



CAREER ISSUES

The Relationship between Previous Tertiary Education and Course Performance in First Year Medical Students at Newcastle University, Australia

LIEVE DE CLERCQ, MSc, SALLIE-ANNE PEARSON, PhD & ISOBEL E ROLFE, FRACP

Faculty of Medicine and Health Science, University of Newcastle, Australia

ABSTRACT **Aim:** *The purpose of this study was to identify the relationship between previous tertiary education background and the performance of first year medical students at Newcastle University, Australia. Specifically, we examined degree type (i.e. arts, science, allied health, nursing or other professional backgrounds), level of degree completion (fully or partially completed), academic achievement (grade point average) and whether or not students had postgraduate qualifications. The relationship between age and gender was also examined.*

Method: *All students admitted to the medical course from 1990 to 1998 with previous tertiary education experience who entered via the "standard" entry pathway and sat the end of year examinations were eligible for the study (N=303). The outcome measures were the results of first assessment ("satisfactory" versus "not satisfactory") and final assessment of the first year ("satisfactory" versus "not satisfactory"). Logistic regression was used to examine the relationship between predictor variables and outcomes.*

Results: *In relation to first assessment results, students with a nursing and arts background were significantly more likely to receive a "not satisfactory" assessment (RR=3.9, 95% CI: 1.6–7.7; RR=2.9, 95% CI: 1.2–6.8, respectively), as were females (RR=1.8, 95% CI: 1.1–3.5) and students with a grade point average of less than a distinction average (RR=2.8, 95% CI: 1.6–5.2). At final assessment, students with a nursing background and those with a less than distinction average were more likely to receive a "not satisfactory" result (RR=20.7, 95% CI: 3.5–123.9 and RR=4.0, 95% CI: 1.2–13.9, respectively); consequently, they were required to repeat first year.*

Conclusion: *Our research suggests that there are some medical student groups who encounter more academic difficulties than others in first year. Identifying these students can assist medical schools to focus academic support appropriately.*

Author for correspondence: Dr. Isobel Rolfe, Faculty of Medicine and Health Sciences, University of Newcastle, University Drive, Callaghan 2308, Australia. Tel: +61 2 49211832. Fax: +61 2 49602088. E-mail: rolfe@mail.newcastle.edu.au

KEYWORDS *Educational status, medical students, admissions, medical education.*

In Australia, medical school selection models are moving away from those also used by many European countries. As such the prototype of students as recent high school graduates with high academic achievement and foundations in the natural sciences is no longer prevalent. Medical school admission policies are now multifaceted and incorporate selection on the basis of academic achievement at high school or university (college) plus the personal qualities of the candidate (Rolfe & Powis, 1997). Very recently some Australian medical schools have adopted North American models whereby candidates must possess a university degree before application (Geffen, 1991). This plurality of models for selection has significantly increased the diversity of medical student populations, especially with respect to the number of candidates with previous university educational experiences.

It is widely assumed that students with previous tertiary (university or college) education have a rich array of life experiences, are more motivated and as such are better equipped to deal with the transitional stresses of university life (Geffen, 1991). Although research suggests that transitional issues are less of a problem for mature students, employment and financial issues, as well as family responsibilities can be major stresses that impact on course performance and can lead to withdrawal (Harth *et al.*, 1990).

Several studies have examined educational background in relation to performance outcomes. Evidence from Newcastle suggests that the performance of students with previous tertiary experience is equivalent to that of students who enter medical school directly from high school, both during the medical degree (Kay *et al.*, in press) and in their first year postgraduation (Grey *et al.*, 2001). Further, the performance of first year doctors is not related to the type of previous tertiary study (Grey *et al.*, 2001). Evidence from the United States, where medical students are required to complete a 4 year degree programme prior to entering medical school, has shown that students with humanities backgrounds had a similar or better standard of course performance than students with science backgrounds (Dickman *et al.*, 1980; Smith, 1998). In Australia, no studies have examined medical school performance in relation to field of tertiary study prior to entry.

Considering the ever-increasing number of applicants to medical school with a tertiary education background, it is important that the performance of these students is examined in relation to admission variables and other pre-medical school characteristics. First year students are an appropriate group to study because differences in performance are usually more marked early in the course than in the final years. This is because of the "survivor effect", the most successful students progressing to final year.

The Bachelor of Medicine programme at the Newcastle University, New South Wales, Australia is a five year full-time course with no subject prerequisites for entry. Candidates enter the medical programme via three entry schemes: “standard”, “overseas full fee paying” or “Aboriginal and Torres Strait Islander”. Most candidates enter via the “standard entry” pathway. Approximately 65% of the standard entry candidates are recently graduated high school (secondary school) students who achieve a score in the top 10% of the Higher School Certificate (New South Wales’s secondary school qualification). The remaining “standard entry” candidates have achieved a credit average in at least 1 year of a full-time recognized tertiary (university or college) degree or diploma course. Candidates achieving the minimum academic requirements are invited to sit written psychometric tests and those scoring in the top centiles of the examination are invited to sit an objective structured interview (Powis & Rolfe *et al.*, 1998). The large number of tertiary entrants in the Newcastle cohorts allows for focused research on this group of candidates.

The aims of this study were to examine the influence of field of previous study, prior level of academic achievement, level of degree completion and the acquirement of postgraduate qualifications on the performance of first year students with a tertiary level education background. The influence of age and gender was also examined.

Method

Subjects

Participants in the study were first year students of the Bachelor of Medicine course at the University of Newcastle, Australia, who had completed at least one year of a tertiary degree, and who were enrolled through “standard” entry between the years 1990 and 1998 inclusive.

Outcome Variables

Assessment in first year was divided into five domains: evaluation of professional skills (Domain 1), critical reasoning (Domain 2), identification, prevention and management of illness (Domain 3), population medicine (Domain 4), and self-directed learning (Domain 5). Should a student require further assessment in one or more domains, they have the opportunity to resit the exam in the domain of deficit twice. A criterion referenced, non-graded assessment system is used, such that students are judged as “satisfactory” if they reach a minimum level of competence, or “non-satisfactory”. If a satisfactory level in all domains is not obtained at the final assessment, first year is repeated.

The outcome measures used in this study were the results of first assessment (“satisfactory” versus “not satisfactory”) and the final assessment (“satisfac-

tory” versus “not satisfactory”) in first year. Students were only allocated a “satisfactory” grade when assessments in all domains were successfully completed.

Independent Variables

Information pertinent to the study was obtained from the Student Admission Form that all students voluntarily complete upon entry to the course. This form includes questions on sociodemographic background, previous educational experience and achievements.

The independent variables considered for this study were as follows.

Previous Tertiary Experience

- Field of study: the College, University degree or diploma type undertaken for at least one year prior to entering medical school. Most degree and diploma level programmes are of three year and one year full-time duration respectively. Field of study was classified according to allied health (e.g. psychology, physiotherapy, speech therapy), science (e.g. biology, chemistry, anatomy), arts (e.g. philosophy or languages), other professional backgrounds (e.g. engineering, computer science, accountancy), and nursing. Due to the number of students who had undertaken a nursing degree, “nursing” was included as a separate category.
- Level of academic achievement: converted aggregate marks were used to represent previous academic achievement as “less than distinction” average, or “greater than or equal to distinction” average.
- Level of degree completion: “partially completed” or “completed”.
- Postgraduate qualifications: students with previous honours, masters, PhD qualifications were classified as having previous postgraduate qualifications.

Sociodemographic Characteristics: Age and Gender

Statistical analysis

Data were analysed using the *Statistical Package for the Social Science*, Version 6.1 for Windows (SPSSx, 1990). The outcome variables were coded dichotomously, “satisfactory” versus “not satisfactory”.

Area of deficit: frequency distributions were calculated to examine students who achieved a “not satisfactory” grade in any of the five individual domains at first or final assessment.

To examine the strength of the relationship between the outcome measures relating to previous tertiary backgrounds and socioeconomic characteristics, relative risks and odd ratios (both crude and adjusted) were estimated together with 95% confidence intervals.

For the purposes of analysis, “field of previous study” was divided into four dichotomous variables: allied health versus all other fields combined, arts

versus all other fields combined and “other professional backgrounds” versus all other fields combined. Science was used as the reference variable in the regression analysis. Age was dichotomized according to a median split of 24 years.

Unconditional logistic regression was performed for both outcome measures with the independent variables to adjust for potential confounders. Adjusted odds ratios and 95% confidence intervals were calculated from the coefficients and standard errors. In this case, the relative risk is a better measure of association between the independent variables of interest and the outcome measures. The odds ratio is not a good estimate of relative risk in these data, as the outcomes of requiring a second assessment or repeating first year medicine are not rare events. In addition, the estimated odds ratios tend to exaggerate the relationship of interest; therefore only relative risks are reported.

Results

Study Sample

A total of 394 students with a previous tertiary education background entered the Newcastle course between 1990 and 1998. There were 56 Aboriginal and Torres Strait Islander and overseas full fee paying students who were not admitted through “standard” entry and eight students who did not sit the end of year assessment. Thus 330 students were eligible for inclusion in the study. There were 27 students who had missing data regarding their previous tertiary experience (8% of eligible students).

A total of 46.8% of the sample were older than 24 years and 57.8% were female. With respect to tertiary education background, the largest category of science comprised 46.8% of the total sample population; 60.7% of students had completed their degree, 50.3% had a level of academic achievement greater or equal to distinction, and 20.4% of students had a postgraduate qualification (Table 1).

First Assessment

A total of 72 (21.2%) students received a “not satisfactory” result; 67% in Domain 3. The proportion of “not satisfactory” students in terms of age, gender, tertiary background, level of academic achievement, level of degree completion and postgraduate qualifications is shown in Table 2. Relative risks (RR) with associated 95% confidence intervals (CI) are included. Nursing and arts students were more likely to be “not satisfactory” than students from all other tertiary backgrounds combined (RR=3.9, 95% CI: 1.6–7.7 and RR=2.9, 95% CI: 1.2–6.8, respectively). Further, students with less than a distinction average and females were more likely to receive a “not satisfactory” result (RR=2.8, 95% CI: 1.6–5.2 and RR=1.8, 95% CI: 1.1–3.5, respectively). The remaining variables were not significantly related to outcome.

Table 1. Sociodemographic characteristics of study sample

	Respondents (<i>n</i>)	%
<i>Age</i>		
Less than or equal to 24 years	161	53.2
Greater than 24 years	142	46.8
<i>Gender</i>		
Male	125	42.2
Female	178	57.8
<i>Field of previous study</i>		
Allied health	57	18.8
Arts	36	10.9
Nursing	41	12.4
Other professional backgrounds	27	8.8
Science	142	46.8
<i>Level of academic achievement</i>		
Less than distinction	150	49.7
Greater or equal to distinction	153	50.3
<i>Level of completion</i>		
Partially completed	119	39.3
Completed	184	60.7
<i>Postgraduate qualification</i>		
Yes	62	20.4
No	241	79.6

Final Assessment

A total of 15 (4%) students were “not satisfactory” in final assessment; 73% in Domain 3. Students with a nursing background and those with less than a distinction average were more likely to receive a “not satisfactory” grade than all other students combined (RR=20.7, 95% CI: 3.5–123.9 and RR=4.0, 95% CI: 1.2–13.9) and therefore were required to repeat first year (Table 3). The remaining variables were not significantly related to outcome.

Discussion

Our study has several potential limitations that need consideration. With respect to the sample, there was a small proportion of missing student data. However, our sample consisted of 92% of “standard entry” students who sat assessments and therefore was representative of performance over a nine year period. We also limited our study to the evaluation of first year students only. We thought by doing this the possibility of variation in

Table 2. Proportion of students with a 'not satisfactory' grade at first assessment according to age, gender and previous tertiary education variables

Variable	<i>n</i>	% requiring further assessment	<i>p</i> -value	Relative risk (RR)	95% confidence interval of RR
<i>Age</i>					
Less than or equal to 24 years	161	23.6	0.62	0.9	0.5–1.6
Greater than 24 years	142	23.9			
<i>Gender</i>					
Female	178	28.7	0.05	1.8	1.1–3.5
Male	125	16.8			
<i>Tertiary background</i>					
Allied health	57	24.6	0.39	1.4	0.7–3.1
All others	246	23.6			
Arts	36	36.1	0.017	2.9	1.2–6.8
All others	267	22.1			
Nursing	41	41.5	0.005	3.9	1.6–7.7
All others	262	21.0			
Other professional backgrounds	27	14.8	0.91	0.9	0.3–3.1
All others	276	24.6			
<i>Grade point average</i>					
Less than distinction	150	32.0	0.007	2.8	1.6–5.2
Greater or equal to distinction	153	15.7			
<i>Level of completion</i>					
Partially completed	119	22.7	0.53	1.2	0.6–2.4
Completed	184	24.5			
<i>Postgraduate qualifications</i>					
Yes	62	17.7	0.93	1.0	0.4–2.3
No	241	25.3			

student performance should be maximized, the potential differences detected between students being more directly related to admissions variables. Evaluating more senior years has the problem of the potential "natural selection" of highly successful students who have a narrower range of performance.

The result that arts students were able to make up their deficits by the end of first year is interesting. Some have argued that students with an arts background, as opposed to a scientific background, could be academically disadvantaged in first year medical school (Montague & Odds, 1990). Over the last few decades, medical school curricula have changed from a predominantly biosciences content to a more bio-psychosocial approach (Maheux *et al.*, 1989).

Table 3. Proportion of students with a ‘not satisfactory’ grade at final assessment according to age, gender and previous tertiary education variables

Variable	<i>n</i>	% requiring further assessment	<i>p</i> -value	Relative risk (RR)	95% confidence interval of RR
<i>Age</i>					
Less than or equal to 24 years	161	3.7	0.53	1.5	0.4–5.7
Greater than 24 years	142	6.3			
<i>Gender</i>					
Female	178	6.2	0.53	1.5	0.3–5.3
Male	125	3.2			
<i>Tertiary background</i>					
Allied health	57	3.5	0.42	2.3	0.3–17.7
All others	246	5.3			
Arts	36	8.3	0.08	5.4	0.8–36.1
All others	267	4.5			
Nursing	41	17.1	0.009	20.7	3.5–123.9
All others	262	3.1			
Other professional backgrounds	27	3.7	0.42	2.7	0.2–33.5
All others	276	5.1			
<i>Grade point average</i>					
Less than distinction	150	7.3	0.03	4.0	1.2–13.9
Greater or equal to distinction	153	2.6			
<i>Level of completion</i>					
Partially completed	119	4.2	0.50	0.6	0.1–2.6
Completed	184	5.4			
<i>Postgraduate qualifications</i>					
Yes	62	4.8	0.20	3.0	0.6–16.8
No	241	5.0			

The results of our study suggest that the extra 2 months time between first and final assessment allows for focused learning to take place.

It is unclear what contributes to the academic difficulties faced by nursing students once in the medical course. Factors such as curriculum, teaching style, assessment and learning methods can potentially contribute to medical school performance. It is possible that previous learning styles developed to progress in most nursing curricula are not compatible with the problem-based teaching and assessment methodologies employed in the Newcastle medical course. Interestingly, recent research conducted on “survivors” of the medical programme has shown no difference in the performance of first year doctors with previous educational backgrounds in nursing compared to those with backgrounds in arts, science or allied

health (Grey *et al.*, 2001). To our knowledge this is the first study that has isolated nursing as a field of previous tertiary study and examined its affect on course performance during first year of a medical degree. Further research is required to understand the factors affecting the performance of this group of students.

The finding that lower academic achievement is significantly related to non-satisfactory performances at first and final assessment is not entirely surprising. Similar outcomes have been reported in other studies (Murden *et al.*, 1978; Carriago-Lo *et al.*, 1997). It is acknowledged that medical courses are academically demanding and that the highest achievers in previous academic examinations are most likely to do well in medical school, particularly if assessment methods are similar to those previously experienced (Powis *et al.*, 1992). If the focus in medical schools is timely progression through the degree, results of this study underscore the need to maintain a minimum academic threshold.

The study suggests a gender difference at first assessment in favour of men, with differences dissipating at final assessment. The evidence concerning gender and course performance is conflicting (Ramsbottom-Lucier *et al.*, 1995; Carriago-Lo *et al.*, 1997). Our previous research at Newcastle has shown that women may perform better as interns, particularly in "humanistic" domains such as communication skills (Barnsley *et al.*, 1994; Rolfe & Pearson, 1994; Rolfe *et al.*, 1995).

The study found that age, level of degree completion and postgraduate qualifications are not predictive of first year course performance. This result partly corresponds with a recent study in Newcastle, which demonstrated that level of completion was not predictive of intern performance ratings (Grey *et al.*, 2001). Our results challenge the suggestion that mature age students may have superior performance (Geffen, 1991).

Our research suggests that there are some student groups who encounter more difficulties than others in first year. To encourage continuation of the course it is important to address these at an early stage. Additional research is required to identify the factors affecting performance and to evaluate whether performance differences persist in later years of the course.

Acknowledgements

This research was performed on behalf of the Programme Evaluation Committee, Faculty of Medicine and Health Sciences, University of Newcastle, New South Wales. The authors would like to thank Tracey Bristow for the use of admissions and assessment data and Clare Ringland for assistance with data preparation.

References

- BARNESLEY, L. *et al.* (1994). Ratings of performance of graduates from traditional and non-traditional medical schools. *Teaching and Learning in Medicine*, 6, 179–184.
- CARRIAGO-LO, L.D., ENARSON, C.E., CRANDALL, S.J., ZACCARO, D.J. & RICHARDS, B.F. (1997). Cognitive and noncognitive predictors of academic difficulty and attrition. *Academic Medicine*, 72, 69–71.
- DICKMAN, R.L., RANDOLPH, E., SARNACKI, D., SCHIMPFHAUSER, F.T. & KATZ, L.A. (1980). Medical students from natural science and nonscience undergraduate backgrounds: similar academic performance and residency selection. *Journal of the American Medical Association*, 243, 2506–2509.
- GEFFEN, L.B. (1991). The case for graduate schools of medicine in Australia. *Medical Journal of Australia*, 155, 737–740.
- GREY, M.R., PEARSON, S., ROLFE, I.E., KAY, F. & POWIS, D.A. (2001). How do Australian doctors with different pre-medical school backgrounds perform as interns? *Education for Health*, 14, 87–96.
- HARTH, S.C., BIGGS, S.G. & THONG, Y.H. (1990). Mature-age entrants to medical school: a controlled study of sociodemographic characteristics, career choice and job satisfaction. *Medical Education*, 24, 488–498.
- KAY, F., PEARSON, S. & ROLFE, I.E. (in press). The influence of admission variables on first year medical school performance: a study from Newcastle University. *Medical Education*.
- MAHEUX, B., BELAND, F., PINAULT, R., RIVEST, P. & VALOIS, L. (1989). Do conventional and innovative medical schools recruit different students? *Medical Education*, 23, 30–38.
- MONTAGUE, W. & ODDS, F.C. (1990). Academic selection criteria and subsequent performance. *Medical Education*, 24, 151–157.
- MURDEN, R., GALLOWAY, G.M., REID, J.C. & COLWILL, J.M. (1978). Academic and personal predictors of clinical success in medical school. *Journal of Medical Education*, 53, 711–719.
- POWIS, D.A. & ROLFE, I. (1998). Selection and performance of medical students at Newcastle, New South Wales. *Education for Health*, 11, 15–23.
- POWIS, D.A., MCMANUS, I.C. & CLEAVE-HOGG, D. (1992). Selection of medical students: philosophic, political, social, and educational bases. *Teaching and Learning in Medicine*, 4, 25–34.
- RAMSBOTTOM-LUCIER, M., JOHNSON, M.S. & ELAM, C.L. (1995). Age and gender differences in students' preadmission qualifications and medical school performances. *Academic Medicine*, 70, 236–239.
- ROLFE, I.E. & PEARSON, S. (1994). Communication skills of interns in New South Wales. *Medical Journal of Australia*, 161, 667–670.
- ROLFE, I.E. & POWIS, D.A. (1997). Selecting Australian doctors of the future. *Medical Journal of Australia*, 166, 229–230.
- ROLFE, I.E., ANDREN, J.M., PEARSON, S., HENSLEY, M.J. & GORDON, J.J. (1995). Clinical competence of interns. *Medical Education*, 29, 225–230.
- SMITH, S.R. (1998). Effect of undergraduate college major on performance in medical school. *Academic Medicine*, 73, 1006–1008.
- SPSSx (1990). *Statistical package for the social sciences*. Chicago, IL: SPSS Inc.