**Entry characteristics and performance in a Masters module in Tropical medicine: a 5 year analysis**

R Weigel1\*, D Robinson1, M Stewart1, S Assinder1

1Liverpool School of Tropical Medicine, Department of Education and Training, Pembroke Place, Liverpool, L3 5QA, UK

\*corresponding author

[ralf.weigel@lstmed.ac.uk](mailto:ralf.weigel@lstmed.ac.uk)

[dan.robinson@lstmed.ac.uk](mailto:dan.robinson@lstmed.ac.uk)

[martyn.stewart@lstmed.ac.uk](mailto:martyn.stewart@lstmed.ac.uk)

[sue.assinder@lstmed.ac.uk](mailto:sue.assinder@lstmed.ac.uk)

**Abstract**

**Objectives:** Postgraduate courses can contribute to better qualified personnel in resource-limited settings. We aim to identify how entry characteristics of applicants predict performance in order to provide support measures early.

**Methods:** We describe demographic data and end-of-module examination marks of medical doctors who enrolled in a first semester module of two one-year MSc programmes between 2010 and 2014. We used t-tests and one-way ANOVA to compare, and post hoc tests to locate differences of mean marks between categories of entry characteristics in univariate analysis. After exclusion of collinear variables, multiple regression examined the effect of several characteristics in multivariable analysis.

**Results:** Overall, 89 students (47% male) with a mean age of 32 (SD 6.4) years who received their medical degree in the UK (19%), other European (22%), African (35%) or other countries (24%) attended the 3-months module. Their mean mark was 69.1% (SD 10.9). Medical graduates from UK universities achieved significantly higher mean marks than graduates from other countries. Students’ age was significantly negatively correlated with the module mark. In multiple linear regression, place of medical degree (β=-0.44, p<0.001) and time since graduation (β=-0.28, p=0.007) were strongest predictors of performance explaining 32% of the variation of mean marks.

**Conclusion:** Students’ performance substantially differs based on their entry criteria in this 1st semester module. Non- UK graduates and mature students might benefit from early support.

**Introduction**

The World Health Organisation (WHO) calls for a transformation and scaling up of health professionals’ education and training in order to address comprehensively the crisis in human resources for health in resource limited settings (1;2). Health professionals “should be educated to mobilise knowledge and to engage in critical reasoning and ethical conduct so that they are competent to participate in patient and population –centred health systems as members of locally responsive and globally connected teams” (3). Academic institutions in developed and developing countries will need to play a main part to realise this vision, including in the UK where most of Europe’s undergraduates and postgraduates in global health-related programmes are studying (4).

There is an urgent need for intensified evaluation of programmes providing medical education and sharing best practices (3) in order to identify what teaching and learning approaches are relevant to the needs of health systems (1). For example, very little is known about the background, learning experience, performance and future impact of students undergoing education in global health-related postgraduate courses. Studies in postgraduate medical education in global health rarely analyse quantitative data about demography and prior academic background of their participants. Qualitative studies (5), alumni surveys (6;7) and reports from Southern academic institutions (8-10) dominate the peer reviewed literature.

The Liverpool School of Tropical Medicine (LSTM) has a long tradition of postgraduate medical education. The Diploma in Tropical Medicine was established in 1904 as a University of Liverpool degree and the first Master’s programme (in Parasitology) started in 1963. Postgraduate education in Tropical Paediatrics started in 1970 with a Diploma course that extended to the MSc in Tropical Paediatrics (MTP) in 1990. The predecessor of the MSc in Tropical and Infectious Diseases (MTID) began in 1983 as the MSc in Tropical Medicine (11). LSTM enrols clinicians with a Bachelor degree in Medicine and Surgery (e.g. MBBS or equivalent) and 1-2 years clinical experience into the MTID and MTP; the programmes are taught full-time over one year in Liverpool and include an independent field-based research project leading to the dissertation.

After a major review of LSTM’s Master’s programmes in 2010 we are now revisiting these programmes to judge the effect. For example, in many courses we replaced didactic lectures by small group teaching to promote active and self- directed learning (12;13) and enhance outcomes. In Semester 1, all MTID and MTP students must pass a module entitled “Current clinical challenges in tropical and infectious diseases” (Trop 938). Our challenge is to predict within the first few weeks which participants are at risk of not achieving their potential and to offer supportive measures early. Therefore, our objective in this paper is to examine associations between the entry characteristics of the Trop 938 students and end of module marks.

**Methods**

Trop 938 uses diverse learning and teaching methods (Box) blending face-to-face with online learning (14) through the virtual learning environment (VLE) (15). Group work allows students to share their experience, learn from each other and fosters deep learning (16). The module’s assessment has three components: two written exams in short answer format including practical microscopy questions based on clinical case scenarios focussing on diagnosis and management (each contributing 40%), and a written (until 2012) or oral exam (contributing 20% to the end-of-module mark) about a public health aspect of one of the topics. Students give feedback about their learning experience through a standardized anonymous end of module survey.

Data collection

Baseline demographic data including English language skills and module marks are routinely collected annually and verified by the Education and Training Department. We used first sit marks because the study is concerned with the initial performance level. Data for the cohorts 2010 to 2014 were abstracted from teaching records and entered into an Excel spreadsheet. The study relies completely on routinely collected data, does not include a new intervention or allows identification of participants. We therefore did not require ethical approval.

Statistical analysis

Summary statistics [frequencies, mean (SD)] for this retrospective study were used to describe entry characteristics, shown as variables and subdivided in categories. Frequencies of nominal categorical variables were compared by the Chi square test; for continuous variables we used the t-test. After testing for normality and equality of variance we used t-tests and one-way ANOVA for univariate analysis to describe differences in the means of the outcome variable end of module mark (kurtosis 0.456, skewness 0.043) within categories of categorical explanatory variables. The more robust Welch F statistic was reported where the assumption of equality of variance was violated. We tested the null hypothesis that there are no differences between means of the module mark for each variable category. If they were found a test was used post-hoc to locate them. The Hochberg GT2 post hoc was chosen as this is most appropriate when the sample sizes are different between groups. Thereafter we examined the correlations between continuous variables using the appropriate coefficient (Pearson’s r or Spearman’s rho) to estimate the magnitude and direction of the association (e.g. 1= perfect positive correlation, 0=no correlation), and collinearity (i.e. r close to 1). To analyse the influence of explanatory variables on the outcome in the presence of other variables we preformed multiple linear regression. The first model included all variables, except age, which contributed most to collinearity. We reduced variables stepwise backward to observe changes in adjusted R-squared values to identify the model that explains most of the variation in the outcome and assessed the fit (17). Weighted beta values indicate the relative contribution of each variable, estimating the effect size (17). Stata version 10.1 (18) and a significance level of 95% were used.

**Results**

The two programmes attracted 89 students from 36 countries over the 5 years. Most of the participants came from European countries (41%) including the UK (19%) and Africa (35%), with half of these from Nigeria. Similarly, most participants also graduated from European or African medical schools (Table 1). Their mean age was 32 (SD 6.4) years and men were slightly older than women (34 vs 31 years). When studying at LSTM they had completed their medical degree a mean of 7 (SD 5.1) years ago. For 19% of the students there was a gap of over 10 years since graduation. All but one of the participants completed the module and sat the examinations. The mean module mark at first sit was 69.1% (SD 10.9) and 53% of students achieved a distinction grade (i.e. a mark of >70%). Frequency distributions of categorical and means of continuous variables between the two programmes did not differ.

Among medical graduates from the UK, other European countries and other non- African countries, the proportion of women was higher than among African graduates [70%, 58% and 67% vs 32%, χ2 (3) = 9.226, p=0.026]. The majority of participants from the UK started the module within 2-4 years after completing medical school (67% of UK participants), while most of the participants from other European countries, Africa and other regions started 5-9 years after their medical degree (71%, 42% and 35% respectively).

Table 1 shows the profile of frequency distributions for the different variables and clear differences can be seen. The variables age and time since medical degree were grouped into bandings for convenience to visualise distributions, but for further analysis were treated as continuous data (years) to maximise resolution.

Tests for differences in mean marks

The differences in mean module marks for the grouping variables are shown in Table 2. The largest differences are associated with the country in which the medical degree was awarded, with students who obtained their degree in the UK and other European countries scoring highest. Tests confirmed that this was the only grouping variable to show difference statistically significant for the limited sample size available (Welch’s F-ratio 15.7, p<0.0001). The size of the effect is large (ϖ2 = 0.336) using partial omega squared appropriate for smaller samples. Post-hoc analysis reveals that a significant difference lies between graduates from UK medical schools and the other groups: the former achieving higher mean marks [79.4% (SD 5.5)] than graduates from other European [71.3% (SD 6.9)], African [67.8% (SD 10.0)] or other countries [61.9% (SD 12.2)], (p=0.067, p=0.001 and p<0.001 respectively). The module marks of graduates from other European countries also differed from those who graduated as medical doctors in countries other than Africa or the UK (p=0.024).

Correlation and multiple linear regression

The students’ age and time since graduating were also found to be associated with the module mark, with moderate, negative and statistically significant associations confirmed by correlation tests [Pearson’s r -0.44 (p<0.0001) and -0.40 (p<0.001) respectively]. The continuous variables age and time since medical degree were collinear and had more than 70% in common (r=0.84, r2=0.705).

After exclusion of the collinear variable age, stepwise backward reduction to two variables in model 5 explained 32% of the variation in the outcome variable module mark (R2adjusted=0.32), a moderate fit (Table 3). In this model the place of medical degree is the most important predictor with a moderate effect followed by time since medical degree with a modest effect on the module mark (β=-0.44, p<0.001 and β=-0.28, p= 0.007 respectively). The scatter graph for model 5 plotting residuals against the fitted values confirmed a random distribution of the scatters (graph not shown).

**Discussion**

Medical doctors with diverse cultural backgrounds attend our two programmes, often many years after their medical graduation, and frequently achieve excellent results. However, our retrospective analysis shows that the academic achievement of such students on this module is associated with where they graduated and how long ago. Participants from the UK and other European countries and participants who graduated more recently from medical school tend to perform better at the end of the module.

Predictors for postgraduate achievement in medics have been examined but most published evidence comes from undergraduates as they progress through their five years at university or from postgraduates seeking medical specialisation (19;20). In a one-year Master’s programme, the data available when students commence the programme is usually limited to that collected routinely as part of the application process. As such, our findings of what might predict performance using this type of data is valuable. On a wider scale, the analysis challenges us to reflect on the module’s teaching and assessment and how it corresponds to the needs of global health education (21;22). Does it help participants to become not only experts in knowledge but “agents for change” with leadership attributes for settings with few resources (3)? The rewards we give influence their learning and practice in future.

We found the place where participants graduated as medical doctors predictive for module performance. Clearly, this variable may stand for many characteristics, including prior learning experiences with exposure to differing learning and teaching styles at universities and how universities select medical students. These experiences will be partly reflected in the academic performance prior to registering for postgraduate studies, and studies suggest that prior achievement is relevant for future academic performance (23). However, with such diverse demographic background among our module participants it is unlikely that undergraduate grades are comparable. Baseline English skill is an important predictor of achievement when it is the language of instruction (24) not only with regard to writing exams but for interacting with other students (25). However, our analysis doesn’t give a clear indication that language is the explanation. Baseline language skills are difficult to stratify in a routine situation and may be too imprecise to truly reflect English language skills. For example in our case, UK citizens originating from non- English speaking countries do not require an IELTS test to study at LSTM. Comparing scores of different English language tests is also difficult. Unmeasured variables may play a role, probably related to the students’ adaptation to cultural differences in our teaching style, given the differences in performance between students with UK, other European or African background.

Furthermore, how long ago module participants graduated from medical school and module marks were associated. Time since graduation is also a broad variable. For example, it could be simply age and ageing is associated with changes in processing and memorizing information. However, evidence of how age affects academic performance is conflicting (26;27). On the one hand medical school was probably for many students the last encounter with academic life, up to date factual information, formal learning, and assessment. On the other hand, professional life offers other learning opportunities. Perhaps viewing this information in the context of the individual’s academic transcripts, personal statement, letters of referees, and descriptions of educational and professional history will be more helpful for the module convenor to get an impression of the applicant’s academic capabilities.

The study has a number of limitations. First, our outcome parameter module mark measures performance at the end of the module. However, we are interested in students’ learning, the progress they make, and the relationship to our participants’ differing educational and professional backgrounds. Their engagement in module-related activities in and outside the classroom would better reflect learning (28), although this unfolds over time. In addition, the introduction of an oral exam in 2012, contributing 20% of the module mark, may have had an impact on the grade distribution. Second, we only examined a very limited number of entry characteristics to predict performance. Others, such as participants’ perceptions of self-efficacy, motivation to study, prior academic success and cognitive ability were not available to be tested. Whilst a wider range of background variables is desirable, as an applied study we were limited to routinely collected data. For any future extension of this study a fuller range of variables would be collected. Third, our retrospective analysis misses data, e.g. on students’ English language skills and date of their undergraduate medical degree. In future, relevant data will be collected prospectively and more completely, allowing a differentiated view. Finally, a qualitative design would complement our quantitative findings.

The study does, however, highlight the value of interrogating course data. The module is situated at a critical stage within the programme, in the first half of the course. Its content emphasises the context of working under resource constrained settings. Therefore, it is disappointing to find from our analysis of student performance that those students who enter the programme with greater clinical working experience in these settings, the mature non-European students, tend to fare less well. In contrast, the European participants more recently graduated from medical school perform better. Why so? It may be partly explained by baseline language skills, but our analysis prompts us to reflect on the current assessment process. It tests mainly knowledge recall alongside proficiency in writing skills, and more recently, includes an oral exam. However, if we assume that more mature, non-European students gained particular strengths from their greater clinical experience then this is not sufficiently captured by this assessment design. Is there a need to modify the assessment to more effectively capture those course-relevant insights and skills from our more mature, non-European student cohort? Furthermore, given the position of this module at the beginning of the programme it is important that the latter do not become de-motivated by any reduction in performance (29) that will prevent them from becoming “agents for change” (3).

Two interventions could help solving the issues identified. First, a modified assessment strategy within the confines of the learning outcomes needs to assess higher levels of thinking (30). Are we assessing the qualities we aim to develop among our course participants? We will place greater emphasis on the critical thinking, judgement and decision-making that will allow the experiential knowledge of the more mature, non-European students to be recognised. The introduction of the oral exam may have helped lessen the emphasis on writing ability and already provides opportunities for students to apply their knowledge critically (31;32). Second, we should assess learning progress rather than end of module performance. Formal formative feedback and summative assessments spread over the entire course of the module would better monitor students’ learning and identify struggling under-performing students at an earlier stage. For this purpose, students’ group work could be assessed summatively although capturing individuals’ contributions is challenging (33). In summary, we have developed an evidence base for tailoring our module delivery to support students who graduated many years ago and have a non-European background. Looking forward, a modified assessment strategy could evaluate our students’ varied abilities more comprehensively, and better prepare LSTM postgraduates for the tasks ahead.

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