

## Original Article.

# Assessment of significant variables to improve admission and teaching learning processes in a medical school

Syed Imran Mehmood\*, Jan C.C. Borleffs\*\*, Syed Razi Muhammad\*\*\*

\*Dow Institute of Health Professionals' Education, Dow University of Health Sciences. \*\*Center for Innovation and Research of Medical Education, University Medical, \*\*Center Groningen and University of Groningen, the Netherlands.

\*\*\*Muhammad Medical College, Mirpurkhas.

## Abstract

**Introduction:** Current selection methods in medical schools emphasize academic competence only, somewhat to the detriment of other essential competencies. Academic grades are frequently considered as the predictors of good academic performance in medical schools and therefore many medical schools still select applicants predominantly on this basis.

**Objective:** To assess this long-standing trend in order to point out the lacunae associated with it and to explore this effect with a view to improve teaching and learning process.

**Methodology:** During this retrospective longitudinal study, we studied the students (n=539) admitted to the college of medicine, King Khalid University, Saudi Arabia, between 2006 and 2011. During these years study conditions (i.e. admission procedure, study program and assessment) remained unchanged. The scores of higher school certificate (HSC) were correlated with study duration (number of semesters) and grade point average (GPA). Pearson's correlation and regression analysis were carried out using effect model.

**Results:** The results of this study do not demonstrate a correlation between HSC scores and study duration ( $r = -.018$ ). The relationship between HSC scores and cumulative GPA was moderate positive ( $r = .476$ ). The HSC scores were found to be poor predictors of the subsequent academic performance ( $R^2 = .273$ ).

**Conclusions:** The HSC score is a poor predictor of the subsequent academic performance. Our intuition, and perhaps our experience, suggests that study time should be positively associated with grades. However, it is not always the case as study duration-grade association may not be true.

**Keywords:** School admission criteria, Medical education, Students, Undergraduate.

## Introduction:

During the last decades the selection of students for entrance into medical schools has been a subject of intense discussion. In Europe and the United States of America many policies vary from weighted lotteries to strong selection procedures measuring cognitive or noncognitive capacities of the candidates<sup>1-3</sup>. As far ideal system is still lacking, in most policies previous academic performance is considered to be a very important factor for selection of students in most medical schools<sup>4</sup>.

Several studies, which have analyzed the relationship between academic requirements and subsequent performance of students in the medical school, have produced conflicting results and at times they have reached provocative conclusions. Some researchers strongly hold the view that A-levels are predictive of outcome at university<sup>5-8</sup> while others hold the opposite belief as true, i.e. A-levels are not predictive of outcome at university<sup>9-10</sup>. Other studies report that the level of correlation between prior academic achievement and study success decreases as students' progress through the course<sup>7,11</sup>. A study by Higher Education Statistics Agency in England and Wales which studied 79005, eighteen years old students entering university in 1997-8 and followed through until 2000-1 showed a clear relation between A-level grades and university outcome. The result is compatible with many other studies of students in general and of medical students in particular. (Accessible at <http://www.hefce.ac.uk>). All these data are achieved in western countries. The numbers of studies dealing with the predictive value of high school results for the study progress in medical school in non-western countries are very limited.<sup>12</sup> El-Hezmi et al (1987) in his ten-year retrospective study of the performance of men and women medical students at King Saud University (Riyadh) reported that there is no relationship between A-level or High School Certificate (HSC) scores and

academic performance in the university<sup>10</sup>. Huda et al<sup>6</sup> also finds no relationship between A-Level / HSC score and academic performance at Ziauddin medical school (Pakistan) after studying the performance of 159 MBBS (Bachelor of Medicine and Bachelor of Surgery) students. There is great need for additional research answering the questions about the optimal selection procedure and determining the relationship between the academic grades and study duration to better understand the nature of the study duration-grade association by examining the effects of student, educational environment on study duration, grades and the study duration-grade association. In Saudi Arabia, there is an urgent need to carry out research in this area of medical education.

During this study we examined four research questions: first, does a relationship exist between the pre-entry academic grades (A-levels/HSC scores and academic performance of students at a medical school? Second, how much value and weightage should be given to A-levels/HSC scores in the medical school admission process? Thirdly, is there a relationship between academic grades at high school and the study duration in a medical school? And fourthly, is there a relationship between study duration and academic grades (expressed as GPA) in medical school?

### *Admission Procedures at medical schools in Saudi Arabia:*

In the Kingdom of Saudi Arabia, the government bears the responsibility of selecting medical students. Students are qualified for enrollment in medical schools after 12 years of successful schooling. The first public medical school in the Kingdom was of King Saud University at Riyadh, since then there has been a rapid increase in medical schools' numbers during the last few decades. Currently there are 27 medical schools, 21 are within public sector while only 6 are in private sector. Saudi Society for Medical Education is the regulatory body. The selection of students

in a medical school depends upon their performance in A-levels/ high school grades and entrance test (consisting of two parts, one of which assess competency in courses of physics, chemistry and biology of high-level school and the other one assesses general IQ level of the students). This entrance test is administered simultaneously all over the kingdom and the placement of the applicants is arranged based on their scores in these exams and the availability of slot in a medical school.

The College of Medicine of King Khalid University is founded in 1998. Each year the college is offering 126 slots for new applicants. The University has a strong regional position and is among the best of Saudi Arabia with 85% of students passed in A-grade last year (Accessible at [http:// www.scfhs.org](http://www.scfhs.org)). The college is using a traditional curriculum and strategies which are very similar as those found at the high schools in Saudi Arabia. Medical students are trained in a six-year curriculum for degrees in Bachelor of Medicine and Bachelor of Surgery (MBBS). The main objective of this programme is to educate and train future doctors and surgeons who will render effective and exemplary healthcare services appropriate to the needs of urban and rural populations of Saudi Arabia.

**Methodology:**

This was a retrospective longitudinal study which has used the results of seven cohorts of undergraduate medical students of the college of medicine, King Khalid University. The study population consists of all the students of these cohorts which were admitted in the years of 2006-2011 and graduated between 2011 to 2017. The number of students per year that entered the college of medicine were 69 (2005), 78 (2006), 80 (2007), 77 (2008), 79 (2009), 78 (2010) and 78 (2011). Students' scores were collected from the Admissions office of King Khalid University. During these years study conditions such as admission procedure, study program and assessment remained unchanged.

*Independent variable:*

High School Certificate (HSC)

This certificate is awarded to students after successful completion of twelve (12) years of schooling. Chemistry, Biology and Physics are the main science subjects which are being taught at HSC level. Assessment methods used in HSC exams are written, practical and oral exams.

*Dependent Variables:*

1: Study Duration

Study duration is expressed as the number of semesters taken by each student to become a doctor. The minimum time required for graduation in King Khalid Medical School is 6 years.

2: Grade Point Average

Study results during the MBBS course were measured by each student's aggregate Grade Point Average (GPA) in the six (6) year medical course.

*Statistical Analysis:*

For calculating the predictive value of HSC score to predict aggregate GPA during medical training, Pearson's correlation and regression analysis were carried out. The fixed effect model (the ability of A-levels/HSC marks to predict overall exams results i.e., GPA) was used to measure the significance of the pre-admission variable to

predict GPA. SPSS®-20 used for statistical analysis. Inferences were drawn based on results obtained from statistical analysis. We were primarily interested in the effect of HSC on the dependent variables. We estimated the regression coefficients to show the impact of an independent variable and assessed the practical importance of the coefficient by looking at the effect size indication for correlations, with 0.10= small, 0.30= moderate and 0.50= large<sup>13</sup>.

**Results:** Table1 displays the students' characteristics. Students records of all 539 students graduated between 2011 to 2017 were available. The mean value of the high school certificate scores at the time of entrance to college of medicine was 96.23. During their study the mean cumulative GPA was 3.22 and the mean study duration was 10.37 semesters. Although a trend towards longer study duration during the study period is suggestive, there were no statistically significant differences among the seven cohorts of students included in this study.

**Table 1: Students' characteristics**

	Pre-entrance	Study results	
	HSc: Mean ±SD	Cumulative GPA Mean ±SD	Study duration: Mean number of semesters ±SD
2005 (n=69)	94.59 ±2.46	3.01 ±0.54	9.10 ±1.64
2006 (n=78)	95.52 ±2.02	3.09 ±0.55	9.47 ±2.14
2007 (n=80)	96.54 ±1.80	3.16 ±0.50	9.45 ±1.93
2008 (n=77)	96.42 ±1.87	3.24 ±0.58	10.60 ±1.44
2009 (n=79)	97.02 ±1.77	3.24 ±0.44	10.39 ±1.46
2010 (n=78)	97.02 ±1.71	3.38 ±0.48	12.45 ±0.82
2011 (n=78)	96.52 ±1.71	3.50 ±0.43	12.07 ±0.35
All students (n=539)	96.23 (2.07)	3.22 (0.53)	10.37 (1.93)

Table 2 depicts the correlation between the HSC certificate scores, cumulative GPA and study duration (expressed as number of semesters). Correlation is significant at 1% level for HSC scores and cumulative GPA (i.e., 47.6%), a linear relationship exists between the same variables which is moderate positive relationship. There is no correlation between HSC scores and study duration. Furthermore, there also exists a significant correlation at 1% between the GPA and duration but the relationship is inverse (-22.4%).

**Table 2: Pearson Correlation Matrix for the study sample (n=539)**

		High School Certificate	Cumulative GPA	Study duration /Semester
High School Certificate	Pearson Correlation	1	0.476	-.018
	Sig (2 tailed)	539	0.000	.672
	N	539	539	539
Cumulative GPA	Pearson Correlation	.476**	1	-.224**
	Sig (2 tailed)	0.000	539	0.000
	N	539	539	539
Study Duration /Semester	Pearson Correlation	-.018	-.224	1
	Sig (2 tailed)	.672	0.000	539
	N	539	539	539

Table 3 depicts the regression analysis of the study sample. The regression model shows that the HSC scores and study duration are statistically significant predictors for the GPA but R<sup>2</sup> value of .273 shows the regression model can only explain 27.3% variation of GPA. Therefore, the model is not the best model for prediction.

**Table 3: Regression Analysis for the study sample (n=539)**

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.522 <sup>a</sup>	.273	.270	.45537

a. Predictors: (Constant), Study Duration/Semester, High School certificate

Table 4 displays the standardised and unstandardised regression coefficients. While analyzing these coefficients taking the cumulative GPA as the dependent variable, it was observed that if the HSC score is increased by 1 %, the GPA is increased by 0.121 score and if the study duration is decreased by one month, the GPA is increased by .059 score. It means that the HSC score is directly proportional to the GPA.

**Table 4: Standardised and Unstandardized regression coefficients**

Coefficients <sup>a</sup>					
Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
1 (constant)	-7.851	.922		-8.518	.000
High School Certificate	.121	.009	.472	12.798	.000
Study Duration/Semester	-.059	.010	-.216	-5.849	.000

**Discussion:**

For the last three decades, the trend of selecting the medical students predominantly based on previous academic performance is in practice in majority of the medical schools across the world. Despite A-levels/HSC being the basis for selection in the Kingdom of Saudi Arabia, little evaluation of its predictive validity has taken place.

For evaluating the predictive validity of A-levels/HSC scores, a retrospective longitudinal study of 539 medical graduates was undertaken to assess the relationship of the admission criteria to subsequent performance in the College of Medicine at King Khalid University.

The current study shows that HSC scores of all cohorts were positively correlated to the academic performance in medical school, expressed as GPA, but the relationship is moderate (.476). These findings are consistent with other research reports wherein positive correlations have been observed between the A-levels/ HSC scores and the medical school grades<sup>4,6-8,11,14-17</sup>. But results of current study do not reveal a prominent predictive validity of A-levels/HSC scores. In fact, the R<sup>2</sup> value of 0.273 shows that the regression model can only explain just 1/4th variation of GPA which a poor predictive value of this selection tool. Possibly, this is caused by the fact that the range of HSC scores of the students enrolled in Medical College is small, as only the best candidates are accepted. On the other hand, similar findings are reported from studies in non-western countries<sup>10</sup>. Therefore, students' characteristics other than school results play an important role in the academic performance. Indeed, characteristics such as motivation, commitment, personality and attitude have strong positive influence on performance at medical schools<sup>8</sup>. Interestingly, our study results do not demonstrate a correlation between HSC scores and study duration. This contrasts with the results of Cohen-Schotanus<sup>16</sup> showing a positive correlation between the high school performance and study duration. As the latter study was performed in a West-European country possibly regional, cultural and differences in the educational systems account for the apparent discrepancy, which can be explained by the following factors.

Firstly, this finding might be due to the fact that the Saudian government is providing monthly unchecked stipend irrespective of the student's performance. Secondly, they are less prone to competitive environment. Thirdly, the other nationalities are not allowed to study in these colleges. This contributes in this way that the level of study is not as high as found in other competitive environments. The students know that they will get to jobs without putting much effort. Fourthly, there is a lack of comprehensive student support and counselling system which also contributes to longer duration of study.

Finally, it was also observed that there exists a significant inverse correlation at 1% between the GPA and study duration (-22.4%). Clearly, several factors can explain this phenomenon. These could be psychological in nature and might be related with performance anxiety. For example, a student who takes the exam first time and passed into first attempt shows better performance than a student who take the exam repeatedly. Another explanation of the inverse relationship of study duration and GPA could be the fact

that, with the longer duration of study, students get sensitized resulting in relaxation. Consequently, this has a negative effect on their performance and GPA's. What are the implications of the current study for admission and teaching learning policies of Saudi and other Gulf countries medical schools? This study shows that although the HSC scores are positively correlated to the academic performance, but the relationship is moderate (.476). However, these HSC scores are only weak predictors ( $R^2$  value = .273) of academic performance during medical school. Consequently, admission solely or predominantly based on previous academic performance can be biased and presumptuous which could allow unsuitable candidates to become future doctors. Therefore, the government should consider a review of its policy regarding the impact of high school grades in the selection of medical students. However; it is unlikely that any single instrument or procedure will be a perfect selection method in the future. A mixture of selection measures covering a broad range of attributes is likely to provide the best way of selecting future doctors etc. The other important finding reveals that there is no correlation between the HSC scores and the study duration in this medical school. It denies the previous assumption that students with good pre-entry academic grades remain also good during medical studies and complete the course in shortest possible time. Study time duration is a pattern of behavior from which motivation can be inferred. That is, study duration can be considered as a motivational variable. Therefore, future research could explore factors related to the association between study time and academic performance at high school by using motivation theory as a guiding principle and framework.

**Conflict of Interest:** All the authors declare no conflict of interest

**Acknowledgements:** The authors are grateful to the Vice president of the University; Deans of colleges of medicine and admission for their support in the project especially Mr Hossam Subbah regarding the collection of data for this study.

**Address for correspondence:**

Syed Imran Mehmood, MBBS, MA, M MedEd (UK), PhD(Netherlands), Director Medical Education, Dow Institute of Health Professionals' Education, Dow University of Health Sciences.

Email: [mehmood.si@duhs.edu.pk](mailto:mehmood.si@duhs.edu.pk)

Syed Razi Muhammad, Professor, Department of Medical Education, Muhammad Medical College, Mirpurkhas.

**References:**

1. Baig LA. Predictive validity of the medical college admission criteria for academic performance; results from the four MBBS batches of Karachi Medical and Dental College. *Journal of Pakistan Medical Association* 2001; 51; 312-16.
2. Collins JP, White GR and Kennedy JA. Entry to medical school: an audit of traditional school requirements. *Medical Education* 1995; 29; 22-28.
3. El-Hezmi MAF, Tekian AD, El-Mahdy S. Performance of men and women medical students at King Saud University, Riyadh: a ten year retrospective study. *Medical Education* 1987; 21; 358-61.
4. Ferguson E, James D, Madeley L. Factors associated with success in medical school: systematic review of the literature. *British Medical Journal* 2002; 324; 952-57.
5. Hojat M, Xu G. A visitor's guide to effect sizes. *Advances in Health Sciences Education*, 2004, 9, 241-249.

6. Huda N, Dosa TI, Alam E, Agha S. Selection procedure as predictor of performance in university examination. *Journal of Pakistan Medical Association*, 2001, 51, 381-384.
7. Lipton A, Huxham GJ & Hamilton D. School results as predictors of medical school achievement. *Medical Education*, 1988, 22, 381-388.
8. Lumsden MA, Bore M, Millar K, Jack R, Powis D. Assessment of personal qualities in relation to admission to medical school. *Medical Education*, 2005, 39, 258-265.
9. McManus IC, Powis D, Wakeford R, Ferguson E, James D, Richards P. Intellectual aptitude tests and A-levels for selecting UK school leaver entrants for medical school. *British Medical Journal*, 2005, 331, 555-559.
10. McManus IC, Smithers E, Partridge P, Keeling A, Fleming PR. A levels and intelligence as predictors of medical careers in UK doctors: 20-years prospective study. *British Medical Journal*, 2003, 327, 139-42.
11. Mitchell, K.J. Traditional Predictors of Performance in Medical School. *Academic Medicine*, 1990, 65, 149-158.
12. Montague W & Odds FC. Academic selection criteria and subsequent performance. *Medical Education*, 1990, 24, 151-157.
13. Reede JY. Predictors of success in medicine. *Clinical Orthopaedics and Related Research*, 1999, 362, 72-77.
14. Reiter HI, Eva KW, Rosenfeld J, Norman GR. Multiple mini-interviews predict clerkship and licensing examination performance. *Medical Education*, 2007, 41, 378-384.
15. Rosenfeld LM, Hojat M, Veloski JJ, Blacklow RS, Goepf C. Delays in completing medical school: predictors and outcomes. *Teaching and Learning in Medicine*, 1992, 4, 162-167.
16. Schotanus JC, Muijtjens AMM, Reinders JJ, Agsteribbe J, Van Rossum JM, Van Der Vleuten CPM. The predictive validity of grade point average scores in a partial lottery medical school admission system. *Medical Education*, 2006, 40, 1012-1019.
17. Tomlinson RWS, Clack GB, Pettingale KW, Anderson J and Ryan KC. The relative role of A level chemistry, Physics and biology in the medical course. *Medical Education*, 1977, 11, 103-108.
18. Tutton P, Price M. Selection of medical students. *British Medical Journal*, 2002, 324, 1170-1171.
19. Uurlings-Strop LC, Stijnen T, Themmen APN, Splinter TAW. Selection of medical students: a controlled experiment. *Medical Education*, 2009, 43, 175-183.