

The influence of admission qualifications on the performance of first and second year medical students at the International Medical University

Ammu Kutty Radhakrishnan¹, Nagarajah Lee², Mei-Ling Young³

Background: Medical schools have long been concerned with establishing a suitable process of admission. The criteria used to select students have traditionally focussed on high academic achievement.

Method: The International Medical University (IMU) accepts students from a wide range of pre-university entry qualifications for admission into the medical programme. The criteria for the various pre-university entry qualifications used by the IMU were agreed and accepted by the IMU Academic Council (AC), which consist of deans of the IMU's partner medical schools (PMS). In this study, the various entry qualifications were first grouped into five categories based on the educational pedagogy. Then, this was aligned with the entry qualification data of all students who had been admitted into the IMU medical programme for the period of December 1993 to March 2000. During this period 1,281 students were enrolled into the IMU medical programme. The relationship between the five groups of pre-university entry qualifications and the students' academic achievement in three end-of-semester (EOS) examinations namely EOS 1, EOS 3, and EOS 5 were analysed.

Results: Students with better grades in their pre-university examinations showed better performance in their EOS examinations, regardless of the subjects that they took at the pre-university level. Cluster analysis revealed that students who came in with certain pre-university qualifications generally performed poorly than the more conventional qualifications. However, after their first year in medical school, there were no significant differences in the clustering of the students.

Conclusion: Students with better grades in their pre-university examinations showed better performance in their EOS examinations, regardless of the science subjects that they took at the pre-university level.

Key words: pre-university, entry qualifications, examinations, criteria for entry

Introduction

Entry into academic programmes in most tertiary education institutions are normally based on the academic performance of the students. Most of the potential candidates sit for an accredited and well-recognised pre-university examination that meets the criteria of most academic courses at the tertiary level. Although academic excellence has been always given the precedence as selection criteria, we cannot deny that there are other important characteristics apart from academic excellence that may contribute to the success of students.^{1,2} However, due the lack of better selection methods, most tertiary education institutions prefer to use academic qualifications as the main student selection criteria. Hence, it is perceived that academic qualification provides the most objective and fair method to fairly select the best students amongst the applicants.

The selection committees in most medical schools have been concerned with establishing suitable criteria of admission into their medical programme. Most universities would agree that the criteria used to select students for the medical programme needs to be effective in predicting competent performance during the course and also after graduation.¹⁻⁵ Most courses at tertiary level would have a minimum academic qualification set as the entry criteria. However, just having the minimum academic qualification will not guarantee an applicant a place in a course, especially if the demand is greater than the supply, i.e. there are more applicants than available seats. This is usually the typical scene in medical programmes all over the world. Thus, the normal procedure of selecting students to be admitted into the medical course has been high academic achievements.⁶⁻⁸ This policy is based on the assumption that there is a strong relationship between academic ability and success in medical school examinations.^{9,10}

IeJSME 2012 6(2): 10-17

¹Pathology Division, Faculty of Medicine and Health Sciences, International Medical University, 126, Jalan 19/155B, Bukit Jalil, 57000 Kuala Lumpur, MALAYSIA

²Center for Graduate Studies, Open University Malaysia, Kuala Lumpur, MALAYSIA

³Chancellery, International Medical University, 126, Jalan 19/155B, Bukit Jalil, 57000 Kuala Lumpur, MALAYSIA

Address for Correspondence:

Professor Ammu Kutty Radhakrishnan, Professor, Pathology Division, Faculty of Medicine and Health, International Medical University, No. 126, Jalan Jalil Perkasa 19, Bukit Jalil, 57000 Kuala Lumpur, MALAYSIA
Email: ammu_radhakrishnan@imu.edu.my

There has been a move by medical schools to shift away from the traditional criteria and use a more diverse method such as admitting students who have taken subjects in humanities, more mature students (e.g. graduates), adding extra aptitude exams as well as interviews.^{1,4,6,11,12} Several public medical schools in the developed countries are also increasing their intake to admit more full-fee paying overseas students, to diversify student intake and to provide additional funding for their medical programme. The Malaysian public medical schools use a few criteria to select students into their medical programme. The main criterion is high academic achievement. Other factors include involvement in sports and other extra-curricular activities. Malaysian students who wish to study medicine at a Malaysian public medical school will have to either sit for the Sijil Tinggi Pelajaran Malaysia (STPM), which is the A-level equivalent examination conducted by the Malaysian Examination Board or graduate from a matriculation course offered by the local public universities or institutions. Although there is a minimum academic entry requirement for admission into any medical school, students admitted into these schools usually have entry qualifications that are far higher than the minimum entry requirement as the demand for a seat in a medical school usually exceeds the supply.

The International Medical University (IMU) uses a wide range of pre-university entry qualifications to select students for its medical programme. The three most commonly used pre-medical entry qualifications are the A-Level (UK), STPM (Malaysian) and Australian Matriculation. Entry into the IMU medical programme does not require previous training in Biology. All students who meet the minimum entry requirements will be asked to attend an interview. The recommendations from the interview board on the suitability of the candidate will be considered by the university's selection committee in deciding the admission of a student into the IMU medical programme.

The aim of this study was to examine the relationship between the various pre-medical entry qualifications

used at the IMU and the previous training in chemistry and biology on students' performance in the end-of-semester (EOS) examinations during the first two-and-a-half years of the IMU medical programme.

Materials and Methods

Subjects

The IMU practices double intake for its medical programme where for each intake, approximately 150 students were admitted in the initial years and the intake size increased gradually in the later years (see Table 1). For this study, we have included all students who had been admitted into the IMU medical programme for the period from December 1993 to March 2000, giving a total of 1281 students (see Table 1).

Table 1: Respondents distribution according to intake and gender

Year	Student Intake*	Number Admitted	Percentage of total** (%)	Male Students	Female students
1993	M1	73	5.7	44	29
1994	M1	42	3.3	30	12
1995	M1	40	3.1	22	18
	M2	49	3.8	28	21
1996	M1	34	2.7	23	11
	M2	64	5.0	38	26
1997	M1	96	7.5	42	54
	M2	51	4.0	25	26
1998	M1	104	8.1	55	49
	M2	143	11.2	73	70
1999	M1	140	10.9	59	81
	M2	132	10.3	55	77
2000	M1	157	12.3	86	70
	M2	156	12.2	68	88
Total		1281	100.0	648	632

* M1 refers to first intake of medical students in one year and M2 refers to the second intake of medical students in the same year

** number admitted/total students (1,281) x100%

Study Variables

The first two-and-a-half years of the IMU medical programme is also referred to as the pre-clinical years. For the first nine cohorts shown in Table 1, there were five end-of-semester (EOS) examinations held at the end-of semesters 1 (EOS 1), 2 (EOS 2), 3 (EOS 3), 4 (EOS 4) and 5 (EOS 5). This was reduced to three EOS examinations (EOS 1, 3 and 5) in 1998. As such, in this study we only used results from the three EOS examinations (EOS 1, 3 and 5) as these were common to all the students listed in Table 1. The students from the second intake of 1998 onwards also had to sit for various end-of-course (EOC) assessments at the end of each body-system course (e.g. cardiovascular system, respiratory system). For these students, the EOC assessments formed part of the continuous assessments in the IMU medical programme where the marks from the EOC contributed 30% of the EOS marks for a particular EOS examination. The topics covered in the EOS 1 were mainly the normal physiology, anatomy and biochemistry 2, whilst Semester 2 covered paraclinical subjects like pathology, microbiology, parasitology, pharmacology and community medicine. Semesters 3 to 5 covered system courses such as cardiovascular, respiratory, haematology, immunology, gastrointestinal, renal, endocrine, reproductive, musculoskeletal and nervous system. The pass mark for all major examinations for the students listed in Table 1 was set as 65%. In order to be in the dean's list, the student will have to score an average of 75% in all the EOS examinations.

In this study, we examined the relationship between the various types of pre-university entry qualifications with the students' academic achievements in the three EOS examinations (EOS 1, EOS 3, and EOS 5). To facilitate the analysis, the various pre-university entry qualifications were grouped into five categories based on the educational pedagogy of the different entry examinations (see Table 2). We also compared the pass rate of the students with and without previous training of biology or chemistry in their pre-medical education in the three EOS examinations.

Table 2: Summary of the students' entry qualifications

	Frequency**	Percent (%)
British A-level or equivalent*	737	57.6
American pre-University or equivalent	42	3.3
Australian Matriculation or equivalent	401	31.4
Foundation Courses	30	2.3
Degree/Diploma	48	3.8
Others	20	1.6
Total	1279	100

* includes students who sat for the Malaysian Higher Education Certificate (HSC or STPM) examination

** frequency/total (1,281) x100%

Statistical Analysis

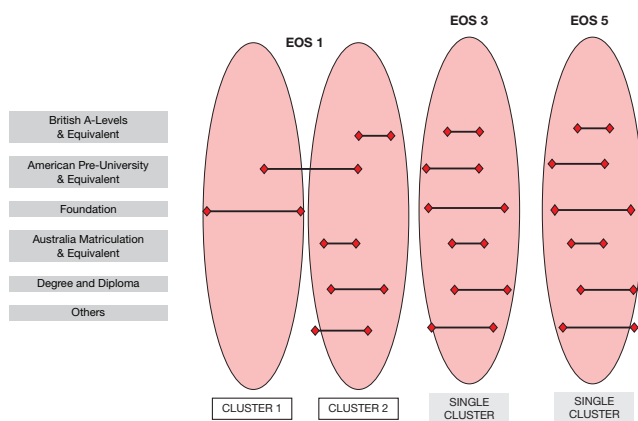
Since the focus of the study is students' academic performance, all the data used in this study were checked for normality. As there was no significant skewedness of the data observed, the one-way ANOVA with 95% confidence interval (CI) was used to test for differences in the academic performance in the three EOS examinations (EOS 1, 3 and 5) with regards to entry qualification. The Chi-Square statistics was used to further test the association between students' grades in the specific science subjects and their performance in the various EOS examinations.

Results

The retrospective data of 1281 students representing 14 cohorts were used in the analysis (see Table 1). During the earlier years (1993 – 1994), there was only one intake of medical students per year whilst from 1995 onwards, there were two intakes of medical students per year. As shown in Table 1, there were approximately equal number of male (50.60%) and female (49.4%) students.

As shown in Table 2, students with a wide range of pre-university entry qualifications are accepted into the IMU's medical programme. Amongst these, the two most common pre-medical entry qualifications are the British A-level or equivalent (57.6%) and the Australian Matriculation (31.4%). The British A-Levels or equivalent comprises A-level, Scottish School Leaving Certificate, Irish School Leaving Certificate, Malaysian Higher School Certificate (STPM), Unified Examination certification and Pre-university certificate while the Australian Matriculation or equivalent consists of South Australian Matriculation (SAM), Tertiary Entrance Examination (TEE), Victorian Certificate (VCE), High School Certificate (HSC), and New Zealand Bursary. The overlap between these pre-medical entry qualifications are shown in Figure 1.

Figure 1: The overlap of mean scores achieved in the end-of-semester (EOS) examinations (EOS 1, 3 and 5) of medical students who entered the IMU medical programme using different pre-university entry qualifications



Since the majority of the students have either the British A-Levels and equivalent or the Australian Matriculation and equivalent as their entry requirements, comparisons were made between these two categories of students in terms of their academic performance in the EOS examinations i.e. EOS 1, EOS 3 and EOS 5. Students with the British A-levels and equivalent showed significantly ($p < 0.05$) better performance in EOS 1 compared to those with the Australian Matriculation and equivalent. However, this difference was no longer observed in the EOS examinations i.e. EOS 3 and EOS 5 (see Table 3). Thus it can be concluded that students with British A-Level and equivalent entry qualification have a better start with the IMU medical programme but their academic performance is not associated with the entry qualifications. In terms of consistency both groups of students showed smaller variability in the EOS 1, EOS 3, and EOS 5 scores while the variability in the EOS examination scores for students with other entry qualifications (e.g. American A-Level and equivalent, Foundation, Degree and Diploma) were much larger (see Table 3). Further analysis showed some interesting clustering among students, those students who came in with certification in Foundation Courses generally had poorer results while those with relevant basic degrees or diploma performed better in the EOS 1 examination. However after being in the medical curriculum for about a year, there seems to be no significant difference in the clustering of the students (see Figure 1).

Table 3: Students' entry qualification and academic performance in end of semester examinations

Examinations	Entry Qualifications	Mean	SD	95% Confidence Interval		Min	Max
				Lower	Upper		
EOS 1	British A-level and equivalent	73.67	8.69	73.04	74.31	29.97	91.75
	American pre-University or equivalent	69.49	12.96	65.45	73.53	24.71	87.85
	Australian Matriculation and equivalent	70.91	9.58	69.97	71.85	28.53	92.82
	Foundation Courses	63.66	12.25	59.00	68.32	32.77	81.27
	Degree/Diploma	73.14	10.10	70.18	76.11	38.76	90.23
EOS 3	Others	72.00	6.52	68.85	75.14	60.58	84.72
	British A-level or equivalent	68.45	8.52	67.80	69.10	14.44	89.33
	American pre-University or equivalent	67.49	7.59	64.96	70.03	50.84	86.15
	Australian Matriculation or equivalent	69.26	7.39	68.51	70.01	46.85	85.94
	Foundation Courses	69.28	6.34	66.60	71.95	57.31	81.19
EOS 5	Degree/Diploma	70.89	7.63	68.45	73.33	47.53	86.19
	Others	68.57	6.73	65.42	71.72	51.23	78.48
	British A-level or equivalent	72.36	6.14	71.38	72.85	47.02	89.20
	American pre-University or equivalent	70.19	6.69	67.89	72.48	56.01	81.31
	Australian Matriculation or equivalent	70.81	7.09	70.06	71.56	43.60	88.65
EOS 5	Foundation Courses	70.42	5.66	67.97	72.87	57.93	82.81
	Degree/Diploma	72.30	6.82	70.06	74.55	58.29	84.30
	Others	71.55	7.30	68.03	75.07	61.00	84.76

(EOS: End-of-Semester)

Entry qualification is a general grading on applicants' academic competence and most medical schools generally do not specify the specific science subjects in which the applicants must have the minimum required grade. Since medical curriculum involves a fair bit of Biology and Chemistry, it is only logical to assume that medical students that have prior knowledge in these two subjects may have some advantage over their other course-mates who did not take biology or chemistry in their pre-university course. The grades of students

with and without exposure to specific science subjects in their pre-university years (see Table 4) in the three EOS examinations were compared. The results showed that learning biology or chemistry in the pre-university years is not a prerequisite for students to do well in the IMU medical programme (see Table 4). This is not only evident for the initial years in the medical course but consistently observed throughout the two-and-a-half years of the pre-clinical phase.

Table 4: Comparing student's performance in end of semester examinations with exposure to specific science subjects at the pre-university level

A' Level Subjects	Sat for Exam	EOS 1			EOS 3			EOS 5		
		< 65 N (%)	≥ 65 N (%)	p-value	< 65 N (%)	≥ 65 N (%)	p-value	< 65 N (%)	≥ 65 N (%)	p-value
Physics	Yes	179 (18.8)	775 (81.2)	0.496	242 (27.5)	639 (72.5)	0.239	122 (14.7)	710 (85.3)	0.672
	No	63 (20.5)	244 (79.5)		88 (31.10)	195 (68.90)		50 (19.2)	210 (80.8)	
Chemistry	Yes	232 (19.6)	954 (80.4)	0.2001	327 (29.7)	773 (70.3)	0.845	158 (15.4)	871 (84.6)	0.399
	No	10 (13.3)	64 (86.5)		18 (28.6)	45 (71.4)		12 (19.35)	50 (80.65)	
Biology	Yes	199 (18.0)	756 (82.0)	0.541	253 (29.6)	601 (70.4)	0.605	116 (14.5)	682 (85.5)	0.647
	No	76 (22.4)	263 (77.6)		87 (28.1)	223 (71.9)		46 (15.6)	248 (84.4)	
Mathematics	Yes	217 (19.3)	909 (80.7)	0.834	307 (29.3)	740 (70.7)	0.801	149 (15.2)	831 (84.8)	0.809
	No	25 (18.5)	110 (81.5)		33 (28.2)	84 (71.8)		18 (16.1)	94 (83.0)	

(EOS: End-of-Semester; N: number)

The cross tab analysis was carried out to determine the association between students' grades in their pre-university science subjects and the end of semester examination results. For this purpose students' pre-university science grades were categorised into two categories; A and B as category one, while C and below

as category two. The results showed that for all the comparisons except achievement in Physics versus end of semester 5 examination score, students in category one performed significantly better in the end of semester examinations (see Table 5).

Table 5: Comparison between achievements in pre university science subjects and end of semester examinations

A' Level Subjects	Grades	EOS 1			EOS 3			EOS 5		
		< 65 N (%)	≥ 65 N (%)	p-value	< 65 N (%)	≥ 65 N (%)	p-value	< 65 N (%)	≥ 65 N (%)	p-value
Physics	A & B	133 (17.5)	629 (82.5)	0.004	164 (23.3)	540 (76.7)	0.0001	93 (13.9)	578 (86.1)	0.18
	C & Lower	46 (24.0)	146 (76.0)		78 (44.1)	99 (55.9)		29 (18.0)	132 (82.0)	
Chemistry	A & B	203 (19.0)	865 (81.0)	0.018	279 (28.1)	714 (71.9)	0.0003	136 (14.6)	797 (85.4)	0.03
	C & Lower	29 (24.6)	89 (75.4)		48 (44.9)	59 (55.1)		22 (22.9)	74 (77.1)	
Biology	A & B	139 (17.3)	664 (82.7)	0.04	209 (27.8)	543 (72.2)	0.001	96 (13.6)	611 (86.4)	0.003
	C & Lower	32 (26.9)	97 (73.1)		44 (43.1)	58 (56.9)		20 (22.0)	71 (78.0)	
Mathematics	A & B	200 (19.4)	833 (80.6)	0.03	273 (28.2)	695 (71.8)	0.005	120 (13.2)	787 (86.8)	0.047
	C & Lower	27 (29.0)	66 (71.0)		34 (43.0)	45 (57.0)		12 (16.4)	61 (83.6)	

(EOS: End-of-Semester; N: number)

Discussion

The main focus of the study is students' entry qualification and the academic performance in medical school. Due to limitation on data availability, this study was confined to pre-clinical phase of the medical programme. The passing mark for the EOS examinations at the IMU for the cohorts listed in Table 1 was set at 65%. Those who fail to achieve this will be given one opportunity to re-sit the examination failing which they will be required to repeat the semester.

In IMU a variety of entry qualifications are considered for enrolment into the medical programme. Most students come with either the British A-Level or equivalent, and Australian Matriculation or equivalent. Only a small percentage uses other entry qualifications such as American A-Level, foundation, and degree/diploma. Students with the British A-levels or equivalent appear to perform better during the initial years but in the later semester, this significant difference seemed to be

absent. There is a great difference between the pedagogy of all the Australian matriculation programmes and the A-levels and equivalent types of programmes. The Australian matriculation programmes utilises newer learning methods as self-directed learning, teamwork in projects and continuous assessments whilst A-levels and equivalent types of programmes uses more of the more traditional approaches. The EOS examinations are more related to content than to the other elements of medical education such as communicating, physical examination and writing reports. Hence, students from the traditional mode of training can out-performed those from the non-conventional type in the initial years but not in later part of the medical programme. Even though the performance of students with the American A-Level or equivalent as well as those with related degree or diploma is comparable with their peers with British A-Level equivalent or Australian Matriculation equivalent, there is variability in the scores obtained for the EOS 1 examination. As the

IMU accepts students from a range of pre-university qualifications that differ in the pedagogy, the IMU has developed an academic banding system in 2004 to ensure consistency. For the medical programme, there are four bands name I, II, III and IV. Band I refers to the highest grades whilst Band IV has the grades for the minimum entry qualifications. Band II and III have grades that fall between Band I and IV. So, since 2004, once a student has submitted his/her application, the student will be categorised into one of the four academic bands.

The study also analysed whether studying biology or chemistry at a pre-university course would help medical students to pass their EOS examinations. In this study, there is no evidence to support the notion that studying Biology or Chemistry during the pre-university years can help students to perform better in the end of semester examinations. This might be helpful for the students to understand some of the concepts taught in the medical curriculum but it does not appear to give the students who take these subjects in their pre-university any added advantage in terms of performance in the EOS examinations. This is in line with the previous report⁵ that also did not find any relationship between studying biology in the pre-university and student performance in examinations or later as doctors. In addition, some authors^{2,3,5,13} had reported that they could not find a significant correlation between previous study of any of the natural sciences and the performance of the students as interns. Some of these authors^{2,5,6,9} had suggested that medical schools might consider expanding their admission criteria to include humanities subjects in the entry requirement, without fearing that their graduates will perform less well as interns. Students' academic competence plays an important role in effective learning.

In conclusion, this study shows that students with better grades in their pre-university examinations perform better in their EOS examinations, regardless of the science subjects they took in their pre university courses.

Acknowledgements

This research was performed on behalf of the Faculty of Medicine, International Medical University (IMU) with the help of the IMU Medical Education and Research Unit (MERU). The authors would like to thank Ms Norzaimah Ahmad from the Medical Education and Research Unit for keying in all the data in the SPSS format and also for her valuable assistance in analysing the data using the SPSS software.

REFERENCES

1. Bore M, Munro D, Powis D. A comprehensive model for the selection of medical students. *Med Teacher* 2009; 31: 1066–72.
2. Barr DA, The art of medicine: Science as superstition: selecting medical students. *The Lancet*, 2010; 376: 678-9.
3. Neame R.L., Powis D.A., Bristow T. Should medical students be selected only from recent school-leavers who have studied science? *Med Education*, 1992; 26: 433-40.
4. Harth S., Briggs J., Thong Y. Mature-age entrants to medical school: a controlled study of demographic characteristics, career choice and job satisfaction. *Med Education*, 1990; 2: 488-98.
5. Woodward C.A., Mcauley R.G. Can the academic background of medical graduates be detected during internship? *Canadian Med Assoc J* 1983; 129: 567-9.
6. Mcmanus I.C. Factors affecting likelihood of applicants being offered a place in medical schools in the United Kingdom in 1996 and 1997: retrospective study • Commentary: League tables will help • Commentary: Some legal aspects arising from the study. *Brit Med J* 1998;317: 1111-7.
7. Powis D.A. Selecting medical students. *Med Education*, 1994;28: 443-69
8. Geffen L.B. The case for graduate schools of medicine in Australia. *Med J Australia*, 1991;155: 737-40.
9. James D, Driver L (1999). Ethnic and sex differences in selection for admission to Nottingham University Medical School. *British Medical Journal*, 1999: 319: 351-2
10. Mcmanus I.C., Richards P. Prospective survey of performance of medical students during preclinical years. *Brit Med J (Clin Res Ed)*, 1986: 293: 124-7.
11. Kay-Lambkin F, Pearson SA, Rolfe I. The influence of admissions variables on first year medical school performance: a study from Newcastle University, Australia. *Medical Education*, 2002: 36: 154-9.
12. Wallace WFM, Sanderson G, Mercer CG, and Gilmore RC. Short- and long-term academic predictors of medical student performance. *Ulster Med J*. 1988; 57(2): 149–54.
13. Ferrier BM, Woodward CA. Does premedical academic background influence medical graduates' perceptions of their medical school or their subsequent career paths and decisions? *Med Education*, 1983: 17: 72-8.