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STUDENT NURSE SELECTION AND PREDICTABILITY OF ACADEMIC SUCCESS:  
THE MULTIPLE MINI INTERVIEW PROJECT

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## **Abstract**

**Background:** With recent reports of public enquiries into failure to care, universities are under pressure to ensure that candidates selected for undergraduate nursing programmes demonstrate academic potential as well as characteristics and values such as compassion, empathy and integrity. The Multiple Mini Interview (MMI) was used in one university as a way of ensuring that candidates had the appropriate numeracy and literacy skills as well as a range of communication, empathy, decision-making and problem-solving skills as well as ethical insights and integrity, initiative and team-work.

**Objectives:** to ascertain whether there is evidence of bias in MMIs (gender, age, nationality and location of secondary education) and to determine the extent to which the MMI is predictive of academic success in nursing.

**Design:** A longitudinal retrospective analysis of student demographics, MMI data and the assessment marks for years 1, 2 and 3

**Settings:** One university in south west London

**Participants:** One cohort of students who commenced their programme in September 2011, including students in all four fields of nursing (adult, child, mental health and learning disability).

**Methods:** Inferential statistics and a Bayesian Multilevel Model

**Results:** MMI interviews in conjunction with MMI numeracy test and MMI literacy test shows little or no bias in terms of ages, gender, nationality or location of secondary school education. Although MMI interviews in conjunction with numeracy and literacy testing is predictive of academic success, it is only weakly predictive.

**Conclusions:** The MMI used in conjunction with literacy and numeracy testing appears to be a successful technique for selecting candidates for nursing. However, other selection methods such as psychological profiling or testing of emotional intelligence may add to the extent to which selection methods are predictive of academic success on nursing

Key words: Student selection, MMI, numeracy testing, literacy testing, interviews

## **Introduction**

Universities are responsible for recruiting and selecting students who possess the right aptitudes, values and potential capacity for nursing and midwifery innovation (Callwood et al 2012). However, recruiting and selecting the right students onto academic nursing programmes is a challenging task for Higher Educational Institutions (HEIs). In the United Kingdom (UK), HEIs are under scrutiny and they are held more accountable than ever before for the quality of the education and support they provide and in driving up standards for positive impact of qualified nurses on patient outcomes (Royal College of Nursing 2012).

Although student satisfaction, retention, and employability are a few of the quality measures against which universities are judged, nursing education is under additional scrutiny because of perceived failures in practice to deliver safe and appropriate care to service users (Francis 2013). As a result, nursing education is undergoing many changes at different levels, including how students are selected for nursing programmes.

The recent reports into failures of care at the Mid Staffordshire NHS Trust in the UK (Francis, 2013) emphasised the need for universities to identify people with the right attributes to enter the profession of nursing. These reports recommended that, as a condition of being accepted onto a nursing degree, aspiring nurses need to demonstrate appropriate values as well as a desire to care for patients, and that this should be tested at the point of selection.

In response, the School of Nursing in a Faculty of Health, Social Care and Education in one university in London, UK, implemented a new method for selecting students who apply to the undergraduate nursing programme. This involved the use of the Multiple Mini-Interview

(MMIs) in conjunction with numeracy and literacy testing. The MMIs are based on six fundamental values, known as the 6C's (Department of Health (DH) 2012). The 6C's are: care, compassion, competence, communication, courage and commitment.

The Nursing and Midwifery Council (NMC) in the UK sets standards and procedures for recruitment and selection of student nurses. These can be categorized under three main themes: academic criteria, 'good health' and 'good character' (NMC, 2010). More recently, Health Education England (HEE) have recommended the inclusion of value-based recruitment into nursing (HEE 2013). Evaluating a candidate's ability to exhibit core nursing values should ensure the correct candidates will be recruited and will excel in the healthcare environment (DH, 2012).

Nursing is a complex job which relies on relationships with patients. Future recruits need a combination of intellectual and social skills, as well as attributes such as empathy, honesty and integrity - traits not often revealed through more traditional interview techniques. The MMI is a value-based approach aiming to recruit students with the right values and attitudes of caring, honesty, compassion, leadership and decision-making to become compassionate and caring professionals with good communication skills. Thus, non-cognitive competencies are assessed at interview, alongside assessment of cognitive abilities through numeracy and literacy tests. It is therefore important that these three selection methods are valid and that applicants from diverse backgrounds have equal opportunities to be successful. In addition, the predictive validity of the MMI, numeracy and literacy tests also needs to be assessed.

Literacy and numeracy testing has been a component of student nurse selection in most universities, usually combined with an interview. More recently, the MMI is being used by

universities across the world to recruit medical students, and is beginning to be used for the recruitment of nursing students. The MMI process is described later in this article. In 2011, the School of Nursing at Kingston University and St George's, University of London (KU/SGUL) introduced the MMI into student nurse selection for candidates applying for their BSc (Hons) and Postgraduate Diploma pre-registration Nursing Programmes. This paper presents a research study undertaken to evaluate the validity and equality of the MMIs for one such cohort.

### **Literature review**

Recent studies show that universities employ many diverse methods for selecting candidates to enter nursing programmes and that there is an absence of evidence-base for most selection methods employed (Taylor et al 2014). Methods currently used nationally and internationally include academic success/grades in secondary school (Salvatori 2001, Timer and Clausen 2011) and more recently, use of emotional intelligence tests (Zysburg et al, 2011; Rankin 2013) and psychological profiling (McLaughlin et al 2007). There is some evidence that academic success in secondary school is a predictor for clinical success in nursing (Timer and Clausen 2011).

In the UK, the NMC require that universities undertake some form of face-to-face interview when selecting candidates. Despite this, questions have been asked in the literature about the reliability and validity of interviews as a selection method (Ehrenfeld and Tabak 2000; Salvatori 2001). Although nursing schools desire, promote and value in their students non-cognitive skills such as integrity, ethical judgement, values and empathy, it has not always been clear whether traditional interviewing methods reveal these traits (Eva et al 2004).

As a result interview questions refer primarily to the programme and subsequent profession and responses from candidates are more likely to be learnt in advance rather than assess the character of the candidate (Perkins et al 2012). It has also been suggested that the problem of bias may occur, for instance, where a candidate is fortunately placed with an interviewer of 'like mind' or with one who can influence an interview panel, whereas an incompatible relationship can prove unfavourable (Quintero et al 2009). They suggested that an interview outcome can be influenced by a "halo effect" where decisions of the panel are influenced more by general feelings of 'like or dislike' than on the answers given by or actual qualities of the interviewee.

To address some of these issues surrounding the selection of candidates, universities are adopting new approaches to selecting candidates for nursing programmes. An example is the use of group activities (Eva et al 2004; Miller 2015). Another is the Multiple Mini Interview. MMI's were introduced into the selection of medical students at McMaster University in Canada (Eva et al 2004). The MMI is now used in the selection of medical and other healthcare students across the world. Early research suggests that the MMI may be a reliable and valid way of selecting nursing students (Rosenfeld et al 2008; Lemay et al 2007; Perkins et al 2012). The more recent pilot study by Perkins et al (2012) suggests that applicants' characteristics demonstrated at the MMI match with subsequent performance.

There is evidence in the literature (e.g., Mooney et al 2008; Morris Thompson et al 2011) that even in the 21<sup>st</sup> century, the main reason for choosing nursing as a career is the desire to help and care for others. However, there is an absence in the literature about how to assess these traits on interview. Evidence suggests that new ways of selecting students onto nursing programmes are needed using methods such as aptitude and ability testing and using group exercises to demonstrate abilities in team-working, logical thinking and critical reasoning



(Miller 2015), use of psychological assessments and use of clinical and ethical scenarios (Lemay et al 2007). Additionally, studies have been undertaken in New Zealand (e.g., Shulruf et al 2011) into predictors of success of student nurses. Shulruf et al (2011) found that academic success in the last year of secondary school was the best predictor of success as a student nurse. Similar findings were reported in other countries by Ali and Naylor (2010) Salvatori (2001), Lancia et al (2013) and Wong and Wong (1999). However, in all of these studies, the definition of success was measured by academic success in nursing schools rather than caring skills, communication, empathy or values.

Although a link has been suggested between student nurse attrition and methods of selection used by schools of nursing, the literature related to attrition is not included in this literature review. However, a number of studies have suggested that student retention may be influenced by selection processes (McCallum et al 2006; McCarey et al 2007). Yet analyses of these studies do not include how attributes such as caring, empathy, communication and values were assessed at selection.

A further study by Wood (2014) although not about MMIs as a selection method, reported on a selection method used at one university where candidates are interviewed jointly between a representative from the school of nursing and one from clinical practice. The interview process uses a template of questions designed to assist in selecting students who have both the academic potential as a nurse as well as the potential to care using probing questions about caring attitudes and asking candidates to discuss previous experiences with team working and communication. However, this was a descriptive article with no evidence of any evaluation research being undertaken into the effectiveness of the approach to selection.

More recently, emphasis is emerging about the importance of values-based recruitment in healthcare (Miller 2015). Health Education England (HEE) which is responsible for the education, training and personal development of all staff in the health service has published a framework for values-based recruitment. This is an approach that attracts and selects students, trainees or employers on the basis of their individual values and behaviours to ensure that they match with the values explicit in the NHS Constitution (HEE 2015). These values include compassion, commitment and integrity. The framework is accompanied by a range of tools and resources to ensure that selection onto education and training programmes for all health care staff incorporate testing of values. This framework advocates the use of the MMI as a method for doing this. This supports Callwood et al (2012) who proposed that the MMI offers an alternative admissions instrument to the personal interview and that its efficacy has been examined by medical schools internationally and evaluated by nursing schools in Canada (Callwood et al 2012) with good reliability and validity (McBurney and Carty 2009) .

It is also suggested that other selection activities can be used alongside the MMI such as previous academic record, personal statement by the candidate and literacy and numeracy testing (Miller 2015; Perkins et al 2012).

### **How the MMIs are implemented in one school of nursing in the UK**

Multiple Mini Interviews (MMIs) have been used by the School of Nursing at KU/SGUL since 2011. Although the literature related to MMIs use this term to describe the interview part of selection, in the School of Nursing at KU/SGUL, MMI refers to three processes that make up student nurse selection: numeracy testing, literacy testing and interviews. Selection takes place over one full day. In the morning, students sit a numeracy test and a literacy test

(short answer/essay). If the students pass both test they proceed to the afternoon where they participate in the MMI interviews, which involves moving through six assessment stations. The stations are short and are timed rigorously. Lecturers, health professionals, and/or service users are at each station and assess the applicants' potential, using a marking grid. Each interviewer stays in the same station throughout as applicants rotate through; the interviewer thus scores each candidate based upon the same interview scenario throughout the course of the test. Each circuit requires at least one administrator to support and manage the MMI process and to keep time.

The six scenarios and the marking grids were developed by a team of lecturers, service users, students and clinicians from partner NHS Trusts and are designed to test communication skills, empathy, decision-making and problem-solving, ethical insights and integrity, initiative and team-work. Students may be asked to complete a task, comment on a situation or take part in a role-play while lecturers, health professionals and health service users observe and assess the applicants' potential for leadership, team-work and decision-making in addition to assessing students' level of consideration of the impact of their decisions, whether they rely on prejudicial assumptions and whether they are aware of their own strengths and limitations.

### **The research study**

This was a longitudinal retrospective analysis of student demographics, MMI data and the assessment marks for years 1, 2 and 3 of one cohort of students who enrolled on the BSc Nursing pre-registration programme at one university in southwest London.

### ***Aim of the study***

The study was undertaken to address: (1) whether there is evidence of bias in MMIs (gender, age, nationality and location of secondary education) and (2) to what extent the MMI is predictive of academic success in nursing.

### ***Population/sample***

The cohort of students for this study commenced their programme in September 2011 and included students in all four fields of nursing (adult, child, mental health and learning disability). There were 182 women (89%) and 22 men (11%) in the cohort studied. Students with UK nationality made up 66% of the sample. The median age was 25 and the age range was 20-34. Students who completed their secondary education in the UK comprised 68% of the sample.

### ***Methods***

The study was a longitudinal retrospective analysis of student demographic data, MMI data (numeracy, literacy and interviews) and assessment scores for year 1, 2 and 3 modules of the programme. Students' MMI scores were correlated with their academic assessment scores for each module in year 1, 2 and 3, and with practice assessments scores in year 1, 2 and 3.

Demographic and assessment data from the students in the cohort were accessed from the students' files and entered into Excel. In addition, MMI scores from these students were added to the same Excel spreadsheet. The data was then entered into SPSS for analysis. This complete data set was then used for final analysis.

### ***Ethical approval***

Ethical approval was not sought or required as the study involved analysis of existing student data.

### *Data analysis*

Inferential statistics were used to measure the statistically significant differences of MMI scores for applicants by age, gender, levels of previous health-care related experiences, ethnic background and location of secondary education. A Bayesian Multilevel Model (Gelman et al 2014) was used to analyse assessment success. This was fitted with Stan software using the StataStan interface (Stan Development Team 2015; Grant et al 2015). For this study, success was defined as the mark, in percentage points, obtained on nursing modules in years 1, 2 and 3. Students who failed an assessment simply have a mark of zero recorded, and passes at subsequent attempts are capped at 40%. Therefore, a fail reflects an unobserved ‘latent mark’ between 0 and 39.5%, and capped passes reflect ‘latent marks’ between 39.5 and 100%. These are measures of success but are not precisely known as numbers. We simply know that they lie in a certain range. The Bayesian multilevel model estimates these latent marks for each student, given the other information known about them and their performance on other modules. Then, each student has an ‘ability’ score (other than that explained by MMI) and each module a ‘difficulty’ score, and these are combined with the MMI scores, and whether the assessment is a first or second attempt, to predict the marks, whether recorded precisely or capped and estimated. Both the ability and difficulty scores are assumed to be normally distributed. The justification for using a Bayesian approach is that it allows us to fit a complex model like this, while also estimating the student abilities unexplained by MMI in an intuitive form. To aid computation, we used the method of weakly informative priors.

## **Findings and discussion**

Preliminary analysis of the scores on the MMI numeracy test and MMI literacy test was undertaken prior to students completing the three-year programme and findings are presented below.

### ***Ethnicity, location of secondary education and performance at MMI interviews***

Non-White British students who did not attend secondary education in the UK underperform on the MMI interviews, and this difference in performance is statistically significant.

(Insert Table 1 near here)

### ***Ethnicity, location of secondary education and performance on numeracy test***

On the numeracy test, the non-white British students who did not study in the UK for their secondary education outperformed those students who did their secondary education in the UK, whether or not those students were of UK origin or not.

### ***Ethnicity, location of secondary education and literacy test scores***

Non-white British students who did not attend secondary school in the UK also do not underperform on the English composition test.

### ***Correlation between interviews, numeracy test and literacy test***

Findings showed that there is little to no correlation between MMI interview, MMI numeracy and MMI literacy scores (numeracy versus interview = 0.05, numeracy versus literacy = 0.13 and interview versus literacy = 0.29). The descriptive statistics for the three components of the MMI are presented in Table 1.

(Insert Table 1 near here)

Following the students' completion of their three year programme in September 2014, a more comprehensive statistical analysis was undertaken to address the two aims of the study; the findings are presented by aim.

***Aim 1: Evidence of bias in MMI***

No statistical significant difference was found in any of the three components of the MMI score (MMI Numeracy test, MMI literacy test, MMI interviews) and field of nursing (Interview:  $p = 0.19$ ; Numeracy:  $p = 0.98$ ; Essay:  $p = 0.63$ ; all by Kruskal-Wallis test).

The presence of any previous healthcare experience was not associated with differences in MMI scores (MMI interview:  $p = 0.09$ ; MMI numeracy test:  $p = 0.26$ ; MMI literacy test:  $p = 0.21$ ; all by t-test). Some of the potential biases, e.g., nationality and location of secondary education, showed significant association with MMI interview and MMI Math (See Table 2).

(Insert Table 2 near here)

When adjusted for the year of entry, the association between numeracy and nationality was no longer borderline significant ( $p = 0.10$ , by Linear Regression). When adjusted for the year of entry, the association between numeracy and secondary education was still significant ( $p = 0.03$ , by Linear Regression).

***Aim 2: MMI in conjunction with literacy and numeracy testing as a predictor of academic success***

The Bayesian model estimated the following regression equation:

$$\text{Predicted mark} = 36.7 + (0.4 * \text{Interview}) + (0.3 * \text{Numeracy}) + (0.04 * \text{Essay}) + (2.1 * \text{Attempt}) + \text{ability score} + \text{difficulty score} \text{ (See Table 3)}$$

(Insert Table 3 near here)

What these statistics mean is that MMI Interview and MMI numeracy marks appear to significantly predict academic success, whereas MMI literacy results do not. Adjusting for location of secondary education, which demonstrated the strongest evidence of bias within the selection process, does not appear to change these results. Subsequent attempts of the same assessment are associated with higher marks, as one would expect. The student abilities vary with a standard deviation of 5.5, while the module difficulties are more variable with a standard deviation of 13.3.

The two right hand columns in Table 3 show how MMI predicts success after adjusting for country of secondary education. Because there is very little difference, it can be concluded that location of secondary education does not confound the relationship between the selection process and academic success.

Statistically, there is little or no evidence of bias in the MMI interviews, MMI numeracy test and MMI literacy test in terms of gender, age, nationality or location of secondary education. The students' abilities (from applying the Bayesian model) compares with the crude mean assessment marks and shows a strong correlation which may indicate that the model adds further information to the crude mean marks. However, students with high mean marks tend to be rated high ability using the Bayesian model. This may suggest that the model is stable and reflects closely the observed data.



The range of MMI interview, MMI numeracy and MMI literacy scores is small and multiplying two standard deviations (SD) by the coefficients in Table 3 indicates that a student in the top 5% for both the MMI and numeracy will be approximately 9% higher in their assessment marks than another student in the bottom 5% for both the MMI and numeracy. This is smaller than the student 'ability' score (from the Bayesian model) and much smaller than the module difficulty or unexplained residual variance.

## **Discussion**

The MMI interviews in conjunction with MMI numeracy test and MMI literacy test shows little or no bias in terms of ages, gender, nationality or location of secondary school education. In addition, although the MMI in conjunction with literacy testing is predictive of academic success, it is only weakly predictive. MMI Interview and MMI numeracy marks appear to significantly predict academic success.

Non-White students who attended secondary education outside the UK underperform on the MMI interviews. This may be due to a number of factors including having English as a second language or coming from a culture where speaking for yourself and voicing opinions and argument is not encouraged. With regard to numeracy tests, the non-white students who attended secondary school outside the UK outperformed those students who undertook their secondary education in the UK, whether or not those students were of UK origin or not. We found no explanation for this and further study of this finding would be useful. In addition, non-white students who undertook secondary education outside the UK did not underperform in the literacy test.

Our findings suggest that there are likely to be many other student characteristics that are predictive of academic success. It may be that other selection methods such as psychological profiling (McLaughlin et al 2007) or testing of emotional intelligence (Zysburg et al, 2011; Rankin 2013) add to the extent to which selection methods are predictive of academic success on nursing programmes.

This school of nursing is continuing to study other student cohorts with regard to the relationship between the selection methods used and academic success. Preliminary findings, for example from subsequent cohorts indicate that the mean MMI numeracy scores have increased year on year since 2011 which may be due to any number of factors such as changes to entry criteria for applicants or degree-level nursing attracting a different level of applicant. Further studies are needed into these observations. In addition, any changes made to the MMI interviews, MMI numeracy test or MMI literacy test need to be studied in terms of marks achieved at selection and predictive academic success.

### **Limitations of the study**

This study cannot be generalised to any other setting or to the use of any other selection method for two reasons. Firstly, the study only examined one group of students in one institution. Secondly, the selection processes of other institutions are likely to differ from those used at this institution and would need to be researched individually. Further studies are needed nationally, and even globally, into methods of selection for student nurses and their impact on academic success.

## **Conclusion**

This study set out to examine statistically the extent to which a new way of selecting nursing student onto a BSc(Hons) nursing programme demonstrated bias in terms of gender, age, nationality and location of secondary education, and whether the selection process is predictive of academic success on the programme. The selection process used appears to be free from bias and some elements of the process are predictors of academic success in nursing.

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