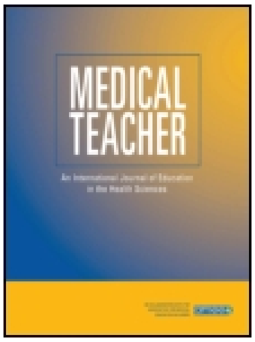

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Demographic attributes and knowledge acquisition among graduate-entry medical students

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Abstract

Background: Recent changes to undergraduate (basic) medical education in Ireland have linked an expansion of student numbers with wide-ranging reforms. Medical schools have broadened access by admitting more mature students from diverse backgrounds and have increased their international student numbers. This has resulted in major changes to the demographic profile of students at Irish medical schools.

Aim: To determine whether the demographic characteristics of students impact on their academic performance and specifically on their rate of knowledge acquisition.

Methods: As a formative assessment exercise, we administered a progress test to all students twice each year during a 4 year graduate-entry medical programme. We compared scores over time between students from different age cohorts, of different gender, of different nationalities and from different academic backgrounds.

Results: In the 1143 tests taken by 285 students to date, there were no significant differences in the rate of knowledge acquisition between the various groups. Early in the course, students from a non-biological science background performed less well than others but outperformed their peers by the time of graduation.

Conclusion: Neither age, gender, nationality nor academic background impacts on the rate of knowledge acquisition among graduate-entry medical students.

Introduction

Recent government-driven reform of undergraduate (basic) medical education in the Republic of Ireland has resulted in greatly increased student numbers, new methods of student selection and new approaches to teaching, learning and student assessment (Fottrell 2006; Thakore 2009). As recently as 2006, 5 medical schools offered just 325 medical school places annually to Irish/EU secondary/high school leavers (Irish Medical Council 2004). The number of places for indigenous students has since doubled and international student numbers have expanded such that the total student intake to Irish medical schools reached 793 in 2010, with 27% being international students (Higher Education Authority: personal communication). Furthermore, a new and exclusively graduate-entry medical school (GEMS) has been established at the University of Limerick (Finucane & Kellett 2007). Collectively, the six Irish medical schools now offer four graduate-entry programmes along with five school-entry programmes.

As part of its reform agenda, the government sought to broaden access to medical education by encouraging applications from students from diverse backgrounds (Fottrell 2006). As a consequence, all graduate-entry programmes are obliged to accept students irrespective of their age and prior academic qualification (Finucane et al. 2008). There are just two criteria for admission – having a degree at a higher honours level in any subject area and having a competitive score in either the Graduate Medical School Admission Test (GAMSAT; Australian Council for Educational Research 2012) or (for international students) in the Medical Colleges Admission Test (MCAT; Association of American Medical Colleges 2012). As a result of these changes, the demographic profile of students at Irish medical schools has undergone a profound and rapid change.

Practice points

- A rapid change in the demographic profile of medical students has the potential to impact on the rate of knowledge acquisition.
- Using a progress test as a marker of knowledge acquisition, we found no differences in the rate of knowledge acquisition among students of different gender and age profile, from different countries and of different academic backgrounds.

From the outset, the GEMS at the University of Limerick has used a progress test for the formative assessment of its students and specifically, to monitor their knowledge acquisition as they progress through the course (Finucane et al. 2010). With progress testing, students in all years periodically undertake a test which is pitched at the level of the final exit examination

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(Verhoeven et al. 2002; Freeman et al. 2010). The expectation is that individual scores increase over time in line with the rate of knowledge acquisition. Progress tests were first introduced into medical programmes over 30 years ago and their use is increasing over time (Arnold & Willoughby 1990). The progress test in use at the GEMS is sourced from McMaster University in Canada, where it was introduced in 1992 (Blake et al. 1996). Through its International Partnership for Progress Testing (Program for Educational Research and Development 2012), McMaster University now offers its progress test to a number of medical schools internationally.

We wondered whether the rate of knowledge acquisition among our students is influenced by such demographic characteristics as age, gender, nationality and previous academic background. In other words, we questioned whether the government policy of promoting student diversity impacted on the rate of student learning. This prompted us to compare student performance in the McMaster progress test for the first 4 years of our new programme across these demographic variables.

Methods

A total of 285 students enrolled in the GEMS programme during the first 4 years of its existence, with the progress test being delivered on eight occasions to the first student intake ($n=32$), on six occasions to the second intake ($n=65$), on four occasions to the third intake ($n=87$) and on two occasions to the fourth intake ($n=101$). Two students left the programme during this period, while an additional 10 students remained in the programme but did not progress as initially expected due to temporary withdrawal and/or examination failure. We analysed the data on students' progress test performance only for as long as they remained with their original student cohort. Thus, for example, for a student who failed to progress after their second year, we analysed progress test scores for the first 2 years only. Furthermore, 12 students to date, each failed to attend a scheduled progress test sitting. As a consequence, 1143 test results relating to 285 students across the 4 years of the programme were available for analysis.

Details of the McMaster progress test are provided elsewhere (Blake et al. 1996; Finucane et al. 2010). In short, each test consists of a 180-item multiple choice question examination using a 'single best answer' response format, with one correct answer and four 'distracters' per item. A negative-marking scheme is used to discourage guessing. Test items address both the basic and clinical sciences; a content template ensures that each test has a balance of items relating to the population, behavioural and biological domains of medicine. Questions are randomly drawn from a 2500-item bank, which is regularly updated. A blackout rule ensures that students will not encounter the same test items more than once as they progress through the course. The test is delivered electronically in real time from a central server at McMaster University. Students have a 3 h limit within which to complete each test. Individual test results are provided on completion of the test with aggregated student performance being analysed and made available at a later date. GEMS students sit the progress test once per semester for each of the four academic years – eight times in total. Taking the test is obligatory and students who fail to do so are called to account.

The demographic information provided by all students at the time of entry to the programme includes information on age, gender and status as an Irish/EU or international student. We also document each student's prior academic career (including all undergraduate and postgraduate degrees awarded) to classify students as having a biological or non-biological sciences background. On the few occasions where the title of a degree did not clearly indicate its biological sciences orientation, we contacted the relevant student for clarification.

Comparison of median scores among the different subgroups was undertaken using the Mann–Whitney *U*-test and the Kruskal–Wallis test. The study was approved by the University of Limerick's Research Ethics Committee.

Results

Of the 285 students who enrolled in the first 4 years of the GEMS programme, 146 (51%) were female and 139 (49%) were male. A total of 199 (70%) were Irish/EU citizens while 86 (30%) were international students, all of whom originated from Canada. Regarding age at the time of admission to the programme, 177 (62%) were aged less than 25 years, 84 (29%) 25–30 years and 24 (8%) over 30 years. Concerning their academic backgrounds, 199 (69.8%) had a prior degree in an area of biological science while 86 (30.2%) came from a non-biological science background. The academic backgrounds of the non-biological science students included Arts & Humanities ($n=35$), Earth Sciences ($n=17$), Engineering ($n=15$), Law ($n=8$), Business ($n=6$) and Information Technology ($n=5$).

Table 1 contains data on the aggregated median scores across all eight tests, while Table 1 and Figure 1 provide comparative data for students of different gender, nationality, age group as well as those form science and non-science backgrounds. As expected, aggregated median scores rise progressively with successive tests, though there was a slight falling off in the median score for the final test. We detected no important difference in the aggregated performance of male and female students, apart from one test where a difference of 10.7% did not reach statistical significance ($p=0.098$) and had disappeared at the time of the next test, taken 5 months later.

In comparing Irish/EU and international students, the latter did marginally better across all eight tests, but this difference also failed to reach statistical significance except on one occasion (Test 5). Regarding age on admission to the programme, aggregated performance in each of the eight tests marginally improved with increasing age, though again these differences did not reach statistical significance for any single test. Finally, we found no statistical difference in the aggregated performance among students with a prior science degree when compared with others, though those with a science degree tended to perform better in the early tests only to be overtaken by non-science students in the later stages of the programme.

Table 1. Aggregated median scores in all eight progress tests among all 285 students and among those of different gender, country of origin, ages and academic background.

	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8
Overall ($n = 285$)	11.3	21.9	31.7	36.3	45.0	45.6	51.5	49.8
Female ($n = 146$)	10.7	22.2	31.7	35.6	43.6	43.3	51.5	50.5
Male ($n = 139$)	11.8	21.8	31.6	37.1	46.1	48.5	51.4	49.6
Difference (%)	−1.1 (9.3)	+0.4 (1.8)	+0.1 (0.3)	−1.5 (4.0)	−2.5 (5.4)	−5.2 (10.7)	+0.1 (0.2)	+0.9 (1.8)
p-Value	0.313	0.741	0.970	0.316	0.231	0.098	0.985	0.722
Irish/EU ($n = 199$)	11.3	21.5	30.7	36.0	43.6	43.9	51.4	49.2
International ($n = 86$)	11.3	23.1	32.9	38.4	48.4	47.0	54.4	55.1
Difference (%)	0	−1.6 (7.4)	−2.2 (7.2)	−2.4 (6.7)	−4.8 (11)*	−3.1 (7.1)	−3.0 (5.8)	−5.9 (12)
p-Value	0.860	0.253	0.075	0.235	0.004	0.259	0.500	0.688
Age <25 ($n = 177$)	10.8	21.5	31.8	35.8	44.6	44.1	51.5	50.4
Age 25–30 ($n = 84$)	11.7	22.4	30.7	36.4	44.9	47.3	50.8	47.9
Age >30 ($n = 24$)	12.2	24.5	35.3	38.0	47.5	50.1	48.8	51.2
Largest difference (%)	−1.4 (13)	−3.0 (14)	−3.5 (11.0)	−2.2 (6.1)	−2.9 (6.5)	−6.0 (13.6)	+2.7 (5.2)	−3.3 (6.9)
p-Value	0.756	0.160	0.082	0.223	0.481	0.183	0.726	0.963
Biolog ($n = 199$)	11.8	22.6	31.9	36.1	44.9	44.2	51.5	49.2
Non-biolog ($n = 86$)	10.0	20.1	31.4	36.8	45.3	46.3	50.8	51.8
Difference (%)	+1.8 (15.3)*	+2.5 (11.1)*	+0.5 (1.6)	−0.7 (1.9)	−0.4 (0.9)	−2.1 (4.8)	+0.7 (1.4)	−2.6 (5.3)
p-Value	0.011	0.008	0.641	0.850	0.786	0.919	0.791	0.880

Notes: Biolog, students with a prior biological sciences degree and Non-biolog, students without such a degree.
*Significant results at $p < 0.05$.

Discussion

The main finding in this study is that the rate of knowledge acquisition over time among students in a graduate-entry medical programme was not influenced by the students' gender, age, nationality and nature of their previous degree. As some of these variables may influence school admissions policies, their lack of impact on the rate of knowledge acquisition warrants further discussion.

The fact that the age and gender of students did not impact on their rate of knowledge acquisition should come as no surprise. Regarding comparisons of academic performance in Irish/EU and international students, previous studies have found that the latter struggle academically, perhaps because of language problems, acculturation issues or both (Mann et al. 2010). In our study, while the differences between Irish/EU and international students was not statistically significant, the latter performed as well or marginally better than indigenous students across all of the tests taken. This probably reflects the fact that all GEMS international students to date have been Canadian and all speak English as their first language. Furthermore, they form a sufficiently large (30% of the total GEMS student population) and homogeneous group to minimise the impact of acculturation issues. The high level of student integration and peer support that is inherent in PBL and other small group activities probably serves to further reduce issues of acculturation.

Perhaps the most important study finding relates to the performance in the progress test of students from a non-biological science background when compared to those with a previous biological science degree. Though we found no statistical difference in the performance of both groups in serial tests, there was a trend for students from a non-biological science background to perform less well in the early stages of the course but to eventually surpass those with a biological science degree. At least in part, our student selection criteria might explain this finding as successful GEMS applicants require a high overall score in either the GAMSAT or the MCAT. Both tests specifically assess reasoning in the Physical and Biological Sciences and we weight this element of the GAMSAT such that it contributes 50% to the overall score. Thus, even those without a prior biological science degree are obliged to have a reasonable grasp of scientific principles before embarking on the course.

We believe that the rapid reduction in the initial knowledge differential between students from science and from non-science backgrounds is due at least in part to the PBL process, which on the one hand exposes gaps in the students' knowledge and challenges them to address such gaps and on the other obliges students to share information and educate one another (Finucane et al. 1998). A narrowing of any initial knowledge differential would therefore be an almost inevitable consequence of studying through PBL (van der Vleuten et al. 1996). With this in mind, there could be concerns that the narrowing of the knowledge differential could be due to a 'dumbing down' effect among those with a biological degree, rather than a 'catch up' process for those without such a degree. If this were the case, the average trajectory of learning would be reduced for GEMS students. We have already published data to show that knowledge acquisition in the first two cohorts of GEMS students is comparable to that of their counterparts at the McMaster University (Finucane et al. 2010). This comparability has since been maintained (unpublished data), thus refuting the notion of a 'dumbing down' effect.

Ours is not the first study to show that students from a non-biological science background can perform well in medical courses. For example, the 'Humanities in Medicine Program' at Mount Sinai School of Medicine guarantees medical school admission to selected students with a humanities and social sciences background (Muller & Kase 2010). However, such students must first undergo abbreviated courses in organic chemistry and physics and must achieve high academic grades

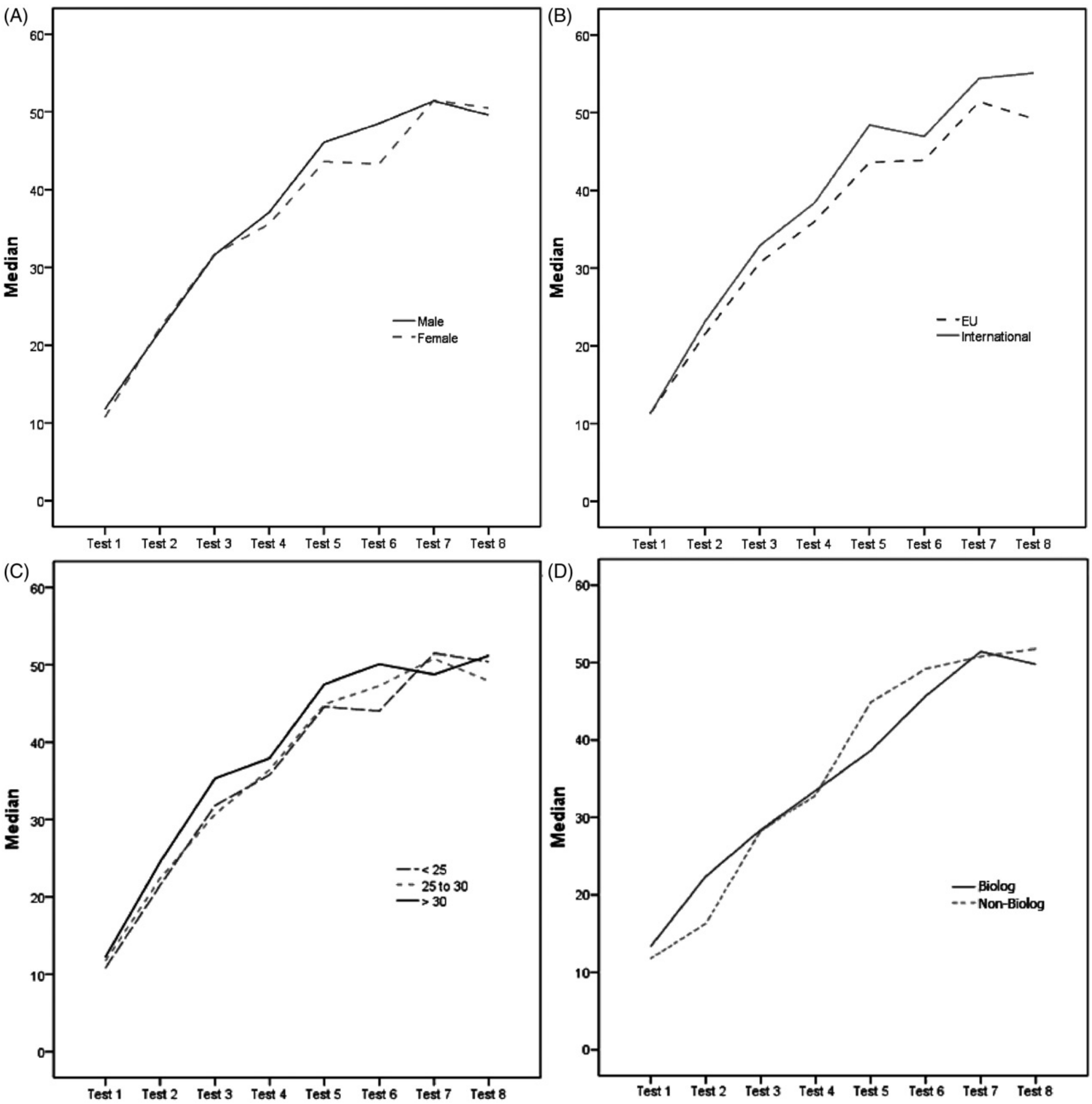

Figure 1. Plot of median scores by (A) gender; (B) country of origin; (C) age group; and (D) academic background.

in biology and general chemistry. Our study goes beyond this in showing that students who are not obliged to study biology, chemistry and physics (other than what is required to get a competitive score in GAMSAT or MCAT) also perform well in a graduate-entry medical programme.

Implications

The findings of this study have implications for GEMS students, faculty and our programme sponsors. In the first instance, we can now reassure our more mature and international students that collectively they are likely to perform as well on the course as others. We can particularly reassure our students from a non-biological science background that in relation to their peers, any initial knowledge differential will disappear as they engage with the programme. In the early days of the GEMS, some faculty argued for the provision of additional didactic teaching in the basic sciences, targeted at those from a non-biological science background – perhaps amounting to a mini 'pre-medical' course. Others resisted, arguing that such a course might serve to undermine the PBL process. We now have evidence to show that our students can cope in the absence of such targeted teaching. Finally, we can advise our sponsors (i.e. various government agencies) that when introducing graduate-entry medical programmes to Ireland in 2007, they were wise to make these available to all students, irrespective of their age profile, nationality or prior academic background.

Declaration of interest: The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the article.

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