproportionately high number of students expressing an interest in a career in neurosurgery. A possible explanation for this could be that students interested in neurosurgery might have been attracted more. A further reason could be that the respondents were influenced by the fact that the authors of the survey are neurosurgeons. Medical students who are interested in a career in neurosurgery are more likely to participate in a survey about a career in neurosurgery. This may have influenced the survey results.

## **Conclusions**

We found that most of the participating students were considering a career in some specialty upon graduation, and most of them in the field of surgery. Interestingly, neurosurgery was the most preferred surgical specialty in our study; this raises the potential that there was a bias for those students who are interested in neurosurgery to respond in greater numbers than those who had no interest in a neurosurgical career. Nevertheless, the majority reported that they did not have enough neurosurgical teaching. The main source of information about neurosurgery was non-neurosurgery, medical school faculty. Most students, in anticipating their medical careers reported they would prefer a good work-life balance. These findings highlight the need to address concerns related to work-life balance, as well as creating a more welcoming and supportive work environment. These measures will attract and retain a diverse group of talented individuals in neurosurgery.

## **Disclosure statement**

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## **Consent to participate**

At the beginning of the questionnaire, we asked participants to participate in this study only if they were willing to give us their consent.

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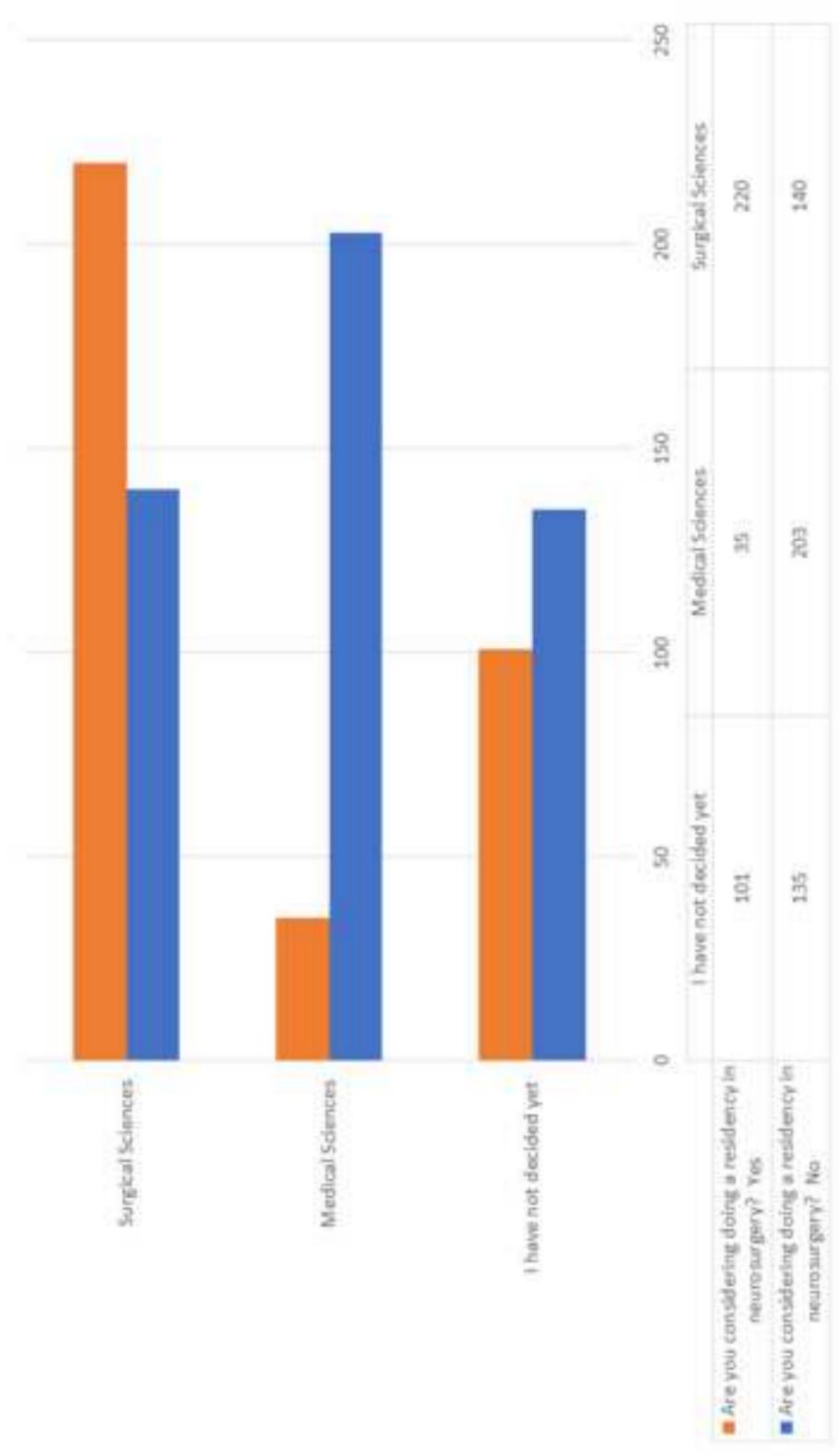
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### Figure legends

**Figure 1:** The distribution of specialty preferences among medical students considering surgical fields. The highest percentage of participants (26.37%) showed a preference for neurosurgery, which was found to be the most favored surgical specialty ( $p < 0.001$ )

**Figure 2:** Sources of information about neurosurgery. The most common source of information was medical faculty (40.2%).

Figure(1)



■ Are you considering doing a residency in neurosurgery? Yes ■ Are you considering doing a residency in neurosurgery? No

