EEG training in Neurology Residency at Egyptian Universities

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Abstract:

Background: Neurology residency training has been apparent to be essentially variable in different countries. Differences include disparities in length and programs' intrinsic components.
Objectives: This study aimed for better understanding of the current EEG training paradigms for adult neurology residents in Egypt.
Materials and Methods: Thus, an e- survey -adopted from Nascimento and colleagues - was e-mailed to the professors chairing Neurology Departments in various Official Universities in Egypt. The collected Egyptian data was analyzed and compared to that from Europe and USA.
Results: This study included a total of 85 institutions involved in neurology training programs: 6 from Egypt, 32 from Europe and 47 from USA. The study showed no significant difference between Egypt and Europe regarding the total number of residents per year, the number of weeks devoted to learning EEG, the number of EEGs read by residents, the primary mechanism for EEG education, and the barriers to EEG teaching. There was a significant difference in the postgraduate year level at which residents take EEG rotation, the requirements for successful completion of the rotation, and the presence/absence of objective measures used for the assessment.
Conclusion: The study concluded that the current EEG learning programs in the adult neurology residency in Egypt are close to those in Europe and USA, yet national and international standardization of these programs is highly recommended.
Keywords: Adult neurology; EEG; Egypt; Residency training programs.

Introduction

Neurology residency training has been apparent to be essentially variable in different countries. Differences include disparities in the length of residency training and programs' intrinsic components, such as the profile of obligatory rotations (**Kleineberg et al., 2020; Zis and Kuks, 2016; Struhal et al., 2011**). Clinical neurophysiology is usually addressed; it is either a separate sub-specialty or a part of neurology residency training. When incorporated into resident training, teaching systems vary from brief, non-practical programs to perform a minimum number of studies (**Kleineberg et al., 2020**).

Two recent studies were conducted to review the neurology residents' EEG training in USA (**Nascimento and Gavvala, 2021**), and the other one compared USA to European systems (**Nascimento et al., 2022**). This latter study used an e-survey.

In this study we aimed for better understanding of the current EEG training paradigms for adult neurology residents in Egypt.

Materials and methods

An e-survey (**Appendix 1**) was e-mailed through the official email of one of the investigators to the professors chairing neurology departments in various official universities (under the umbrella of the Egyptian Higher Council of Universities). Each of them was asked to share in the study with two answered e-surveys; one to be filled by the received chair professor and/or the training responsible staff members, and the other by the most junior assistant lecturers (in the fourth postgraduate year).

This e-survey was adopted after the authors' approval from Nascimento and colleagues (2022) (**Nascimento et al., 2022**).

The structure of the e-surveys used to assess Egyptian training programs were almost like the ones used in Europe and USA, however minor adaptations in wording were done to suit Egyptian teaching system and to suit target audience whether chairperson or post graduate student.

The study was approved by the department scientific committee. The collected Egyptian data will be analyzed and compared to that from Europe and USA.

Statistical analysis

Statistical analysis was carried out using Jamovi-open statistical software for the desktop and cloud (2.3.28). Categorical data is expressed in terms of count and percent (%) and compared using Fisher's exact test. Quantitative data is expressed in terms of mean and standard deviation or median, 25th and 75th percentiles. Comparisons between two groups were done using Mann-Whitney test, whereas comparisons between three groups were done using one way ANOVA (Kruskal-Wallis test) followed by post hoc analysis using Dwass-Steel-Critchlow-Flinger pairwise comparisons. In all used tests $P<0.05$ was considered significant.

Results

This study included a total of 85 institutions involved in neurology training programs: 6 from Egypt, 32 from Europe, and 47 from USA.

A total of 24 institutions were contacted in Egypt, only 6 had responded (the response rate was 25%), 32 out of 47 (68% response rate) in Europe, and 47 out of 161 program directors responded in USA (with a response rate of 29%), $p<0.001$.

The number of adult neurology residents varied greatly among the included institutions where, in Egypt, the number of adult neurology residents who completed a neurology residency training program per year ranged from 2 to 15, with a median of 4. In Europe the numbers were much higher. This could be attributed to the greater number of neurology training institutions in Europe. However, there was no significant difference regarding the total number of residents per year.

The number of weeks devoted to learning EEG showed great variation among different institutions where it was much higher in Egypt ranging from 2 to 24 weeks, with a median of 18 weeks, followed by USA (7 weeks) then Europe (4 weeks). However, there was no statistically significant difference between the three destinations.

There was a significant difference in the postgraduate year level at which residents take EEG rotation p=0.004. In Egypt, EEG learning rotation is scheduled in the third postgraduate year in 50% of the institutions., this is similar to USA where the rotations are mostly in the second (51%) as well as third year (40%) with evident overlap. Whereas in Europe, the responses were distributed more evenly over five years.

All the EEG learning rotation in Egypt were completed in the first 3 post graduate years, which coincides with the bylaws for fulfilment of master's degree in adult neurology.

There was a statistically significant difference in the settings for EEG rotations responses p<0.001. In Egypt, there was equal distribution between two of the settings namely outpatient clinic as well as epilepsy monitoring unit with each scoring 42% of the responses. In Europe, more responses were for outpatient clinics (58%) followed by 42% for the epilepsy monitoring unit. Whereas USA responses were more towards epilepsy monitoring units (57%). It is worth mentioning that none of the responses from either Europe or USA stated neurophysiology unit which scored 17% of the response in Egypt.

There was no significant difference between the three locations regarding the number of EEGs read by residents. In Egypt, the number of EEGs read exceeds 40; most of them (55%) were routine, followed by prolonged EEG (36%) and lastly continuous EEG (9.1%).

The previously discussed replies are displayed in (**Table.1**).

Table 1. Comparison between responses to survey questions across the three groups

Questions and Responses	Egypt	Europe	USA	P value
Number of neurology residents/year				
Number of residents median (25th, 75th)	4 (2,6)	31 (10,80)	--	0.075
Number of weeks for EEG learning				
Number of weeks median (25th, 75th)	18 (9,24)	4 (4,12)	7 (4 – 8)	0.141
Postgraduate year(s) for EEG rotation				
Postgraduate year 1	1 (17%)	4 (12%)	1 (2.1%)	0.004
Postgraduate year 2	2 (33%)	8 (24%)	24 (51%)	
Postgraduate year 3	3 (50%)	9 (27%)	19 (40%)	
Postgraduate year 4	0	8 (24%)	3 (6.4%)	
Postgraduate year 5	0	4 (12%)	0	
EEG rotation settings				
Outpatient clinic	5 (42%)	14 (58%)	33 (43%)	<0.001
Epilepsy monitoring unit	5 (42%)	10 (42%)	43 (57%)	
Neurophysiology unit	2 (17%)	0	0	
Number of EEGs read in the program / resident				
0 - 10	0	4 (13.3%)	7 (14.9%)	0.132
11 – 20	1 (16.7%)	1 (3.3%)	9 (19.1%)	
21 – 30	0	3 (10%)	10 (21.3%)	
31 – 40	0	3 (10%)	5 (10.6%)	
>40	5 (83.3%)	19 (63.3%)	16 (34%)	

There was no significant difference regarding the primary mechanism for EEG education. There was a significant difference in the presence/absence of objective measures used for the assessment. In Egypt, barrier responses were distributed almost equally. There was no significant difference across the locations regarding barriers to EEG teaching. Possible solution(s) to overcome these barriers and improve EEG education in adult neurology residency programs were mainly more equipment (67%), followed by more dedication (33%). This is shown in (**Table. 2**).

Table 2. Mechanisms of education and assessment

Responses	Egypt	Europe	USA	P value
Mechanism(s) of EEG teaching				
Bedside teaching	6 (26%)	6 (16%)	24 (15%)	
Instructions throughout the year	5 (22%)	10 (27%)	44 (28%)	
Teaching during epilepsy clinic	5 (22%)	7 (19%)	31 (20%)	0.57
During EEG rotation	4 (17%)	11 (30%)	45 (28%)	
Intense instructions for 2 months	3 (13%)	2 (5.4%)	14 (8.9%)	
No formal dedicates	0	1 (2.7%)	0	
Barrier(s) of EEG teaching				
Insufficient dedicates	2 (29%)	7 (44%)	5 (12%)	0.074
Insufficient EEG exposure	2 (29%)	6 (38%)	15 (38%)	
No barriers	3 (43%)	3 (19%)	20 (50%)	
Presence of objective assessment measures for EEG competency				
Yes	4 (67%)	16 (53%)	0	<0.001
No	2	14	45.5% (30)	

There was a significant difference between Egypt and Europe in assessment measures for EEG competency p=0.018, where in Egypt the knowledge and mastering of advanced techniques and attendance of workshops scored equal responses (33%) followed by attendance and exams (17%). While in Europe, attendance and exams scored the highest percentage of responses (31%), followed by EEG interpretation (25%).

There was a no significant difference between Egypt and Europe regarding the requirements for the successful completion of EEG rotation. In Egypt, 50% of responses were post rotation exam (formative assessment) which could be easily documented and evaluated.

There were equal responses for mastering advanced techniques and workshop attendance. While in Europe, supervised EEG reading was the main way of assessment of completion (42%), followed by post rotation exams (25%). Interestingly, almost equal percentages of responses in both Egypt (25%) and Europe (29%) reported the lack of requirements for program completion.

There was no significant difference in personnel reading the EEG and the responses percentages were almost equally distributed among the choices in Europe, however, in Egypt, responses were equal for general neurologists (29%) and neurologists with epilepsy training (29%), followed by neurologists with neurophysiology training (24%). Details are displayed in (**Table.3).**

Table 3. Comparison between programs in Egypt and Europe

Questions and Responses	Egypt	Europe	P value
Assessment measures for EEG competency			
None	2 (34%)	4 (25%)	
Attendance and exam	1 (17%)	5 (31%)	
Advanced techniques	2 (33%)	0	
Workshops	2 (33%)	0	0.018
Specific number of EEGs	0	3 (19%)	
EEG interpretation skills	0	4 (25%)	
Requirements for program completion			
None	2 (25%)	7 (29%)	0.3
Post rotation exam	4 (50%)	6 (25%)	
Supervised EEG reading	1 (12%)	10 (42%)	
Final formal Exam	1 (12%)	1 (4.2%)	
Personnel responsible for EEG reading in the practice			
General Neurologist	5 (29%)	16 (24%)	0.73
Neurologist with epilepsy training	5 (29%)	13 (19%)	
Neurologist with neurophysiology training	4 (24%)	16 (24%)	
Neurologist with epilepsy and neurophysiology training	2 (12%)	11 (16%)	
Neurophysiologist	1 (5.9%)	12 (18%)	

Discussion

This study started by a sincere urge to stand by actual EEG teaching/learning standards in Egypt. This was ignited by reading the prestigious manuscript of Nascimento and colleagues that was published in 2022 (**Nascimento et al., 2022**). This work was inclusive of previously published studies with likewise aims and adopted the exact vision we have, that understanding education systems is the first step towards improving resident EEG training.

Following their e-survey, we constructed a questionnaire emailed it to our valued chairpersons of Neurology departments in the Egyptian universities. We are here discussing the comparisons between the Egyptian responses and those mentioned by Nascimento and colleagues in 2022 (**Nascimento et al., 2022**).

In Egypt, 25% of targeted bodies responded, which was close to USA responders (29%) (**Nascimento and Gavvala, 2021**). However we considered this response rate to be one of the major limitations in this study, it is still close to the typical response rate linked to academic surveys (**Baruch, 1999**). Yet, both rates, Egyptian and American, were far from the 68% responders in Europe (**Nascimento et al., 2022**). Although e-survey seems to be accessible and saves time and effort, some researchers are not familiar with it and found it time consuming.

We stress on the importance of increasing awareness among scientific institutions about the importance of data collection and the power data analysis can carry and how this would positively impact the scientific community and allow further improvement of teaching in general.

The total number of residents who complete adult neurology residency training per year as well as the weeks devoted to learning EEG were comparable in Egypt, Europe, and USA

(**Nascimento and Gavvala, 2021**; **Nascimento et al., 2022**).

The postgraduate year (PGY) when adult neurology residents typically take the EEG rotation, had various replies comparing the three locations. Even heterogeneous replies were appreciated within the same location (**Nascimento et al., 2022**).

The previous two replies to the duration of training as well as the timing of the training during the residency are critical learning standards. As advised by Benbadis in 2007, "ACGME should require minimum electroencephalography training in neurology residency, in terms of quantity (so many months, so many studies) and quality (under the supervision of electroencephalographers/ epileptologists)".

We are here advising that EEG rotation is done twice during the residency to guarantee quality and quantity of training and to gain both fundamental and advanced skills. The first time is suggested during the basic segment of the program. Another time is achieved while finalizing the program.

The settings of the EEG rotations showed significant differences. In the three locations, the options of an outpatient clinic as well as EMU were valid. It is worth mentioning that in Egypt, there are only two specialized Clinical neurophysiology units (Cairo University and Bani Sweif University).

The reply to the number of EEGs read was remarkably deficient in the Egyptian sample, with only 6 replies.

The requirement(s) for successful completion of the EEG rotation in adult neurology residency programs were compared among Egyptian and European samples only. This comparison showed a significant difference. This difference is alarming to us. For more than a decade, Benbadis in 2007 was suggested drastically defining competency for neurologists who interpret EEGs. More recently, Nascimento and colleagues in 2022 mentioned that it

would be reasonable to standardize these educational measures on an international level.

Our previous alarm was partially snoozed, finding that the primary mechanisms for EEG didactic education in adult neurology residency programs across the three regions were alike, with no comparative statistical difference.

The barriers to EEG teaching in the three regions were not significantly different and were mainly insufficient dedicated and insufficient EEG exposure. Yet, the residency programs among the three regions do not utilize objective measures for assessing EEG competency similarly. Thus, we are re-enforcing the recommendation of Nascimento and colleagues in 2022 (**Nascimento et al., 2022**) to set guidelines outlining minimum training requirements for EEG education in residency to standardize the residents' unleashed measurable experience. Such measures could vary among post-rotation exams, supervised EEG readings, or final formal exams as used in Egypt and Europe, similarly. However, further measures could always be updated.

The final inquiry for who typically reads EEG in the neurology practice (85 responses) showed no significant difference between Egypt and Europe. However, Benbadis in 2007 recommended the use of a backup or confirmatory interpretation for non-real-time management decisions.

Updates for EEG training is dynamically changing. Non-traditional teaching methods, such as e-learning programs, were developed by the International League Against Epilepsy (ILAE) (**Beniczky et al., 2020**). Regularly, the American Clinical Neurophysiology society (ACNS) update educational programs and practical guidelines for EEG and other clinical Neurophysiology subspecialties. From May 2024; the Arabic version of these EEG guidelines is available. Also, The International Federation of Clinical

neurophysiology (IFCN) demonstrates updated educational material. This, and further future updates, can be integrated into educational programs to make sure that neurology residents always have fresh knowledge about EEG interpretation.

Conclusion

This study is concluding that the current EEG learning programs in the adult neurology residency in Egypt are close to those in Europe and USA, yet national and international standardization of these programs is highly recommended.

Declaration of interest: The authors report there are no competing interests to declare.

Data availability statment: Data not published within this article will be made available at request from any qualified investigator.

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