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Original Article

Benchmarking of Neurosurgery Training in Pakistan

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Abstract

Introduction: Neurosurgery is a challenging field of surgery. A neurosurgeon has to be trained with the finest skills, knowledge, and competencies necessary to provide high-quality patient care. Maintaining postgraduate training standards is a challenge in Pakistan due to low budget allocation to the health sector. This study aims to assess the difference in parameters among different institutes in different sectors and provinces offering neurosurgery training in Pakistan. **Methods:** A nationwide survey was conducted by the Neurosurgery Department at Liaquat National Hospital Karachi, from November 2019 to February 2020. Data were collected through a questionnaire from neurosurgery trainees from all over the country. The questionnaire was divided into the following sections: Sociodemographics and infrastructure of training site, clinical skills training and exposure, knowledge-based education, and workload. The data were kept confidential and institutional names were not inquired or disclosed. **Results:** The response rate was 85.3% (151/177), with more males (80%) than females. The total number of trainees was higher in government than private institutions ($P < 0.005$). The frequency ($P = 0.030$) and number of trainees ($P < 0.005$) inducted per cycle was more among government institutions. Participation in international conferences was higher among trainees in private sector ($P = 0.006$). The frequency of clinics was significantly higher in private institutions ($P < 0.005$), though the number of patients seen per clinic was lower than in government sector ($P < 0.005$). At a provincial level, there was a significant difference in gender distribution ($P = 0.020$), total number of trainees ($P < 0.005$), number of residents per induction ($P < 0.005$), frequency of mortality and morbidity meetings ($P < 0.005$), morning meetings ($P < 0.005$), number of calls per week ($P < 0.005$), number of workshops attended ($P < 0.005$), exposure to radiation ($P = 0.003$), frequency of outpatient departments (OPDs) attended per week ($P = 0.002$), and number of patients seen per OPD (P 0.02). **Conclusion:** This study reported variability in the quality of neurosurgery training programs within public and private sector with even greater differences between the four provinces of Pakistan. We recommend continuous assessments and re-accreditation of these training programs through subject experts and health-care educationists to improve the quality of training programs; hence the quality of service and patient care.

Keywords: *Accreditation council for graduate medical education, college of physicians and surgeons Pakistan, khyber Pakhtunkhwa, outpatient department*

Introduction

The 10,000-h rule applies to any cognitively complex field, from playing a violin to being a neurosurgeon. According to the rule, to ace any such task, at least 10,000 h of practice are required. Yet, a limitation of this rule is that it focuses on the amount of time spent practicing, not the quality of that practice. Anders Ericsson says, "Not every type of practice leads to improved ability. You don't get benefits from mechanical repetition, but by adjusting your execution over and over to get closer to your goal."[1] Neurosurgery is one of the most challenging fields in terms of a direct link with morbidity and mortality. This means that a neurosurgeon has to be trained with the finest skills, knowledge, and competencies necessary to provide high-quality patient care. The quality and standards of training programs depend on the infrastructure of the training facility. Maintaining high-quality training standards are a challenge especially in Pakistan, with low budget allocation to the health sector.

In Pakistan, there are significant variations in quality of neurosurgery training programs.[2] Therefore, these programs need ongoing evaluation to standardize training and improve the quality of education. In a populated country like Pakistan, the

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health-care demand far exceeds the facilities available for a neurosurgical specialty. To date, there are an estimated 22 neurosurgery training centers with 177 registered neurosurgery residents in training. Although neurosurgery has evolved in Pakistan over the past few decades, little is known about standardization of training at these public and private sector universities and hospitals. The training programs are accredited by the College of Physicians and Surgeons of Pakistan (CPSP). In the past, two nationwide surveys were conducted in 2011 and 2016 to evaluate neurosurgery training in Pakistan.[3,4] This study focuses on the differences in infrastructure and the training opportunities provided by neurosurgery training programs in private and public sector; and at a provincial level in Pakistan. We intend to evaluate the neurosurgery residency programs to make specific recommendations to improve the standard of neurosurgery training in Pakistan.

Methods

A nationwide survey was conducted from neurosurgery trainees to assess the infrastructure and standards of the neurosurgery training program in different institutions of Pakistan. The study was conducted by the neurosurgery department at Liaquat National Hospital Karachi, from November 2019 to February 2020. Approval from the Institutional Research Committee was taken after developing a protocol. On November 5, 2019, the first E-mail invitation was sent to 177 neurosurgery trainees certified by CPSP, from 22 institutes in all provinces of Pakistan. A reminder E-mail was sent at 2 weeks and after 2 months. Informed consent was taken from the participants. The questionnaire included 22 questions on different training aspects. The questionnaire was divided into the following sections: Sociodemographics of participants and infrastructure of training site, clinical skills training and exposure, knowledge-based education, and workload. The data were kept confidential and institutional names were not inquired or disclosed.

The data were collected through Google Docs forms, which were later transferred into IBM SPSS Version 21 on which data analysis was performed. Frequencies and percentages were computed to report categorical variables. Chi-square test/Fisher's exact test was applied to compare study variables between provinces and government/private sector. $P < 0.05$ was considered as statistically significant.

Categorical variables such as gender, number of residents, induction of residents, number of residents per induction, frequency of morbidity and mortality meetings, frequency of resident assessment test, frequency of academic morning meetings, number of calls per week, number of international conferences attended, sponsorship, number of workshops attended, exposure to radiatio n, number of outpatient departments (OPDs) per week and average number of patients per OPD were reported as frequency and percentage. These categorical variables were compared between provinces, private and government sector using Chi-square or Fisher's exact test as appropriate. A two-tailed $P < 0.05$ was considered statistically significant.

Results

Out of 177 neurosurgery residents in Pakistan who were invited for the study, 151 responded to the survey with a response rate of 85.3%. One form was incompletely filled, so it was excluded from the analysis. Out of 150 complete responses, 129 (86%) trainees worked in the government sector, and rest worked in private institutions ($n = 21$, 14%). As shown in Table 1, majority of those who responded were from Punjab ($n = 73$, 48.6%), followed by Sindh ($n = 40$, 26.67%), Khyber Pakhtunkhwa (KPK) ($n = 34$, 22.67%), and Baluchistan ($n = 3$, 2%).

Half of the residents were <30 years of age ($n = 75$, 50%). The majority of them were males ($n = 121$, 80.7%), while 29 (19.3%) were females. As for marital status, 82 (54.3%) were married, of which 56 (37.1%) had children. Most of them had more than 3 years of training ($n = 67$, 44.6%), 32 (21.3%) were in the 3rd year of training while 20 (13.3%) and 18 (12%) were in 2nd and 1st year of training respectively. Out of the total, 13 (8.6%) people were postfellowship.

Table 1 shows the difference of training parameters between government and private sector programs. There was a significant difference between the private and government sectors for total number of residents ($P < 0.005$). A number of residents were higher in government than private institutions. The frequency of cycle for resident's induction was also significantly different (higher among government institutions) among the two sectors ($P = 0.030$). Responses received for the number of residents per induction were also significantly higher in government sector.

The two groups also differed on the frequency of international conferences attended by residents ($P = 0.006$). Participation in international conferences was higher among residents training in private sector. The frequency of clinics was significantly higher in private institutions, though the number of patients seen per clinic was lower than in government sector ($P < 0.005$).

Table 2 shows the difference of training parameters among residents in different provinces. Gender distribution was significantly different among provinces ($P = 0.020$). Among all provinces, the proportion of male residents was higher as compared to female residents. In contrast, none of the residents was female in Baluchistan, and KPK, there was only one female resident. Total number of working residents differed among four provinces ($P < 0.005$). The proportion of residents who responded that their institute had not more than 10 residents was high for Baluchistan ($n = 3$, 100%) and KPK ($n = 19$, 55.9%) whereas 23 (57.5%) and 51 (69.9%) residents from Sindh and Punjab respectively reported more than ten residents in their

Table 1: Training variables of neurosurgery residency program among government and private sectors

Variable	Sector		*P*
	Government, *n* (%)	Private, *n* (%)	
Gender			
Male	106 (82.2)	15 (71.4)	0.245†
Female	23 (17.8)	6 (28.6)	
Total number of residents			
<10	41 (31.8)	20 (95.2)	<0.005**
>10	88 (68.2)	1 (4.8)	
Induction of residents			
6 monthly	116 (89.9)	15 (71.4)	0.030†*
Yearly	13 (10.1)	6 (28.6)	
Number of residents per induction			
>4	41 (31.8)	0 (0)	<0.005**
<4	88 (68.2)	21 (100)	
Morbidity and mortality meetings/month			
>1	17 (13.2)	5 (23.8)	0.434
<1	112 (86.8)	16 (76.2)	
Resident assessment test in a month			
<2	109 (84.5)	18 (85.7)	0.221
>2	20 (15.5)	3 (14.3)	
Academic morning meetings			
Daily	36 (27.9)	5 (23.8)	0.240
Weekly	79 (61.2)	15 (71.4)	
Monthly or less	14 (10.9)	1 (4.8)	
Number of calls per week			
>2	40 (31)	10 (47.6)	0.730
<2	89 (69)	11 (52.4)	
Intl. conferences attended			
<3	53 (41.1)	16 (76.2)	0.006**
>3	8 (6.2)	3 (14.3)	
None	68 (52.7)	2 (9.5)	
Sponsorship			
Yes	29 (22.5)	6 (28.6)	0.580†
No	100 (77.5)	15 (71.4)	
Workshops attended			
<3	52 (40.3)	8 (38.1)	0.826
>3	29 (22.5)	6 (28.6)	
None	48 (37.2)	7 (33.3)	
Exposure to radiation			
Mild	70 (54.3)	10 (47.6)	0.732
Mod. to severe	59 (45.7)	11 (52.4)	
OPDs per week			
>3	16 (12.4)	13 (61.9)	<0.005**
<3	113 (87.6)	8 (38.1)	
Average number of patients			
<150	63 (48.8)	21 (100)	<0.005**
>150	66 (51.2)	0 (0)	

*Statistically significant at $P<0.05$, **Statistically significant at $P<0.01$,†Fisher Exact test reported. OPDs - Out patient department

institutes. Responses received for the number of residents per induction were also significantly different among provinces ($P < 0.005$). The highest response for induction of more than four residents was received from KPK followed by Sindh, Baluchistan, and Punjab. Moreover, the proportions of residents who reported induction of more than four residents were significantly high for all provinces. The proportion of residents who reported frequency of mortality and morbidity meetings up to 2 in a month was highest for Baluchistan followed by KPK, Sindh and Punjab ($P < 0.005$). The frequency of daily morning meetings was highest for Sindh compared to KPK,

Table 2: Difference in training variables of neurosurgery residency program among 4 provinces of Pakistan

Variable	Provinces				*P*
	Sindh, *n* (%)	Punjab, *n* (%)	Baluchistan,.*n* (%)	KPK, *n* (%)	
Gender					
Female	12 (30)	16 (21.9)	0 (0)	1 (2.9)	0.020*
Male	28 (70)	57 (78.1)	3 (100)	33 (97.1)	
Total number of residents					
<10	17 (42.5)	22 (30.1)	3 (100)	19 (55.9)	<0.005**
>10	23 (57.5)	51 (69.9)	0 (0)	15 (44.1)	
Induction of residents					
6 monthly	32 (80)	66 (90.4)	2 (66.7)	31 (91.2)	0.242
Yearly	8 (20)	7 (9.6)	1 (33.3)	3 (8.8)	
Number of residents per induction					
>4	30 (75)	47 (64.4)	2 (66.7)	30 (88.2)	<0.005**
<4	10 (25)	26 (35.6)	1 (33.3)	4 (11.8)	
Morbidity and mortality meetings/month					
>1	6 (15)	14 (19.2)	0 (0)	2 (5.9)	<0.005**
<1	34 (85)	59 (80.8)	3 (100)	32 (94.1)	
Academic morning meetings					
Daily	27 (67.5)	9 (12.3)	0 (0)	5 (14.7)	<0.005**
Weekly	11 (27.5)	54 (74)	2 (66.7)	27 (79.4)	
Monthly or less	2 (5)	10 (13.7)	1 (33.3)	2 (5.9)	
Resident assessment tests in a month					
<2	36 (90)	60 (82.2)	3 (100)	28 (82.4)	0.272
>2	4 (10)	13 (17.8)	0 (0)	6 (17.6)	
Number of calls per week					
<2	33 (82.5)	48 (65.8)	3 (100)	16 (47.1)	0.005**
>2	7 (17.5)	25 (34.2)	0 (0)	18 (52.9)	
Intl. conferences attended					
<3	18 (45)	34 (46.6)	1 (33.3)	16 (47.1)	0.349
>3	6 (15)	1 (1.4)	0 (0)	4 (11.8)	
None	16 (40)	38 (52.1)	2 (66.7)	14 (41.2)	
Sponsorship					
No	30 (75)	61 (83.6)	2 (66.7)	22 (64.7)	0.180
Yes	10 (25)	12 (16.4)	1 (33.3)	12 (35.3)	
Workshops attended					
<3	16 (40)	28 (38.4)	0 (0)	16 (47.1)	<0.005**
>3	23 (57.5)	6 (8.2)	0 (0)	6 (17.6)	
None	1 (2.5)	39 (53.4)	3 (100)	12 (35.3)	
Exposure to radiation					
Mild	17 (42.5)	48 (65.8)	2 (66.7)	13 (38.2)	0.003**
Mod to severe	23 (57.5)	25 (34.2)	1 (33.3)	21 (61.8)	
OPDs per week					
>3	13 (32.5)	12 (16.4)	0 (0)	4 (11.8)	0.002**
<3	27 (67.5)	61 (83.6)	3 (100)	30 (88.2)	
The average number of patients					
<150	17 (42.5)	46 (63)	3 (100)	18 (52.9)	0.028*
>150	23 (57.5)	27 (37)	0 (0)	16 (47.1)	

*Statistically significant at $P<0.05$, **statistically significant at $P<0.01$. KPK - Khyber Pakhtunkhwa; OPDs - Outpatient Departments

Baluchistan, and Punjab ($P < 0.005$). Number of calls per week attended by residents was also significantly different among provinces ($P < 0.005$). The trainees were attending the highest number of calls per week in KPK followed by Sindh and Punjab. None of the residents from Baluchistan reported that they attended more than two calls in a week. The residents attending more workshops during training were highest in Sindh as compared to other provinces. The degree of exposure to radiation was also different among four provinces, as reported by residents ($P = 0.003$). The exposure was highest in KPK and Sindh. We assessed the perception of trainees regarding radiation exposure and did

not measure the actual exposure through dosimetry. This is indeed a limitation of the questionnaire. The frequency of OPDs per week differed among four provinces ($P = 0.002$). The number of OPDs per week was highest in Sindh followed by Punjab, KPK and Baluchistan. The highest number of patients per clinic were reported from Sindh followed by KPK and Punjab.

Discussion

At the time of independence, in August 1947, there were no neurosurgeons in the east or west wings of Pakistan. O. V. Jooma introduced neurosurgery as an acclaimed surgical discipline in 1951 and set foot in Jinnah Postgraduate Medical Center in Karachi. He performed the first neurosurgical operation in the history of Pakistan in October 1951; a thoracolumbar laminectomy for a spinal cord tumor. Following him many neurosurgeons mostly trained from overseas, laid the foundation of neurosurgery departments in different cities. The training program (Neurosurgery) in Pakistan was initiated after the establishment of the CPSP in 1962.[5] Neurosurgery is a challenging field that demands high-quality patient care, which requires rigorous training. In the past, the apprenticeship model of training which rotated around the mentor, his skills, tuitions, and principles was followed. However, with the evolution of surgical education, a marked shift was observed from mentor-based learning to structured institution-based learning.[6] With this shift, structured neurosurgery training evolved in Pakistan, certified by accreditation council for graduate medical education (ACGME)[7] and accredited by the World Federation of Neurosurgical Societies.[8]

A paper published in 2007 reports one neurosurgeon per 5.5 million population in Pakistan,[9] while in 2019 the ratio improved to 1:1 million with 212 neurosurgeons for 212 million people.[10] This was nowhere near to that of developed countries (i.e., 1 neurosurgeon per 80,000 people). Although the total number of neurosurgeons has increased but so has the population. Among developing countries, Vietnam reported 600 neurosurgeons for 98 million people, with a ratio of 0.612 neurosurgeons per 100,000 population which is still half of the required number.[9] In Pakistan, neurosurgery has developed considerably, yet it is unequivocal in different provinces of Pakistan. Our survey shows that the government sector of Punjab bears most of the burden of the neurosurgery training program. Baluchistan's literacy rate is far from satisfactory[11] and reflects poorly on the specialty training. There is only one CPSP certified neurosurgery training center in the region. An alarming fact is that despite having the highest literacy rate in Pakistan,[11] Gilgit-Baltistan has no medical training institutes/hospitals in the province. Gilgit-based postgraduates turn to other provinces like KPK, Punjab and scarcely Sindh for Residency and Post fellowship programs.

Although women have set foot in the field of neurosurgery, but the numbers are still low. In 1960 first woman was certified as a neurosurgeon, when men were already on the crest of the wave. According to the survey done in 2014 in Pakistan, there were only 4% females among all neurosurgeons[4] while in our study, we found 19.3% of female neurosurgical trainees. Only time will tell that how many of these brave girls will go on to practice in Pakistan, despite obstacles from the community and the social obstacles. Barriers to females not choosing this specialty for training need to be highlighted, and a strategic plan to be constructed to address these issue to make the field more female-friendly.

For an advanced and challenging field of neurosurgery, choosing a training facility for the residency program always poses a dilemma. The structure of healthcare in Pakistan is not uniform throughout the country, and in different provinces. There is a large variation among different institutions, offering training in terms of the financial support, administrative policy, referral system and workload of each participating center. Even though there are several well-established and internationally recognized private teaching hospitals, this survey shows that more trainees were recruited in government tertiary-care training programs while at the same time, induction to private hospitals is patchy with recruitment of more than 15 in some centers and less than 5 in others. 59.3% of respondents had more than 10 residents in their department. Majority of these were from public sector due to six monthly induction and higher number of residents per induction. This translates to less duty timings with a chance of suboptimal training due to a higher mentee mentor ratio. More residents are required in public sector due to a higher patient load which means that there should be more supervisors. In order to balance the ratio, institutes should follow the guidelines of training program; inducting not more than four residents per supervisor 6 monthly. This should not exceed eight inductions per unit with no more than eight residents per supervisor.

Harvey Cushing, the founder of neurosurgery, demonstrated that any medical specialty, including neurosurgery, is about acquiring skills and effective clinical practice, teaching, research, and administration. One has to learn to gain competency and remain updated in the field to ensure best practice. This is not only acquired in operation theatres but with continuous medical education through case discussions, meetings, academic, and bedside learning. Morbidity and mortality meetings allow us to reflect on one's practice and learn from medical errors, complications, and unanticipated outcomes experienced by others. Morbidity and mortality meetings are ACGME mandated educational series, which ought to occur regularly in teaching institutes. Only few of the institutes conduct these morbidity and mortality regularly. Existing literature focuses on how these meetings are beneficial and relevant to resident education rather than the standardization and optimal frequency of these sessions. A study conducted in March

2020 showed that in lower-middle-income countries 86% of trainees consider these morbidity and mortality meetings to be essential and beneficial to neurosurgery training.[6,12] Academic morning meetings and resident assessment tests are essential teaching components of any surgical training programs. 90% of the response (94 weekly and 41 for daily) for conducting academic morning meetings for resident education. Regular morbidity and mortality ($P \leq 0.005$) and academic morning meetings ($P \leq 0.005$) were observed more in Punjab and Sindh. This may be because of established neurosurgery services and training programs in these more populated provinces.

An opportunity to learn and improve practical skills in neurosurgery is limited in some clinical setups. A trainee should strive to attend workshops and international conferences, to stay abreast with the current advancements of the field of neurosurgery. In our study, 53% of the respondents had participated in international conferences comparatively more in the private sector. We speculate that the reasons for this difference could be more availability of sponsorship and mentorship in private sector. Unfortunately, half of the respondents had not attended any conference, which needs to be addressed if the trainees are supported by the institution. Hands-on workshops are considered bedrocks for surgical skills training in which residents develop essential surgical skills taught in a feedback. In our study, 63.3% of the residents found these workshops extremely useful. Although there was a significant difference between provinces regarding attendance and number of workshops conducted. We therefore recommend standardization of training and teaching activities.

Over 500 million people in Pakistan live under the poverty line.[13] The neurosurgeons to patient ratio in Pakistan is way below par.[10] This increases the workload on trainees both in public and private sector. On the one hand, 73% of trainees reported two or less calls per week (50–80 h). This is relatively less hours per week for a 4 years residency program and is a result of more trainees in neurosurgery department especially in public sector ($P \leq 0.005$). 37% of trainees reported working for more than 90 h per week, more common in KPK, likely because of more workload and less trainees. ACGME

has proposed an 80-h/week duty time limitation.[14,15] A study done in Canada revealed that 58% residents were satisfied with 80–89 h of duty per week[16] though this may be exhausting and leaves little time for consolidation of the knowledge and skills.[17] Sixty-one percent of the private setups have three or more than three OPDs per week, with approximately 150 patients seen in a day. This translates to more consultation time and attention to quality patient care.

Conclusion

This study reported variability in the quality of neurosurgery training programs within public and private sector with even greater differences between the four provinces of Pakistan. Although neurosurgery training is well established in Pakistan but programs need to be standardized to improve the quality of training. We recommend continuous assessments, re-accreditation and standardization of these training programs through subject experts and health-care educationists, as recommended by the CPSP. These measures would help to improve the quality of training programs and hence the quality of service and patients care.

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Conflicts of interest

There are no conflicts of interest.

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