Taibah University

Journal of Taibah University Medical Sciences

www.sciencedirect.com

Educational Study

The predictive value of individual admission criteria on academic performance in a Saudi medical college

Khalid R. Murshid, FRCS(C)

Department of Surgery, College of Medicine, Taibah University, Almadinah Almunawwarah, Kingdom of Saudi Arabia

Abstract *Objective:* To assess the reliability of the selection criteria used at Taibah University College of Medicine, Almadinah Almunawwarah, Kingdom of Saudi Arabia, for predicing academic performance, in order to determine those that are most reliable.

Methods: A retrospective cohort study was conducted on the 478 students in the first 4 years of a 6-year programme at the College of Medicine between February and April 2012. The variables examined were high-school grades, aptitude test scores, achievement test scores and the balanced percentage. The criterion was the college grade point average of the students at each academic level. Pearson correlation coefficient and regression analysis were used to assess the associations between scores. SPSS version 19 was used for data analysis.

Results: A significant positive relation ($p < 0.01$) was found between high-school grade and achievement test score and the college grade point average, high-school grade being the most predictive. No significant relation was found with aptitude test score.

Conclusions: The selection criteria used at Taibah University College of Medicine are variably reliable in predicting academic achievement: some should be enforced, while others might be replaced by more predictable criteria of academic outcome.

Introduction

In the Kingdom of Saudi Arabia, as is in most countries, graduates of medical schools enjoy a privileged status, both socially and financially. There is therefore strong competition for the limited places in medical schools. At Taibah University College of Medicine, only one of four applicants fulfilling the requirements for the preparatory year for the health colleges (medicine, dentistry, pharmacology and applied medical sciences) is admitted, and only one of three who complete this year are admitted to medicine. This low ratio of admission: applicant is similar to that in most medical colleges, not only in the Kingdom of Saudi Arabia but worldwide.

Corresponding author: Associate Professor of Surgery, Department of Surgery, College of Medicine, Taibah University, P.O. Box 121, Almadinah Almunawwarah 41411, Kingdom of Saudi Arabia. Tel.: +966 4 8460006; fax: +966 4 8461407.
E-mail: kmurshid57@gmail.com
Peer review under responsibility of Taibah University.

ELSEVIER | **Production and hosting by Elsevier**

The strong competition allows medical schools to be highly selective in their admissions, with the aim of selecting only those students who are most likely to complete their medical education and presumably become good doctors; it also minimizes the number of poor performers or 'strugglers', who were reported in one study to account for 15%.[1] Medical schools worldwide therefore use a number of selection criteria, some academic and some non-academic. In 2004, in an attempt to reduce diversity in selection criteria among medical schools and to ensure an evidence-based approach, the Admissions to Higher Education Steering Group in the United Kingdom warned against the use of selection methods that had not been shown to be valid and reliable.[2] The validity of an admission criterion is defined as the degree to which it predicts an applicant's performance during and after his or her undergraduate medical training, and reliability is defined as the reproducibility of the results obtained when a measurement is repeated on the same study sample.[3]

Before the turn of the century, admission to Saudi medical schools was based solely on the percentage score of the student in his or her final year in high school. With increasing popularity of medical schools in particular and of health colleges in general in the 1990s, medical schools introduced more selective admission criteria. In 2001, to ensure more reliable, valid criteria, the Ministry of Higher Education added two nationwide examinations with multiple-choice questions, the 'aptitude test' and the 'achievement test', which were administered simultaneously at multiple centres across the country under the supervision of the National Centre for Assessment in Higher Education. The aptitude test shows the deeper understanding of given reading materials and some mathematical problem-solving ability, while the achievement test assesses the accumulated scientific knowledge of the student during the 3 years of high school in chemistry, biology, physics and mathematics, as well as English.[4,5] In addition, some universities added various forms of semi-structured interviews to their selection criteria, mainly to determine the attitudes and personal attributes of an applicant, which are not covered by other criteria or tests. As interviews are resource-intensive, time-consuming and expensive (if conducted properly), they are not used in all colleges.

The ideal selection process used should be evidence-based, transparent, based on merit, legally defensible and as fair as possible. In this paper, the author analyses some of the criteria used at the Taibah University College of Medicine for their reliability as predictors of academic performance.

Materials and Methods

A retrospective cohort study was conducted on the 478 male and female undergraduates in the first 4 years of study at the College of Medicine between February and April 2012. The College has a 6-year traditional curriculum: 5 years after a preparatory year in the colleges of medicine, dentistry, pharmacology and applied medical sciences. Multiple filters are used to screen applicants: only students with an overall high-school score of at least 90% and an overall average score of at least 90% in English, physics, chemistry and biology are allowed to apply for the preparatory year. A balanced percentage is then calculated for each applicant, which consists of the high-school percentage (40%), the result of the achievement test (30%) and the score on the aptitude test (30%). Applicants then undergo a semi-structured interview, in which they are rated only as 'pass' or 'fail' and which does not contribute to the balanced percentage. Applicants who pass the interview are then listed according to their balanced percentage in descending order, and those at the top of the list are admitted to the preparatory year programme for the health colleges, depending on the available seats. Of the students admitted to the preparatory year, those who complete it are listed in descending order according to their score, and the first 60 students with medicine as their first choice are accepted into medical school. This procedure is conducted separately for male and female applicants.

I examined the high-school grade, the aptitude test score, the achievement test score and the balanced percentage to determine their predictive value for academic performance as reflected by the college grade point average. The admission interview was not included. A student's college grade point average is calculated by multiplying the student's grade in each course on a five-point scale by the number of credit hours for that course and dividing the result by the total number of credit hours taken by the student.

The data were analysed with SPSS version 19. The relation between the admission (independent) variables and the college grade point average (the dependent variable) was analysed by Pearson correlation coefficient and regression analyses, and the p value was considered significant at < 0.05.

Results

Table 1 shows the distribution of the 478 students at the time of the study according to gender and college year. The number of female students slightly outnumbered males (52.1% vs. 47.9%).

The mean college grade point average for the 249 female students was 4.1382 (standard deviation, 0.7038), and that for the 229 male students was 3.9510 (standard deviation, 0.9723) on a five-point scale.

Table 2 shows a significant positive relation ($p < 0.01$) between high-school grade, balanced percentage and achievement test score in descending order and college grade point average; there was no significant relation with aptitude test score. The strong correlations between the balanced percentage and the achievement test percentage (.867), aptitude test percentage (.735) and high-school grade (.401) are due to the fact that the balanced percentage is a composite of the other independent variables; it therefore cannot be considered a truly independent variable. To investigate the influence of high-

Table 1: Distribution of student participants by study year and gender.

Study year	No. of students			Percentage of total
	Male	Female	Total	
First	63	63	126	26.4
Second	59	64	123	25.7
Third	50	66	116	24.3
Final	57	56	113	23.6
Total	229	249	478	100.0

Table 2: Correlations between criteria and academic achievement for 478 medical students.

Criterion	College grade average (out of 5)	High-school grade (%)	Aptitude test (%)	Achievement test (%)	Balanced percentage
College grade average (out of 5)					
Pearson correlation	1	.434[**]	.039	.213[**]	.270[**]
Significance		.000	.393	.000	.000
High-school grade (%)					
Pearson correlation	.434[**]	1	.116[*]	.243[**]	.401[**]
Significance	.000		.011	.000	.000
Aptitude test (%)					
Pearson correlation	.039	.116	1	.420[**]	.735[**]
Significance	.393	.011		.000	.000
Achievement test (%)					
Pearson correlation	.213[**]	.243[**]	.420[**]	1	.867[**]
Significance	.000	.000	.000		.000
Balanced percentage					
Pearson correlation	.270[**]	.401[**]	.735[**]	.867[**]	1
Significance	.000	.000	.000	.000	

[*] Correlation is significant at the 0.05 level (two-tailed).
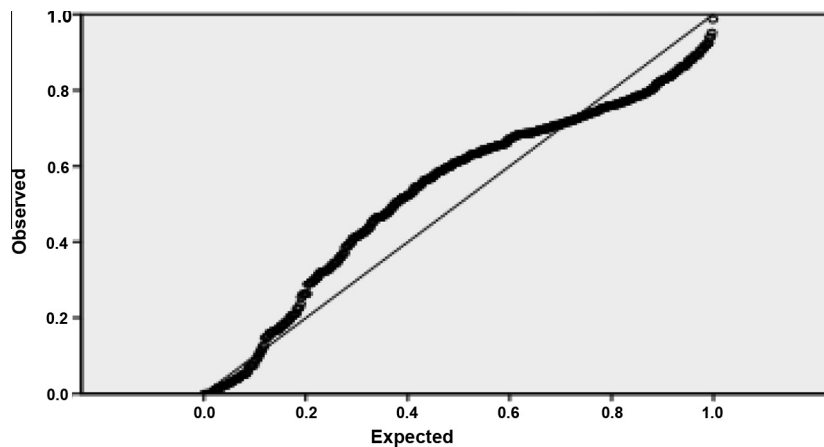[**] Correlation is significant at the 0.01 level (two-tailed).

Figure 1: Observed versus expected probability of academic success by college grade score.

school grade, aptitude test score and achievement test score without the balanced percentage, I used regression analysis. Figure 1 shows that the three independent variables accounted for 19.9 of the variance in the college grade point average. The effects of all three variables were significant at $p = 0.000$.

The results of this study indicate that high-school grade percentage and achievement test percentage are good predictors of college grade point average, while aptitude test percentage was not significant.

Discussion

The results of this study show that a student's pre-admission academic level, as reflected by the high-school grade point average and achievement test score, best predicts the student's college grade point average, the former being more strongly related. This is in contrast to the findings of Al-Rukban et al., who reported that the achievement test was the most significant predictive factor and the high-school percentage was not statistically significant.[5]

J. Benbassat and R. Baumal[3] claim that admission into medical schools is based on three premises; (1) Cognitive achievements only. (2) Other qualities in applicants with cognitive achievements above a certain threshold level. These include over 70 traits documented in the literature.[7] (3) The competence of the graduates depends solely on the quality of the teaching program at their medical school, with applicants' attributes carrying little predictive value. In the United Kingdom, medical colleges use widely similar admission criteria, academic ability being coupled with attributes such as a 'well rounded' personality, motivation for medicine, extracurricular interests and experience of teamwork and leadership skills.[8]

Dutch medical schools selected a proportion of candidates among high-school graduates through a lottery weighted for academic attainment.[9] In the United States, the requirements vary from college to college and include undergraduate grade point averages and performance in the Medical College Admissions Test (MCAT). Most colleges also conduct well-structured, validated interviews to identify one or more nonacademic characteristics. A similar approach to selection is used in Canadian medical colleges.[7] There has been a growing movement towards consideration of nonacademic personal qualities, which have been found to be just as important and influential for the learning and practice of medicine as academic ability.[10] The University of Adelaide, Australia, examined the empirical evidence for the selection of medical students and adopted a national written examination of reasoning and interaction skills, a structured oral assessment and a threshold matriculation score.[11]

The criteria for selecting students for admission to medical schools can therefore be grouped into four categories:

Academic criteria

Prior academic achievement is highly reliable and moderately valid and is also an indicator of the ability of a candidate to assimilate the large amount of knowledge involved in learning medicine.[3] Academic criteria are easy to apply; they require no further testing and do not involve the logistics of well-structured interviews. The scores achieved by the applicant in prior examinations are 'already there'. The main indicators of cognitive (academic) achievement are grade point averages, to assess knowledge of academic subjects, and the results of aptitude tests, to assess reasoning, intelligence and culturally acquired knowledge.[3,12] Cognitive criteria have repeatedly been found to predict medical school grades.[13–15] Aptitude tests include a computer-based assessment for sampling personal characteristics (CASper) required by McMaster University medical college (Canada), the Medical Colleges Admission Test (MCAT) required by North American medical colleges, the Graduate Australian Medical School Admissions Test (GAMSAT)[16] and the Saudi Arabian aptitude test. In the present study, the aptitude test was not predictive of the college grade point average. Therefore, the content of this test should be improved, it should be replaced with another assessment tool, or its validity in predicting clinical competence rather than college grade point average should be assessed.

Academic, non-scientific criteria

Although these criteria are academic, they have little relation to the science of medicine. They are used by medical colleges to which graduates of undergraduate programmes other than the sciences can be admitted, such as the McMaster, McGill and Mount Sinai schools of medicine. The rationale for using these criteria is that they indicate that the student is capable of scoring high grades, or in other words is able to learn.

Non-academic professional criteria

A number of non-academic criteria (neither the number nor the nature of which is agreed upon) are also important in forming a 'good' doctor. The literature reports over 70 such criteria,[7] including leadership qualities, communication skills, service to the community, conscientiousness and empathy. Extracurricular activities, work experience and an autobiographical essay describing their background, decision-making, scientific problem-solving, verbal reasoning, writing ability, interpersonal relationships, reliability, self-directed learning and motivation for pursuing a medical career have been included in such criteria. These are generally considered to be non-cognitive criteria, although some may have a cognitive basis and may therefore overlap with other criteria. Some are assessed in aptitude tests, while others are sought during interviews. The reliability and validity of non-cognitive criteria are, however, low or uncertain.[3]

Nonacademic, nonscientific, nonprofessional criteria

As strange as it may seem, some medical colleges apply criteria that are neither academic nor related to the science of medicine and do not indicate professional capability. In The Netherlands, selection was done in a national lottery approach from 1972.[17] Failure to gain admission on the basis of low past academic achievements or even a lottery is probably more acceptable to applicants than rejection after an interview or a ruling that they lack certain non-cognitive traits,[3] which can be humiliating and affect an applicant's self-esteem.[18]

Interviews are sometimes used to select students for admission on the basis of personal characteristics, in particular personality, reasoning and communication skills. Most studies have not found that admission interviews predict college grade point averages,[14,19–21] and some indicate that their inherently subjective nature may reduce reliability.[14] Other studies, however, have shown that high scores on admission interviews predict good communication skills,[22] performance on tests of diagnostic reasoning,[19] achievement of honours[23] and letters of recommendation on graduation,[13] while low scores were associated with a higher rate of withdrawal from medical school.[23] Unstructured interviews, which are subjective, will be biased. Kreiter et al.[24] questioned the fairness of interviews as an admission criterion after a review that showed that they had low to moderate reliability. One type of interview with good reliability and little bias is the 'multiple mini-interview' used at McMaster University;[14,25] however, its reliability and validity depends on how it is structured and conducted.

In general, grade point averages are readily available, highly reliable and have been consistently found to predict medical school grades, with good correlation coefficients.[13,26] Interviews add little to the selection process,[13] as they are neither as valid nor as reliable; in addition, they require time, money and manpower.[6] Wilkinson et al.[6] found that the grade point average was most strongly correlated with academic performance; the association was strongest in the earlier years of college and waned between year 1 and year 4. They also found that interview scores were associated with increasing performance between year 1 and year 4.

Consequently, grade point averages and other measures of academic achievement are used by all medical schools, either as a threshold requirement or as a criterion for ranking applicants for admission.[3] Most medical schools use a combination of prior academic performance (grade point average), performance on a specific test (to assess certain reasoning and decision-making abilities) and an interview (to reveal charac-

teristics not shown by other methods). There is, however, little consistency in the combination of, or the weight given to, each component in decision-making.[8,16]

At Taibah University College of Medicine, we apply a combination of selection criteria (in the form of a balanced percentage), in addition to a semi-structured interview for inclusion or exclusion. Although there is evidence that the 'multiple mini-interview' predicts future clinical skill,[14] the interview was not included, for several reasons. The first is that our semi-structured interview is not properly structured to eliminate bias and to guarantee objectivity. The second is the logistics involved, in terms of financial, human and temporal resources required to conduct a proper 'multiple mini-interview' for each student. The third is that the objective was to determine the relations between the different criteria and college grade point average scores, which have been shown to be more strongly related to academic criteria than interviews, which better predict clinical practice after graduation.[6,13,14]

It has been shown that the combined predictive validity of admission criteria was higher than that of each of the criteria alone.[27] This study had mixed results regarding the balanced percentage, which is a combination of admission criteria: it correlated significantly (stronger than the achievement test score, but less strongly than the high school grade point average) with the college grade point average.

A review of medical schools in the United Kingdom concluded that pure measures of reasoning ability are less predictive of academic performance than measures of knowledge, such as A levels.[28] Most studies on the predictive validity of admission criteria focus on the correspondence with college grade point averages or with performance on licensing examinations and as interns.[29–32] Burch raised the important question "Are we measuring what we want to measure?"[33] If our objective is for students to score high grade point averages in medical school, then what we are doing is correct; however, if we consider that most of the evidence shows that pre-admission academic criteria can predict only college grade point averages, which may differ from clinical performance after graduation, and our objective is to graduate competent physicians, then we agree with Burch that we need early predictors (pre-admission if possible) of clinical competence.[33] This may not be an easy task. Groves,[34] in a study of clinical reasoning, found that a hallmark of expert clinical performance is skill in clinical reasoning and that clinical reasoning develops throughout undergraduate medical training.[34] It is therefore not a criterion that is available at the time of admission. In another study, however, Groves et al.[19] found that performance in a pre-admission interview was significantly related to the development of clinical reasoning skills in medical school, which may tilt the balance in favour of structured 'multiple mini-interviews', with emphasis on seeking those elements of importance in the development of clinical reasoning. This emphasis might improve the outcome, provided that the interview remains objective and unbiased.

Limitations of the study

Although all the students were included in the study, the number (478) is still too small to make definite recommendations. In addition, the study included only students up to the fourth year of college and not those in their final 2 years. The results therefore do not reflect the effects of the selection criteria near graduation, which may be of more interest to both medical educators and health care providers, as the final years involve more clinical practice. In addition, my results represent only one undergraduate medical school. To my knowledge, all except one medical school in the Kingdom of Saudi Arabia are undergraduate schools, and all are likely to use the same criteria (high-school grade point average, achievement test score, aptitude test score, with or without an interview of some kind). While a nationwide study would give more useful results, it would be difficult to conduct, simply because nearly every school has its own selection policy with regard to the weight given to the different criteria, making comparisons difficult. Another factor is the difference in the curricula used at medical schools, ranging from the purely traditional curriculum used at Taibah University College of Medicine to a purely problem-based curriculum in some colleges, with various hybrid and system-based curricula in between. The use of a traditional curriculum at Taibah University (the format closest to the teaching system used in high-school) could explain the results of this study, which shows that high-school grades and achievement tests are most representative of college grade point averages. Nonetheless, the present study provides some insight into the selection criteria commonly applied in most medical colleges worldwide and those used to differing degrees in Saudi medical colleges and highlights points that might have to be studied further. This may affect the way the balanced percentage is calculated or may result in replacing the balanced percentage by more reliable, valid criteria.

Conlusion

Some of the admission criteria used currently at Taibah University College of Medicine provide better insight into the future academic performance of students than others. These criteria should be further investigated and evaluated. If our objective is to select the students most likely to score the highest college grade point averages, the high-school grades and achievement test scores should carry more weight in our selection of students. If, however, our aim is to select those candidates who will make better doctors, a threshold score based on the results of achievement tests and high-school grades should be coupled with a structured 'multiple mini-interview' with emphasis on those elements of importance in the development of clinical reasoning, provided the interviews remain objective and unbiased and include a clear indication of the keenness of the candidate to join the medical profession.

Author details

The author held the positions of Vice-Dean (2003–2005) and then Dean of Taibah University College of Medicine (2005–2009).

thank Professor Salman Yousuf Guraya for his statistical assistance and analysis of data as well his valued editorial suggestions.

References

1. Yates J, James D. Predicting the 'strugglers': a case–control study of students at Nottingham University Medical School. **BMJ 2006**; 332(7548): 1009–1013.
2. Admissions to Higher Education Steering Group (2007). In: *Fair admissions to higher education: recommendations for good practice*. Nottingham: Department for Education and Skills Publications. < http://www.admissions-review.org.uk >; 2004 [accessed July, 2012].
3. Benbassat J, Baumal R. Uncertainties in the selection of applicants for medical school. **Adv Health Sci Educ Theory Pract 2007**; 12(4): 509–521.
4. National Center for Assessment in Higher Education. *The aptitude test (online)*. < http://www.qeyas.com/Qiyas/info/Default.aspx >; [accessed July, 2012].
5. Al-Rukban MO, Munshi FM, Abdulghani HM, Al-Hoqail I. The ability of the preadmission criteria to predict performance in a Saudi medical school. **Saudi Med J 2010**; 31(5): 179–183.
6. Wilkinson D et al. Medical school selection criteria and the prediction of academic performance: evidence leading to change in policy and practice at the University of Queensland. **Med J Aust 2008**; 188(6): 349–354.
7. Albanese MA, Snow MH, Skochelak SE, Huggett KN, Farrell PM. Assessing personal qualities in medical school admissions. **Acad Med 2003**; 78: 313–321.
8. Parry J et al. Admissions processes for 5 year medical courses at English schools: review. **BMJ 2006**; 332: 1005–1009.
9. Coebergh J. Dutch medical schools abandon selection for lottery system for places. **Student BMJ 2003**; 11: 138.
10. Searle J, McHarg J. Selection for medical school: just pick the right students and the rest is easy! **Med Educ 2003**; 37: 458–463.
11. Turnbull D, Buckley P, Robinson JS, Mather G, Leahy C, Marley J. Increasing the evidence base for selection for undergraduate medicine: four case studies investigating process and interim outcomes. **Med Educ 2003**; 37: 1115–1120.
12. McManus IC, Iqbal S, Chandrarajan A, Ferguson E, Leaviss J. Unhappiness and dissatisfaction in doctors cannot be predicted by selectors from medical school application forms: a prospective, longitudinal study. **BMC Med Educ 2005**; 5: 38.
13. Ferguson E, James D, Madeley L. Factors associated with success in medical school: systematic review of the literature. **BMJ 2002**; 324(7343): 952–957.
14. Eva KW, Rosenfeld J, Reiter HI, Norman GR. An admissions OSCE: the multiple mini interview. **Med Educ 2004**; 38(3): 314–326.
15. Julian E. Validity of the medical college admission test for predicting medical school performance. **Acad Med 2005**; 80: 910–917.
16. Australian Council for Educational Research. *GAMSAT Graduate Australian Medical School Admissions Test information booklet 2008*. Melbourne < http://www.gamsat.acer.edu.au/images/info-book/GAMSAT_InfoBook.pdf >; 2007 [accessed July 2012].
17. ten Cate O, Smal K. Educational assessment center techniques for entrance selection in medical school. **Acad Med 2002**; 77(7): 737.
18. Norman G. The morality of medical school admissions. **Adv Health Sci Educ Theory Pract 2004**; 9(2): 79–82.
19. Groves M, O'Rourke P, Alexander H. The association between student characteristics and the development of clinical reasoning in a graduate-entry, PBL medical programme. **Med Teach 2003**; 25: 626–631.
20. Smith SR. Medical school and residency performances of students admitted with and without an admission interview. **Acad Med 1991**; 66(8): 474–476.
21. Basco WT, Gilbert GE, Chessman AW, Blue AV. The ability of a medical school admission process to predict clinical performance and patients' satisfaction. **Acad Med 2000**; 75(7): 743–747.
22. Kulatunga-Moruzi C, Norman GR. Validity of admissions measures in predicting performance outcomes: the contribution of cognitive and non-cognitive dimensions. **Teach Learn Med 2002**; 14(1): 34–42.
23. Powis DA, Waring C, Bristow T, O'Connell DL. The structured interview as a tool for predicting premature withdrawal from medical school. **Aust N Z J Med 1992**; 22(6): 692–698.
24. Kreiter CD, Yin P, Solow C, Brennan RL. Investigating the reliability of the medical school admissions interview. **Adv Health Sci Educ Theory Pract 2004**; 9(2): 147–159.
25. Eva KW, Reiter HI, Rosenfeld J, Norman GR. The relationship between interviewers' characteristics and ratings assigned during a multiple mini-interview. **Acad Med 2004**; 79(6): 602–609.
26. McManus IC, Smithers E, Partrige P, Keeling A, Fleming PR. A levels and aptitude as predictors of medical careers in UK doctors: a 20 year prospective study. **BMJ 2003**; 327(7407): 139–142.
27. Ferguson E, James D, O'Hehir F, Sanders A, McManus IC. Pilot study of the roles of personality, references, and personal statements in relation to performance over the 5 years of a medical degree. **BMJ 2003**; 326(7386): 429–432.
28. McManus IC, Powis DA, Wakeford R, Ferguson E, James D, Richards P. Intellectual aptitude tests and A levels for selecting UK school leaver entrants for medical school. **BMJ 2005**; 331(7516): 555–559.
29. Veloski JJ, Callahan CA, Xu G, Hojat M, Nash DB. Prediction of students' performances on licensing examinations using age, race, sex, undergraduate grade point averages, and MCAT scores. **Acad Med 2000**; 75(10): S28–S30.
30. Blue AV, Gilbert GE, Elam CL, Basco Jr WT. Does institutional selectivity aid in the prediction of medical school performance? **Acad Med 2000**; 75(Suppl. 10): S31–S33.
31. de Clercq L, Pearson S, Rolfe I. The relationship between previous tertiary education and course performance in first year medical students at Newcastle University. **Aust Educ Health (Abingdon) 2001**; 14: 417–426.
32. Grey MR, Pearson SA, Rolfe IE, Kay FJ, Powis DA. How do Australian doctors with different pre-medical school backgrounds perform as interns? **Educ Health (Abingdon) 2001**; 14: 87–96.
33. Burch VC. Medical school admissions: where to next? **Adv Health Sci Educ Theory Pract 2009**; 14(2): 153–157.
34. Groves M. The clinical reasoning process: a study of its development in medical students. PhD thesis. Brisbane: University of Queensland; 2002.