

The Predictive Validity of Prior Academic Achievement as an Indicator of Medical Students' Performance at University of Khartoum

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Abstract

Background: There is emphasis on the selection method that better predicts doctors' performance. Universities select medical students based mainly and sometimes solely on high academic achievement. Claims were often made for some minimum threshold ability level while systematic research suggested a higher threshold to be more appropriate. Admission to medical colleges in Sudan is based solely on student's score in secondary school certificate, derived from matriculation examinations. We aimed to assess the validity of this selection policy and to determine the score that best predicts students' performance.

Methods: We included the last two graduated batches of the Faculty of Medicine, University of Khartoum, Sudan. Students' score in Sudanese secondary school certificate and their final examinations results in the faculty were analyzed. Statistical analysis was carried out using SPSS software, version 20.

Results: The predictive validity of students' score in secondary school certificate was 0.303. English, Mathematics, and Chemistry grades predicted better performance in the faculty.

Conclusion: Our results supported the current selection policy and other methods that test students' non-cognitive domain (more is better policy). This system guides selecting between students who sat for matriculation examinations once or more and between those with high/less marks in English language.

Keywords: PREDICTIVE VALIDITY, PRIOR ACADEMIC ACHIEVEMENT, MEDICAL STUDENTS' PERFORMANCE

Journal of Medical Education Summer 2019; 18(3):125-131

Introduction

Selection of students is important in medical education. The type of selected students at baseline is a major determinant of type of graduates that cultivate (1). Most academic institutions' selection policy depends on academic criteria (2). Academic criteria correlate with career progression and success at postgraduate membership and fellowship examinations and dropout rates (3-5). However these correlations were weak and only predicted certain aspects of career progression (6).

Claims were often made for some minimum threshold ability level which is 'good enough' while systematic research suggested that 'more is better' (7). Very few studies describe the minimum academic standard for intending medical students (8).

The selection of medical students based on academic criteria alone has led to the admission of students that would later have lower scores in many non-cognitive dimensions as future doctors (9). Future doctors should not be selected solely on academic performance criteria (10). Other skills and qualities need to be present from the start. Certain abilities and attributes may become more important late in the education and training pathway, such as leadership and decision-making. Barnsley

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and colleagues compared the performance of two groups of medical students (selected only based on prior academic achievement or based on personal qualities with a lower academic threshold) during the early years of medical practice in several medical schools. The latter interns were rated as good as or better than the former in all aspects of evaluated professional activity (11). Therefore, selection methods were developed to assess both cognitive and non-cognitive domains (12).

Medical schools should ensure that the selection strategy would accurately select those who are committed to meeting the medical and social needs of the communities they serve (8). However, many organizations failed to conduct validation studies because they were difficult to administer. These studies often require tracking the performance of trainees over several years, from selection for medical school through to senior posts (2).

Still, further studies are required to decide the minimum academic standard and minimum adequate personal characteristics of medical students. Also, an optimum multimethod selection system for both undergraduate study and postgraduate training should be designed and validated (2, 13-15)

Currently, in Sudan admission to medical colleges is based on students' score on Sudanese secondary school certificate derived from matriculation examinations. The Sudanese secondary school certificate is a certificate indicating the students' grades in seven obligatory subjects and their score. Usually students sit for the examinations at the end of third year, the final year in secondary school. The examinations take place once a year and cover common secondary school topics (Mathematics, Physics, Biology, Chemistry, English language, Arabic language, and Religion studies) (16). Thousands of secondary school graduates compete in these extremely difficult examinations to enter public and private universities. While public universities are tuition-free, there is a private section within the public universities that require tuition. Moreover, many private

universities in Sudan charge high fees but have a lower credibility than public universities. The best ranked candidates, according to their Sudanese secondary school certificate scores are admitted to public medical schools. Each medical college has an admission cut-off. The Faculty of Medicine, University of Khartoum admits students with the highest scores each year (17).

Although this selection method has been used for many years as the only method for admission to medical colleges, to the best of our knowledge, there have been no studies on the predictive validity of Sudanese secondary school certificate and on scores with the highest predictive validity. The dependence on Sudanese secondary school certificate as a sole selection method for admission to medical school is a matter of concern. Moreover, the validity of the predetermined admission score for each medical school should be assessed. We aimed to assess the association of the Sudanese secondary school certificate scores with subsequent student performance at the Faculty of Medicine, University of Khartoum, Sudan. We tried to determine the minimum score that better predicted their performance. Our other aim was to detect the effect of English language on students' performance because English language is considered as a second language in Sudan and studies from Arabic communities have reported that English language is one of the factors affecting students' performance in medical colleges.

Materials and Methods

The study was a descriptive study conducted at the Faculty of Medicine, University of Khartoum, Sudan, and included the last two graduated student batches. The study included students admitted according to the cut-off score of entry determined for admission to faculty of medicine, University of Khartoum (known as public admission) as well as students admitted with lower entry score (known as private admission). Students' Sudanese secondary school certificates which include score of entry and subject grades

(Biology, Chemistry, Physics, Mathematics, English, Arabic language, Religion studies) and students' examination results for each year of medicine were collected from their records in the faculty. Students' files were coded by one of the academic office staff before the start of data collection to protect their privacy.

The final examinations grades were obtained from students' graduation transcript. Performance in the faculty was categorized into performance in basic medical sciences, performance in clinical sciences, and sum of the two scores was the overall performance. The score of performance in basic medical sciences included the sum of grades of Sudanese Studies, Mathematics, Physics, Chemistry, Computer, Biology, Anatomy, Physiology, Biochemistry, Neuroscience, Behavioural Science, Microbiology, Immunology, Pharmacology, Pathology, Arabic, English, and Islamic Culture.

Performance in clinical sciences included summation of grades of forensic medicine, ENT, Medical Ethics, Infectious diseases, ophthalmology, Radiology, Dermatology, Psychiatry, Anaesthesia, Community Medicine, Primary health Care, Orthopaedics, Surgery, Medicine, Paediatrics and Obstetrics and Gynaecology. In case students repeated an assessment, their first result was used for analysis. Ethical clearance was obtained from the Ethics Committee of the University of Khartoum, Faculty of Medicine.

Statistical analysis was carried out using SPSS software, version 20. Kolmogorov-Smirnov test was used to test the normal data distribution. Non-parametric tests were used to analyze abnormally distributed data. Validity coefficients below $r=0.1$ was considered as weak, 0.1-0.5 as moderate, and above $r=0.5$ as strong coefficients (2).

Results

Overall, 550 students were evaluated in the two batches of which 68.6% were women. The distributions of the three performance scores (basic medical sciences [$P=0.016$], clinical

sciences [$P=0.000$], and overall performance [$P<0.000$]) at the faculty and their entry ($P=0.000$) score were not normally distributed. We found significant moderate correlation between entry score and students' performance in the faculty. The correlation was stronger with performance in basic medical sciences compared with their performance in clinical sciences (table 1).

To further discriminate students' performance in the faculty with respect to their secondary school performance, students were grouped into those who had graduated and never repeated an academic year and those who had repeated an academic year. Students who had never repeated an academic year had higher entry scores than the repeaters (92.6 versus 91.4 respectively) as well as better performance in the faculty (table 2).

Multiple linear regression analysis identified that better performance in secondary school subjects (English, Arabic, Mathematics and Chemistry) were predictors of better performance in the faculty. However, the R square was 0.137 which indicated that around 14% of the variation in performance in the faculty was accounted for by performance in English, Arabic, Mathematics, and Chemistry. Students who did better in basic medical sciences did better in clinical sciences ($r=0.739$, $P=0.000$).

Multiple linear regression model identified Chemistry (secondary school subject, $P=0.04$), English ($P=0.003$), Neuroscience ($P=0.008$), Microbiology ($P=0.042$), Pathology ($P=0.000$) and Behavioural Sciences ($P=0.037$) as predictors of good performance in clinical sciences (R square=0.690).

Students who attempted the secondary school leaving examinations more than once had less performance in the faculty. Negative correlation was detected between number of attempts and overall performance r value=0.390, $P=0.000$. Percentage of repeaters increased as number of attempts increased.

Students who were admitted in the private section showed less performance and high rate of repetition when compared to those admitted in the public section (table 3).

Table 1: Correlation between entry score and students' performance

Parameter	r value*	P value*
Performance in basic medical sciences	0.423	0.000
Performance in clinical sciences	0.303	0.000
Overall performance	0.383	0.000

*Using Spearman's rho coefficient test

Table 2: Performance of repeaters and non-repeaters in medical school

Mean rank of performance score	Repeated	Not repeated	P value*
Basic sciences*	66.27	297.22	0.000
Clinical sciences*	84.38	261.98	0.000
Overall performance *	52.57	263.27	0.000

*Derived from Independent sample Mann-Whitney U Test

Table 3: Type of admission and overall performance and repetition rate

Type of admission	Overall performance	Number of repeaters	Percentage of repeaters
Private	98.9	16	20.3
Public	111.7	38	9.5
Pearson Chi-square P value	0.006		

Discussion

It is crucial to choose the right competent physician from the time of admission through medical college. Still there is a lot of debate on the validity of performance in earlier life for predicting outcomes later in medical college or post-graduate education (18, 19). Also the minimum academic standard still needs to be solidly determined (7). This study analyzed students' performance in Sudanese matriculation examinations and their performance in the faculty of medicine, University of Khartoum. The study detected significant moderate correlation between students' score in Sudanese secondary school certificate and their performance in the faculty. The correlation was stronger for performance in basic medical sciences. This finding is in line with international studies showing that high grades in university examinations predicted undergraduate and postgraduate performance (3-5, 20, 21). McManus and co-workers stated that prior academic achievement predicts performance in undergraduate and post-graduate medical examinations and the effects were consistent for many years (21).

We also found that students with higher entry score had lower rates of repeating an academic year in their records. Attempting secondary school leaving examinations for more than once was also associated with low performance in the faculty and high rate of repetition. Students who were admitted in the private section showed less performance and high rate of repetition when compared to those admitted in the public section. These findings together may have implication in selecting medical students; priority should be given to students with a score of 92.6% or higher and for those who gain their score from their first attempt. However, in this study the correlation was moderate indicating that other selection methods in addition to the score of entry are needed.

With respect to the subjects that better predict performance in medical college, studies have shown that A level Chemistry predicted performance in medical colleges as well as A level Biology, but the results were still controversial (19, 22, 23). In our study, better performance in English language, Mathematics and Chemistry predicted better performance in the faculty. The strongest correlation was with Chemistry. Chemistry has a major role

in medicine as a wide range of biomedical reactions take place in our bodies.

English language is not the mother tongue of Sudanese students, although instruction is in English at the faculty. Students who performed better in English language in secondary school and in the first year in the faculty, performed better throughout their medical study. A study in Saudi Arabia showed that English language grade in the secondary school predicted performance in medical college (20). These findings indicate the need to direct more effort in teaching English language to medical students in secondary school and during the first year in the medical college.

Students' performance in basic medical sciences correlated with their performance in clinical sciences. The performance in clinical science was weakly correlated with score of secondary school certificate. One study showed that pre-clinical GPA of medical students was strongly correlated to and predicted medical students GPA in the clinical phase. Pre-admission criteria for medical school were weakly correlated with the students' performance in clinical phase (24). These findings indicate the need to assess those attributes that affect students' clinical performance prior to admission. The mentioned study also recommended that medical colleges should carefully monitor students with low pre-clinical GPA to provide additional support. Basic sciences are highly important in medical education. The progression of a student to understand and practice medicine requires that student master basic medical sciences and that was evident from the results from our study and previous ones. Basic sciences are the foundations upon which students interpret clinical findings as explained in the reporter-interpreter-manager-educator framework. The competent physician must be able to use his/her knowledge of basic sciences for diagnostic reasoning as explained by the Flexner model (25).

In the current study, chemistry of the Sudanese secondary school certificate predicted student performance in clinical sciences. Other predictors

were Neuroscience, Microbiology, Pathology and Behavioural Sciences. Flexner and Pritchett reported that gross anatomy, embryology, histology, physiology, pathology, bacteriology and pharmacology are the most fundamental basic sciences for student clinical reasoning (26). Biomedical science has expanded greatly in the previous years and is progressing rapidly. These advances were incorporated in the curriculum and the curriculum continues to address the fundamental sciences necessary for clinical sciences stated by Flexner. Thus, the curriculum is being continuously modified by adding new content and technologies, which ultimately would outgrow the Flexnerian model (27).

Conclusions

The study results provided moderate support for using measures of educational achievement in students' selection. However, as the correlations were moderate and less for clinical sciences adding other selection methods that assess non-cognitive domains are needed. Giving priority to students who attain scores of >92% in Sudanese secondary school certificate as well as those who are accepted after their first exam and have high chemistry and English scores is a better hypothesis.

Medical colleges need to direct more effort in teaching English language to freshman students. Medical colleges should carefully monitor students who sat for matriculation examinations for more than one time as well as those admitted in the private section, those with low performance in basic medical sciences and those who repeated an academic year to provide additional mentorship and academic support.

Acknowledgment

Sincere thanks goes to the personnel at the academic office for coding of students' records.

Conflict of Interest: None Declared.

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