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A Quantitative Examination of Undergraduate Neuroscience Majors Applying and Matriculating to Osteopathic Medical School

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Undergraduates choose to become neuroscience majors for a number of reasons including future career goals. Faculty and administration of undergraduate neuroscience programs understand that many neuroscience majors have aspirations of applying and matriculating to medical school (Prichard, 2015); however a quantitative understanding of this particular student population remains unknown, especially in the context of the national growth in undergraduate neuroscience education (Ramos et al., 2011). In the present report, we use medical school application data to establish a novel quantitative understanding of the number of neuroscience majors that apply and matriculate to osteopathic medical school. Our data indicate that a substantial number of neuroscience majors do indeed apply and matriculate to medical school compared to other majors in the life sciences, math and

physical sciences, and humanities. These data are relevant to faculty and administration of undergraduate neuroscience programs and suggest that when programmatic, curricular, and training decisions are made, they should be made in the context of the diverse motivations and professional goals of neuroscience majors including careers in medicine. Finally, our novel quantitative approach of determining student motivation and professional goals based on application/matriculation data, can complement traditional methods such as surveys and questionnaires and can be used to determine the extent to which neuroscience majors apply to other professional and graduate degree programs.

Key words: neuroscience majors; medical school; osteopathic medical school; physiology

Quantitative analyses have documented the growth of undergraduate neuroscience education in the US as measured both by the number of colleges and universities with undergraduate neuroscience programs as well as the number of graduates from these programs (Ramos et al., 2011). Along with the growth of undergraduate neuroscience have come the challenges of providing the appropriate curricula, training, mentoring, research experiences, etc. for neuroscience majors. In response to these challenges, there has been substantial growth in pedagogical and curricular innovation for the undergraduate neuroscience lecture hall and laboratory documented in publications such as the *Journal of Undergraduate Neuroscience Education* and elsewhere.

Undergraduates pursue a neuroscience major for many reasons, one of which includes admission to medical school in pursuit of a career in medicine. While individual institutions may keep track of the number of undergraduate neuroscience majors that apply/matriculate to medical school, a broader quantitative analysis of the number of neuroscience majors applying to and matriculating to medical school is lacking.

In the present report, we use quantitative data to demonstrate that neuroscience majors constitute a substantial portion of osteopathic medical school applicants and matriculants. In addition, an increase in the number of neuroscience applicants and matriculants was observed over the course of the 2012-2014 academic

years examined. These data are relevant to college and university faculty and administration and help to provide a greater understanding of the needs and professional goals of undergraduate neuroscience majors.

MATERIALS AND METHODS

The American Association of Colleges of Osteopathic Medicine (AACOM) oversees a centralized application portal for students applying to all osteopathic medical schools in the US with the exception of University of North Texas Health Science Center/Texas College of Osteopathic Medicine. As part of the application process, students self-report their undergraduate major from 120 possible majors (including *No Major*) listed on the application form which includes majors in the life sciences, math and physical sciences, social sciences, and humanities. We performed a search of the database of self-reported majors that completed the AACOM application for admittance during the 2012-2014 academic years. These years include data where *Neuroscience* was included as a major category on the application form. In particular, the number of applicants and the number of subsequent matriculants for several major categories were calculated and the percentage from the total number of applicants and matriculants was computed.

In order to estimate the number of graduates from undergraduate neuroscience programs, we used data from the National Center for Education Statistics (NCES;

MAJOR	N in 2014	% in 2014	N in 2013	% in 2013	N in 2012	% in 2012
Biology	7,903	36.63	7,335	37.26	6,695	37.37
Psychology	1,423	6.60	1,269	6.45	1,124	6.27
Biochemistry	1,246	5.78	1,026	5.21	915	5.11
No Major	895	4.15	696	3.54	592	3.30
Chemistry	886	4.11	858	4.36	802	4.48
Neuroscience	798	3.70	673	3.42	542	3.03
Biomedical Science	547	2.54	523	2.66	376	2.10
Health Sciences	537	2.49	442	2.25	371	2.07
Premedical	498	2.31	445	2.26	524	2.93
Microbiology	447	2.07	412	2.09	385	2.15
TOTAL APPLICANTS	21,575		19,684		17,914	

MAJOR	N in 2014	% in 2014	N in 2013	% in 2013	N in 2012	% in 2012
Biology	2,848	37.93	2,923	38.51	2,488	38.11
Psychology	489	6.51	428	5.64	357	5.47
Biochemistry	464	6.18	389	5.13	349	5.35
No Major	312	4.16	269	3.54	237	3.63
Chemistry	296	3.94	353	4.65	263	4.03
Neuroscience	264	3.52	266	3.50	221	3.38
Biomedical Science	191	2.54	202	2.66	133	2.04
Health Sciences	180	2.40	174	2.29	132	2.02
Microbiology	176	2.34	159	2.09	121	1.85
Premedical	165	2.20	187	2.46	192	2.94
TOTAL MATRICULANTS	7,509		7,590		6,529	

Table 1 and 2. Number and percentage of the top 10 self-reported majors applying (*Table 1*) and matriculating (*Table 2*) to Colleges of Osteopathic Medicine during the 2014, 2013, and 2012 academic years. Total number of applicants and matriculants were determined from the total number of applicants and matriculants responding to 120 possible majors listed on application form. Academic years are listed left-to-right from 2014 to 2012.

nces.ed.gov) and the Integrated Postsecondary Education Data System (IPEDS) according to methods previously described (Ramos et al., 2011). Briefly, these databases were used to query the colleges and universities with undergraduate programs listed by search-term “neuro” in the program name including: 1] Neuroanatomy, 2] Neurobiology & Anatomy, 3] Neurobiology & Behavior,

4] Neurobiology & Neurosciences, Other, 5] Neuropharmacology, 6] Neuroscience. The number of graduates (2012-2014 academic years) from these programs for each of the identified institutions was collected from these databases. All data used in these analyses is found as Supplementary Material. The strengths and limitations of using data from these

databases for estimates of graduation statistics from neuroscience programs has been discussed previously (Ramos et al., 2011).

RESULTS

As shown in Table 1, *Neuroscience* was among the top 10 self-reported majors of applicants to Colleges of Osteopathic Medicine (COMs) from 2014 back to 2012. From among the many thousands of applicants to COMs, students who reported *Neuroscience* as their undergraduate major constituted nearly 4% of all applicants in the most recent year, 2014 (798 applicants). Over the three-year period examined, both the number and percentage of neuroscience applicants has risen slightly despite the general increase in total number of applicants to COMs. In contrast, the number and/or percentage of applicants self-reporting other majors among the top 10 have decreased over this same period such as microbiology, biology, and chemistry.

Data relating to the number of applicants to COMs who were admitted and subsequently matriculated a COM were also examined as it relates to the self-reported undergraduate major. As shown in Table 2, *Neuroscience* was among the top 10 majors self-reported by matriculants, and neuroscience majors constitute a similar percentage of students who matriculate to a COM relative to the number who apply (Table 1). Over the course of the three-year period examined, the percentage of neuroscience majors who matriculate to a COM has also increased slightly.

In order to determine how these numbers relate to estimates of the total number of graduates from neuroscience programs, we examined data from NCES/IPEDS for academic years 2014-2012 using methods previously described (Ramos et al., 2011). As shown in Supplementary Table 1, analyses of institutions with undergraduate neuroscience programs revealed a total of 4212, 3722, and 3236 graduates over the course the 2014-2012 academic years, respectively. Based on these data and the applicant/matriculants data for those same years, we estimate that approximately 19%, 18% and 17% of all neuroscience majors applied to COMs (respectively), while 6%, 7%, and 7% of all neuroscience majors matriculated (respectively) during those three academic years.

DISCUSSION

In the present report we provide novel data documenting the growth and extent of undergraduate neuroscience majors who apply and matriculate to medical school. Our data indicate that relative to many other self-reported majors, applying and ultimately attending medical school is a goal of many undergraduate neuroscience majors. This is supported by our findings that *Neuroscience* was among the top 10 majors self-reported by applicants and matriculants over other majors in the life sciences and physical sciences such as molecular biology, microbiology, etc. Over the three-year period examined, our data also suggest that there exists an increasing trend in the percentage of applicants as well as matriculants to COMs

who were self-reported neuroscience majors – even as the total number of applicants increases.

Based on our estimates of the number of neuroscience program graduates from NCES/IPEDS, we estimate that 19-17% of neuroscience majors have aspirations of applying to medical school in pursuit of a career in medicine. An important caveat of these data is that if we have an underestimate of the total number of neuroscience graduates, than a smaller percentage of majors is interested in applying/matriculating to medical school than we report here. In addition, as the number of undergraduate neuroscience programs increase nationwide, so too will the number of total number of graduates which will affect our estimates. However, it remains unclear whether students interested in a career in medicine, are moving away from pursuing majors traditionally associated with “pre-med” students (biology, chemistry, microbiology, etc.), and choosing to pursue a neuroscience major when that option is available to them at their undergraduate institution (Prichard, 2015). Thus, obtaining a better quantitative understanding of the number of neuroscience majors interested in a career in medicine is an important area for continued investigation.

Understanding the motivations for choosing to pursue an undergraduate degree in neuroscience has important implications for program administration and faculty. In particular, faculty should be most concerned with delivering a curriculum and sufficient training experiences in preparation for the goals of the students. Our quantitative data demonstrate that a career in medicine is an important goal for many neuroscience majors, which should be considered when making curricular and training decisions affecting undergraduate neuroscience programs. Teaching and curricular resources for faculty and administration in the context of increasing neuroscience majors interested in careers in medicine was recently described by Prichard (2015).

Despite its novelty and quantitative nature, our data is limited in several ways. First, we have data only from applicants to U.S. COMs (not including University of North Texas Health Science Center/Texas College of Osteopathic Medicine). Additional data from the applicants and matriculates to allopathic and off-shore medical schools would provide a greater understanding of the national landscape of neuroscience majors interested in careers in medicine. Nevertheless, we speculate that the percentages of neuroscience majors applying and matriculating to allopathic and off-shore medical schools is similar to that of COMs, unless there is some factor that makes applying to a given type of medical school more/less attractive. Second, our data is based on the self-reported major of applicants to COMs. Thus, it is not clear to what extent students in a neuroscience *concentration* housed in a biology or psychology department self-reported as being a neuroscience major. One way to resolve this possible discrepancy would be to systematically review the academic transcript of every applicant; however, this would be too labor- and time-intensive. We speculate that most applicants would have indeed selected the category that best defines the field of

study of their undergraduate coursework and training. Finally, we have data from a limited number of years making it difficult to accurately describe the historical growth and change in the number of neuroscience majors applying and matriculating to medical school. Nor can we use our data to accurately predict future growth or change. Nevertheless, our data are relevant to faculty and administration of undergraduate neuroscience programs and indicate that when programmatic, curricular, and training decisions are made, they should be made in the context of the diverse motivations and professional goals of neuroscience majors including careers in medicine. Finally, our quantitative approach of using application/matriculation data provides a novel means of determining student motivation and professional goals which can complement traditional methods such as surveys and questionnaires and can be used to determine the extent to which neuroscience majors apply to other professional and graduate degree programs.

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