



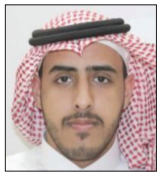
Original Article

Factors affecting the choice of becoming a neurosurgeon in the western region of Saudi Arabia

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ABSTRACT

Background: The preference of medical specialty for students can start even before enrollment into medical school, or as late as following their graduation. During their senior years, students often get a prospective on the working environment and the difficulties faced in the field. This, along with other factors, can strongly alter their career choice. This study aims to explore the degree of interest in neurosurgical specialty among medical students and the factors influencing their choice of becoming a neurosurgeon in the western region of Saudi Arabia.

Methods: This is a cross-sectional study which was done across three universities of the western region of Saudi Arabia including King Saud bin Abdulaziz University for Health Sciences, Umm Al Qura University, and King Abdulaziz University.

Results: A sample of 1023 students from the second medical year up to the internship was conducted, and out of them, 585 (57.2%) were males and 438 (42.8%) were females. Three hundred and fifty-nine (35.1%) of the students were interested in neurosurgery, while 664 (64.9%) were not. The data show that females have more interest (40.8% of females) compared to males (35.1% of males). Furthermore, there was a general trend toward a decrease in the interest in neurosurgery with time. The impact on patients "rewarding feeling" was the most reported attraction to the specialty, followed by income. Stress was the most reported deterring factor among students. Neurosurgery is one of the most challenging specialties, yet it is still considered one of the most competitive ones.

Conclusion: Many factors have been found to influence medical students' choices to apply for neurosurgical training as we described. Interestingly, we noted higher interest among female students, and among college freshmen compared to their counterparts. Further studies should be conducted on a larger scale to analyze these findings.

Keywords: Neurosurgery, Neurosurgery's attractive, Neurosurgery's students, Students interest

INTRODUCTION

The preference of medical specialty for students can start even before enrollment into medical school, or as late as following their graduation. During their senior years, students often get a

prospective on the working environment and the difficulties faced in the field. This along with other factors, can strongly alter their career choice. By clinical years, medical students have a better idea about the working environment, nature of work, and difficulties faced in those fields. In neurosurgery, its interesting that although it is one of the most competitive specialties in medicine, many students avoid and keep away from it.^[17]

Choosing a specialty is considered one of the most stressful and critical choices in the life of medical students, for students are faced with numerous possibilities with little exposure to them.^[11] However, students still manage to reach answers by exploring the attracting and deterring factors for each specialty during their Medical School years. Neurosurgery-being no exception-has a vast list of factors that can impact the decision of the students. The factors can vary from nonmodifiable factors such as gender, where it have been observed that females are less likely to join a surgical program to modifiable factors including personal interest, personality types, geographic advantages, life-work balance, competitiveness, length of training, and other factors that will be discussed.^[15]

Previous efforts on the subject are scarce; in addition, we could not find any study that covered the whole kingdom, and no study asked about both positives and negatives. In our study, we want to get a comprehensive perspective on medical students' perception of neurosurgery as a career path and the reasons that make them choose or avoid it. We hope that we can also get a geographical representation of the results; thus, we may see some correlation between students' regions and their beliefs and feelings toward neurosurgery.

MATERIALS AND METHODS

This cross-sectional study was done across three universities of the western region of Saudi Arabia including King Saud bin Abdulaziz University for Health Sciences, Umm Al Qura University, and King Abdulaziz University. A sample of 1023 students was conducted using Google sheets and was randomly sent by two assigned students from each university to students from the second medical year up to internship equally both male and female across the three universities. We excluded nonmedical students and 1st-year medical students; also an incomplete questionnaire was excluded from the study. A pilot study was applied before the start of the study on 35 students (they were not included in the study sample) to check for readability, comprehension, question design, and length of the questionnaire. The questionnaire consisted of three main sections. The first part is regarding demographic characteristics such as age, gender, medical year, and GPA. Second part regarding the knowledge of neurosurgery as a career and what is required of the student to be accepted in the residency program and to see the

interest of the participant toward the specialty whether he or she attended a course, conference, or project related to neurosurgery. The last part is regarding what makes them attracted or deterred in neurosurgery specialty. Many factors were asked to see what attracts the students toward the specialty such as competitiveness, research opportunities, technology advance in the field, and prestige of the specialty. Factors that make students deter from the specialty also were asked such as long working hours, poor social life, and few training centers.

Ethical considerations

The study was approved by the Institutional Review Board (IRB) of the hospital with the number (NRJ21J/213/09). Written consent was obtained from each participant and a summary of the research was discussed before distribution of the questionnaire. Coding sheets were used to protect the names of the students. Data were stored in a workplace PC protected by a password.

RESULTS

In this study, we received 1023 valid responses from medical students studying in King Saud bin Abdulaziz University for Health Sciences, Umm Al Qura University, and King Abdulaziz University, which are the biggest universities in the western region of Saudi Arabia. Out of these medical students, 585 (57.2%) were males and 438 (42.8%) were females. Regarding their interest in neurosurgery, 359 (35.1%) of them were interested, while 664 (64.9%) were not. Using a Chi-square test of independence, we tested the null hypothesis that males and females are not equally interested in neurosurgery with high significance ($P < 0.001$). The result shows that females have more interest (40.8%) compared to males (30.7%). The respondents' education level in the university starting with 2nd-year 237 (23.2%), 3rd-year 174 (17%), 4th-year 96 (9.38%), 5th-year 260 (25.4%), 6th-year 211 (20.6%), and internship 45 (4.4%). In addition to that, education level was significantly affecting the interest in neurosurgery, in which there was a decreased level of interest with an increase in the education level ($P < 0.001$). In the 2nd year, 55.70% were interested while in the internship only (11.11%) were interested in neurosurgery. Students who are fully understanding the specialty by attending conferences 69 (6.7%) or had done projects 67 (6.5%) are interested in comparison to those who did not attend a conference or have a project in the field ($P < 0.001$) [Table 1].

Even though more students (64.9%) were not interested in neurosurgery, there were multiple attractors that have been listed from all students regardless of their interest. The top 3 attracting factors were: positive impact on patients "rewarding" 576 (56.3%), income 557 (54.4%),

Table 1: Demographics and exposure level to neurosurgery

	Interested				P-value
	Yes		No		
	n	%	n	%	
Gender					
Male	180	30.77	405	69.23	0.001
Female	179	40.87	259	59.13	
Education level					<0.001
2	132	55.70	105	44.30	
3	91	52.30	83	47.70	
4	35	36.46	61	63.54	
5	58	22.31	202	77.69	
6	38	18.01	173	81.99	
7	5	11.11	40	88.89	
Understand what a career in neurosurgery involves					0.336
Yes	289	35.90	516	64.10	
No	70	32.11	148	67.89	
Understand what is required of me to obtain a position in a neurosurgery residency program					0.689
Yes	132	34.20	254	65.80	
No	227	35.64	410	64.36	
Conference					<0.001 (2.698e-8)
Yes	46	66.67	23	33.33	
No	313	32.81	641	67.19	
Project					<0.001 (1.906e-6)
Yes	42	62.69	25	37.31	
No	317	33.16	639	66.84	
Teaching					0.153
Yes	156	32.70	321	67.30	
No	203	37.18	343	62.82	

and interest in neuroscience 387 (37.8%). However, interest in neuroscience was significantly higher in students who were interested (77%) in comparison to those who were not (17%). Regarding the income, the students (56%) who are not interested consider it more attractive than those (51%) who are, and the females appear less attracted by the income in comparison to males ($P < 0.001$). Other factors including, competitive field, research opportunities, innovation/technology, Impact on patients, interest in neuroscience, variety of cases, and having role-model were reported as attractive factors in students who were interested more than others ($P < 0.001$). In contrast, academic field preference, the prestige associated with the specialty, geographic location of the training center, number of on-calls, and successful placement of recent graduates into desired subspecialty fellowship were reported comparably in both interested and not interested students [Table 2].

Multiple deterring factors have been reported from the students. The most-reported three deterring factors were as follow: (i) stress (66.1%), (ii), difficulty/neurophobia (55%), (iii) and the specialty risk (54.8%). The long training period was considered as deterring factor for interested

Table 2: Attracting factors toward neurosurgery among medical students

Attracting Factors	Interested				P-value
	Yes		No		
	n	%	n	%	
Competitive field					<0.001
Yes	131	36	158	24	
No	228	64	506	76	
Research opportunities					<0.001
Yes	138	38	149	22	
No	221	62	515	78	
Innovation/technology					<0.001
Yes	154	43	178	27	
No	205	57	486	73	
Impact on patients "Rewarding"					<0.001
Yes	228	64	348	52	
No	131	36	316	48	
Academic field preference					0.002
Yes	95	26	119	18	
No	264	74	545	82	
Income					0.149
Yes	184	51	373	56	
No	175	49	291	44	
The prestige associated with the specialty					0.1
Yes	119	33	186	28	
No	240	67	478	72	
Interested in neuroscience					<0.001
Yes	275	77	112	17	
No	84	23	552	83	
Practical aspect, Surgical techniques or High skill required					<0.001
Yes	194	54	166	25	
No	165	46	498	75	
Variety of the cases and population character					<0.001
Yes	165	46	187	28	
No	194	54	477	72	
The geographic location of the training center					0.217
Yes	29	8	71	11	
No	330	92	593	89	
Having a role-model					<0.001
Yes	103	29	128	19	
No	256	71	536	81	
Number of on-calls					0.018
Yes	34	9	99	15	
No	325	91	565	85	
Successful placement of recent graduates into desired subspecialty fellowship					0.78
Yes	66	18	116	17	
No	293	82	548	83	

students (43%) lower than those who are not interested (54%) ($P < 0.001$). Similarly, practical aspect, long surgeries were also reported more in not interested students (52%) in comparison to interested students (45%) ($P > 0.001$). However, many deterring factors are surprisingly comparable between both groups of students including competitive field, risk, difficulty/neurophobia, income, lifestyle, work-

life balance, stress, gender diversity, complex patients, few trainings centers, and limited job opportunities [Table 3].

DISCUSSION

The choice of a future career in medical practice can be a daunting experience for medical students and interns, as there are many factors to consider. It is a complex decision, strongly influenced by personal preferences and contact with the work environment. Medical students frequently tend to give consideration to a program's academic accomplishments,

reputation, patient volume, and diversity, flexible working hours, the influence of consultants/mentors, to a lesser extent, and salary and research opportunities.^[15,20]

Neurosurgery enjoys a distinct position among the medical specialties as a constantly evolving field with rapid innovations in surgical operations and management. Approximately 5 million essential neurosurgical cases are unmet in low- and middle-income countries every year. On a local level, a report was published in 2019, estimating the density of neurosurgeons in the Kingdom of Saudi Arabia to be approximately 1/250,000 population.^[3] Being a specialty in such high demand with much potential for significant clinical and research impact, neurosurgery continuously faces challenges to appeal to qualified applicants who may otherwise consider a career in this field.^[2] A Canadian study conducted, in 2015, found that although 90% of medical students find neurosurgery to be an interesting specialty, only a third of them would consider a neurosurgical career.^[20] Similarly, a study from Africa showed that 31.7% of medical students expressed definite interest in a neurosurgical career.^[4] Locally, a study from Riyadh conducted in 2018, by AlQahtani *et al.*, showed that only 3% of the medical students considered neurosurgery as a future career.^[15] Among participants in our study, 35% were interested in neurosurgery as a future career, a higher percentage of interest compared to the local studies, and an overall comparable result to the international literature.

It is worth mentioning that an exception to the current literature has been reported by two studies from Ireland and Oman, the percentages of medical student who considered neurosurgery to be their ultimate career in those reports were 78% and 72 %, respectively.^[2,4] An interesting finding that deserves more detailed analysis of the factors positively influencing these significantly high levels of interest among their participants.

Medical students' exposure to any clinical specialty is, indeed, of an important influential power in students career choice. Specifically, exposure to the work culture typical of the specialty, as well as the type of cases and the special challenges of each specialty.^[9] The medical student's exposure to neurosurgery often occurs late into their clinical years when students may have already decided on a career pathway. Several studies have indicated that medical students refrain from undertaking a neurosurgical career due to the earlier clinical experiences that they have had with other surgical specialties. As a matter of fact, that the priorities of students continue to change with time.^[19] A study from New Jersey medical school, in 2013, showed that among medical students who initially reported an interest in neurosurgery, only a third (29.5%) of them began residency training in the field of neurological surgery following graduation from medical school.^[1] In our study, the more senior the

Table 3: Deterring factors away from neurosurgery among medical students

Deterring Factors	Interested				P-value
	Yes		No		
	n	%	n	%	
Competitive field					
Yes	128	36	225	34	0.618
No	231	64	439	66	
Other career interests					
Yes	118	33	406	61	<0.001
No	241	67	258	39	
Risk					
Yes	212	59	349	53	0.054
No	147	41	315	47	
Long training time					
Yes	154	43	357	54	0.001
No	205	57	307	46	
Difficulty/neurophobia					
Yes	199	55	367	55	0.987
No	160	45	297	45	
Income					
Yes	22	6	38	6	0.901
No	337	94	626	94	
Lifestyle, work-life balance					
Yes	162	45	346	52	0.039
No	197	55	318	48	
Practical aspect, long surgeries					
Yes	89	25	231	35	0.001
No	270	75	433	65	
Stress					
Yes	240	67	436	66	0.753
No	119	33	228	34	
Gender diversity					
Yes	57	16	80	12	0.105
No	302	84	584	88	
Complex patients					
Yes	120	33	275	41	0.015
No	239	67	389	59	
Few trainings centers					
Yes	72	20	114	17	0.29
No	287	80	550	83	
Limited job opportunities					
Yes	63	18	121	18	0.855
No	296	82	543	82	

respondents were, the lower the interest in neurosurgery gets. Interns, 5th-, and 6th-year students were less interested in pursuing neurosurgical training compared to freshmen. About 56% of 2nd year medical students in our study were interested in neurosurgery, compared to only 11% interested respondents among interns.

The interest in neurosurgery can be traced to numerous factors. Studies comparing students who desire a career in surgery suggest that predictors of surgical interest include enthusiasm for the procedures and impacts, desire for intellectual challenge, positive interactions with surgeons, perceptions of prestige, and minimal discouragement by lifestyle concerns and work hours.^[21] Neurosurgery is reported to be a highly rewarding specialty and students expect high satisfaction from overcoming daily challenges, observing patient improvement, and the prestigious status that are given by neurosurgery as a specialty. Sixty-four percentages of the interested respondents in our study believed that the impact on patients is rewarding making it the most attractive factor. Similarly, a study that was done to obtain the level of career satisfaction in neurosurgery residents, reported that 50% of respondents were highly satisfied with intrinsic reward for helping patients.^[14] Passion and interest in neuroscience greatly influence the interest and career choice decision as well. A study was done in China reported that there was a positive correlation between the likelihood of specializing in neuroscience and students' self-perceived knowledge in this specialty, while students with low neuroscience knowledge were less likely to consider neurosurgery as a future career.^[4] Among the respondents in our study, 77% of those interested in neurosurgical career and 17% of those who are not reported passion for neuroscience, respectively. Income was among the top three influential factors in our study. Fifty-six percentage of students who are not interested in neurosurgery, and nearly half of the interested student labeled salary as an attractive factor to the specialty. We also found, with statistical significance, that males were more keen on income as influential factor

compared to females, who appeared to be less attracted by the income in comparison to males [Figure 1].

It is difficult, on the other hand, to know with certainty the reasons for the relatively low neurosurgical residency applications, which appear to be multifactorial.^[1] In our study, stressful lifestyle was found to be the leading factor (66.1%) deviating students from pursuing a career in neurosurgery. Stressful lifestyle, *per se*, has not been studied independently as to its effect on the career student decision. Nonetheless, neurosurgery is actually known for its challenging and stressful lifestyle. Neurosurgeons and neurosurgery residents frequently report elevated levels of stress reaching up to 53% in some reports.^[12] A recent US national survey on stress and burnout in the neurosurgical community found that more than one-half of the respondents showed signs of burnout, reporting a higher level of burnout when compared with other medical specialties and that only one-third of respondents would recommend a career in neurosurgery.^[17,20] It is likely that during their clinical rotations, medical students sense the stress that neurosurgeons experience during their day-to-day life, which in our study showed to be significantly important factor in deviation away from applying to this specialty.

Neurological surgery being a high-risk specialty, and a likely target for malpractice claims, makes it even less appealing specialty. Studies show that approximately 60% of neurosurgeons consider medical malpractice premiums an extreme burden, causing many working neurosurgeons to eliminate high-risk procedures from their practices.^[1] In our study, we found that medical students perceived neurosurgery to be a high-risk specialty, and that dealing with high-risk patients and procedures was reported to be the second most deterring factors from pursuing neurosurgery among 54.8% of the respondents [Figure 2].

Neurophobia, a phenomenon described by Ralph Jozefowicz, defined by fear of the basic and clinical neuroscience and is thought to be due to the students' inability to apply their knowledge of basic sciences to clinical situations.^[4,13] Various

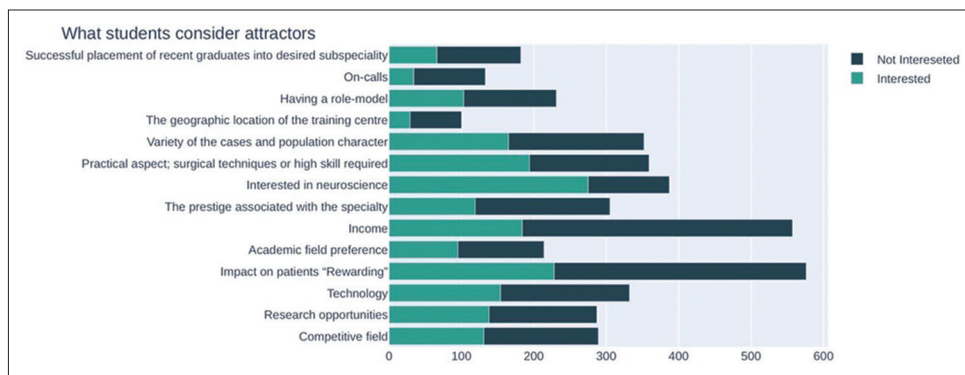


Figure 1: This graph showing the attractive factors for neurosurgery for both interested and not interested students.

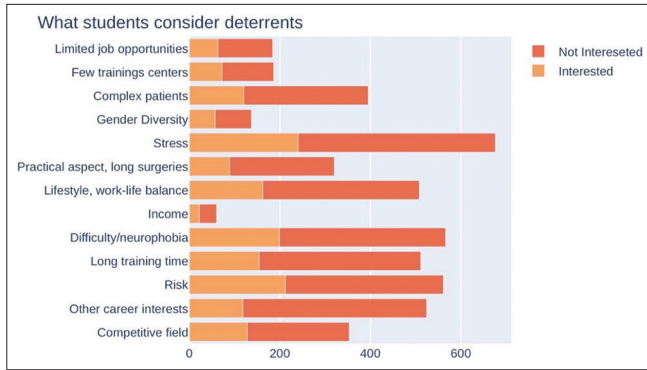


Figure 2: This graph showing the deterring factors for neurosurgery for both interested and not interested students.

studies reported this phenomenon to be common among medical students. A study from China conducted to assess the level of perceived specialty difficulty, neurology and neurosurgery ranked the highest among clinical specialties that are perceived to be difficult among medical and surgical specialties, respectively.^[6] In our study, 55% of the students who refrained from choosing a career in neurosurgery believed that neurosurgery and neurosciences were difficult.

Several additional factors such as the lack of controllable lifestyle, length of residency program, job opportunities, and the long duration of training years in neurosurgery residency program have also been linked to this deviation away from the specialty.^[4,7] In our study group, the long training period, complex practical aspect, and long surgeries were considered important deterring factors among noninterested students more than those who are interested.

In the reported literature, work and life balance alone play an important influencing factor in career choice for medical students. Numerous studies have demonstrated an increased desire for work-life balance among medical students and a trend toward greater interest in more lifestyle-friendly specialties including radiology, ophthalmology, anesthesiology, and dermatology.^[21] A local study from Saudi Arabia eastern region defined lifestyle (controllable vs. uncontrollable) as the most influential and important factor while choosing a specialty for their future medical career.^[5] Al Sharqi *et al.* reported that participants believed that neurosurgery can affect their family and social life as it is a very demanding specialty.^[5]

It is fair to say that individuals who value a balanced lifestyle, time-appropriate residency, and a predictable work schedule are not good candidates for a demanding specialty such as neurosurgery. Nonetheless, lifestyle plays a major role in the career decisions of women in particular, as societal norms not only grant women a larger proportion of caregiving duties but also hold women to a higher standard within these roles.^[10] In general, women with a strong work ethic,

interest in competitive specialties, and career orientation will undoubtedly be captivated by neurosurgery. McNutt *et al.* reported that the satisfaction level and perceived happiness among female residents with their current specialties strongly influenced the female medical students' decision in selecting such a residency programs.^[15] Studies have also demonstrated that the presence of role models and mentoring is the most influential factors for female medical students as the driving forces behind career selection, rather than the often assumed "lifestyle" issues.^[16]

In a report published 2018, women represented only 12% of neurosurgeons in the United States and Canada. A slight but steady increase has been noted in women pursuing neurosurgical residency in the United States from 10% in the 1990s 7–17.5% in 2018.^[10,16] On a local level, a highly standardized training program was launched to meet the increasing demands of the rapidly growing Saudi population.^[3] Since 1995, the Saudi Board of Neurosurgery (SBNS) set and administered by the Saudi Commission for Health Specialties and conducted and maintained at accredited institutions that are in major cities around the kingdom. According to a study published in 2021 by Algahtani *et al.*, female residents represented 21% of the total trainees enrolled into the SBNS, a percentage that is considered well above the figures reported from the developed countries over time. We found a statistically significant higher interest levels in the neurosurgery among females students in our study compared to their males counterpart, and nearly, half of the female participants reported an interest in a neurosurgical career. This can be, in fact, attributed to the decent exposure of female medical student to the female neurosurgery residents within the various training centers in the western region of Saudi Arabia.

It is well established that an earlier organized involvement in medical student education can result in an improved understanding of the specialty challenges among students, resulting in a greater number of well-qualified residency applicants enrolling into neurosurgery. That mentioned, such exposure may aid in waving the frequently overestimated negative assumptions on neurosurgical specialty, especially in institutes which were primary care and nonsurgical specialties are being emphasized on during the medical students' early clinical years.^[18,21] In our study, we found that medical students with closer exposure to neurosurgery had a rather better understanding the specialty and were more likely to have neurosurgery as their career choice. Around 6% of all study participants had a more dedicated exposure to the neurosurgery in the form of attending neurosurgical conferences and were involved in neurosurgery-related research projects, and this correlated with statistical significance to interest in neurosurgery.

Different previous studies highlighted factors that may increase the interest of medical students toward the surgical specialties

including neurosurgery. Resident involvement in medical student education, faculty-student interaction, the mentorship programs, the inclusion of didactic lectures by clinical surgeons, and early exposure to surgical clerkships was all important influential factors.^[5] Specific strategies that have been shown to improve interest include: alleviating lifestyle concerns, emphasis on neurosurgeons satisfaction rates, awareness of the positive impacts on patient and reward, increasing awareness of research opportunities, providing mentorship, hands-on operating observerships, and increased staff/resident involvement in undergraduate medical education.^[21]

As a technology-intensive surgical discipline, it is essential that medical students with an interest in pursuing neurosurgery receive early, regular exposure to clinical vignettes, and neuroanatomy. In light of the demanding career and lifestyle of neurosurgeons, it is important to provide a basis, on which medical students make an informed decision for themselves rather than on the highly competitive nature of the specialty. This, however, is particularly challenging as the level of knowledge and skills in neurosurgery field often makes it difficult to get a closer hands-on experience by medical students.^[5,8,17]

CONCLUSION

The medical student interest level in neurosurgery, a competitive and highly demanding field, in the western region of Saudi Arabia compares to international statistics. Interestingly, we found a general trend toward reduced interest in neurosurgery among senior medical students when compared to freshmen. We also found higher interest among female students. Further studies done on a larger scale should be done to analyze these findings.

Declaration of patient consent

Institutional Review Board (IRB) permission obtained for the study.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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