Advances in Medical Education and Practice

Dovepress

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ORIGINAL RESEARCH

Medical Students at the School of Medicine and Health Sciences, University of Papua New Guinea: Predictors of Performance and Student Backgrounds

This article was published in the following Dove Press journal:
Advances in Medical Education and Practice

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Background: Papua New Guinea, a lower middle income country with a population of around 8.5 million, the majority of whom live in rural areas, produces far fewer than the number of medical graduates required to meet the WHO-recommended doctor/population ratio. The School of Medicine and Health Sciences is under pressure to increase its output and ensure the graduates are able to function in rural settings. Through two studies, we aimed to determine the predictors of student performance and their socioeconomic and educational background to assist in determining admission policies and improve completion rates.

Methods: A retrospective study analysed data relating to student performance from six annual cohorts. A cross-sectional study among currently enrolled students sought information about their socioeconomic and educational background.

Results: Of the 300 students enrolled in the six cohorts, 176 (59%) completed the programme in the scheduled 4 years. There were no differences in completion rates by gender or route of entry to the programme. Grade point average at medical school entry predicted academic performance. Sixty-four per cent of the students who failed to complete in four years attributed their poor academic performance to social issues. Overall attrition was only 8%. Seventy-six per cent (162/214) of the enrolled students completed the cross-sectional survey. Most (79%) of students' fathers and 58% of mothers had postsecondary education. Seventy-three per cent of respondents indicated that they had been to preschool or elementary school. Thirty-six per cent had attended primary school in a village or government/mission station. Just over half (53%) of the students indicated that English had been the language most used in primary school. Males were more likely to have made a specific career choice than females. The majority (141/162, 88%) of the students indicated that they had experienced some academic difficulty during the years.

Conclusion: Prior academic performance predicted timely completion of the MBBS programme. Just over a third of students had attended rural village primary schools. Social and domestic issues were common and adversely affected academic performance.

Keywords: predictors, academic performance, socioeconomic and educational background

Introduction

Papua New Guinea has a population of some 8.5 million people, the large majority of whom live in rural areas. The country has strikingly varied geographical features, some areas rugged and remote, with high mountains in the central ridge and other areas characterised by flat river plains on the coast. Many of the rural areas are

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http://doi.org/10.2147/AMEP.S252120

difficult to access, and in such areas, health services, if they exist at all, are rudimentary. Life expectancy at birth is around 63y, one of the lowest in the region. [1] The maternal mortality ratio is the highest in the region – reported in the 2016–2018 Demographic and Health Survey as 171 (95% CI 85–247)/100,000).[2] Under-five mortality is around 49/1000 and infant mortality around 33/1000.[3] Until the last 20 years or so, the country's major health problems were infectious diseases (malaria, pneumonia, meningitis, diarrhoea and tuberculosis), with high rates of undernutrition in children. Whilst these problems persist, the incidence of non-communicable diseases, including diabetes, coronary artery disease, hypertension and stroke is rapidly increasing – particularly in the urban area, though the mortality and disease patterns are diverse, as is the population with PNG's 800 cultural and linguistic groups.[4,5] These features, together with a young population with high fertility fuelling rapid population growth, HIV, poorly controlled tuberculosis (TB) and development of multidrug and extremely drug resistant TB, a heavy load of trauma, and increasing numbers of patients with cancer, particularly cervical and oral cancers, put additional strain on the weak and fragile health system. Increasing literacy and the access to media have fuelled the demand for advanced technology and medical and surgical treatment.

The public University of Papua New Guinea (UPNG), the largest tertiary institution in the country, was established in 1965. Tertiary Education is heavily subsidised through direct funding and the availability of student scholarships based on academic performance. The Faculty of Medicine was established in 1967 with its first graduates in 1973. The Faculty structure was changed to a School structure in 1999, and the current School of Medicine and Health Sciences (SMHS) incorporates divisions of nursing, dentistry, health sciences, pathology, basic medical sciences and public health. Initially, the MBBS programme was based on a traditional didactic curriculum, but this was changed to a mixed curriculum based on Problem-Based Learning (PBL)[6,8] in 2000.

The MBBS PBL-based programme admits students from Science Foundation Years (SFY) of the UPNG and Pacific Adventist University (PAU), students with a first science degree, and students from Pacific islands who have completed a high school grade 13 year. The programme is integrated (Basic Medical Sciences and Clinical Sciences taught in conjunction) and community orientated, is based on self-directed learning and is of minimum four years duration.

For the last 20 years the output of medical doctors has varied between 40 and 50 annually, very far below the World Bank's realistic assessment of the need for 100/year by 2020 and 200/year by 2030 and the WHO "threshold" standard of 366 by 2020.[9] The SMHS remains the only training institution in the country currently producing medical graduates. There has been increasing pressure to increase output, but major issues of provision of adequate staffing and infrastructure have precluded this. There are also concerns about the educational background of the students admitted and their ability to cope with the rigours of the MBBS programme. In addition to the demands for an increase in intake, PNG's population distribution requires that most of the school's graduates be capable of and interested in working in rural settings.

Studies in other countries, including lower and middle-income countries, strongly suggest that students' social background and geographical origins are important predictors of career choice and that students from rural areas are more likely than those from urban areas to work in rural environments after initial training.[10] The Training for Health Equity Graduate Outcome Study reported that "rural and low income background and regional location of medical school were the most important predictors of intent to practice in a rural location".[11] Whether or not this applies to the PNG situation is unknown. The interactions of poverty and educational attainment have important implications for the children from disadvantaged communities and their potential for entering medical school.[12]

To inform the school's response to the above pressures, we conducted two related studies. The first was a retrospective study to determine the factors predicting student performance in the PBL-based curriculum. The second was a more descriptive cross-sectional study of the social and educational background of the current students and the problems they experienced during their time in the programme.

Methods

Study 1. Retrospective Study

Data were extracted from the Medical Education Unit office database for six (2008 to 2013) incoming cohorts of students from entry to exit. Data included gender, route of entry into the programme, Grade Point Average (GPA) at entry and at the end of the first year. GPAs of those who

completed in the four years were compared with those of students who had prolonged programmes or who failed to complete the programme. Reasons for interruption in the programme were determined from examination of the curriculum office records. Data were entered into Excel and analysed with SPSS (Version 20). Association between variables was tested using Pearson's correlation. Student's *t*-test was used to compare means and chi squared and Fisher Exact tests were used to compare proportions. Statistical significance was set at $p<0.05$.

Study 2. Cross-Sectional Survey

Data were collected through a self-administered, anonymous, pretested, descriptive questionnaire survey (supplementary file). All 214 students in the four years of the programme were asked to participate. Variables included age, gender, marital status, primary and secondary education background, education and employment status and current residence location of parents or guardians. Students were also asked if they had experienced any academic difficulties and to indicate which one or more of the difficulties listed and to indicate their reasons and motivation for studying medicine. Also queried were their sources of financial support, exposure to computers during their earlier schooling and current ownership of a smartphone. Data were entered into an Excel database and imported to SPSS (version 23) for analysis.

Results

Study 1. Retrospective Study

The numbers of students enrolled in each year's cohort from 2008 through 2013 and the number and proportion completing the programme in 4 years are shown in Table 1.

Table 1 Annual Intake and 4 -Year Completion Rates 2008–2013

Year	Annual Intake N	Graduated 4 Years Later	
		N	(%)
2008	49	32	(65%)
2009	45	32	(71%)
2010	47	25	(53%)
2011	54	33	(61%)
2012	58	26	(45%)
2013	47	28	(59%)
Total	300	176	(59%)
Mean (SD)[a]	50 (5.0)	29 (3.4)	(58%)

Note: [a]Standard Deviation.

One hundred and seventy-two (57%) of the total sample were male, and overall only 59% of the students completed the programme in four years. The numbers and proportions of students graduating in four years by route of entry are shown in Table 2. There was no statistically significant difference in four-year completion rate between students entering by different routes (p= 0.08). The students from Open College (External studies) had the lowest four-year completion rate. Of the 176 students completing in four years, 97 (55%) were males which was comparable (p=0.7) with the total proportion of males enrolled, 57%.

The mean and median entry GPAs of students completing in four years compared with those with interrupted progress are shown in Table 3. The analysis excluded Pacific islands and non-school leavers for whom entry GPA was not available or difficult to compare with UPNG. Entry GPAs for PAU students (out of 4 on the transcript) were converted to SMHS GPA equivalent (out of 5). There was a clear association between entry GPA and completion in four years (Student's *t*-test p=0.001. There was a weak correlation (r=0.314) between students' GPA at

Table 2 Students Completing in Four Years by Route of Entry

Entry Source	Intakes (N=300)	No (%) Completing in Four Years
UPNG SFY[a]	193	117 (61%)
PAU SFY[b]	32	17 (53%
Graduate students	22	14 (63%)
Pacific islands	22	14 (63%)
UPNG Open College	23	9 (41%)
Others	1	1
Unknown	7	4
Total	300	176 (59%)

Notes: [a]University of Papua New Guinea Science Foundation Year. [b]Pacific Adventist University Science Foundation Year.

Table 3 Entry GPAs of Students Completing in Four Years and Those with Interrupted Progress

Entry GPA	Uninterrupted Progress n=160 (59%)	Interrupted Progress n=112 (41%)
Mean (SD)[a]	3.9 (0.41)[b]	3.71 (0.38)[b]
Median	3.85	3.63
Interquartile range	3.63–4.20	3.46–3.92

Notes: [a]Standard Deviation. [b]Difference between means 0.19 (95% confidence interval 0.09–0.29) p=0.001.

entry and at the end of the first year of the programme and stronger correlation between GPA at the end of the first year and the end of subsequent years (r= 0.56, 0.51 and 0.47). Of the 124 students who had an interrupted programme, 24 either were excluded or withdrew (5 on disciplinary grounds, 18 on academic grounds and 1 student withdrawing for personal reasons, Fifty-seven (19%) of the 300 students) completed in 5 years, 29 (10%) in 6 years and 13 (4%) up to 10 years from entry. The outcome for 1 student is unknown. The overall attrition for the 6 years' cohorts was 8%. Sixty-four per cent of the students who failed to complete in four years attributed their poor academic performance to social issues.

Eighty-seven students were noted to have personal and social difficulties which interfered with their academic performance and progress. Financial issues accounted for 45 (52%), pregnancy for 25 (29%), significant illness for 7 (8%) and psychosocial issues for 10 (11.5%). Males were significantly more likely than females to indicate financial difficulties (37/52–71% vs.8/35–23%; p<0.001) and psychosocial issues (9/52 −17% vs. 1/35–3%; Fisher exact p<0.04) than females.

Of the students who graduated after a prolonged programme, 45% repeated 2nd or 3rd (largely preclinical) years, 31% 4th or 5th years, and 24% delayed the start of the clinical attachments.

Study 2. Questionnaire Survey

The response rate was 76% (162/214) with no difference in gender response rates (78% of enrolled male vs. 84% of females). The respondent mean (SD) age was 23 (3.15), median 21 and ranged from 18 to 36 years. One-eighth or 20/160 (12.5%) of the respondents were married or in a de facto relationship, one was divorced and 15 (9%) had children.

Parental Education, Employment and Residence

The details of parental education and employment status are outlined in Table 4. Almost 80% of the students' fathers and 58% of mothers had postsecondary education with 49% of fathers and 23.4% of mothers having received University education. A significantly higher proportion of the fathers had paid employment than the mothers (82% vs. 56%; p<0.001). The difference in the proportion of mothers and fathers working as health professionals did not quite reach significance (P=0.07). Eleven of the 19 fathers or male guardians were doctors compared with 3 of 22 mothers or female guardians, of whom 16 were nurses. However, most of the fathers, 84/142 (59%) fathers, were in the higher paid occupations, compared with 46/119 (39%) of the mothers (p=0.001). About a quarter, or 39/160 (24%) of parents or guardians were living in their village or in a rural government or mission station, whilst 61 (38%) were residents in Port Moresby (the national capital). Slightly less than half of all the students, 46%, reported being the first in their families to study at university level.

Table 4 Details of Parental Education and Employment Status

Education and PAID Employment	Fathers No. (%)	Mothers No. (%)
Highest level of Education		
No education	14 (9%)	19 (12%)
Primary	9 (6%)	25 (16%)
Secondary	11 (7%)	23 (15%)
Post-Secondary	127 (79%)[a]	91 (58%)[a]
University	79 (49%)[b]	37 (23%)[b]
Paid employment		
Paid Employment	130/158 (82%)[c]	90/161 (56%)[c]
Health Professional	19/130 (15%)[d]	22/90 (24%)[d]

Notes: [a]p<0.001, [b]p<0.001, [c]p<0.001, [d] p=0.07.

Financial Support and Payment of Fees

The vast majority, 146/159 (91%) overall, with 81/82 (96%) females and 65/77 (83%) males (p=0.019) indicated that their biological parents had been their main financial supporters. Only about one-fifth, or 29/159 (18%) overall, 7/77 (9%) of the males and 22/82 (27%) of the females (p=0.001), indicated that paying UPNG fees had not been a problem for their families.

Education Background

Almost three-quarters, or 73% of respondents, indicated they had been to preschool or elementary school prior to moving into formal education. Table 5 shows the location of the students' primary and secondary education.

Fifty-seven (36%) had attended primary school in a village or government/mission stations and 26 (16%) had attended an International Education Authority primary school. Lower proportions, 26% and 7%, respectively, had attended such schools for secondary education, with Town/City government secondary

Table 5 Details of Students' Educational Background

Location/ Administration of Schooling	Primary School No. (%)	Secondary School No. (%)
Village Government station	40 (25%)	28 (17%)
Village Church station	17 (11%)	15 (9%)
Town/City Government	45 (28%)	74 (46%)
Town City Church Primary	30 (19%)	26 (16%)
International Education Authority	26 (16%)	12 (7%)
Overseas	2 (1)	4 (2.5%)
Other	2 (1)	3 (2%)

schools being the type of school attended by the largest group, 46%, of the students.

Eighty-five (53%) of the students indicated that English had been the language most used in primary school, and there was a significant gender difference, with the females reporting being more likely than males to have been taught mainly in English.

Access to Technology

Higher proportions of female than male students had access to television (p=0.08) and computer (<0.001) during primary school and to computers in secondary school (p=0.006). The vast majority, 149 (92%) of students owned a smartphone, 67/77 males and 82/84 females (p=0.01), and second and third year students were more likely to own a smartphone than those in fourth and fifth year (p=0.02). Forty per cent of the students used Google search as their most frequent source of information.

Reasons and Motivation for Studying Medicine

Table 6 documents the reasons the students were studying Medicine, and Table 7 indicates the students' responses to the question on motivation. A higher proportion of males than females indicated that they had made a specific career choice (p=0.023).

Academic Difficulties

Most, or 141/162 (88%) of the students indicated they had experienced some academic difficulties. Table 8 indicates academic difficulties faced and the proportion of the 141 students reporting specific difficulties.

Table 6 Students' Reasons for Studying Medicine

Description	Male (n=75)	Female (n=82)	All (n=157)
	No. (%)	No. (%)	No. (%)
I have always wanted to be a doctor	30 (40%)	49 (60%)	79 (50%)
I was born to be a doctor	10 (13%)	9 (11%)	19 (12%)
My parents have always wanted me to be a doctor	7 (9%)	10 (12%)	17 (11%)
Seemed like a reasonable choice	28 (37%)[a]	14 (17%)[a]	42 (27%)

Note: [a]p=0.023.

Table 7 Students' Motivation for Studying Medicine

Motivation	No/151 (%)
I will be able to improve the health status of my community	24 (16%)
I will be able to contribute to the health services of the country	86 (57%)
I will be able to apply science to solving challenging health problems	21(14%)
I will be able to earn enough to support my present and future family	14 (9%)
The training will equip me to be a leader	6 (4%)

Table 8 Specific Academic Difficulties Reported

Academic Difficulty Reported	Proportion (%)
Adjusting to the workload	60
Developing effective learning skills	56[a]
Too much social/other activities	36
Teacher's expectations	32
Family/domestic crisis	21
Academic staff intimidating.	17
Medical conditions interfering	13
Tutorial group work difficult	10
Others.	8

Note: [a]Females > males (p=0.004).

Discussion

There did not appear to be major differences in academic performance in terms of finishing within the expected four years between males and females or between students entering the programme from the different routes. However, our data did suggest that those from Open

College (External Studies) were more likely to have prolongation of the programme than others.

Academic achievement as measured by GPA at entry was clearly associated with uninterrupted progress through the programme. This has major implications for student selection – not only to the SMHS but to other institutions planning to graduate medical students in the future. The overall attrition rate of 8% was comparable to that in other Medical Schools.[13,16] Inevitably there will be students who find the medical programme difficult, and it was instructive to note that 88% of the current students admitted that they had faced one or more academic difficulty. Female students seemed to be more self-analytical than their male counterparts, with higher proportions indicating difficulty in developing effective learning skills and in understanding teachers' expectations. Near peer group mentoring has been shown to reduce stress, assist in the transition to medical training in first year students and to assist with personal and professional development of both junior and mentoring students.[17] A recent small trial of peer mentoring in the school was well received and the school plans to formalise the programme. Training of academic staff in adult learning may improve the student learning environment. Our two studies were consistent in the finding that the proportion of male students affected by social and domestic difficulties was greater than that of the females. It was alarming that 21% of those reporting difficulties faced such problems, and indicates the urgent need for the school to provide formal counselling services and appropriate referral pathways for seeking professional help when needed.

It was not surprising that many of our students come from a: "middle class" background, with 79% of fathers and 58% of mothers having post-secondary education, compared with only 11% and 8%, respectively, of the general population.[18] The relatively high proportion of fathers and mothers in paid employment, 82% and 56%, respectively, was also not surprising. Nevertheless, 28% of the parents or guardians were living in nonurban situations and 36% of the students had attended village or station primary schools. The anonymous nature of our study did not allow us to compare academic performance of students from the different academic backgrounds. A recent unpublished study showed that the age at which PNG children learnt to communicate in the English language was closely associated with academic performance in the MBBS programme, with increasing age of onset of English acquisition and age at literacy being inversely correlated with GPA.[19] Students entering from Science Foundation Year (around 90% of them) were the "high achievers" with the best entry GPAs. It is at least possible that some educationally disadvantaged students who may well have the qualities to become good medical and health practitioners are left behind.

Female students were more likely than their male counterparts to have had access to computers in primary and secondary school and more likely to have smartphones. In addition, a higher proportion of the families of female students had not experienced difficulties in paying fees, suggesting differences in social background – or perhaps more intentional support to female than to male children.

One limitation of the study was that more of the variables did not overlap between the studies, such as entry GPA and student origins. GPA was not included in the cross-sectional study since it was felt that it could potentially affect anonymity and deter participation. However, the fact that more than a quarter of our students originated from rural areas, just under half were the first in their families to receive university education and females were receiving technological support and entering and graduating with parity to males, together indicate that a significant degree of social mobility through medical education is evident in students of diverse social backgrounds in PNG.

Conclusion

Entry GPA as an indicator of prior academic performance predicted timely completion of the MBBS programme. Whilst only 59% of the students completed the programme in the scheduled time, overall attrition was 8%. Although predominantly of middle-class background a third of students had received primary education at rural village schools. Social and domestic issues are common and adversely affect academic performance. The studies provide information which should assist in student selection and indicate the necessity of improving student counselling and support services. Further studies could usefully explore the social factors influencing academic performance, and knowledge of the major stresses faced by the students and their coping strategies could provide the basis for improvement in the schools capacity to support students facing psychological stress. An understanding of students' study skills and habits, including time management, planning and writing ability could lead to early interventions to assist students struggling with academic requirements.

Abbreviations

GPA, grade point average; MBBS, Bachelor of Medicine, Bachelor of Surgery; PAU, Pacific Adventist University;

PBL, problem-based learning; PNG, Papua New Guinea; SFY, Science Foundation Year; SMHS, School of Medicine and Health Sciences; TB, tuberculosis; UPNG, University of Papua New Guinea; WHO, World Health Organisation.

Data Sharing Statement

All data and materials are available at the School of Medicine and Health Sciences Medical Education Unit.

Ethics Approval and Consent to Participate

The studies were approved by the University of Papua New Guinea School of Medicine and Health Sciences Research and Ethics committee. Participation in the student survey was entirely voluntary.

Acknowledgments

We acknowledge the students who took part in the survey and are grateful to Ms. Lineth Pokas for entering and cleaning the student survey data.

Author Contributions

All authors made substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; took part in drafting the article or revising it critically for important intellectual content; gave final approval of the version to be published; and agree to be accountable for all aspects of the work.

Disclosure

The authors report no conflicts of interest in this work.

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