**Introduction** Performance in an admission test and carefully conducted, structured interview provides a uniform basis for the assessment of applicants prepared in different systems of education for admission to an institute of higher professional learning. We studied the predictability of the system of education followed by the students prior to entrance into the Medical College, the admission test scores, and interview ratings on performance after five trimesters at the Aga Khan University Medical College.

**Method** A cohort of 374 medical students who were admitted during 1989–1994, were considered. The associations between the admission test score, interview ratings, system of education, and the scores obtained for anatomy, physiology, biochemistry and community health sciences examinations held after five trimesters were analysed using appropriate statistical procedures.

**Results** Interview ratings were associated with the scores in Physiology but not other subjects. The chief finding of this study was the association between the system of education and performance in both the admission test and the examination after five trimesters. Students who followed the British school curricula for 13 years scored significantly higher than those who followed the 12 years of the Pakistani system. When controlled for the admission test score, the difference in mean scores of the two groups was still evident for two subjects; community health sciences and physiology.

**Conclusion** We believe that the evidence indicates differences in learning methods inculcated by the system of education prior to entry into the Medical College, notwithstanding the 1-year difference in duration of education.

**Keywords** College admission test, *statistics; educational, measurements, *standards; education, medical, undergraduate; Great Britain; learning; Pakistan.

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individuals whose academic achievements are not in the top 1–2% but who have unusual personal qualities and track records which will make them excellent doctors. Therefore, it has been strongly suggested that assessments of the academic ability for admission should be combined with those of personal qualities.\textsuperscript{1,2,11}

Medical schools in North America usually consider the undergraduate grade point average (GPA) and the medical college admission test (MCAT) scores to identify candidates for further assessment by interview. Colliver et al.\textsuperscript{3} established the validity of the MCAT and the undergraduate GPA as the main predictors of students’ performance both in clinical and basic science courses.

The Aga Khan University Medical College admitted its first batch of students in 1983. Currently, it has an annual enrolment capacity of approximately 80. These students are developed in a 5-year curriculum towards 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 health care appropriate to the needs of urban and rural populations of Pakistan and similar developing nations. The criteria for admission to the Medical College are merit and potential for leadership.

Students from all over the world can apply but the majority of applicants are from Pakistan. Approximately 5% of applicants are from other parts of the world, particularly Canada and the USA. Most applicants from Pakistan follow the national system of education, hereafter referred to as the Pakistani system. The other established system of education is the British. Students educated in the British system complete the General Certificate of Education, Ordinary Level after 11 years of school followed by 2 years for the Advanced Level. Students in the Pakistani system complete 10 years of schooling and take the Secondary School Certificate (SSC), followed by 2 years in a college of intermediate education for the Higher Secondary Certificate (HSC). However, a mix of Pakistani and British systems is also possible. In the rest of this paper we refer to this third group as OHS. The OHS group completes the Ordinary level in the British system and then study for 2 years in the Pakistani system for the HSC. It is important to note that the students from the British system of education and the OHS group have a total of 13 years of education before applying to Aga Khan University Medical College, an extra year compared with those educated wholly in the Pakistani system.

The admission procedure at Aga Khan University consists of two stages. First, the applicants living in Pakistan are required to take an admission test administered by the University irrespective of their education. The questions test their application of knowledge based on the syllabi for the HSC in chemistry, biology and physics and SSC in mathematics. The test for English assesses comprehension of written language. The total score in the five components of this admission test is used to short-list the applicants for interviews. MCAT or SAT test scores are used to short-list applicants from American and other systems of education who are unable to take the Aga Khan University admission test.

Each short-listed applicant is interviewed separately by two faculty members of the Medical College, each for 30 min. The purpose of the interview is to assess non-academic attributes such as independent thinking, interest in issues of health, maturity, social and cultural awareness, and potential for leadership. When the interviews are completed, all information on each applicant is presented to an Admission Committee consisting of 11 members. After hearing the comments of the interviewers and considering the admission test scores and other academic achievements of a candidate, each member gives a rating from 1 to 4, indicating their recommendation for admission. The sum of the rating scores, expressed as a percentage, is the final rank-ordered list for admission.

In 1996, the University conducted a comprehensive review of its admission procedure based on the available information collected by the Students Affairs office. The review revealed several interesting findings. This
Predictability of medical students' performance • M H Rahbar et al.

Methods
A cohort of 374 out of a total of 398 medical students admitted between 1989 and 1994, were considered in this study. The scores were available for all five components of the Aga Khan University admission test: mathematics, chemistry, physics, biology and English. The total score expressed as a percentage was used for short listing candidates for the interview process. The threshold for the short list was the same for all students regardless of the system of education, but varied from year to year.

All interviewers, including those with considerable experience, participate in a 1-day workshop conducted by the Office of Student Affairs. The interviewers are briefed and trained to derive meaningful information that is relevant to the characteristics defined in a checklist, to prepare a written report on each characteristic, and to derive an overall assessment. In addition, they learn about common pitfalls, sensitivities and limitations of interviews.

All short-listed candidates are randomly assigned to two interviewers. In order to avoid bias, interviewers are not given any information about scholastic performance and admission test scores. Interviewers assess non-academic attributes such as independent thinking, interest in the issues of health, maturity, social and cultural awareness, and potential for leadership. The interviewer’s rating is given by the following letter grades: A (excellent); B (above average); C (average); D (below average). Based on these interview ratings, candidates are categorized into four groups, as follows: AA; AB; BB; and others. For example, AB represents an assessment in which one of the interviewers has rated A and the other has rated B.

The performance of the students in the components of the MBBS Part 1 examination, which is conducted after five trimesters, was considered as the outcome variable. The five subjects tested are: anatomy, biochemistry, physiology, community health sciences and Islamic and Pakistan studies. The courses covered during the first five trimesters in community health sciences include: health & community development, biostatistics, epidemiology, primary health care technologies, and occupational & environmental health. Experience had shown that the performance of most students who dropped out of the programme had failed in at least one component of this examination. It is important to note that a minimum aggregate score of 55% for the five subjects is required for progression, although the minimum passing score for each subject is 50%.

The $\chi^2$-test and general linear models, including analysis of variance (ANOVA) and covariance (ANCOVA), were applied. The main objective of the analysis was to determine whether performance in the admission test, interview ratings and the system of education prior to admission in the medical college predict performance in any component of the MBBS Part 1 examination. In addition, the analysis of covariance was performed to control for the baseline differences (admission test scores) whilst examining scores in the MBBS Part 1. We especially investigated significant differences in medical school performance among the three groups, derived from the different systems of education. All the statistical tests were performed at a 0.05 level of significance using the statistical package SAS.5

Results
Of the 374 students considered in this study, approximately 50% were from the Pakistani system of education, 23% from the British system, 21% from a mix of the two systems (OHS). The remaining 6% from North American and other systems were not considered because admission test scores were not available. Hence, only three groups of students were studied in respect of their educational preparation before entry to the Medical College.

The overall percentage of female students in our study was approximately 45%. This percentage was 41% for students from Pakistani system; 47.6% for students from British system, and 52.9% for the students from the OHS group. However, the association between gender and the system of was not considered statistically significant ($\chi^2 = 3.67; P = 0.16$). In addition, there was no significant difference between the performance of male and female students with respect to the total admission test scores ($t = 0.97; P = 0.33$). As gender could not confound our results, in the remainder of this paper, the data are combined for both genders.

Table 1 shows the total number of applicants, the number of short-listed applicants who were interviewed, and the number admitted between 1989 and 1994. It is noteworthy that approximately 2% of the applicants from the Pakistani system of education were admitted; the percentage of applicants admitted from the British system was 18%, and from the OHS group, 10%.

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Table 2 shows the means and standard deviations of scores, stratified according to systems of education, for the five components of the admission test: biology, chemistry, physics, mathematics and English. Mean scores of students from the Pakistani system were significantly lower than the British in all five subjects. In addition, the mean scores of the students from the Pakistani system were significantly lower than the OHS group in all subjects except biology. However, the mean scores of the OHS group were significantly lower than the students from the British system in biology, chemistry, and mathematics. In Tables 2, 4 and 5, the superscript letters a, b, and c are used to indicate the pair-wise comparisons of mean scores. Significant differences are identified by the same letter. For example, for biology, the letter ‘a’ in the columns for Pakistani and British systems of education indicates a significant difference between the two mean scores.

The distribution of interview ratings, stratified by the system of education, is presented in Table 3. The $\chi^2$-test of independence showed no significant association between interview ratings and the system of education ($\chi^2 = 0.84; P = 0.90$).

Table 4 shows the mean scores and standard deviations for the five subjects tested in the MBBS Part 1 examination, stratified by system of education. The mean scores in anatomy, biochemistry, physiology and community health sciences of students from the British system are significantly higher than the mean scores of students from the Pakistani system. The mean score in physiology of the students from the Pakistani system is significantly lower than the OHS group. The mean
Predictability of medical students’ performance

The correlation coefficients between the total score of the admission test and each of the five subjects of the MBBS Part 1 were calculated for all three groups of students. These coefficients ranged from 0.21 to 0.41 and were statistically significant for physiology, anatomy, biochemistry, and community health sciences. The score in physiology had the highest correlation with the total admission test score \( (r = 0.41; P = 0.7) \). However, correlation between the score in Islamic & Pakistan studies and the total admission test score was not statistically significant \( (r = 0.04; P = 0.48) \).

The relationship between interview ratings and scores in five subjects of the MBBS Part 1 examination is given in Table 5. Interview ratings do not have a significant association with subject scores in the MBBS Part 1 examination, except for physiology \( (F = 4.3; P = 0.01) \).

Finally, ANCOVA was used to test whether any significant differences existed in subject scores of the MBBS Part 1 among the three groups of students, in respect of the systems of education, when the data of students who had achieved the same total scores in the admission test were considered. Having controlled for the baseline differences in the admission test scores, the differences between the Pakistani and British systems of education remained statistically significant for community health sciences \( (F = 15.5; P = 0.0001) \) and physiology \( (F = 2.8; P = 0.09) \), but not for anatomy, biochemistry and Islamic and Pakistan studies.

Discussion

The purpose of any admission procedure in a medical school is to identify individuals who will make suitable doctors. The characteristics tested for selection are intended to be predictive of future performance in the medical school and subsequent practice. The quality of assessment depends on the precision and appropriateness of measurements.1

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### Table 3

<table>
<thead>
<tr>
<th>Interview ratings</th>
<th>Number of candidates categorized according to system of education</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pakistani ( n = 199 )</td>
</tr>
<tr>
<td>AA</td>
<td>30.6</td>
</tr>
<tr>
<td>AB</td>
<td>40.2</td>
</tr>
<tr>
<td>BB</td>
<td>14.6</td>
</tr>
<tr>
<td>Others</td>
<td>14.6</td>
</tr>
</tbody>
</table>

---

### Table 4

<table>
<thead>
<tr>
<th>MBBS Part 1 subjects</th>
<th>System of education</th>
<th>( P )-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pakistani ( n = 199 )</td>
<td>Mixed (OHS) ( n = 85 )</td>
</tr>
<tr>
<td>Anatomy</td>
<td>62.0 (8.8)(^{a})</td>
<td>63.1 (7.3)(^{a})</td>
</tr>
<tr>
<td>Bio-chemistry</td>
<td>65.2 (8.7)(^{a})</td>
<td>65.7 (7.8)(^{b})</td>
</tr>
<tr>
<td>Physiology</td>
<td>61.8 (7.4)(^{a,c})</td>
<td>63.9 (7.4)(^{b,c})</td>
</tr>
<tr>
<td>Community Health Sciences</td>
<td>63.1 (7.5)(^{a})</td>
<td>64.6 (5.8)(^{b})</td>
</tr>
<tr>
<td>Islamic and Pakistan Studies</td>
<td>63.9 (9.3)</td>
<td>64.9 (7.6)</td>
</tr>
</tbody>
</table>

\(^{1}\)Unadjusted \( F \) ratio = 10.04; \( F \) ratio (adjusted for total admission test score = 0.19 \( (P = 0.66) \); \(^{2}\)Unadjusted \( F \) ratio = 9.30; \( F \) ratio (adjusted for total admission test score) = 0.29 \( (P = 0.59) \); \(^{3}\)Unadjusted \( F \) ratio = 42.39; \( F \) ratio (adjusted for total admission test score) = 2.76 \( (P = 0.09) \); \(^{4}\)Unadjusted \( F \) ratio = 66.23; \( F \) ratio (adjusted for total admission test score) = 15.51 \( (P = 0.0001) \); \(^{5}\)Unadjusted \( F \) ratio = 0.10; \( F \) ratio (adjusted for total admission test score) = 0.08 \( (P = 0.77) \).

\( a,b,c \) Indicate the significant differences in pair-wise comparisons of mean scores. Presence of the same letter in the columns for two systems of education indicate a significant difference between the mean scores.
Different medical schools provide a variety of educational experiences in terms of content and style. Some programmes will be more effective with certain types of student, because of their academic background, learning styles, or personal motivation and interests. The ultimate goal therefore is to match applicants in terms of their skills, attitudes, interests and aspirations, with courses of study in which they are likely to be successful. The principles of a selection procedure should be clear, equitable and valid. Medical schools should design admission criteria which address both academic and non-scholastic characteristics, such as social commitment. Assessment techniques should be studied in every medical school for their validity in identifying the necessary non-cognitive qualities (World Federation for Medical Education, 1994). The admission procedure at Aga Khan University is based on merit and has no provision for special categories or privileged status.

Our results show that the admission test (total score) predicts scholastic performance in the first five trimesters of undergraduate medical education. This is consistent with studies which demonstrated the predictability of success in medical school based on academic ability, for example at school or college. However, others have shown that there is only a modest correlation between prior academic achievement and success in medical school. In our study we have observed a significant association between the admission test scores and the subject scores in the MBBS Part 1 examination, with the exception of Islamic and Pakistan studies.

An important finding of our study is the association between the system of education and academic ability both prior to admission, as judged by the total score in the admission test, and in the MBBS Part 1 examination. Students from the British system of education and the OHS group tend to perform better than their counterparts from the Pakistani system of education. The observed differences could be attributed to either the system of education or the fact that students from the British system of education and OHS group become eligible for matriculation after a total of 13 years of education, while students from the Pakistani system become eligible after 12 years.

The results obtained from ANCOVA provide further insight into the relationship between the system of education and the scores in the MBBS Part 1 examination, when controlled for the baseline differences in the admission test scores. The results indicate that the system of education has an effect on the scores in community health sciences and physiology but not in anatomy, biochemistry and Islamic & Pakistan studies. Regarding evidence for the influence of the system of education on academic ability before admission, as judged by performance in the admission test, students from the British system had significantly higher mean scores than the OHS group in biology, chemistry and mathematics. Taken together, these observations indicate that preparation for learning in Medical College is acquired more effectively during 13 years in the British system of education than either the Pakistani system or the combination (consisting of 11 years in the British system and the last 2 years in the Pakistani system). Moreover, the difference between the performance of students from the Pakistani system and the OHS group in both the admission test and the MBBS Part 1 indicates better preparation for learning during the first 11 years of education in the British system.

### Table 5 Performance of students in MBBS Part 1 examination, categorized according to interview ratings

<table>
<thead>
<tr>
<th>MBBS Part 1 subjects</th>
<th>AA ($n = 111$)</th>
<th>AB ($n = 151$)</th>
<th>BB ($n = 59$)</th>
<th>Others ($n = 53$)</th>
<th>$P$-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (STD)</td>
<td>Mean (STD)</td>
<td>Mean (STD)</td>
<td>Mean (STD)</td>
<td></td>
</tr>
<tr>
<td>Anatomy</td>
<td>62.3 (7.7)</td>
<td>62.6 (8.6)</td>
<td>63.4 (7.7)</td>
<td>64.9 (7.5)</td>
<td>0.11(^1)</td>
</tr>
<tr>
<td>Biochemistry</td>
<td>65.1 (8.4)(^{a,b,c})</td>
<td>66.4 (7.8)</td>
<td>66.3 (8.4)</td>
<td>67.1 (8.9)</td>
<td>0.42</td>
</tr>
<tr>
<td>Physiology</td>
<td>62.0 (7.1)(^{a,b,c})</td>
<td>63.8 (6.8)</td>
<td>64.7 (8.6)(^b)</td>
<td>65.6 (8.0)(^b)</td>
<td>0.01(^3)</td>
</tr>
<tr>
<td>Community Health Sciences</td>
<td>64.5 (5.4)</td>
<td>64.6 (8.3)</td>
<td>64.9 (7.1)</td>
<td>64.7 (6.6)</td>
<td>1.0(^4)</td>
</tr>
<tr>
<td>Islamic and Pakistan Studies</td>
<td>64.9 (7.3)</td>
<td>63.7 (9.6)</td>
<td>64.0 (8.9)</td>
<td>64.7 (7.3)</td>
<td>0.7(^5)</td>
</tr>
</tbody>
</table>

\(^{1}\text{Unadjusted } F \text{ ratio} = 2.0;^{2}\text{Unadjusted } F \text{ ratio} = 1.1;^{3}\text{Unadjusted } F \text{ ratio} = 4.3;^{4}\text{Unadjusted } F \text{ ratio} = 0.5;^{5}\text{Unadjusted } F \text{ ratio} = 0.5.\) 
\(^{a,b,c}\text{Indicate the significant differences in pair-wise comparisons of mean scores. Presence of the same letter in the columns for two systems of education indicate a significant difference between the mean scores.}\)
The fact that the differences in scores of some subjects can be related to the system of education after five trimesters in the Medical College indicates a relationship with the mode of learning, which is also reflected in the differences in scores of the admission test. This inference is supported by the lack of relationship between the scores in Islamic & Pakistan studies and either the admission test or the system of education. This is because the chief requirement for the examination is memorization and recall, although the course is concerned with broad social and ethical considerations.

It was also observed that interview ratings are not related to the scholastic performance of students in the MBBS Part 1 examination, except in physiology. The findings that performance on the admission test is a better predictor of performance on MBBS part 1 examination than interview ratings are expected because of format and similarities. The interview ratings can probably more closely predict clinical competence areas such as interpersonal relationships, empathy, compassion and other aspects of clinical performance which are different from the scholastic achievements.

Shaw et al. (1995) showed that gender influenced interview ratings. However, in our study such association was not considered statistically significant. This is not surprising as the criteria for admission to the Medical College at Aga Khan University are merit and does not allow discrimination against gender, race, religion, etc.

Finally, it is important to note that the students who were admitted from the Pakistani system were highly selected among their own group (top 1–2%), compared to those from the British system (top 17–18% of their own group). This indicates that the gap between the two groups could have been much wider than reported in this paper if similar top ranks were selected from each group. This will further strengthen the association between the system of education and the performance in some of the subjects in the MBBS Part 1 examination.

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Contributors

MHR is the lead author for this original research paper. With the other authors, he conceived, tested and analysed the research hypotheses. CV reviewed and revised the manuscript. FS conducted the data analyses under the supervision of MHR, assisted in the literature search and co-wrote the initial draft. AAZ and LA reviewed the paper and provided feedback.

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