

Admission criteria to Saudi medical schools

Which is the best predictor for successful achievement?

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ABSTRACT

الأهداف: تقييم العلاقة بين معايير القبول الحالية في كليات الطب والمعدل التراكمي لطلبة كلية الطب في نهاية العام السادس في ثلاث كليات طبية داخل المملكة العربية السعودية.

الطريقة: أجريت هذه الدراسة الاستطلاعية التحليلية في ثلاث كليات طبية حكومية داخل المملكة العربية السعودية وذلك خلال الفترة من يناير 2011م إلى فبراير 2012م. ولقد استخدمت درجات الثانوية العامة، والاختبار التحصيلي، واختبار القدرات، ودرجة الرياضيات، ودرجة اللغة الإنجليزية في المدرسة الثانوية كمعايير للتنبؤ بالمعدل التراكمي في السنة السادسة. ولقد تم اعتبار المعدل التراكمي معياراً متغيراً حسابياً للنظر في العلاقة بين المعايير الخمسة المستخدمة من جهة وبين المعدل التراكمي من جهة أخرى وذلك باستخدام ارتباط بيرسون وتحليل الانحدار المتعدد حسابياً. وتمت الموافقة على الدراسة من قبل مجلس المراجعة المؤسسية والأخلاقية في اللجنة المتخصصة بكلية الطب بالطائف.

النتائج: شملت الدراسة 727 طالب من مختلف الكليات الطبية، ولقد لوحظ وجود ارتباط إيجابي واضح من الناحية الإحصائية بين جميع المتغيرات الخمسة كل على حده وبين المعدل التراكمي من جهة أخرى. ووجدنا من خلال الانحدار اللوجستي المتعدد بأن كلا من الاختبار التحصيلي، ودرجة اللغة الإنجليزية في المدرسة الثانوية، ودرجات الثانوية العامة، واختبار القدرات كانت مؤشرات واضحة على مستوى درجات الطلاب في المعدل التراكمي. ويمكن اعتبار الاختلاف بنسبة 20.8% في المعدل التراكمي عند حساب معايير القبول.

خاتمة: أظهرت الدراسة بأن هناك معايير متعددة تستخدم لقبول الطلبة بكلية الطب، إلا أن الدراسة قد أظهرت بأن الاختبار التحصيلي يعد من أهم تلك المعايير. كما أن درجات الثانوية العامة في اللغة الإنجليزية ظهرت أيضاً كمؤشر مستقل يعكس أداء الطلبة الدراسي داخل الكلية. لذلك ينبغي على كليات الطب أن تعطي أهمية أكبر لهذه العوامل في صنع القرارات بشأن القبول في برامج بكالوريوس الطب والجراحة العامة.

Objectives: To assess the relationship between current pre-admission criteria and medical student's grade

point average (GPA) at the end of year 6 in 3 medical schools in the Kingdom of Saudi Arabia.

Methods: We conducted this observational analytical study at 3 government medical schools in the Kingdom of Saudi Arabia between January 2011 and February 2012. High school grades, achievement test (Tahsili test) scores, aptitude test (Qudraat tests) scores, Mathematics, and English grades in the high school were used to predict medical student's GPA at the end of year 6. The criterion variable was student's cumulative GPA at the end of year 6. Correlation between pre-admission variables and GPA was calculated using Pearson's correlation, and multiple regression analyses. The Institutional review board and ethical committee at Taif Medical College approved the study.

Results: We included 727 students in this study from the chosen medical schools. A significant positive correlation was observed among all pre-admission variables and GPA. Inclusion of all 5 sets in multiple regression analyses revealed that the achievement test, English grade in the high school, high school grade and aptitude test (Qudraat tests) were statistically predictive of GPA. A 20.8% variance in the GPA can be accounted for by the pre-admission criteria.

Conclusion: Multiple pre-admission factors predict medical students GPA. Achievement test is the most important predictor. High school grades in English emerged as an independent predictor. Medical schools should give more attention to these predictors during admissions.

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As a corollary of high demand of proficient healthcare providers, the field of medical education has been revolutionized in the Kingdom of Saudi Arabia since the turn of this century. In this context, 21 new medical schools, each with a medical college, have been opened in the Kingdom.¹ This shows the commitment not only of the government towards spreading higher education in the Kingdom, but also of the people towards obtaining high quality qualifications in the health care sector. Hence, the number of applicants to any medical school rises every year.² It, therefore, becomes imperative that the medical education system in the Kingdom has a high quality filtering system during the selection of students to its medical schools. Which one, or more, of the admission criterion is closely associated with high performance later during undergraduate medical studies? This would help in filtering students and giving greater emphasis on that particular test while selecting students for medical studies.

Globally, in addition to high school grades, various types of achievement and aptitude tests have been employed in the selection process of medical students.³ These incorporate both candidate's academic as well as non-academic aptitudes like critical reasoning and intelligence abilities; essential traits for efficient healthcare providers.⁴ For more than one decade, the eligibility criterion for applying to a medical school within the Kingdom of Saudi Arabia is 90% marks in high school. In 2001, the Ministry of Higher Education added a set of tests in addition to the 90% condition.² A) High school grades get 30% of the weightage. B) The "achievement test" (Tahsili) gets 40% of the weightage. This test is based on Chemistry, Biology, Physics, Mathematics, and English. It is an Multiple choice questions based exam. C) The "Aptitude test" (Qudraat) accounts for 30% of the weightage. It assesses higher cognitive functioning. Reading material and mathematical problems are presented in this test. The aptitude test and the achievement test are held under the supervision of the Ministry of Higher Education. Usually, the decision regarding the selection of students is made by the sum of these 3 written examinations. Some medical schools have a structured interviewing system as well, the degree of which is variable. Despite the theoretical rationale behind these pre-admission cognitive tests,^{3,4} a wealth of scientific research provides contentious evidence in the agreement of these tests as valuable predictors of success in medical college. Julian⁵ reported a positive relationship among Medical College Admission Test (MCAT) scores, medical schools scores and the United States Medical Licensing Examination (USMLE) scores. This study shows that the MCAT

scores were the best predictors of grade point average (GPA) obtained during medical studies. A similar relation was shown in a 2006 study by Meagher et al⁶ in which the authors showed that Pharmacy College Admission Test (PCAT) scores were positive predictors of GPA obtained during Pharmacy graduate programs. On the contrary, Gray et al⁷ encountered no relationship between Dental Admission Test (DAT) scores and final grades attained in 9 dental clinical courses. They suggested that DAT scores had no predictive value in clinical achievement.

An error free, objective, and valid procedure of admission is required for medical schools where the number of applicants is increasing annually, but where seats are limited. Selection becomes difficult since the applicants receive very high marks in their high school examinations. Many medical schools select not only on the basis of high academic qualification, but also on the basis of non-cognitive elements like communication skills, confidence, empathy, maturity, and motivation to work in the medical field.^{8,9} The intention is to ascertain personal qualities in the applicants that will help them deal with the demands of this profession. The emphasis on such factors, however, is not enough and the main deciding elements for selection are the marks in various post-high schools tests plus marks achieved in the high school. It would be of great benefit for the selection committee if it were known which one (or more) of these cognitive factors best predicts future performance so that more weightage could be assigned.

Therefore this study aims to investigate the relation between the pre-medical school exams and the GPA obtained during medical studies. Only a few studies have been carried out within the Kingdom of Saudi Arabia and Gulf region that try to find the predictive strength of pre-admission criteria in determining academic success in medical schools. One of the main limitations of these studies is that they deal with data from a single medical school. Also, most studies considered high school marks as one variable. Our study is unique in that it considers data from 3 government owned medical schools. Further, this study uses high school English and Mathematics scores as separate variables to develop a prediction model.

Methods. We conducted this retrospective, observational, analytical study at 3 government medical schools in the Kingdom of Saudi Arabia between January 2011 and February 2012. The pre-admission criteria to these medical schools consisted of 3 components: high school grades, achievement test (Tahsili), and aptitude test (Qudraat). The weightage assigned to these tests

according to the Ministry of Health are as follows: high school grades (30%), achievement test (40%), and aptitude test (30%).² In this study, 5 sets were utilized to examine the predictive power of pre-admission variables in relation to criterion variable as follows:

Predictor variables. These included: A) High school grades %. B) Achievement test % (Tahsili test), which covers general concepts in: Biology, Chemistry, Physics, Mathematics, and English. The questions vary in terms of the nature of its focus on cognitive levels, include understanding, application, and conclusion. The proportion of questions distributed materials as follows: Biology 20%, Chemistry 20%, Physics 20%, Mathematics 20%, English 20%. C) Aptitude test % (Qudraat test %), which is a test that measures analytical and deductive abilities. It focuses on the measurement of: 1. Reading and comprehension abilities; 2. The ability to understand logical relationships. The ability to solve problems based on basic mathematical concepts; 3. The ability to conclude. 4. Measurement capabilities. d) Mathematics and English grades in high school although these components are included in total high school grades; in this study, these were considered as separate predictors.

Criterion variable. Student GPA. For each medical student, an end-of-year GPA was created by multiplying each course grade by the number of credit hours for that course, then dividing this sum by the total number of credit hours for that student. The resulting averages were converted to a common 5.0 scale. A total of 727 medical students from these medical schools were included in

the study. The criterion variables were medical school year 1-6 GPAs, which were initially analyzed separately, and subsequently combined into cumulative GPA, which is reported here as end of the year 6 GPA. All 5 pre-admission predictor sets were analyzed in relation to criterion variable. All data were entered into the pre-designed forms, which included medical school name (confidential), cumulative end of the year 6 GPAs, high school grades (in percentages), achievement test (Tahsili test) and aptitude test (Qudraat tests) (in percentages), and English and Mathematics grades in high school (in percentages). The Institutional review board and ethical committee at Taif Medical College approved the study.

We used the Statistical Package for Social Sciences (SPSS Inc., Chicago, IL, USA) version 17 to analyze all data. Descriptive statistics (including mean±SD) were computed for quantitative variables. The correlation between pre-admission variables and criterion variable was examined using Pearson's correlation coefficient. The p -value was considered statistically significant at $p<0.05$. To determine the nature and strength of relationship between predictors and criterion variable, stepwise multiple regression analyses were performed. Criteria used were probability $p<0.05$ to select a predictor, and $p>0.10$ to remove a predictor from the model.

Results. Descriptive statistics. The overall mean±SD of 727 medical student's cumulative GPAs were 3.11±0.66. Table 1 demonstrates the descriptive statistics of the rest of the variables used in this study.

Correlation coefficients. Analysis using Pearson's correlation coefficient revealed a statistically significant positive linear relationship between selected predictors and cumulative medical student's GPA at the end of year 6 (Table 2). Despite the positive significant correlation, all predictors showed weak correlation coefficients ($r=0.378$; $p=0.000$). On the contrary, the Mathematics grade in high school had a weak correlation coefficient, which was statistically highly significant ($r=0.14$; $p=0.000$). The correlation coefficient of high school grades were 0.22 ($p=0.0001$), 0.24 ($p=0.000$) for the aptitude test (Qudraat tests) test, and 0.25 ($p=0.000$) for English grades.

The regression analyses. Multiple stepwise regression analyses were performed using cumulative medical student's GPAs as the dependent (criterion) variable, and high school grades, achievement test (Tahsili test), aptitude test (Qudraat tests), English and Mathematics grades in high school as exploratory (predictor) variables. The R^2 is interpreted as the proportion of variability in a dependent variable that can be explained

Table 1 - Descriptive statistics of pre-admission variables.

Variables	Mean±SD
High school grades (%)	97.95±1.78
Achievement (Tahsili) test (scores)	82.57±6.73
Aptitude (Qudraat) test (scores)	82.89±6.61
Mathematics grades in high school (%)	96.32±5.08
English grades in high school (%)	97.88±3.95
SD - Standard deviation	

Table 2 - Correlation between pre-admission variables and GPA.

Pre-admission variables	Medical student GPAs	
	Correlation	p -value*
High school grade (%)	0.22	0.0001
Achievement (Tahsili) test (%)	0.39	0.0000
Aptitude (Qudraat) test (%)	0.24	0.0000
Mathematics grades in high school (%)	0.14	0.0000
English grades in high school (%)	0.25	0.0000
*Using Pearson's correlation, GPA - grade point average		

Table 3 - Multiple regression for predicting grade point average (GPA) performance at the end of year 6.

Pre-admission variables	Medical student GPAs			
	β	SE	<i>p</i> -value	95% CI
Achievement (Tahsili) test scores ^a	0.317	0.612	0.0000	0.024-0.039
English grades in high school ^b	0.149	0.599	0.0000	0.013-0.037
High school grades ^c	0.128	0.584	0.0000	0.022-0.073
Aptitude (Qudraat) test scores ^d	0.079	0.592	0.034	0.001-0.015

β (Standardized Coefficient) - ability of each pre-admission variables to predict the GPA; CI - confidence interval, ^aModel 1 - achievement test scores; ^bModel 2 - achievement test scores + English grades in high school; ^cModel 3 - achievement scores + English grades in high school + high school grades; ^dModel 4 - achievement test scores + English grades in high school + high school grades + aptitude test scores; ^aR² (%) - 15.2% (for achievement test scores); ^bR² - 18.6% (for achievement test scores + English grades in high school); ^cR² - 20.2% (for achievement test scores + English grades in high school + high school grades); ^dR² - 20.8% (for achievement test scores + English grades in high school + high school grades + aptitude test scores), SE - standard error

by the predictors used in the model building process. The predictors in the multiple regression model, which included achievement grades as percentage, English grades, high school grades, and aptitude grades as percentage accounted for 20.8% of the variability in the cumulative GPA performance at the end of year 6 (Table 3). From this model, the most important predictors were achievement grades as percentage, English grades as percentage, and high school grades as percentage. Together these 3 variables accounted for 20.8% of the total explanatory power of the equation (Table 3). The Mathematics grades in high school did not appreciably change the predictive power of the model, hence, did not emerge as an important predictor of cumulative GPA performance at the end of year 6.

Finally, after exclusion of the Mathematics grades from the model, inclusion of the remaining 4 sets of pre-admission variables in a regression analysis as predictors of GPA performance revealed that all were statistically predictive of the GPA, especially achievement test grades as percentage, English, and high school grades as percentage ($p=0.0000$) (Table 3).

Discussion. Selection process of students into the undergraduate medical program in the Kingdom of Saudi Arabia is mainly based on high school grades, achievement test, and aptitude test scores. The aim of this study was to evaluate the ability of these pre-admission criteria to predict the performance of students at the end of the program. In addition to these criteria, 2 more sub-components (English and Mathematics grades in high school) were also used to evaluate the relative utility of these as independent predictors of medical student's subsequent performance at the end of the program.

In this study, a combination of multiple cognitive criteria (namely, achievement test grades, English grades in high school, high school grades, and aptitude test grades as percentage) emerged as good predictors of medical students' performance. A number of studies emphasized the importance of multiple factors when considering an applicant for admission. High school grades, achievement, and aptitude tests are statistically predictive of academic performance in health sciences and medical college, as previously confirmed by Al Alwan et al¹⁰ in their longitudinal cohort studies conducted in Saudi Arabia. Al-Alwan, in another study,¹¹ demonstrated a positive significant correlation between academic performance and pre-admission criteria (high school grade, achievement, and aptitude tests).

English grades in high school turned out to be an independent predictor of medical student's academic performance in terms of GPA in this study. In the study by Al-Nasir and Robertson,¹² the English test also emerged as a good predictor of medical student performance. The findings of their study suggest that this pre-admission parameter should be incorporated in the admission process of medical graduates.

On critical analysis, the achievement test scores showed a significant positive correlation as compared with the rest of the pre-admission predictors in this study. The significant correlation between the academic abilities and the achievement test with the GPA supports the cognitive nature of this admission criterion. The role of the achievement test has been accentuated by many authors, locally as well as internationally. Al-Rukban and co-workers¹³ reported the achievement test (Tahsili) as an independent predictor of medical student GPA, in agreement with our findings. Al Alwan and associates¹⁰ reported a high significant correlation of academic

performance and achievement test in their case study. In the United States, in addition to academic performance in high school, the MCAT is an essential admission tool. Although, the predictive validity of this achievement test ranges from small to medium for medical school performance,¹⁴ Julian⁵ reported a positive relationship of this achievement test to medical school scores, and concluded this as the best predictor of GPA obtained during medical studies.

Hence, pre-admission cognitive tests have an enormous impact on medical student academic performance; this was attributable to 20.8% of the variance in the GPA that could explain the cognitive tools. Other non-cognitive elements also need to be evaluated in the admission process, and that is why there are other pre-admission factors not recognized in this study. These non-academic parameters evaluate applicants' attitude (like communication skills, empathy, confidence, and motivation to work) and are considered to be foremost determinants in overall student performance in medical school.^{8,9} As a consequence of this, the predictive validity of MCAT ranged from small to medium in the meta-analysis conducted by Donnon et al,¹⁴ and they emphasized the need to incorporate the assessment of non-academic tools to enhance a fair selection process.

The limitation of this study was the inclusion of only cognitive pre-admission criteria to predict the medical student's performance. Further studies are required to demonstrate the overall predictive factors of student's academic performance in terms of both cognitive and non-cognitive pre-admission parameters.

It can be concluded from the current study that multiple cognitive pre-admission factors are responsible for the prediction of medical student's GPA at the end of year 6. Among these, the achievement test is the most important predictor. Furthermore, English grades in the high school also emerged as an independent predictor of medical student's performance. Hence, any selection committee should consider these predictive factors during the admission process, and weightage should be assigned accordingly.

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