The Effectiveness of AGU-MCAT In Predicting Medical Student Performance In Year One of the College of Medicine of the Arabian Gulf University

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Abstract:

Introduction

To graduate good doctors, medical-schools should adopt proper student procedures to select among applicant students. When selecting students, many medical colleges focus solely on their academic achievement on high school examinations, which do not reflect all important attributes of student. For several years, the College of Medicine and Medical Sciences of the Arabian Gulf University, has introduced and administered the AGU-MCAT (Arabian Gulf University Medical College Assessment Test) for screening student applicants. This study aimed to assess the ability of the AGU-MCAT to predict students' performance during their first college study, as an example of one school's multi-dimensional admissions screening process

Method

The AGU-MCAT is made up of three parts, including a written test on science, an English test and an interview. In the first part, students' science knowledge is tested with 100 multiple choice questions. The English exam assesses students' English reading and listening skills. Lastly, students are interviewed by two faculty members and one senior student to explore their personal qualities.

The 138 students who passed the AGU-MCAT in September, 2008 and matriculated in the school were studied. Their performance during Year One,

including their performance on exams in the various disciplines, was compared to their achievement on the three AGU-MCAT components.

Results

AGU-MCAT's total mark and its science component had the highest linear relationship to students' performance in the various disciplines in Year One, while the strongest predictor of students' performance at the end of Year 1 was the AGU-MCAT's science test (R^2=45.5%). Students' grades in high school did not predict their achievement in Year 1.

Conclusion

The AGU-MCAT used to screen applicants to the school also predicts students' performance during Year One.

Introduction

Beyond a sound knowledge and excellent skills, doctors should possess many other abilities including being able to ***exhibit appropriate attitude***, provide excellent care, be a good listener and able to show empathy. For this reason, a proper selection procedure should be performed for students applying for admission to medical school. They should undergo assessments to ensure that only appropriate students are enrolled. In most Arab countries, and probably in many other parts of the world, the focus of the selection processes of new applicants to medical school has traditionally been their academic achievement (grades) on their high school examinations, particularly in certain science subjects [1,2]. This emphasis has led to the exclusion of many applicants who have outstanding personal qualities [3]; hence, selection of medical students on the basis of academic criteria alone is inadequate. Selection should include an assessment of students' personal qualities [1] in addition to measurements of their non-academic and academic abilities [4]. These traits cannot be assessed by a written exam or through demonstrated academic achievements in school, but rather require interviews which are not part of the admission procedures of many medical schools around the world [5]. The proper selection of medical students, which includes an interview, by many Western medical schools is considered the main reason for their low student attrition rates. Failure to complete school is the key threat to students who enter anticipating a future career in medicine.

The Arabian Gulf University (AGU) was established in early 1983. Its College of Medicine and Medical Sciences (CMMS) has as its principle objective to graduate community-oriented generalist physicians who have good problem

solving skills. Therefore, its six-year curriculum was designed to be problem-based (PBL) and community-oriented. For such a curriculum, a special caliber of student is required, that is students who have basic abilities to recognize and solve problems and who are self-motivated and independent [6].

In most countries of the Gulf Region, as in many parts of the world, students enter medical college immediately after high school graduation and their acceptance depends on their achievement in high school final examinations. Since students applying to the Arabian Gulf University come from the Gulf Cooperation Council (GCC) countries and present a wide variation in background and ability; it is necessary for the school to develop an assessment tool that serves to identify and select the best 150 out of around 300 students applying for admission each year. To that end, the AGU-MCAT (Arabian Gulf University; Medical College Assessment Test) was introduced and has been used since 2001. It consists of three screening parts: a written science examination (covering math, physics, biology and chemistry); a written English language examination and an interview. The written examination is developed annually by a group of senior faculty from different disciplines under the supervision of the Admission Committee. In preparing the exam, these faculty remain mindful of the curriculum taught at the high school level in the various GCC countries.

Year One of CMMS, with its main objective of orienting students to medical studies, consists principally of two semesters with a total of 32 credit hours. Subjects taught in Year One are: biology, physics, chemistry, biostatistics, epidemiology, two psycho-social sciences, Islamic studies, computer science and an intensive 10 credit hours in English. Students in Year One are

continuously assessed by written and practical examinations. There are two exams at mid-term with another two exams at end of each semester. For most written examinations, multiple choice questions are used and are corrected electronically. Students must pass all disciplines (by obtaining a score of over 60%) before they are allowed to proceed to Year Two.

Over the years, it has been found that student attrition during and immediately following Year One was high, reaching up to 14%. Similar attrition rate figures have been reported around the world. In Auckland, one in ten students fails to complete their medical training either due to academic failure or withdrawal [3].

This study asks whether the AGU-MCAT administered to applicants to the CMMS predicts student performance and achievement in the first year of the CMMS curriculum, for those who pass the exam and matriculate in the school. If it proves predictive, this would help justify its use in our school to identify students who should be denied admission or should be required to undergo remedial education before earning admission.

Year One performance is important in our school as it is considered the gateway through which students must pass before being allowed to continue their medical studies. From a student perspective, Year One is considered the most difficult year for two reasons: it is taught entirely in English whereas high school for most students was taught principally in Arabic; and the medical sciences incorporated into the basic sciences curriculum of Year One are challenging for many.

Methodology:

This study included 138 male and female students who were selected for admission to Year One of CMMS during the academic year 2008-2009. These students were out of 210 students who applied for admission and out of 165 who fulfilled the admission criteria to sit for the AGU-MCAT in September 2008. Admission criteria are that students have scored not less than 90% in their high school examination, not be older than 25 years and pass the AGU-MCAT. The first part of the AGU-MCAT (Science) consisted of 100 multiple choice questions structured to reflect the knowledge level of GCC high school graduates (see Appendix 1 for examples). The English test examined students' abilities in grammar, comprehension, reading and listening. The interview component of the AGU-MCAT was conducted by a panel of three individuals (two senior faculty members and a Year Six medical student) lasting thirty minutes. It used a structured questionnaire assessing seven areas: personality, attitude, ***determination in studying medicine and becoming a doctor,*** problem-solving understanding, ***self-dependent personality***, character and empathy.

An overall grade is given to students factoring in both their performance on the AGU-MCAT and in high school. Twenty five percent of the grade is based on marks obtained in high school examinations, 25% on high school marks in science subjects, 35% on the AGU-MCAT science test and 15% on the interview. The marks obtained in the AGU-MCAT English test are not included in the AGU-MCAT final marks, but are used to identify students whose level of proficiency in the English language is likely to hinder their study of medicine in the school. Students who did not achieve a satisfactory

passing score on the science test, demonstrated poor English or were not strongly recommended by the interviewers were not granted admission to CMMS.

The results of AGU-MCAT were compared to the student performance in Year One reflected by their academic grade point average (AGPA). AGPA is the total GPA score students obtain at the end of Year One for all of the 11 courses studied. It combines the first and second semesters' grades.

All data were entered and analyzed using the Statistical Package of Social Sciences (SPSS) Version 17.0. Multiple linear regression analysis was used to identify the components of the AGU-MCAT that are significant in predicting students' AGPA based on the value of R-Square. Also, the Pearson correlation coefficient was used to measure the strength of the linear relationship between the different components of the AGU-MCAT and students' AGPA at the end of Year One. P-values of less than 0.05 were considered statistically significant.

Results:

Out of the one hundred and sixty five students who fulfilled the admission criteria to sit the AGU-MCAT examination in September 2008, 138 were offered admission to the CMMS. Of these 138 students, 84 (60.9%) were female. Student age ranged from 17 to 19 years. Forty-eight (34.8%) came from Saudi Arabia, 52 (37.7%) from Bahrain, 31 (22.5%) from Kuwait, 5 from Oman and 2 were Arabs living in the GCC.

Pearson correlation coefficients (r) were used to measure the linear relationship between the different components of the AGU-MCAT and students' AGPA at end of Year One. We found that all components of the AGU-MCAT were significantly correlated with AGPA. The total score on the AGU-MCAT and the Science test component of the AGU-MCAT were found to have the highest linear relationship with students' AGPA (r=0.726, p-value= 0.000 and r=0.675, p-value=0.000 respectively).

Regression analysis was used to evaluate the relationship between scores on four components of the AGU-MCAT and students' achievement in Year One. The regression model was significant (p-value=0.000) and found to explain 56.4% of the variation in AGRA (R^2= 56.4%). It was also found that the science and English tests and the interview components of the AGU-MCAT were highly significant in predicting the students' AGPA. (Table 1)

***Table 1 Insert here.**

Effect of the Various Components of AGU-MCAT on Student AGPA:

Stepwise regression analysis was performed to identify the AGU-MCAT component or combination of components that were most strongly related to student AGPA. Table 2 displays the most important factors in predicting

students' AGPA reflected in the size of the corresponding R^2, which is the percent of variation in AGPA explained by these factors. Findings show that neither overall high school grades nor high school science grades predicted students' AGPA at the end of Year One (R^2=2.7% and 3.6% respectively). Also, the single component of AGU-MCAT most strongly predicting student performance at the end of Year One is the science test of the AGU-MCAT (R^2=45.5%). The predictive effect increases minimally when either the English test (R^2=53.7%) or the interview score (R^2=51.8%) is added.

***Table 2 Insert here.**

Effect of Gender

The AGPA for both genders was correlated with various parts of the AGU-MCAT. Pearson correlation coefficient showed a significant linear relationship for male students between all components of the AGU-MCAT and their AGPA. Findings were the same for female students, except there is no significant linear relationship between high school total grades and high school science grades with students' AGAP.

Regression models were significant for both genders (Male, p-value=0.000, R^2=67.7%; Female, p-value=0.000, R^2=58.4%). However, in males the AGU-MCAT science test score and the interview score were significant predictors of student achievement, while in females, the high school science grades, the AGU-MCAT science test score and the English test score were significant predictors of student AGPA. (Tables 3 and 4)

***Table 3 Insert here.**

***Table 4 Insert here.**

Discussion:

Although in CMMS the first year is considered Year One of Medical School, students undergo an extensive preparatory program to prepare them for medical studies of the following years and for the type of teaching adopted by the CMMS, which is problem-based and community-oriented. Since English is the school's language for teaching and many students have not had enough English during high school, a good number find Year One is a challenging and difficult year. To be eligible for promotion to Year Two, students must pass all subjects and receive an overall pass mark of not less than 60.

Many different variables have been used by medical colleges in an attempt to predict medical school performance. Our study found all components of the AGU-MCAT were significantly correlated with AGPA. However, the total mark obtained on the AGU-MCAT and on its science component had the highest linear relationship to student performance in Year One, while the strongest single factor predicting student performance at the end of Year One was the AGU-MCAT science test, which explained 45.5% of the variance in AGPA across students. The ability to predict Year One scores increases minimally when either the English test score (to 53.7%) or the interview score (to 51.8%) is added. Similar findings have been reported elsewhere [7,8]. Elam and Johnson found that the biological science sub score of the Medical College Admissions Test in the United States was the only significant pre-admission predictor of students' performance on Step 1 of the U.S. Medical Licensing Examination (USMLE) [9]. This finding was also supported by a study by Al Rukban et al. in 2008 which reported the achievement test (a science test given for students opting to study medicine) was statistically

predictive of student grade point average at their college of medicine in Saudi Arabia [10].

Our study also found that student grades in high school did not predict students' achievements in Year One. Similar findings were also reported by other medical colleges, such as the School of Medicine, University of Auckland, New Zealand, where of the high school exit examination grades accounted for only 16% of the variance in subsequent examinations [1].

Admission to medical school should not be based solely on high school grades and scores on a standardized admission test because these do not assess the extremely important non-cognitive attributes of students [11]. To test the non-cognitive characteristics of the candidate, schools must use methods other than written exams. Interviewing applicants should be the most important tool for selecting students. Many schools are paying closer attention to the interview as an effective screening tool [10,12,13]. At the University of Newcastle, New South Wales, Australia, the objective, structured interview is an integral part of the process of selecting to study medicine [13]. Interviews are commonly used to measure the non-cognitive traits of medical school applicants [14].

The interview part of the AGU-MCAT is usually conducted for thirty minutes by a panel of three members (two faculty with a senior medical student) using a structured questionnaire assessing seven non-cognitive areas relating to independence, self-motivation, self-appraisal, sensitivity, determination,

understanding problem-solving, communication skills, personality, character, empathy, etc. Other international medical colleges have reported involving senior medical students and other outside, non-medical individuals in the selection interview [15,16,17], in addition to using structured interviews [12]. The interview part of the AGU-MCAT has proven to be a good tool for detecting of many hidden student attributes in addition to helping to predict achievement in Year One of medical studies.

Unlike the written part of the AGU-MCAT, which tests cognitive abilities, and is highly reliable, the reliability and validity of the interview can be low or uncertain [18]. But the interview also has ***considerable advantages***, over other approaches in student selection [5]. Realizing this, the Monash Faculty of Medicine in Australia, and others, take personal qualities as appraised in semi-structured interviews into account, alongside academic merit, in the undergraduate selection process [17].

Our study confirms other studies' findings that how performance on admissions criteria correlates with student performance in medical school can differ for males and females [8]. In males, the strongest predictor was the science component and interview, while, in females the strongest predictor was the science test score. Studies have found that men had higher MCAT scores than women in all age groups, but older women had higher undergraduate GPAs than older men [19].

Medical student attrition leads to adverse emotional and social consequences for individual students, and also financial difficulties and morale problems for

medical schools [20]. Since AGU's establishment, the student attrition rate during and after Year one has been high, reaching up to 14%. Although this figure does seem high, it is in line with figures reported by medical schools from around the world [21]. For example, at the School of Medicine in UNAM Mexico, over 50% of students enrolled in the first year do not graduate and, of all admitted students, 11.3% do not graduate on time due to academic reasons [22]. Based on this study's findings, we believe that the AGU-MCAT test could help the school reduce student attrition rates.

Limitations:

The study outcome might be limited because it was only a one year study. More information could be obtained if the study was to be repeated to include more than one batch of students applying for admission to the college.

Conclusion:

The AGU-MCAT has previously proven to be a good screening method for students applying for admission to AGU. We find in this study that it also predicts student performance during Year One. With the overall increase in the number of high school graduates who choose to study medicine and the limited places available in medical schools, we recommend that other schools should use such a test in the student selection process. The interview component of the AGU-MCAT is very important in detecting applicants' non-cognitive abilities and behavior patterns. As found in other schools, neither high school grades nor high school science grades predict student achievement in Year One. Therefore the selection of students into medical college should not principally be based on these two measures, although many schools still do so. Such recommendations may not be applicable to North American and Canadian medical schools because students there must first earn an undergraduate degree before applying to medical school, and students' performance in college may better predict medical school performance than applicants' high school performance does for schools in most other countries, including the Middle East.

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Table 1. Parameter Estimates of Regression Coefficients Relating Students' AGPA to Various Components of AGU-MCAT (n=138)

Predictor	Coef	SE Coef	T	p-value
Constant	-30.56	0.5554	-0.88	0.383
High School Total Grades	0.5731	34.90	1.03	0.304
High School Science Grades	0.0655	0.4091	0.16	0.873
AGU-MCAT Science Test	0.46523	0.06374	7.30	0.000
AGU-MCAT English Test	0.14449	0.04852	2.98	0.003
AGU-MCAT Interview	0.18422	0.08093	2.28	0.024

Table 2. Percent of Variation in Students' AGPA, R^2, Explained by each Component of the AGU-MCAT and by High School Grades, Singularly and in Combination (n=138) 1

Factor(s)	R^2
All parts of AGU-MCAT, High School and High School Science	56.4%
Science test, English tests and Interview of AGU-MCAT	55.3%
Science and English tests of AGU-MCAT	53.7%
Total Score of AGU-MCAT	52.7%
Science test with the Interview of AGU-MCAT	51.8%
Science test of AGU-MCAT	45.5%
English test with the Interview of AGU-MCAT	36.8%
English test of AGU-MCAT	35.0%
Interview part of AGU-MCAT	19.0%
High School Science Grades	3.6%
High School Grades	2.7%

Table 3. Parameter Estimates of Regression Coefficients for Male Students Relating Various Components of the AGU-MCAT and High School Grades to Year One AGPA (n=54)

Predictor	Coef	SE Coef	T	p-value
Constant	-108.62	66.63	-1.63	0.110
High School Total Grades	0.7607	0.8455	0.90	0.373
High School Science Grades	0.4842	0.8384	0.58	0.566
AGU-MCAT Science Test	0.6347	0.1091	5.82	0.000
AGU-MCAT English Test	0.0138	0.1008	0.14	0.892
AGU-MCAT Interview	0.3454	0.1370	2.52	0.015

Table 4.Parameter Estimates of Regression Coefficients for Female Students Relating Various Components of the AGU-MCAT and High School Grades to Year one AGPA (n=84)

Predictor	Coef	SE Coef	T	p-value
Constant	69.29	35.74	1.94	0.056
High School Total Grades	-1.0921	0.6334	-1.72	0.089
High School Science Grades	0.9174	0.4153	2.21	0.030
AGU-MCAT Science Test	0.38419	0.06130	6.27	0.000
AGU-MCAT English Test	0.17171	0.04314	3.98	0.000
AGU-MCAT Interview	0.00219	0.07965	0.03	0.978

Appendix 1:

-If sin (7x) = cos (2x), x angular then the value x =

a. 18°
b. 10°
c. 36°
d. 20°

-A function $f(x)$ is continuous at an interior point c of its domain if:

a. $\lim_{\mathbf{x}\to\mathbf{c}} f(\mathbf{x}) = \mathbf{l}$, $l \in R$
b. $f(\mathbf{x}) = \mathbf{l}$, $l \in R$
c. $\lim_{\mathbf{x}\to\mathbf{c}} f(\mathbf{x}) = f(\mathbf{c})$
d. $\lim_{\mathbf{x}\to\mathbf{c}} f(\mathbf{x}) \neq f(\mathbf{c})$

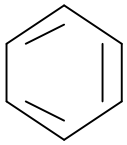
-A 1M (one molar) solution os made by dissolving:

a. 1 gram of a substance in 1 liter of water
b. 1 gram of a substance in water to give 1 liter of final solution
c. 1 gram of a substance in 1 liter of water
d. 1 mole of a substance in water to give 1 liter of final solution

-The reaction takes place when a base is added to an ammonium Ion buffer (NH_3/NH_4+) is:

a) $NH_3 + OH- \text{ ---------- } NH_2 + H_2O$
b) $NH_4^+ + OH- \text{ ---------- } NH_3 + H_2O$
c) $NH_3 + H+ \text{ ---------- } NH_4+$
d) $NH_4^+ + H_2O \text{ ---------- } NH_3 + H_3O+$

-Which one of the following compounds is an example of an alkene?

a - 

b- $CH_3CH_2CH_2CH_3$

c- $HC \equiv CCH_3$

d- None of the above

Appendix 1:

-Which of the following compounds contains phosphorus?

a) DNA
b) Proteins
c) Cholesterol
d) Fat

-In all of the following cases there is a net movement of water across a semi-permeable membrane **EXCEPT** from:

a. a glucose solution to a more concentrated fructose solution
b. a side containing water only to a dilute fructose solution
c. a side containing water only to a concentrated fructose solution
d. a glucose solution to a sucrose solution of equal concentration

-A force of F on a mass M causes an acceleration of 12 A. What acceleration will result from a force of 3F on a mass of 0.5M?

a. 72 A
b. 54 A
c. 12 A
d. 24 A

-Three books X, Y, Z, rest on a table as shown in the diagram. The net force acting on book Y is

a. 4 N down
b. 5 N down
c. 10 N up
d. Zero