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Brief Reports

A geographic-location-based medical school admissions process does not influence pre-clerkship and licensing examination academic performance

Un processus d'admission aux programmes de médecine basé sur la localisation géographique n'influence pas les résultats académiques avant l'externat ni ceux à l'examen menant à l'obtention du permis d'exercice

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Abstract

Background: Students are selected for admission to the Northern Ontario School of Medicine University (NOSM U) MD degree program using criteria aiming to maximize access of persons thought most likely to practice in the region, including use of a geographic context score (GCS) which ranks those with lived experience in northern Ontario and/or rurality most highly. This study investigates the effect of this admissions process upon medical school academic performance.

Methods: We used a retrospective cohort design combined with multiple linear regression analysis to investigate the relationship between admission scores and performance on pre-clerkship courses, and the Medical Council of Canada Qualifying Exam Part 1 (MCCQE1).

The GCS did not significantly explain performance variance on any pre-clerkship course, nor on the MCCQE1, while the undergraduate Grade Point Average correlated with most assessment scores. The number of prior undergraduate biomedical courses predicted science and clinical skills performance, particularly in Year 1, but not with MCCQE1 scores. Performance on Year 2 courses, particularly foundational sciences and clinical skills, significantly predicted MCCQE1 scores.

Results: Our data suggest that admission geographic context scoring is unrelated to future academic performance. Further, students with fewer prior undergraduate biomedical courses may benefit from increased support and/or a modified program during the early years.

Résumé

Contexte : La sélection étudiants à l'École de médecine du Nord de l'Ontario est fondée sur des critères visant à faciliter l'admission de candidats qu'on estime susceptibles de pratiquer dans la région. Un de ces critères est le score de contexte géographique (SCG) qui classe au premier rang les personnes ayant déjà vécu dans le Nord de l'Ontario ou en milieu rural. Cette étude examine l'effet de ce processus d'admission sur les résultats académiques des étudiants en médecine.

Méthodes : Nous avons utilisé un modèle de cohorte rétrospective et une analyse par régression linéaire multiple pour étudier la relation entre les scores d'admission et les résultats obtenus aux cours avant l'externat et à l'examen d'aptitude du Conseil médical du Canada (EACMC), partie 1.

Le SCG n'explique pas de manière significative la variance des résultats dans les cours pré-cliniques, ni à l'EACMC1, tandis que la moyenne pondérée cumulative au premier cycle est en corrélation avec la plupart des scores d'évaluation. Le nombre de cours en sciences biomédicales suivis dans un programme de premier cycle ont permis de prédire les résultats en sciences et en compétences cliniques, en particulier en première année, mais pas les résultats à l'EACMC1. Les résultats aux cours de deuxième année, en particulier de sciences fondamentales et de compétences cliniques, ont permis de prédire de manière significative les résultats à l'EACMC1.

Résultats : Nos données portent à croire que le score de contexte géographique au moment de l'admission est sans lien avec les résultats académiques subséquents. En outre, les étudiants ayant suivi moins de cours en sciences biomédicales au premier cycle pourraient bénéficier d'un soutien plus important ou d'un programme adapté au cours des premières années.

Introduction

Health outcomes vary widely between different demographic groups due to a variety of determinants.[1,2] One such factor is the geographic location that a person inhabits. For example, those living in rural communities have higher disease mortality and morbidity, and lower life expectancy, than their urban counterparts.[3] Underlying such statistics is lesser access to timely healthcare in these areas, not least because of a shortage of physicians.[4]

The Northern Ontario School of Medicine University (NOSMU) was established in 2005 to alleviate the physician shortage in the northernmost part of the Canadian province of Ontario.[5,6] The university is host to both post-graduate training, and the Doctor of Medicine degree (also known as undergraduate medical education; UME) which is the focus of this study.[7] The program comprises a mainly in-classroom 'pre-clerkship' in Years 1 and 2, a community-based longitudinal clerkship in Year 3, and a clinical rotations and electives-based clerkship during Year 4.[7]

NOSMU uses many of the principles of place-based education[8-10] in the design of its educational programs which are focused on training student to practice medicine in the region.[6,11] This is complemented by admitting students to medical training who are thought more likely to stay and practice. A key plank of the admissions strategy is to consider the applicant's place connections in the form of a of 'geographic context score', an admissions technique which is known to enhance retention post-graduation.[12] Applicants provide information on where they have lived for one year or more within Canada from the time they were born to the time of application. The geographic context scoring algorithm uses postal codes to place applicants into census metropolitan areas (CMA) as defined by Canadian Census data, resulting in a score based on lived experience in northern Ontario, rural and remote Ontario, and rural and remote rest of Canada CMA's. The algorithm assigns higher scores to those who have longer lived experiences in CMA's in northern and rural locations in Ontario. This is in addition to the criteria more commonly used by medical schools including undergraduate grade point average (uGPA), autobiographic essays and an interview score derived from performance on the Multiple Mini Interview (MMI) system used by the program.[13] Students must have at least a 4-year undergraduate degree (in any subject). Unlike many other schools, the NOSM U undergraduate program does not use the Medical College Admission Test (MCAT) due to concerns that it would impede entry from the very demographic groups that the university wishes to attract.[12,14]

While it has been argued that NOSMU has higher retention rates due to this approach,[15] any consequence of this unusual admission process on how students perform in and beyond medical school is unknown. We have used data from four cohorts of students to investigate the relationship between admissions scores, performance on the Medical Council of Canada Qualifying Exam Part 1 (MCCQE1), the licensing exam sat at the end of medical school, and on multiple choice type assessments taken during the first two years of training.

Methods

We used a retrospective cohort design with anonymized, secondary data being obtained from admissions and assessment records kept for four cohorts of students admitted between 2009/2010 and 2012/2013 academic years (n = 59, 57, 58, 57 respectively). During this time assessment methods were consistent between years and all students had sat the MCCQE1 by 2017. The dataset contained 248 students, but the analyzed data comprised 231 students that had data points for all variables (for repeated assessments the first score was used).

Admission application scores include a numerical interval rating of (i) uGPA, (ii) the medical school application form (biographical score), and (iii) GCS, with each component making up approximately 1/3 of the total pre-interview score used to select students for the MMI. The final application score was equally weighted between the pre-interview and MMI score. We also included information which was not used to determine who is admitted in our analysis including demographic data (age and gender), and prior educational history including the number of degrees obtained, the number of university biomedical courses taken prior to admission, and the time spent out of school before admission.

Pre-clerkship assessment scores were included from multiple choice exams for the Year 1 and 2 courses Professional and Personal Aspects of Medical Practice which encompasses all aspects of professional behavior, Social and Population Health which includes the determinants of health, Foundations of Medicine (the medical sciences), and Clinical Skills in Healthcare.

The relationship between the various variables was investigated using multiple linear regression analysis to calculate beta values and their standard errors and

statistical significance, as well as the overall regression coefficient.

Results

Two analyses were performed: (i) between admissions data and assessment scores, and (ii) between pre-clerkship course scores (grades) and the MCCQE1.

The beta values for the multiple regression between admissions scores and exam performance did not reach statistical significance ($P > 0.05$) for GCS, autobiographic, and interview scores, and the years since last university course (Table 1). The uGPA score was a significant ($P < 0.05$) positive predictor of two out of four Year 1 grades, all four Year 2 course grades, and the MCCQE1. The number of biomedical courses taken at a university level prior to admission into medical school was a significant predictor of Year 1 and 2 Foundations of Medicine and Clinical Skills courses, but not the MCCQE1; student age was a significant negative predictor of MCCQE1 performance, but not of that of the pre-clerkship courses.

Three out of four Year 2 course grades significantly correlated with MCCQE1 performance, particularly that of the Foundations course, while in Year 1 a significant relationship was observed for only Social and Population Health (Table 2). The overall model regression coefficient was higher for the relationship between the MCCQE1 score and the eight pre-clerkship grades (Table 1; $r^2 = 0.492$) compared to that for the admissions scores (Table 2; $r^2 = 0.127$). Note that inclusion of the 17 students who either left the program or had incomplete data did not change the conclusions of the analysis.

Discussion

We found that only the uGPA from university studies prior to admission, rather than other elements such as GCS and interview scores, was a statistically significant predictor of academic performance throughout medical school including the MCCQE1. The magnitude of the relationship was not large, with the beta value indicating that uGPA could account for a 7.2% difference in academic grades over the entire uGPA range, agreeing with most other studies (but see reference 20 which found no relationship).[16-20] As the format (or blueprint) of the MCCQE1 changed in 2018 after the data used for this study had been collected,[21] future work may usefully investigate whether such a relationship remains.

Our finding that the GCS had no relationship with academic performance suggests that this form of weighting is not academically deleterious. In other words, students whose total admission score is more heavily weighted towards the geographic sub-score perform no differently to those admitted due to scoring higher on another sub-score. This indicates there are enough applicants having the necessary academic attainment to be successful in medical school even after the applicant pool is, in effect, restricted by geographic weighting. This study, however, is silent on how the absolute performance of NOSMU students compares to that of other medical schools.

We found that the number of prior biomedical science courses undertaken at university related to pre-clerkship academic performance on the Foundations and Clinical Skills courses, especially in first year. This differs from previous studies reporting that the type of academic degree e.g. science, social science, humanities, had no relationship to in-program or licensing exam performance.[22-28] This may be due to previous studies not segregating biomedical degrees from other types of scientific training which may have obscured the relationship we observed. Alternatively, the lack of use of the MCAT at NOSMU could act additively with not having biomedical science prerequisites to result in some students having relatively lower entry science knowledge compared to elsewhere. Notably, the negative correlation between less prior biomedical science exposure and academic performance did not continue through medical school, with no significant relationship being observed with the MCCQE1 scores.[29]

The overall regression coefficient relating pre-clerkship academic performance to that on the MCCQE1 explains 49.2% of the variance, which was much larger than that for the admissions scores which explain 12.7%, indicating that the risk of poor student performance on the MCCQE1 is better estimated once the student is in the program. That Year 2 Foundations and Clinical Skills courses are better correlated with the MCCQE1 than the Year 1 courses may be due to students still adjusting to medical studies in first year. Our results mirror pre-clerkship science course performance predicting scores on the US Osteopathic licensing exam.[30]

Table 1. Multiple regression analysis relating admissions scores to student assessment performance

Admissions factors (Mean ± SD, range)	Assessment Instrument (Mean ± SD, range)								
	Personal and professional (84.9 ± 4.7, 72.9 - 97.2)		*Social and population health* (82.6 ± 6.1, 54.5 - 96.9)		*Foundations of medicine* (78.4 ± 7.2, 49.0 - 93.5)		*Clinical skills* (80.6 ± 5.7, 58.6 - 94.6)		*MCCQE1* (518.6 ± 68.3, 346 – 694)
	Year 1	*Year 2*	*Year 1*	*Year 2*	*Year 1*	*Year 2*	*Year 1*	*Year 2*	
Autobio-graphic Score (27.8 ± 3.9, 10.0 – 32.0)	-0.023 (0.067)	0.013 (0.067)	0.091 (0.067)	-0.013 (0.068)	0.016 (0.061)	0.040 (0.064)	-0.014 (0.067)	0.066 (0.066)	-0.026 (0.066)
Interview Score (41.4 ± 2.4, 33.3 - 48.1)	0.028 (0.075)	0.113 (0.073)	0.012 (0.074)	0.105 (0.074)	-0.037 (0.067)	-0.039 (0.070)	-0.075 (0.073)	0.030 (0.073)	0.015 (0.071)
Geographic Context Score (27.8 ± 3.9, 10.0 – 32.0)	0.040 (0.076)	0.039 (0.074)	0.015 (0.074)	0.110 (0.074)	0.004 (0.068)	0.045 (0.070)	-0.051 (0.073)	0.061 (0.074)	0.118 (0.072)
Grade Point Average (23.9 ± 5.3, 9.0 – 30.0)	0.156 (0.080)	0.239 (0.078)**	0.202 (0.078)*	0.252 (0.079)**	0.259 (0.071)***	0.277 (0.074)***	0.114 (0.077)	0.213 (0.078)**	0.259 (0.076)***
Age (30.7 ± 6.1, 21.0 – 56.0)	-0.037 (0.087)	-0.110 (0.084)	-0.157 (0.085)	-0.088 (0.085)	-0.058 (0.078)	-0.059 (0.080)	-0.057 (0.084)	-0.045 (0.084)	-0.191 (0.082)*
Number of degrees (1.4 ± 0.7, 1 – 4)	0.091 (0.075)	-0.039 (0.073)	-0.008 (0.073)	-0.030 (0.074)	-0.184 (0.067) **	-0.088 (0.069)	-0.150 (0.072)*	-0.015 (0.073)	-0.053 (0.071)
Number of prior biomedical courses (11.3 ± 7.0, 0 – 26)	0.077 (0.068)	0.114 (0.066)	0.083 (0.067)	0.061 (0.067)	0.303 (0.061) ***	0.257 (0.063)***	0.160 (0.066)*	0.200 (0.066)**	0.109 (0.065)
Years since last university course (0.9 ± 2.1, 0 – 21)	0.030 (0.076)	-0.006 (0.074)	0.068 (0.075)	-0.006 (0.067)	0.070 (0.068)	0.039 (0.070)	0.039 (0.074)	0.090 (0.074)	0.073 (0.073)
Overall model regression coefficient r (r^2 is in parenthesis)	0.188 (0.035)	0.300 (0.090)**	0.289 (0.084)	0.258 (0.067)*	0.478 (0.228)***	0.420 (0.176)*	0.312 (0.097) **	0.298 (0.089)**	0.357 (0.127)***

*Multiple regression analyses were conducted using one of the 8 pre-clerkship course grades (four courses in Year 1, and four in Year 2) as the dependent variable, and the admissions parameters as independent variables. The table shows beta-values for each parameter with the standard error of the beta value in parenthesis, along with the overall regression coefficient for that assessment (final row). The statistical significance is indicated by *: P < 0.05, **: P < 0.01, ***: P < 0.001. Summary statistics are shown for the demographic, admissions and assessment data of 231 students admitted into the NOSM MD program between 2009 and 2012 who had complete datasets. MCCQE1 – Medical Council of Canada Qualifying Exam Part 1.*

Table 2. Multiple regression analysis relating pre-clerkship course grades to performance on the Medical Council of Canada Qualifying Exam Part 1.

Course		Beta value (std. error)
Personal and professional aspects of medicine	Year 1	0.064 (0.054)
	Year 2	0.142 (0.054) **
Social and population health	Year 1	0.127 (0.061) *
	Year 2	0.000 (0.058)
Foundations of medicine	Year 1	-0.126 (0.078)
	Year 2	0.349 (0.080) ***
Clinical skills	Year 1	0.095 (0.071)
	Year 2	0.232 (0.068)***
Overall model regression coefficient r (r^2 is in parenthesis)		0.702 (0.492)***

*A multiple regression analysis was conducted using each of the 8 pre-clerkship course grades (four in Year 1, and four in Year 2) as the independent variables, and the Medical Council of Canada Qualifying Exam Part 1 (MCCQE1) scores as the dependent variable. The Table shows beta-values with standard errors in parenthesis for each course grade, along with the regression coefficient (final row). The statistical significance is indicated by *: P < 0.05, **: P < 0.01, ***: P < 0.001. For mean, standard deviations and ranges of each score please refer to Table 1.*

Conclusions

Our data suggest that the magnitude of a student's GCS during admission is unrelated to their subsequent academic performance in the UME program and hence, in the NOSM context at least, can be safely used as a mechanism to increase regional retention. We did find that the extent of prior exposure to biomedical education relates to academic performance, especially in the sciences, although this relationship ceased to be significant by the final year of the program. This suggests that offering additional support and/or a modified curriculum to students who lack a biomedical undergraduate degree may be useful.

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