Medical Education

Student performance during the medical course: Role of pre-admission eligibility and selection criteria

NEELIMA GUPTA, GAURAV NAGPAL, UPREET DHALIWAL

ABSTRACT

Background. Marks scored in class XII determine the eligibility to apply to a medical course in India; selection is through an entrance test. Some students do poorly in the medical course. We assessed the eligibility and selection criteria as predictors of in-course performance.

Methods. This cross-sectional study included marks in class XII and in each professional examination, and the Delhi University Medical–Dental Entrance Test (DUMET) rank for five batches of medical students. Students were grouped as those who passed professionals in the first attempt and those who did not. Unpaired *t*-test and Mann–Whitney U test compared class XII marks and mean DUMET scores between the two groups; ROC analysis determined class XII cut-off marks above which no student failed a professional.

Results. Students who passed a professional in the first attempt had higher marks in class XII ($p \leq 0.001$). DUMET rank, however, was comparable for the two groups ($p > 0.05$ each). Above a cut-off of 77.8% (in physics, chemistry and biology) students were significantly likely to never fail any professional.

Conclusions. Prior academic achievement is a useful measure of in-course performance; however, the current eligibility cut-off results in poor in-course performance by some students. The DUMET is a poor predictor of performance. There is need to reform eligibility and selection criteria to admit students who will do well in the medical course.

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INTRODUCTION

The medical course is much sought after by students in India. Eligibility to apply is based on marks scored in the class XII (senior secondary) school examination, and many academically bright students apply for admission. Similar to other countries, demand exceeds supply, and students have to be screened by selection tests.[1–6] During the study period, selection in Delhi was based on academic criteria in the form of a combined entrance test, the Delhi University Medical–Dental Entrance Test (DUMET). Many medical colleges across the globe use similar criteria;[2–5] however, studies have shown that academic selection criteria alone are poor predictors of success in medical school.[3,4] Thus, researchers recommend that selections should be based not only on cognitive, but also on non-cognitive attributes and learning abilities that are necessary for medical graduates to practice skilfully.[5]

We assessed the utility of eligibility and selection criteria used for admission by correlating marks attained in class XII, and rank achieved in the DUMET, with subsequent academic performance in summative examinations. Our hypothesis was that students who do well in class XII and in the entrance examination will also do well in the medical course. Our results may help in generating ideas for reform in eligibility criteria or in the format of the entrance test, as required.

METHODS

We did a retrospective cross-sectional study of six consecutive batches of students admitted to our institution, who had appeared in all four summative examinations (admission batches 1999 to 2004). After approval by the institutional ethical committee, the following data were retrieved from student records available in the Academic Section of the institution: marks scored in the class XII examination (total marks, marks in physics, chemistry and biology [PCB] combined, and marks in English); rank in the DUMET; category of admission (general or reserved); and total marks scored in each professional examination.

Some class XII and DUMET records were incomplete. An attempt was made to contact students through the alumni and details requested through email. In some cases, the data were not provided despite a repeat request. Thereafter, we deemed a student record to be usable for the study if either one or both were available: total marks obtained in class XII (even if marks in PCB and English were not available) or DUMET rank. Where both were missing, that student's data were not included in the study.

About 15% of students were admitted through the All-India Combined Pre-Medical Test (AICPMT). Since these ranks are allocated on an all-India basis, while DUMET ranks are allocated to students from Delhi only, they are likely to be numerically diverse. To avoid confounding the impact of rank on performance in the professional examinations, we did not consider the AICPMT ranks in the final analysis.

Further, as per Government of India guidelines, Delhi University reserves 49.5% of its total seats for minority and underprivileged students; the remaining seats are allocated to general category students.[7] Reservation during the years pertaining to the study stood at 22.5%, since reservation for Other Backward Classes (27%) had not been implemented at that time. To be eligible to appear in the DUMET, a general category student had to score at least 50% marks in PCB; a lower eligibility (40%–45%) was set for minority and underprivileged students. Based on the rank they

University College of Medical Sciences and Guru Teg Bahadur Hospital, University of Delhi, Dilshad Garden, Delhi 110095, India
NEELIMA GUPTA Department of Otorhinolaryngology
UPREET DHALIWAL Department of Ophthalmology
Centre for Sight, Rohini, Delhi 110085, India
GAURAV NAGPAL
Correspondence to UPREET DHALIWAL; *upreetdhaliwal@yahoo.com*

achieved in the DUMET, Delhi University drew up a separate list of eligible students, depending on category. A general category student had to score at least 50% marks in the DUMET, while Scheduled Caste and Scheduled Tribe students had to score 40% to be considered eligible for admission. Since the two lists are not comparable, the correlation of class XII marks, and of rank with performance, was analysed separately for the two categories of students.

The data were entered into a Microsoft Excel worksheet where students were designated by year and code number to preserve anonymity. SPSS-17 was used for statistical analysis. The batches (depending on year of admission) were compared for mean marks in class XII using one-way ANOVA; this was followed by Tukey test for multiple comparisons. For each professional examination, students were considered in two groups: those who passed the examination in the first attempt and those who took two or more attempts to pass. Unpaired *t*-test was used to compare mean marks scored in class XII, and Mann–Whitney U test was used to compare mean DUMET scores between these two groups of students. ROC analysis was used to find the cut-off marks in class XII above which no student failed a professional examination.

RESULTS

One hundred students were admitted to each of the six batches (*n*=600 students). Students admitted from 1999 to 2003 had comparable average marks in class XII, while the marks scored by students admitted in 2004 differed significantly from the rest (Table I). To avoid skewing the results, the data of the batch of 2004 were excluded for all further analysis, while data pertaining to the other five batches were merged.

The average marks scored in class XII (total and in PCB) were consistently and significantly higher in the case of students who passed a professional examination in the first attempt, regardless of the category (Table II). However, the rank in the DUMET did not differ for students who passed and students who failed a professional in the first attempt (Table III). Nor did the rank in DUMET correlate with the average marks scored in any of the professional examinations for general category (p=0.724, 0.981, 0.564 and 0.435 for the first, second, third and final professionals, respectively), or reserved category students (p=0.383, 0.686, 0.481 and 0.693 for the first, second, third and final professionals, respectively).

General category students who never failed any professional examination had scored higher in class XII (mean [SD] 401.3 [37.08]) compared to students who ever failed in any subject in any professional examination (mean [SD] 363.1 [45.13]; p<0.001) and the same was true for reserved category students (mean [SD] 401.30 [37.08]) compared to students who failed (mean [SD] 363.1 [45.13]; p<0.001). Table IV shows the percentage scored in PCB (class XII) above which no student failed a professional examination. The area under the curve for PCB was significant (p<0.01) for each professional examination, and for all professionals combined, in both general and reserved categories. The cut-off marks in English above which no student failed any professional examination was 56.5%.

DISCUSSION

Before merging the data of the diverse batches, a comparison of marks scored by them in class XII was done. This revealed that the batch of students admitted in 2004 had scored significantly better marks in their class XII examination than all the other batches. The reason for the difference was not clear. There was apparently no

TABLE I. Year-wise comparison of average marks scored in class XII

Year of admission	Number of students with complete records	Mean (SD) marks in class XII (maximum marks=500)	Tukey test
1999	76	370.8 (49.86)	p<0.001*
2000	98	386.1 (51.22)	p=0.046*
2001	92	384.2 (51.85)	p=0.024*
2002	97	380.9 (45.40)	p=0.004*
2003	98	373.4 (53.90)	p<0.001*
2004	99	406.4 (42.88)	—
Total	560	384.2 (50.41)	—

*significantly different from year 2004

TABLE II. Comparison of marks scored in class XII between students who passed a professional in the first attempt and those who did not

Marks scored in class XII	Professional one		Professional two		Professional three		Final professional	
	1 attempt	>1 attempt	1 attempt	>1 attempt	1 attempt	>1 attempt	1 attempt	>1 attempt
Category: General								
Number of students	319	44	324	39	322	41	292	71
Mean (SD) marks all subjects*	397.43 (37.97)	348.57 (43.72)	395.17 (40.75)	358.38 (45.13)	394.69 (41.09)	362.68 (46.60)	397.72 (40.69)	363.30 (40.61)
p value	<0.001		<0.001		<0.001		<0.001	
Number of students	246	38	251	33	248	36	229	55
PCB† marks	248.48 (22.79)	216.82 (31.32)	247.22 (23.92)	221.12 (23.92)	247.03 (24.36)	221.25 (32.58)	248.15 (24.32)	226.13 (30.19)
p value	<0.001		<0.001		<0.001		<0.001	
Category: Reserved								
Number of students	60	38	60	38	57	41	53	45
Mean (SD) marks all subjects*	363.28 (42.88)	296.79 (44.59)	355.92 (47.07)	308.42 (52.42)	358.25 (48.78)	309.45 (49.84)	363.02 (44.80)	306.50 (48.81)
p value	<0.001		<0.001		<0.001		<0.001	
Number of students	40	33	44	29	40	33	36	37
PCB† marks	223.95 (27.88)	182.76 (24.47)	214.89 (31.36)	190.83 (31.48)	221.95 (30.80)	185.50 (26.08)	223.58 (31.81)	186.89 (24.21)
p value	<0.001		0.002		<0.001		<0.001	

* maximum marks 500 †PCB physics, chemistry, biology; maximum marks 300

TABLE III. Comparison of DUMET* rank between students who passed a professional in the first attempt and those who did not

Rank in DUMET	Professional one		Professional two		Professional three		Final professional	
	1 attempt	>1 attempt	1 attempt	>1 attempt	1 attempt	>1 attempt	1 attempt	>1 attempt
Category: General								
Number of students	128	15	125	18	122	21	116	27
Median	163	169	163	173	163	173	164	163
IQR†	138–195	141–197	141–196	130–204	142–194	125–199	141–196	130–196
p value‡	0.697		0.937		0.547		0.456	
Category: Reserved								
Number of students	28	11	26	13	27	11	23	16
Median	59	64	58	63	59	59	56	65
IQR†	49–70	53–70	50–71	54–71	52–70	50–69	48–67	56–72
p value‡	0.339		0.395		0.923		0.084	

*DUMET Delhi University Medical–Dental Entrance Test †Inter-quartile range ‡Mann–Whitney U test

TABLE IV. Class XII cut-off percentage in physics, chemistry and biology combined, above which students did not fail a professional examination

Professional examination passed in first attempt	Class XII cut-off percentage	
	General category	Reserved category
Professional one	77.2	72.3
Professional two	76.5	66.0
Professional three	75.8	66.0
Final professional	74.2	67.5
All professionals	74.2	69.3

change in the class XII syllabus or examination scheme between 2003 and 2004; perhaps easier questions or lenient marking contributed to better marks. To avoid any possible chance of skewing the results we did not include this batch in the final analysis.

A major finding of our study is that students with higher marks in class XII were significantly likely to never fail a professional examination. The literature is replete with similar evidence; students who do well in school also tend to do well in the medical course.[8–13] The reason may be that students who are high achievers in school continue to do well in college. This finding argues for the use of class XII marks as a tool, not only in setting eligibility criteria, but also in the selection of students for admission to a medical course. The state of Tamil Nadu already has a model in place where around 70% of students are admitted based on marks scored in class XII; they do not have to appear in an entrance examination.[14] The eligibility is also set high; students must score 70% or more in PCB combined in class XII. The merit list, thus, includes students with the highest marks in class XII. It might be instructional to assess the in-course performance of students admitted through such a system and compare it with one such as ours.

In our set up, as recommended by the Medical Council of India, marks scored in class XII decide the eligibility to apply; however, the cut-off currently in use is low, at 50% in PCB for general candidates, and 5%–10% lower for minority and underprivileged students. According to our findings, keeping such a low cut-off compromises the quality of students selected. When they do not do well in the medical course, or leave without completing it, they are wasting personal and national resources, and are at risk of depression.[15] Our study suggests that we should have a higher cut-off for eligibility; this applies to both the general and reserved category students. As shown in Table IV, setting 74.2% as the minimum eligibility for general category, and 69.3% for reserved categories, virtually eliminates any chance of failing a professional examination. All India Institute of Medical Sciences, Delhi; Armed Forces Medical College, Pune; and Christian Medical College, Vellore, already have higher standards (60%–70% aggregate in PCB) for eligibility;[16–18] these institutions consistently rank among the top in annual national surveys.[19] In addition, rather than settle for a passing grade, some institutions include a minimum cut-off for English in their eligibility criteria; thus, All India Institute of Medical Sciences requires a 60% aggregate in English and PCB combined, while the Armed Forces Medical College requires students to score ≥50% in English at the class XII level. This requirement pertaining to the English language seems justified since the medical course is taught in English. Authors from other parts of the globe have shown that poor English language skills impact academic performance, particularly for those students whose medium of instruction in schools is not English.[20,21] Our study also shows that those who scored above 56.5% in English, did not fail a professional examination. Studies from across India could provide more evidence for setting higher eligibility cut-offs; the cut-offs could include both science subjects and English. Perhaps something in-between the current and the proposed cut-off will be realistic. A moderate cut-off would not penalize good performers who have done poorly in their class XII examinations due to isolated reasons; it may also assure better performance in the medical course than we presently see.

The high demand for a career in medicine in India ensures an oversupply of applicants, most of them having scored high marks in class XII. There is, therefore, a need to screen out students, and the tool used is an entrance test. As a representative sample of an entrance test, we chose the DUMET. This entrance test had poor ability to predict future performance of selected candidates; however, for want of better methods of screening vast numbers of applicants, such tests have to be continued in the foreseeable future. Ideally, an entrance test should be able to screen out students who will do poorly in the course. Studies affirm that one-shot observations using a single instrument, however psychometrically sound, cannot be expected to provide a comprehensive evaluation.[22,23] Tools that incorporate only multiple-choice questions (MCQs) ignore aptitude and other characteristics; these are characteristics that make a good medical practitioner.[1,24,25] Reports suggest that results of MCQ-based selection tests can be influenced by factors such as non-familiarity with MCQs and guess-work; moreover, they may not test what they purport to

test.[26–28] Studies worldwide have shown similar results, suggesting that entrance tests need revision.[4,8,12,23] Either the tests should be modified, or several selection tools should be combined, so that they select the optimum student group.[8] Selection procedures exist that combine a variety of cognitive tests, aptitude measures and interviews; however, there is confusion on which tool, or which combination of tools, is ideal.[8,9,29,30] It is imperative to conduct more studies across India which evaluate the current selection procedure and explore ways to improve the quality of the cohort selected. Preferably, the tools should be designed such that they select students who will make professional, ethical, sensitive medical practitioners, and who are also cognitively and technically capable.[31,32] The Medical Council of India has recommeded a common test throughout India for entrance to the medical course (the National Eligibility and Entrance Test or NEET).[33] Based on our findings, a strong case is made for including prior academic achievement as a component of the selection tool, and for modifying the current entrance examination format. There is a need to develop an optimum mix of assessments to select students for medical studies. The optimal selection modality may take some time to develop keeping in view logistic problems for implementing it across the country.

Our results are based on data from a single institution and may not apply to other institutions in India or the world. Nevertheless, most medical institutions in India use cognitive selection criteria and our findings may be of interest to those who make policies for selection criteria and design selection tests for medical admissions. In particular, the admission policy proposed by the Medical Council of India (NEET),[33] whenever it is implemented, should take into account the findings of this study. We studied class XII marks for all categories of students; thus, the implication that students with lower marks in class XII will do poorly in the medical course applies to all. This means that if the quality of students is to be improved, the eligibility cut-off must be increased for both general and reserved categories.

In conclusion, prior academic achievement (marks in class XII) is a good measure of subsequent performance in the medical course; however, the eligibility cut-off is set low, resulting in poor in-course performance by some students. The purely cognitive entrance test, on the other hand, is a poor predictor of performance. There is a need to initiate reform in both eligibility and selection criteria to capture the appropriate cohort of students who will do well in the medical course.

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