



Identifying Medical Student Perceptions on the Difficulty of Learning Different Topics of the Undergraduate Anatomy Curriculum

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Abstract

Anatomy education research has identified neuroanatomy and pelvic anatomy as particularly challenging to medical students. However, perceptions of the whole undergraduate anatomy curriculum have not been properly determined. One hundred eighty-five second year medical student evaluations showed that neuroanatomy and head and neck and pelvic anatomy were rated significantly harder than the remainder of the curriculum ($p < 0.0001$). However, students at the National Undergraduate Neuroanatomy Competition did not rate neuroanatomy harder than the other subjects. This study identifies topics which are perceived to be the most difficult to learn and targeting these will make the biggest differences in medical student learning experience.

Keywords Neuroanatomy education

Background

The face of anatomy education is changing rapidly under the pressure of limited resources. The amount of time devoted to anatomy within the undergraduate curriculum in the UK has declined [1], and yet, the same standards of knowledge are expected of our future doctors. Concerns have been raised by clinicians that tomorrow's doctors do not possess a level of knowledge suitable for safe medical practice [2]. These concerns appear to be mirrored by medical students where 70% of students in one study from Australia felt that there was not enough teaching time in anatomy and less than half of the same student group thought they possessed enough knowledge to practise competently [3].

The decline in the time allocated to anatomy teaching within the curriculum has not fallen proportionally for all elements of anatomy education; neuroanatomy has been relatively well protected [4]. This suggests that anatomy educators recognise

that the more challenging topics require more teaching time than others. In light of this situation, it is important to know where the weaknesses in student knowledge exist so that time and resources can be allocated accordingly.

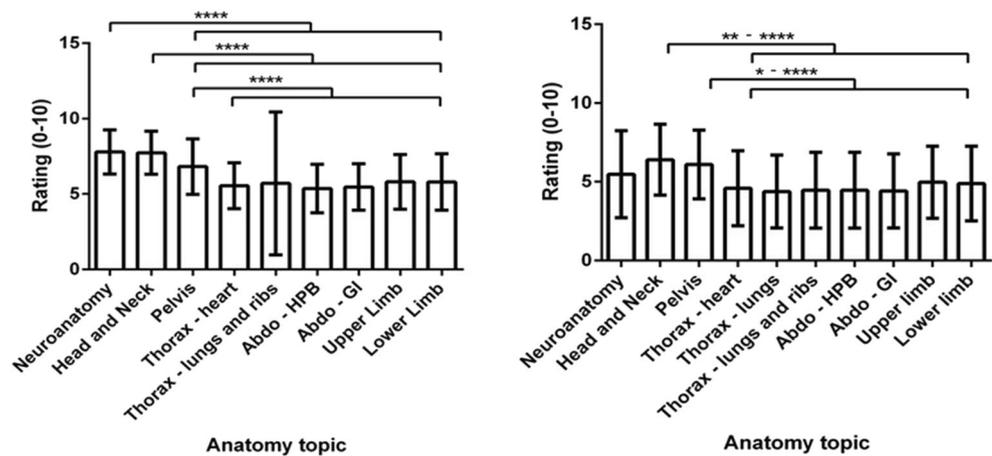
The learning experience of medical students in anatomy is an important factor to consider when assessing performance and outcomes. The most fundamental method for evaluating the learning experience of medical students is to determine their feelings towards the difficulty of learning each subtopic. In 2002, Kramer published a survey on medical students asking them to identify the problem areas in anatomy and what made them difficult. This study highlighted that neuroanatomy and pelvic anatomy were of particular difficulty to their students; however, it did not evaluate student perceptions on the whole curriculum [5]. Javaid et al. [6] have recently published student ratings on the whole curriculum and neuroanatomy was again rated as the most difficult subject.

The study presented here builds on the work of Kramer and Solely, and Javaid et al. to confirm student ratings on the whole curriculum as well as determine how these ratings compare to a group of medical students with a neuroscience interest. These reasons have the potential to inform future teaching practices which can be tailored to the specific subtopic at hand.

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Fig. 1 Ratings on difficulty of anatomy topics for **a** general medical students and **b** NUNC competitors. HPB hepatopancreatobiliary, GI gastrointestinal. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, **** $p < 0.0001$



Activity

In 2014, all second year medical students on the 5-year undergraduate medicine course at the University of Southampton ($n = 212$) were invited to complete a paper-based questionnaire following the end of their second year examinations. At this stage in their training, these students had been exposed to the entire pre-clinical anatomy curriculum.

In order to evaluate whether or not ratings on topic difficulty changed in medical students with a specific interest in neuroanatomy, the same questionnaire was distributed to the 91 competitors at the 2015 National Undergraduate Neuroanatomy Competition (NUNC). This competition is a 1-day event run annually at the University of Southampton and is open to all medical students from the UK and Republic of Ireland who enter on a voluntary basis. The structure of the competition has been previously described [7, 8]. These competitors represented 21 different medical schools throughout the UK. Forty-two (46.2%) medical students were in their lecture-based “pre-clinical” stage of undergraduate education and the remainder were in full-time clinical placements.

The survey instrument comprised of three areas: (1) demographics, (2) ratings out of 10 on the perceived difficulty of each area of the anatomy curriculum and (3) which single area students found most challenging and why.

This survey was validated with a Cronbach alpha score of 0.72. The data was analysed using GraphPad Prism version 6. Ethical approval for this study was approved by the Faculty of Medicine Ethics Committee: ID 799 and 3951.

Results

Of the 212 second year medical students approached, 185 feedback forms were received (89% response rate). Kruskal-Wallis analysis showed significant variance within the difficulty ratings out of 10 for each subject ($p < 0.0001$). Post hoc multiple comparison testing showed that the average student ratings for neuroanatomy (7.79/10) and head and neck (H&N) anatomy (7.76/10) were not significantly different from each other but were both significantly higher than all of the other anatomy topics ($p < 0.0001$). Pelvic anatomy was rated 6.8 out of 10 which despite being significantly lower than neuroanatomy and H&N anatomy was still significantly higher than all of the remaining topics ($p < 0.0001$). There were no significant differences amongst the other anatomical subjects (Fig. 1a).

The pattern of difficulty rating from those who attended the NUNC was similar but with some notable differences. Head and neck (6.4/10) and pelvic (6.1/10) anatomy were significantly harder than every other subject except for neuroanatomy. However, unlike the second year medical students above, the NUNC attendees did not rate neuroanatomy (5.5/10) significantly harder than everything else (Fig. 1b).

The second component of the questionnaire determined the students’ subjective single most difficult topic and why. Of the 185 second year students and the 91 NUNC attendee feedback forms, 167 (88.4%) and 77 (84.6%) respectively had this component completed correctly. Amongst the second year students, more than half felt that neuroanatomy was the hardest subject. This is in contrast to a notably smaller proportion of

Table 1 The anatomical subject selected as the single most difficult by general medical and NUNC students

	Neuroanatomy (%)	H&N (%)	Pelvis (%)	Thorax (%)	Abdomen (%)	Limbs (%)
Second year ($n = 167$)	52.1	22.2	21	0.6	1.2	3
NUNC ($n = 77$)	33.8	23.4	28.6	2.6	2.6	9.1

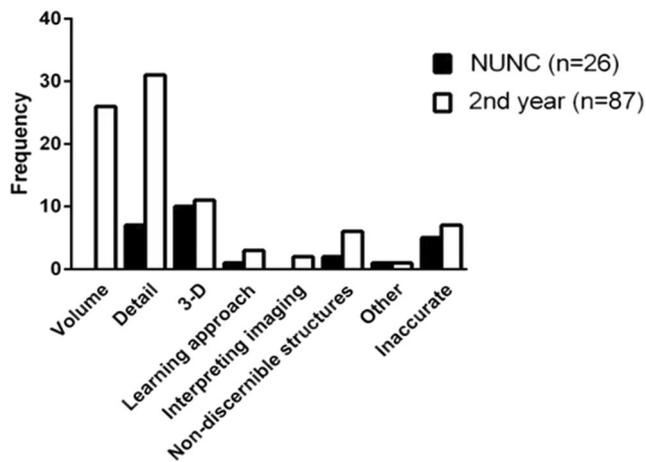


Fig. 2 The reasons why students find neuroanatomy to be the most difficult subject

students rating neuroanatomy as the hardest subject amongst the NUNC attendees (Table 1). Pelvic and H&N anatomy were consistently rated amongst the hardest anatomy subjects to learn mirroring the ratings out of 10 described above.

The second year ($n = 87$) and NUNC ($n = 26$) students who rated neuroanatomy to be the hardest subject also gave their reasons why they thought this to be the case (Fig. 2). This shows that the NUNC attendees have less issue with the volume of material and the intricate details involved compared with the second year medical students.

Discussion

Learning anatomy is one of the core components of medical education and there is extensive research into its teaching methods. For these methods to be employed effectively, they need to be directed to the areas where they are needed the most and where students will reap the most benefit.

The results presented here build on the previous work of Kramer and Soley [5] and Javaid et al. [6] with an expansion to cover student opinions of the entire curriculum and further probe into perceptions of learning neuroanatomy. The medical students at the University of Southampton rate neuroanatomy, head and neck, and pelvic anatomy to be significantly harder than the rest of the subjects (Fig. 1a). This finding is consistent with the results of Kramer [5] and Javaid et al. [6].

The competitors at NUNC are students with a special interest in neuroanatomy and did not rate neuroanatomy as being significantly harder than any of the other anatomy topics (Fig. 1b). Whilst this is not unexpected, it demonstrates that neuroanatomy is not universally feared by all medical students. Examining why the NUNC competitors lack neurophobia may guide future educational interventions designed to reverse negative perceptions towards neuroanatomy.

Further to these ratings, approximately half of medical students in this study believe that neuroanatomy is the single most difficult topic. The implications of this are evident in later medical practice as seen through the increasing literature references to neurophobia, which identifies difficulty with neuroanatomy as a key component [9]. The NUNC competitors were far less likely to rate neuroanatomy as difficult due to high volume of material or problems with the fine detail (Fig. 2). The factors which influence student outlook on what volume of material is insurmountable require further investigation but are a combination of both intrinsic factors such as academic ability and self-confidence, and extrinsic factors such as how the material is presented and delivered by the faculty. Changes to the teaching delivery such as providing the clinical importance of anatomical structures and repetition of material may reduce the sense of large amounts of seemingly worthless rote learning [10], and thus the volume of material becomes less daunting. The NUNC students with their natural interest in neurology and neurosurgery will be ahead of general medical students in this process because they are more likely to be engaged in clinical neuroscience and will have revised the material in preparation for the examination which may influence their perception on the volume of the material.

Head and neck, and pelvic anatomy are reported as more difficult than other subjects by both NUNC and general medical students which is consistent with the previous study by Javaid et al. [6] The observation that NUNC students still find these hard whilst they do not struggle with neuroanatomy suggests that perceptions on these subjects could be altered if they approached head and neck or pelvic anatomy in the same way as they do in neuroanatomy. Educational changes to how these subjects are approached by medical students may allow the loss of fear towards neuroanatomy to be mirrored in head and neck and pelvic anatomy. Javaid et al. have suggested changes such as case-based teaching and online resources may help engage students in neuroanatomy [6].

Smith et al. identified that time constraints in the curriculum are linked to students' perceptions that there is too much to learn [11]. An initiative at George's, Kings and St Thomas's medical schools in the UK increased the length of curriculum time in neuroanatomy and was successful in reducing neurophobia [12]. The NUNC students are likely to spend extra time studying neuroanatomy either through revision for the competition or their own intrinsic interest which may explain why they do not find the volume of material daunting. The protection of curriculum time dedicated to neuroanatomy [4] is therefore well justified; there may even be justification to increase this time to facilitate better digestion and assimilation of required knowledge.

In addition to its role in causing neurophobia, a high-volume subject is associated with a shift towards a strategic learning style [13] which may have implications on

long-term knowledge retention amongst medical students. Such problems may benefit from repetition and a spiral learning approach to allow for proper consolidation and retention of knowledge. The use of extra-curricular revision sessions, such as those already being run in neuroanatomy at the University of Southampton [14], may allow for such repetition.

Within this study, it is important to address several limitations. Firstly, the results from the NUNC represent medical students at a range of stages in their training and perceptions may change throughout the course of the medical degree. Secondly, the range of institutions and their teaching methods may pose differing underlying reasons as to why students hold certain perceptions. Lastly, the NUNC attracts many *neurophiles* who are likely to have a biased opinion towards their perceptions of the difficulty of neuroanatomy.

In conclusion, this study begins to quantify the student perceptions on the whole anatomy curriculum and confirms neuroanatomy as one of the most difficult subjects. This neurophobia is not universal and changes to educational practice have the potential to change how students perceive the difficulty of an anatomy topic.

Compliance with Ethical Standards

Ethical approval for this study was approved by the Faculty of Medicine Ethics Committee: ID 799 and 3951.

Conflict of Interest The authors declare that there is no conflict of interest.

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