

The Predictive Validity of Standardized Tests and English Proficiency for Saudi Medical Students' Performance in Biology

Abdulaziz Althewini

English Department, College of Science and Health Professions, King Saud bin Abdulaziz University for Health Sciences and King Abdullah International Medical Research Center, Saudi Arabia

Corresponding author: Abdulaziz Althewini, E-mail: A.Aalthewini@gmail

ARTICLE INFO

Article history

Received: September 01, 2019

Accepted: October 23, 2019

Published: October 31, 2019

Volume: 7 Issue: 4

Conflicts of interest: None

Funding: None

ABSTRACT

The study is designed to examine the predictive power of Saudi-admission criteria for student performance in an introductory biology course. It focuses on the second semester at King Saud bin Abdulaziz University for Health Sciences. The study addresses whether the General Aptitude test (GAT), the Scholastic Achievement Admission Test (SAAT), and the students' English proficiency, taken together can accurately predict student performance in the biology course. Their English proficiency was measured by using the average grade in the intensive English courses taken in the first semester, in addition to the average grade in the reading and communication proficiency tests. The research involved the results of 250 male students in the admission criteria and biology-course grades. Simple linear and multivariate regression models are used to determine the predictive variance of each admission criterion for student success in the biology course. The results demonstrate that the admission criteria are significant predictors, but with a variance of 26.6%. The results also show that individually, GAT and SAAT are the poorest predictors, whereas the reading and communication proficiency tests were the best. The findings reveal that the predictive power of these admission criteria as a combined model is low. Additionally, more investigation is necessary to ascertain whether these criteria are also low predictors in other subjects and in overall college learning.

Key words: Biology Education, College Admission, English Proficiency, Medical Education, Predictive Validity, Standardized Tests

INTRODUCTION

Saudi high-school graduates are required to take certain standardized tests as admission criteria when they apply for college. These tests are the General Aptitude Test (GAT) and the Scholastic Achievement Admission Test (SAAT). Both tests are major admission criteria that serve universities by filtering out students when they fall below the minimum score. In addition, the minimum score required is designated differently among Saudi universities. GAT, created by the national Saudi Center of Measurement (QIYAS), tests students' analytical skills and learning ability. SAAT, on the other hand, focuses on student comprehension of the various concepts in biology, chemistry, physics, and mathematics that are covered in the courses of the last three levels of high school.

Little research has been done on the predictive validity of these tests for medical students' performance in college, however. The efficacy of these tests in predicting student performance in college is therefore open to question. Furthermore, although some Saudi universities consider English proficiency as one of the components required for

college admission, no study has yet investigated the actual validity of the English-proficiency admission criterion among students. Here, the aim of the study is to discover whether these standardized tests, together with the students' English proficiency, can predict the performance of medical students during the first year of a biology course. This study is unique in the Saudi health-education context since it is the first to analyze the relationship between the standardized tests and English proficiency as admission criteria and the student performance in biology.

This study is situated within the current academic discussion and argument regarding the admission criteria for medical students. It comes as a response to the worldwide call for further inquiry into the process of student selection for medical colleges (Ferguson, James, & Madeley, 2002; McManus, Ferguson, Wakeford, Powis, & James, 2011; Roberts and Prideaux, 2010; Wilkinson, Zhang, Byrne, Luke, Ozolins, Parker, & Peterson, 2008). There is a growing need, especially in health-sciences education, for a deeper analysis of the selection process in order to assess its fairness, accountability, and reliability; as well as considering its complexity

(Prideaux, Roberts, Eva, Centeno, Mccrorie, Mcmanus, & Wilkinson, 2011; Schwartz, 2004). Such analysis is vital for determining the value of the current selection process (Benbassat and Baumal, 2007; Parry, Mathers, Stevens, Parsons, Lilford, Spurgeon, & Thomas, 2006).

There is currently a global endeavor to closely study and analyze the relationship between admission criteria and students' work in colleges. The admission criteria among countries obviously differs, as the existing research on this issue at the global level shows. Nonetheless, the general approach is similar in the focus on standardized tests, and with an emerging trend of assessing non-academic personal-reasoning qualities at the same time (Albanese, Snow, Skochelak, Huggett, & Farrell, 2003; Searle and McHarg, 2003; Turnbull, Buckley, Robinson, Mather, Leahy, & Marley, 2003), and towards mental traits (Ferguson, McManus, James, O'Hehir, & Sanders, 2003; Jessee, O'Neil, & Dosch, 2006; Sefcik, Prerost, & Arbet, 2009). In the U.S., the Medical College Admission Test (MCAT) and pre-degree grade point average are used to assess student ability (Callahan, Hojat, Veloski, Erdmann, & Gonnella, 2010; Donnon, Paolucci, & Violato, 2007; Evans and Wen, 2007). In the U.K., the United Kingdom Clinical Aptitude Test (UKCAT), personal statement, and interview are used; whereas in Australia, the Graduate Australian Medical Schools Admission Test (GAMSAT) and college grade-point average (GPA) are used (McManus, Smithers, Partridge, Keeling, & Fleming, 2003). These admission criteria are designed to help medical colleges select the best available students to ensure that the students accepted are capable of advancing in their education and profession.

Regarding these admission assessments across the countries mentioned, studies have found some relationship between them and students' college performance. Looking especially at standardized tests such as MCAT, UKCAT, and GAMSAT, Julian (2005) and Peskun, Detsky, & Shandling (2007) indicate that a relationship exists between MCAT and student performance in medical school to the extent of 12% of variance when combined with the undergraduate GPA. Further, Wright and Bradley (2010) conclude that UKCAT is a significant indicator of student performance in the first and second year of college. Similarly, Coates (2008) asserts that GAMSAT, along with the undergraduate GPA, is a fairly accurate predictor of student progress in the first and second year of college.

This paper therefore aims to study such a relationship within Saudi Arabia and to present data, together with some well-supported conclusions, to policymakers in the field of higher education. It is a response to the growing need to analyze the patterns of the predictors and the student progress that is necessary to determine the fairness and complexity of the various admission criteria.

OVERVIEW

Before going into the study questions and analysis, it is first vital to offer an overview of the study background, illustrating the study setting, the biology course in question, and the English proficiency of students.

The study takes place in the first year of the pre-professional program in King Saud bin Abdulaziz University for Health Sciences (KSAUHS). In this program, students take lower-intermediate English courses in the first semester, and then science courses are comprised of biology, chemistry, and physics in the second semester. Subsequently, based on their GPA of both semesters, the students are nominated for several medical colleges. These include the College of Medicine (COM), College of Pharmacy (COP), College of Dentistry (COD), and the College of Applied Medical Sciences (CAMS). As the top college, with more limited places, COM requires a higher GPA, followed by COD and then COP. CAMS, however, does not require a minimum GPA range, so any students not accepted in the other colleges, can enroll there.

Students taking the biology course learn the basic concepts of the subject using English as the medium of instruction. The course first introduces them to the basic principles of the cellular and molecular basis of life, as well as to biochemical processes, cellular structure and function, and cell growth and division, in addition to viruses and bacteria. Upon completion of this course, students should be able to demonstrate an understanding of life at the cellular and molecular levels. At the end of the course, students are expected to define the structure and function of the cell and of bacteria and viruses, as well as describe the biochemical events that occur in the cell, the basic molecular biology of the cell, and cell division. Their learning is assessed through one mid-term exam, along with the final exam.

This study adopts two methods for assessing the students' English proficiency. The first is taking the average student score in the English courses, which involve reading, grammar, and communication, and that are taken in the first semester. The second method is through their performance in the reading and communication proficiency tests. These tests were assessed and revised by a group of English teachers before being administered. The reading test aims to assess whether students are able to read and comprehend various general and academic texts written for university students, by applying both referencing and inferencing skills. It tests the following areas:

- Identifying main ideas and supporting details in a reading passage.
- Applying reading and critical thinking strategies to move beyond the literal meaning of a passage.
- Distinguishing between opinions and scientific facts.
- Interpreting diagrams, charts and illustrations.
- Identifying cause and effect in a reading passage.

The test also focuses on the students' knowledge of vocabulary and its use, including synonyms, as well as their understanding of parts of speech.

Regarding the communication test, students need to demonstrate an ability to use different rhetorical modes including definition, comparison, and contrast. They also need to paraphrase and summarize, and to write a multi-paragraph text or essay. The latter examines the following skills:

- Making predictions based on the text, analyzing, and drawing conclusions.

- Analyzing the rhetorical structure of a reading passage.
- Formulating a topic sentence using a restricted topic and controlling idea.
- Developing the paragraph by using main points and supporting details.

Both the reading- and communication-proficiency tests, together with the English average score, are the components of English proficiency used in this study for predicting student performance in biology.

RESEARCH QUESTIONS

The research questions look at the predictive validity of GAT, SAAT, and English proficiency for student performance in biology. The questions are as follows:

1. Do GAT, SAAT, English average, reading proficiency test, and communication proficiency test individually predict student performance in biology? If so, which of these is the most significant predictor?
2. When GAT, SAAT, English average, reading proficiency test, and communication proficiency test are combined in a statistical model (with multivariate-regression analysis), to what extent do they predict student performance in biology?

METHOD

The study collected the scores of GAT, SAAT, the English proficiency average score, the reading and communication tests, and the biology test results from 250 students out of 261 with a response rate of 95%. All the students were asked for their

permission to share their scores for study purposes. They entered their scores in an online recording system where their data were kept in confidentiality and anonymity. The data obtained from the students were then analyzed through simple linear regression and multivariate-regression analysis with the SPSS program. There are five predictive (independent) variables: GAT, SAAT, the English average score, the reading and communication tests, and one dependent variable: the biology grade.

RESULTS

For the first research question, running individual models for each predictive variable separately helps to estimate the percentages of the dependent-variable variances explained by each predictive variable. The variance of each predictive variable is presented in Table 1.

The table shows that when the variables are viewed individually, GAT explains 5.0%, SAAT: 5.3%, the English average: 12.2%, the reading test: 19.0% and the communication test: 18.1% of the variance of the biology grade. Even though all the coefficients are significant, the most important metric is t value: the regression coefficient divided by its standard error. Therefore, the most important individual predictors of the biology grade are the reading and communication tests.

The multivariate model, including all the independent variables, explains 26,6% of the biology-grade variance, which is a better result than that from any separate model, as shown in Table 2.

Three out of the five coefficients are significant with different levels of confidence, as shown in Table 3:

Table 1. Individual model summary to predict biology grades

Model	Variable	R	R square	Adjusted R square	Regression coefficient	Std. error	t	Coefficient p-value
1	GAT	0.223	0.050	0.046	0.034	0.010	3.400	0.001
2	SAAT	0.231	0.053	0.049	0.035	0.009	3.889	0.000
3	English average	0.349	0.122	0.118	0.590	0.105	5.619	0.000
4	Reading test	0.436	0.190	0.187	0.363	0.049	7.408	0.000
5	Communication test	0.425	0.181	0.177	0.415	0.057	7.281	0.000

Table 2. Combined model summary

Model	Variable	R	R Square	Adjusted R square	Std. error of the estimate
1	Communication test, GAT, SAAT, English average, reading test	0.516	0.266	0.250	0.667

Table 3. Significance of coefficients

Model	Unstandardized coefficients		Standardized coefficients	t	Sig.	
	B	Std. Error	Beta			
1						
	(Constant)	-0.398	0.957		-0.416	0.678
	GAT	0.012	0.010	0.077	1.232	0.219
	SAAT	0.014	0.009	0.096	1.525	0.129
	English average	0.191	0.115	0.113	1.668	0.097
	Reading test	0.168	0.067	0.202	2.521	0.012
	Communication test	0.220	0.074	0.227	2.991	0.003

Table 3 shows that the communication test is the strongest predictor of the biology grade ($p < 0.01$), followed by the reading test ($p < 0.05$), and the English average ($p < 0.1$). Based on the results in this table, the regression equation for predicting the biology grade is $= -0.398 + 0.012 * \text{GAT} + 0.014 * \text{SAAT} + 0.191 * \text{English average} + 0.168 * \text{reading test} + 0.220 * \text{communication test}$.

DISCUSSION

Looking at the individual model for each predictive variable, the reading test accounts for 19.0% and the communication test, 18.1% of the variance in the biology scores. Both were the most significant individual predictors. This outcome reveals that both these tests can to some extent predict the student performance in biology. It implies that English language proficiency is key for students' success in college regardless of their high school instruction in Arabic. GAT and SAAT, however, although significant, have a very low variance of the biology score. This means that neither GAT nor SAAT are suitable predictors for the introductory biology course.

When such standardized tests are seen globally, the low variance is not surprising. As Julian (2005) and Peskun et al. (2007) report, the relationship between MCAT and student performance in medical school has 12% variance when combined with the undergraduate GPA. Nonetheless, despite the low-predictive variance, the Saudi community views these tests as reliable and trustworthy. Possible reasons for this apparent anomaly could include the fact that both tests were in Arabic, whereas the biology course was in English, and so the language shift could decrease the predictive validity. Also, the content of both tests, including the question format and the skills assessed, were completely different from the biology course content. In GAT, students are assessed on logical and critical thinking, as well as on reading comprehension; whereas in SAAT, students are evaluated on their background knowledge of biology, physics, and chemistry. SAAT should have been the best predictor, given its similar contents to the biology course, but the language shift and the different educational goals make it the least accurate predictor for the biology course. Other local studies found similar results as in Al Alwan, Al Kushi, Tamim, Magzoub, & Elzubeir (2012) and Murshid (2012). Both studies found that SAAT is less predictive for Saudi students' performance in science courses.

The combined model that includes all independent variables explains 26.6% of the biology-grade variance. It also shows that the communication and reading tests are the strongest predictors. The variance is still low, however, implying only a moderate relationship between the independent variables and the biology grade. The variance could be higher for a larger number of participants, and if additional relative-independent variables are included in the model.

The very low score of GAT and SAAT in the combined model may cause the policy makers in the Saudi educational system to consider certain questions. They could look at whether these two tests should be related to the students' college performance in the future, rather than simply evaluating their learning achievements at high

school. The fact that neither of these tests can predict student performance in the introductory biology course, a subject that students have studied at high school, is somewhat intriguing. It could be that the courses in high school and college are somehow disconnected: the course materials and tests may be designed differently, for example. Thus, if we aim to measure the students' performance in an advanced biology course in the third or fourth year of college, what would be the result? It could be lower based on this analysis. These questions deserve attention from the policy makers and university administrators as part of their search for better and more reliable admission criteria.

This study has certain limitations in that it is situated within the Saudi academic community and focuses on students aiming for medical colleges. It considers student performance in one single course, taking a micro-perspective and conducting deep analysis into how well several independent variables can predict students' grades in biology.

CONCLUSION

The GAT and SAAT tests and the level of English proficiency did not therefore give a strong prediction of the Saudi students' performance in biology. Even in the combined model, which gave the best result, the prediction variance of 26.6% is still low. Whether these admission criteria are also low predictors for other subjects and in overall college learning is a matter that requires more investigation. Saudi policy makers need to consider whether GAT and SAAT really measure the students' readiness for college, and if not, as this study implies, to include more reliable admission criteria that could help students adapt more easily to the relevant college courses. The time has certainly come for the Saudi higher-education community to take the initiative and conduct the appropriate research into college admission criteria to ensure more fairness and help to minimize the gap between high school and college.

REFERENCES

- Al Alwan, I., Al Kushi, M., Tamim, H., Magzoub, M., & Elzubeir, M. (2012). Health sciences and medical college pre admission criteria and prediction of in-course academic performance: a longitudinal cohort study. *Advances in Health Sciences Education, 18*(3), 427-438.
- Albanese, M. A., Snow, M. H., Skochelak, S. E., Huggett, K. N., & Farrell, P. M. (2003). Assessing personal qualities in medical school admissions. *Academic Medicine, 78*(3), 313-321.
- Benbassat, J., & Baumal, R. (2007). Uncertainties in the selection of applicants for medical school. *Advances in Health Sciences Education, 12*(4), 509-521.
- Callahan, C. A., Hojat, M., Veloski, J., Erdmann, J. B., & Gonnella, J. S. (2010). The predictive validity of three versions of the MCAT in relation to performance in medical school, residency, and licensing examinations: a longitudinal study of 36 classes of Jefferson Medical College. *Academic Medicine, 85*(6), 980-987.

- Coates, H. (2008). Establishing the criterion validity of the graduate medical school admissions test (GAMSAT). *Medical education*, 42(10), 999–1006.
- Donnon, T., Paolucci, E. O., & Violato, C. (2007). The predictive validity of the MCAT for medical school performance and medical board licensing examinations: a meta-analysis of the published research. *Academic Medicine*, 82(1), 100–106.
- Evans, P., & Wen, F. K. (2007). Does the medical college admission test predict global academic performance in osteopathic medical school? *Journal of the American Osteopathic Association*, 107(4), 157.
- Ferguson, E., James, D., & Madeley, L. (2002). Factors associated with success in medical school: systematic review of the literature. *Bmj*, 324(7343), 952–957.
- Groves, M. A., Gordon, J., & Ryan, G. (2007). Entry tests for graduate medical programs: is it time to re-think? *Medical Journal of Australia*, 186(9), 486.
- Ferguson, E., McManus, I. C., James, D., O’Hehir, F., & Sanders, A. (2003). Pilot study of the roles of personality, references, and personal statements in relation to performance over the five years of a medical degree. *Bmj*, 326(7386), 429–432.
- Jessee, S. A., O’Neil, P. N., & Dosch, R. O. (2006). Matching student personality types and learning preferences to teaching methodologies. *Journal of Dental Education*, 70, 644–651.
- Julian, E. R. (2005). Validity of the Medical College Admission Test for predicting medical school performance. *Academic Medicine*, 80(10), 910–917.
- McManus, I. C., Smithers, E., Partridge, P., Keeling, A., & Fleming, P. R. (2003). A levels and intelligence as predictors of medical careers in UK doctors: 20 year prospective study. *Bmj*, 327(7407), 139–142.
- McManus, I. C., Ferguson, E., Wakeford, R., Powis, D., & James, D. (2011). Predictive validity of the Biomedical Admissions Test: an evaluation and case study. *Medical teacher*, 33(1), 53–57.
- Murshid, K. R. (2013). The predictive value of individual admission criteria on academic performance in a Saudi medical college. *Journal of Taibah University Medical Sciences*, 8(1), 18–23.
- Parry, J., Mathers, J., Stevens, A., Parsons, A., Lilford, R., Spurgeon, P., & Thomas, H. (2006). Admissions processes for five year medical courses at English schools. *Bmj*, 332(7548), 1005–1009.
- Peskun, C., Detsky, A., & Shandling, M. (2007). Effectiveness of medical school admissions criteria in predicting residency ranking four years later. *Medical education*, 41(1), 57–64.
- Prideaux, D., Roberts, C., Eva, K., Centeno, A., Mccrorie, P., Mcmanus, C., & Wilkinson, D. (2011). Assessment for selection for the health care professions and specialty training: consensus statement and recommendations from the Ottawa 2010 Conference. *Medical teacher*, 33(3), 215–223.
- Roberts, C., & Prideaux, D. (2010). Selection for medical schools: re-imaging as an international discourse. *Medical education*, 44(11), 1054–1056.
- Schwartz, S. (2004). Fair admissions to higher education: recommendations for good practice. London: Higher Education Steering Group.
- Searle, J., & McHarg, J. (2003). Selection for medical school: just pick the right students and the rest is easy!. *Medical education*, 37(5), 458–463.
- Sefcik, D. J., Prerost, F. J., & Arbet, S. E. (2009). Personality types and performance on aptitude and achievement tests: Implications for osteopathic medical education. *Journal of American Osteopathic Association*, 109(6), 296–301.
- Turnbull, D., Buckley, P., Robinson, J. S., Mather, G., Leahy, C., & Marley, J. (2003). Increasing the evidence base for selection for undergraduate medicine: four case studies investigating process and interim outcomes. *Medical education*, 37(12), 1115–1120.
- Wilkinson, D., Zhang, J., Byrne, G. J., Luke, H., Ozolins, I. Z., Parker, M. H., & Peterson, R. F. (2008). Medical school selection criteria and the prediction of academic performance. *Medical journal of Australia*, 189(4), 235.
- Wright, S. R., & Bradley, P. M. (2010). Has the UK Clinical Aptitude Test improved medical student selection? *Medical education*, 44