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The mediators of minority ethnic underperformance in final medical school examinations

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Abstract

Background: UK-trained medical students and doctors from minority ethnic groups underperform academically. It is unclear why this problem exists, which makes it difficult to know how to address it.

Aim: Investigate whether demographic and psychological factors mediate the relationship between ethnicity and final examination scores.

Sample: Two consecutive cohorts of Year 5 (final year) UCL Medical School students (n=703; 51% minority ethnic). 587 (83%) had previously completed a questionnaire in Year 3.

Methods: Participants were administered a questionnaire that included a short version of the NEO-PI-R, the Study Process Questionnaire, and the General Health Questionnaire as well as socio-demographic measures in 2005 and 2006. Participants were then followed up to final year (2007 to 2010). White and minority ethnic students' questionnaire responses and final examination grades were compared using univariate tests. The effect of ethnicity on final year grades after taking into account the questionnaire variables was calculated using hierarchical multiple linear regression.

Results: Univariate ethnic differences were found on age, personality, learning styles, living at home, first language, parental factors and prior education. Minority ethnic students had lower final exam scores, were more likely to fail, and less likely to achieve a

merit or distinction in finals. Multivariate analyses showed ethnicity predicted final exam scores even after taking into account questionnaire factors.

Conclusions: Ethnic differences in the final year performance of two cohorts of UCL medical students were not due to differences in psychological or demographic factors, which suggests alternative explanations are responsible for the ethnic attainment gap in medicine.

Background

The underachievement of minority ethnic groups is a problem across UK higher education (Connor, Tyres, Modood, & Hillage, 2004; Broeke & Nichols, 2007; Richardson, 2008). Within higher education, medical students are selected to be high academic achievers, but despite this, minority ethnic students still achieve lower grades at medical school than their white colleagues. This ethnic attainment gap has been found at various medical schools in the UK (Woolf, Potts & McManus, 2011), the US (Xu, Veloski, Hojat et al, 1993; Dawson, Iwamoto, Ross et al, 1994; Koenig, Sireci & Wiley, 1998; Veloski, Callahan, Xu, et al 2000; Colliver, Swartz & Robbs 2001), and in other 'Western' English-speaking countries (Kay-Lambkin, Pearson & Rolfe, 2002; Liddell & Koritas, 2004).

The reasons for the ethnic gap in attainment are unclear. Often all that can be said is that a difference exists, with no apparent mechanism, and with confounding always a possibility. In rare cases, racial discrimination can be invoked, as in studies of selection for medical school (McManus, Richards, Winder et al, 1995) and medical jobs (Esmail & Everington, 1993). The force of the claim in each of those cases comes from the study design. The Esmail and Everington study sent matched application forms, differing only in name and ethnicity, and hence differences in interview rates were directly dependent upon ethnicity

and ethnicity alone. The McManus et al study relied, in effect, on Mendelian randomization, applicants of mixed ethnicity (with one parent white and the other non-White, receiving more offers if the male parent were white (and hence the surname was European), than if the female parent were white (and the surname was non-European).

As far as we know, those two studies are unique in the UK medical education literature in being able directly to ascribe observed ethnic differences to discrimination. Other studies invoke the much more complex phenomenon of underperformance, which may arise from a mix of social and cultural factors, possibly stretching back generations. Cohort studies, in which participants are not randomised, have to use statistical methods to disentangle any effects of overt discrimination from those of underperformance. That being said, we can be fairly sure that overt discrimination in examinations *per se* is unlikely to be the cause of the ethnic gap, not least because the effects are also found in machine-marked knowledge examinations (Dewhurst, McManus, Mollon et al 2007; Woolf et al 2011). More subtle effects, such as stereotyping (Lempp & Seale, 2006; Woolf, Cave, Greenhalgh & Dacre 2008) or stereotype threat (Steele & Aronson, 1995) may affect minority students' learning and performance, but difficulty in measuring such subtle effects means much of the quantitative research in this area has concentrated on seeing whether data routinely collected by universities can help explain the ethnic gap in attainment. We briefly review the evidence for the three most common suggestions - socioeconomic group, prior attainment and language - before explaining our approach to investigating this problem.

Socioeconomic group

Minority ethnic groups tend to have higher levels of socioeconomic deprivation (The Cabinet Office, 2003; Platt, 2009), and both ethnicity and socioeconomic group are linked

to attainment in compulsory education (Department for Education and Skills, 2006; Strand, 2008; Zwick & Green, 2007). For example, in the UK, much of the difference in the examination performance of white British and Pakistani and Bangladeshi pupils at age 16 is due to the latter's lower socioeconomic group (Strand, 2008). Ethnicity and socioeconomic group also have indirect effects on GCSE and A-level achievement via parental education and schooling (McManus, Woolf & Dacre, 2008). In higher education, Fielding Charlton, Kounali and Leckie (2008) analysed the degree results of 66,432 students taking finals at UK universities in 2004-5 [*nb* although medicine and dentistry was included, medicine does not have a classified degree, and therefore the medicine and dentistry results in the study refer only to intercalated degrees (*cf* Richardson, 2008)]. Fielding et al (2008) used multilevel modelling techniques to examine which factors mediated or moderated the relationship between ethnicity and degree attainment. The results showed that socioeconomic group did account for a small amount of the ethnic gap, but did not fully explain it.

Medical students traditionally come from the highest socioeconomic groups (Seyan, Greenhalgh & Dorling, 2004) and therefore ethnic differences in medicine may be related to socioeconomic status in a way not found in the general university population. Some reports have claimed that socioeconomic group relates to medical school performance (The Royal Commission on Medical Education, 1968) but this relationship has not been found in other studies (McManus & Richards, 1986). Few studies have analysed differences in medical school attainment by both socioeconomic group and ethnicity. A systematic review of UK studies (Woolf et al, 2011) found only two, and both showed effects of ethnicity on attainment which were not accounted for by differences in socioeconomic status or schooling (Lumb & Vail, 2004; Yates & James, 2010).

Prior attainment

School-leaving examination performance is probably the strongest predictor of medical school exam performance (James & Chilvers 2001; Ferguson, James & Madeley, 2002; McManus, Smithers, Partridge et al 2003), but few UK studies have looked at ethnic differences in medical school attainment controlling for this factor. The two we found showed ethnic differences persisted when controlling for prior attainment (Lumb & Vail, 2004; Yates & James, 2007).

Language or communication difficulties

Studies from around the globe have found that medical students who are native speakers of the language in which they are being assessed achieve higher scores (Chur-Hansen, 1997; Frischenschlager, Haidinger & Mitterauer, 2005; Liddell & Koritsas, 2004). Although language and ethnicity are linked, they are of course different. UK studies looking at whether language ability explains ethnic differences in medical school attainment have mixed results. Wass, Roberts, Hoogenboom and colleagues (2003) found that minority ethnic students achieved lower final year communications skills grades, and qualitative analysis suggested that a sub-group of male minority ethnic students performed particularly poorly and that white examiners and minority candidates may have had subtly different interpretations of “good” communication. Haq, Higham, Morris & Dacre (2005) however found ethnic differences in the Year 3 medical school attainment of native English speakers, suggesting language ability cannot fully explain minority underperformance.

The current study

The current study sought to explore whether the above-mentioned factors, or other factors previously found to influence medical school attainment (e.g. Ferguson et al. 2002) could account for ethnic differences in attainment at one UK medical school. In particular we sought to measure the effects of psychological factors including personality, stress (psychological morbidity), study habits and negative experiences in addition to the demographic and academic factors usually examined in studies of this type.

Methods

Participants and procedure

The sample consisted of 703 UCL medical students who were asked to complete a questionnaire at the start of Year 3 and then went on to complete final year (Year 5) medical school examinations. See Figure 1 for a diagram explaining the sample.

Participants were on average 23 years old at the start of final year (range=21-36); 39% (274/703) were male; 38% (269/703) were white British. The largest minority ethnic group was the Asian or British Asian Indian group (121/703; 17%), see Table 1. Ethnic data were missing for 12 participants. Some ethnic groups were too small for meaningful comparison, so the data were collapsed into a white group (white British, white Irish, white other; n=327) and a minority ethnic group (all other ethnic groups including mixed; n=362).

Table 1 about here

All students who started Year 3 in 2005 (n=383) and 2006 (n=346) were asked to complete a 15-minute questionnaire during a compulsory introductory lecture at the start of the year. See below for details of the psychological and demographic measures included in that

questionnaire. As an incentive, three completed questionnaires were picked at random at the end of the lecture, and those participants each received £10. The questionnaire response rate was 83% (602/729). The 729 Year 3 medical students were then followed up to final year. Six dropped out of medical school before taking Year 3 exams, a further 11 dropped out before taking Year 4 exams and a further nine dropped out before taking finals (total dropout n=26; reasons for dropout unknown). This gave a total of 703 students with final year examination results, of who 587/703 (83%) also had questionnaire data.

Final year examination grades for all participants (and sex, ethnicity and age data for non-respondents) were collected from medical student records using the following procedure, which was approved by the UCL Ethics Committee. All Year 3 students were emailed by the Year 3 administrator and asked to write back if they did not consent to their demographic and examination data being used for medical school educational research projects. One student wrote to say they did not consent to that, although that same student also completed a questionnaire which included giving consent to accessing their examination and demographic data for the purposes of the current study. As such, their data were included in the analyses for this study only.

Figure 1 about here

Participants who responded to the questionnaire in Year 3 were different from the non-respondents. They were more likely to be white (Fisher's exact $p < .01$) and female (Fisher's exact $p = .029$), and had statistically significantly higher final year written exam marks [$t(701) = -3.29$; $p = .003$] and higher practical exam (Objective Structured Clinical

Examination: OSCE) marks [$t(701)=-3.01$; $p=.001$]. They were also less likely to fail their overall finals examination (Fisher's exact $p=.043$). See Table 2.

Table 2 about here

Measures

Ethnicity

Participants self-categorised into one of the sixteen 2001 UK Census categories. As mentioned above, because some ethnic groups were too small for meaningful statistical comparison, the categories were collapsed into a 2-level ethnicity variable: 'white' (white British, white Irish, white other, combined) and 'minority ethnic' (all other ethnic groups including mixed, combined). For more detailed analyses, another ethnicity variable with four levels ['white British', 'Asian or Asian British Indian', 'white other' (white Irish and white other combined) 'all other minority ethnic' (all minority ethnic groups, except Asian or Asian British Indian, combined)] was created.

Age

Date of birth was used to create a variable called 'age at start of final year'. Most students were of similar age, so the variable was skewed and the relationship between age at final year and final year exam grades was non-linear. Age at final year was therefore split into four categories: 23 and under; 24; 25; and 26 and over. Most participants were either 23 or 24, probably reflecting normal progression through medical school and either entry straight from school or after a gap year. Those who were 25 at final year had probably repeated a

year or entered medical school slightly late for some reason. Those who were 26 and over were almost all graduate-entry students.

Socioeconomic group

Socioeconomic group was measured slightly differently in the 2005 and 2006 cohorts. The 2005 cohort were asked to indicate their parents' occupation and their socioeconomic group using the Registrar General's classification. This was updated for the 2006 cohort whose SEG was measured using the current National Statistics Socio-economic Classification (NS-SEC)

http://www.statistics.gov.uk/methods_quality/ns_sec/history_origin_concept.asp. In order to combine the two, the socioeconomic group variable was collapsed into two categories: 'socioeconomic group 1' and 'other'.

Study habits

Study process and study habits were measured at the start of Year 3 using an 18-item version of the Biggs Study Process Questionnaire (1987) – see Fox *et al* (2001) for details. This questionnaire has been used previously with medical students (McManus, Richards, Winder & Sproston, 1998). The three study process factors (surface, deep and strategic) were created by summing scores on the appropriate scale items (e.g. McManus, Keeling, Paice, 2004). The possible range of scores was 6-30.

Negative life events

Participants' experience of negative life events was measured at the start of Year 3 using the Modified List of Threatening Experiences (Andrews & Wilding, 2004). When students

reported more than one instance of an event occurring in the previous three years, the newest incidence was counted.

Psychological morbidity

Psychological morbidity or stress at the start of Year 3 was measured using the 12-item version of the General Health Questionnaire (GHQ-12: Goldberg, 1992). This instrument has previously been used with junior doctors (e.g. McManus, Winder & Gordon, 2002; Paice, Rutter, Wetherell et al, 2002). The GHQ-12 was scored using the Likert method, giving a possible range of 0-36; and the binary method, giving a possible range of 0-12 and where a score above 4 is a probable case (e.g. Guthrie, Black, Bagalkote et al., 1998; Moffat, McConnachie, Ross et al., 2004).

Motivation for becoming a doctor

At the start of Year 3, participants rated on a 4 point scale how important 16 items were in their decision to become a doctor (not important; slightly important; fairly important; very important). The items were designed to measure an unspecified number of underlying motivational factors and were subjected to a factor analysis with a Varimax rotation. The factors were extracted in SPSS and these scores were used in subsequent analyses. The scree plot suggested three or four factors and Kaiser's criterion suggested five factors. Items with loadings above 0.3 were included in the interpretation of a factor. Three, four and five factor solutions were scrutinised and the four factor solution appeared to provide the most logical and comprehensive summary of the data, explaining 53% of the variance in the overall score on the motivation question. See Table 3. All of the factors were approximately normally distributed, except for *Helping Others*, which was negatively skewed, indicating that many students were motivated to become doctors for this reason.

Table 3 about here

Personality

The 'Big 5' personality traits (Neuroticism, Extraversion, Openness to Experience, Agreeableness and Conscientiousness) were measured at the start of Year 3 using a 15-item questionnaire based on the NEO-PI-R (Costa & McCrae, 1992). This questionnaire has been used in previous studies with medical students (McManus et al, 2003) and applicants to medical school (McManus et al, 2004). Scores on each trait were calculated by summing the scores on the three items designed to measure each factor. This gave a possible range of 3-15 on each factor.

Previous academic attainment

School examination results for candidates who took UK examinations were obtained from student records. General Certificate of Secondary Education (GCSE) examinations are typically taken at age 16. Grades A* to E indicate a pass. Candidates usually sit a minimum of five GCSEs. Many medical students take 10. Advanced (A) level examinations are school-leaving examinations and are typically taken at age 18. Grades A to D indicate a pass. Candidates usually sit three or four A levels.

To obtain a mean GCSE points score, each GCSE grade was scored 6 points for an A*, 5 for an A, 4 for a B etc. These values were summed and then divided by the number of GCSEs taken. Similarly A levels were scored 10 points for an A, 8 for a B etc, and the mean for the best three A levels (excluding General Studies A level, which is often not recognised as a full A level by universities) was calculated.

Other questionnaire items

Participants were asked questions relating to their educational and social background. See Table 4 for a summary of all the variables in the questionnaire and the methods used to score them. The ‘Oxbridge’ variable requires further explanation. In Year 3 UCL Medical School accepts a small number of students who completed the first part of their undergraduate medical course at Oxford or Cambridge (‘Oxbridge’) universities. Those students complete Years 3, 4 and final year with the rest of the UCL cohort. Sixteen percent of the Year 3 questionnaire respondents were Oxbridge transfers (96/602). Data on early place of medical training was unavailable for the non-respondents.

Table 4 about here

Medical school examinations

The final MBBS examination is the culmination of 6 years of study (5 medical school years plus one intercalated degree year). It is a high stakes written and practical examination that measures whether students have the knowledge, skills, and attitudes needed for the first year of clinical practice as a doctor. The written assessment consists of two or three 3-hour written papers, marked by computer. Scores on each paper are given equal weight and averaged to create an overall written score. The clinical assessment is practical and comprises two Objective Structure Clinical Examinations (OSCE), which is comprised of several “stations”. At each station, students will take a history, conduct a physical examination, or demonstrate their communication skills or their application of the law and professional guidance. Their performance at each station is assessed by a trained examiner. See Dacre, Dunkley, Gaffan, Sturrock (2006) for further details about the OSCE. The

scores on both OSCEs are given equal weight and averaged to create an overall OSCE (clinical) score.

In determining the overall finals mark, the written and OSCE assessments are given equal weight. Students who fail either the written or the OSCE, or who have three or more upheld complaints about their fitness to practice, are said to have failed finals.

Statistical analyses

Descriptive and inferential statistics were conducted using SPSS v15.0, Stata/IC 11.0. Gpower 3.1 was used for power calculations.

Transformation of examination results

Data for 2005 and 2006 cohorts were combined for analysis. Examinations were marked on different scales so raw scores were z-transformed (mean of zero, standard deviation of one) before being combined.

Univariate analyses: ethnic differences on examination results

The relationship between ethnicity and examination results was calculated for all participants. Univariate tests compared the final year written examination and OSCE scores of different ethnic groups. Independent t-tests were conducted for the 2-level ethnicity variable; and 1 x 4 ANOVAs with Fisher's least significant difference (LSD) tests for post-hoc multiple comparisons were conducted for the 4-level ethnicity variable. Fisher's exact tests were used to compare the proportion of white and minority ethnic students who achieved a pass, fail, merit or distinction overall in finals. To check for response bias, the univariate analyses were repeated for the subset of participants who responded to the questionnaire.

Univariate analyses: relationship between ethnicity, questionnaire variables and examination results

Univariate relationships between ethnicity, the questionnaire variables, and final year results (both continuous scores, and proportions of failures, passes and merits/distinctions) were calculated for questionnaire respondents. Independent t-tests were used to compare the mean scores of two groups, and Pearson's r to calculate the relationship between two continuous variables. When assumptions of normality were violated, non-parametric equivalents of these tests (Mann-Whitney U tests and Spearman's correlation) were used. Fisher's exact tests were used to compare proportions of two or more groups on categorical variables. Due to the number of tests conducted, p values of $<.01$ were considered statistically significant.

Multivariate analyses

Two hierarchical multiple linear regressions of the univariately significant questionnaire variables onto OSCE and written exam results were performed. Predictor variables were categorised into either proximal or distal factors and were entered into each regression in two blocks. Ethnicity was entered in a third block to identify the additional variance to which it contributed.

Proximal factors were those which related to participants' time at medical school (study habits, motivation for studying medicine, negative events, living at home in Year 3 etc). Age at final year was considered a proximal factor as it related to when students entered medical school and their progression. Distal factors related to participants' time before medical school (type of school attended, GCSE and A level scores, parental factors etc).

Although personality was measured in Year 3, it was considered a distal factor because personality traits due to their relative stability over time (Matthews & Deary, 1998). Place of early medical training was considered a distal factor because it relates to participants' time before UCL medical school.

Mean substitution was used for missing values. P values of $<.05$ were considered statistically significant. Due to the large number of missing GCSE data, the analyses were repeated excluding this variable, and the results compared to the full models.

Statistical power

Calculations using Gpower 3.1 suggested that a sample of 600 participants divided approximately equally by ethnicity with $\alpha=0.05$ and a power (1-beta) of 0.80, could detect an effect size of 0.20. A typical effect size in undergraduates of 0.42 has been found previously (Woolf et al, 2011) which this study had a power of 99.9% of detecting.

Ethical approval

The research was granted approval by the UCL Graduate School Ethics Committee (Reference: 0511/001).

Results

Descriptive statistics

Examination results

All examination results were z-transformed and thus had a mean of zero and standard deviation of one. Three quarters of all students (529/703; 75%) achieved a pass in final year examinations. Ten percent (71/703) achieved a merit and 11% (79/703) achieved a distinction. Only 3.4% (24/703) failed. Of the 587 questionnaire respondents who completed final year, 16 (2.7%) failed and 133 (27.2%) achieved a merit or distinction.

Questionnaire variables

In terms of students' socio-demographics and education, most participants (515/573; 87.9%) were educated in the UK and over half (328/586; 56%) went to a fee-paying school. Two thirds (397/586; 68%) had a father in the top socioeconomic group and nearly three quarters (427/579; 72.9%) had at least one university-educated parent. Most participants spoke English as a first language (481/585; 82%), but only just over half (348/586; 59.4) had at least one parent who spoke English as a first language, reflecting the ethnic mix of the sample (see Table 1). Nearly all participants (516/585; 88%) had come to medical school either straight from school or after a year out. On average, participants had very good school-leaving results: 9.5 (SD=.9) out of a maximum 10 points at A level and 5.3 (SD=.5) out of a maximum 6 points at GCSE.

The median age students first considered becoming a doctor was 14 and the median age at which they definitely decided was 16. Students were generally motivated to become

doctors at the start of Year 3. Over three quarters of students (455/582; 77.6%) stated they definitely wanted to practice medicine after qualification, and most (356/575; 62%) had never considered dropping out of medical school. In terms of experiences of threatening life events, by the start of Year 3, nearly half (251/586; 43%) of participants had had experience of a serious illness or injury in a close friend or relative, 38% (220/586) had experienced the death of a close friend or relative, 39% (231/586) had experienced relationship difficulties, 37% (215/586) had had something valuable stolen from them, 21% (122/586) had experienced the death of a first degree relative, and 15% (86/586) had personal experience of a serious illness or injury. Descriptive statistics for the remaining continuous psychological questionnaire variables including reasons for becoming a doctor, personality, study habits, and stress are shown in Table 5.

Table 5 about here

Univariate analyses

Ethnic differences in examination results

Independent t-tests showed white students achieved significantly higher examination scores than the minority ethnic student group in final year written exams [mean white=.22, SD white=.92; mean minority ethnic=-.12, SD minority ethnic=.88; $t(687)=4.63$; $p<.001$] and final year OSCEs [mean white=.31, SD white=.88; mean minority ethnic=-.15, SD minority ethnic=.99; $t(687)=6.39$ $p<.001$].

More detailed analyses using the 4-level ethnicity variable showed a significant effect of ethnicity on the written exam [$F(3,695)=8.8$; $p<.001$], with post hoc tests revealing that the white British group (mean=.23, SD=.91) achieved significantly higher scores than the ‘all

other minority ethnic' group (mean=-.20, SD=1.01) ($p<.001$). The white British group did not however differ significantly from the Indian group (mean=.04, SD=1.03) ($p=.078$) or the white other group (mean=.19, SD=.93) ($p=.817$), and the Indian group also outperformed the 'all other minority ethnic' group ($p=.025$). See Figure 2.

On the OSCE, ethnicity was also significant [$F(3,695)=14.9$; $p<0.001$], with post hoc testing showing that the white British group (mean=.37, SD=.83) achieved significantly higher final year OSCE scores than the Indian group (mean=-.05, SD=.86) ($p<.001$), the 'white other' group (mean=.02, SD=1.0) ($p=.008$), and the 'all other minority ethnic' group (mean=-.20, SD=1.0) ($p<.001$). There were no significant post hoc differences between the Indian, 'white other' or 'all other minority ethnic' groups on the OSCE. See Figure 2.

Figure 2 about here.

The same pattern of results was found when the analyses were repeated with the questionnaire respondents only.

Ethnic differences on questionnaire variables

Minority ethnic and white respondents had different age profiles ($z=-5.22$; $p<.001$).

Although the median age of both groups was 24, a significantly higher proportion of white students were aged 25 and over (33.2% of white students vs 14.2% of minority ethnic students). Related to this, white students were more likely to have completed a degree prior to entering medical school (Fisher's exact $p<.001$). White students were also less likely to

be living at home at the start of Year 3 (Fisher's exact $p < .001$). In terms of social background, minority ethnic students were more likely to have at least one parent who is a doctor (Fisher's exact $p = .001$), but there were no significant differences in the proportion of white and minority ethnic students who went to fee paying schools or who had a father in the highest socioeconomic group. In language terms, minority ethnic students were less likely to speak English as a first language (Fisher's exact $p < .001$) and also less likely to have at least one parent who speaks English as a first language (Fisher's exact $p < .001$). In psychological terms, minority ethnic students were lower on the personality trait openness to experience [$t(577) = 2.94$; $p = .004$], lower on deep learning study habits [$t(561) = 2.70$; $p = .008$] and higher on surface learning study habits [$t(567) = -3.09$; $p = .003$]. Minority ethnic students were less likely ever to have experienced relationship difficulties by the start of Year 3 (Fisher's exact $p = .009$).

Relationship between questionnaire variables and examination scores

Participants who achieved higher written examination scores had higher GCSE ($r = .23$; $p < .001$) and A level grades ($r = .29$; $p < .001$) and were younger at entry to final year (Spearman's $r = -.15$; $p = .003$). They were more likely to have transferred from Oxford or Cambridge [$t(584) = 6.66$; $p < .001$] and less likely to have been living at home at the start of Year 3 [$t(582) = 2.70$; $p = .007$]. They were more likely to speak English as a first language [$t(583) = 2.75$; $p = .006$] and more likely to have at least one parent who speaks English as a first language [$t(580) = 2.77$; $p = .006$]. They used more strategic study habits ($r = .14$; $p < .001$) and were more conscientious ($r = .16$; $p < .001$).

The same variables were also related to higher final year OSCE scores. In addition, participants who were motivated to become a doctor for financial and status reasons ($r = .14$; $p = .001$), who had been schooled in the UK [$t(571) = 3.63$; $p < .001$] and who had a father

from the highest socioeconomic group [$t(573)=3.64$; $p<.001$] achieved higher OSCE scores.

Relationship between ethnicity, questionnaire variables, and fail, merit or distinction in final year

Due to the small number of students who failed, and the large number of predictor variables, it was not feasible to perform a logistic regression; however it was possible to conduct univariate tests. Table 6 summarises the results described below.

Compared to those who passed, achieved a merit, or achieved a distinction, students who failed final year were older (Fisher's exact $p<.001$); had lower GCSE [$t(482)=-2.96$; $p=.003$] and A level grades [$t(544)=-3.68$; $p<.001$]; more likely to have been living at home at the start of Year 3 (Fisher's exact $p<.001$); less likely to speak English as a first language (Fisher's exact $p=.003$) and were more likely to be from a minority ethnic group (Fisher's exact $p=.002$).

On the other hand, students who achieved a merit or distinction in final year had higher GCSE [$t(482)=-4.09$; $p<.001$] and A level grades [$t(544)=-4.70$; $p<.001$], were more likely to be Oxbridge transfers (Fisher's exact $p<.001$), more likely to have a father in socioeconomic group 1 (Fisher's exact $p=.003$,) and more likely to have at least one parent who speaks English as a first language (Fisher's exact $p=.007$). They were more strategic learners [$t(570)=-4.32$; $p<.001$], more conscientious [$t(578)=-4.45$; $p<.001$] and more likely to be of white ethnicity (Fisher's exact $p<.001$).

It is important to note that ethnicity, living at home, being an Oxbridge transfer, speaking English as a first language, and having at least one parent who speaks English as a first language were all statistically related to each other, as well as being related to passing, failing, or achieving a merit or distinction. As such it is not possible to identify which of those factors, if any, were causally related to minority ethnic students' failure to pass or to achieve a merit or distinction in their final examinations.

Table 6 about here

Multivariate analyses

Regression of ethnicity and questionnaire variables onto written examination scores

The proximal factors in Model 1 explained 5% of the variance in final year written scores. The largest effects were having strategic study habits, which positively predicted performance ($\beta=.15$; $p=.001$) and having lived at home at the start of Year 3, which negatively predicted performance ($\beta=-.14$; $p=.001$). Students aged 24 ($\beta=-.09$; $p=.047$), 25 ($\beta=-.12$; $p=.007$), and 26 or over ($\beta=-.14$; $p=.002$) also achieved lower scores than those aged 23 or under [nb three dummy age variables with 23 and under as the baseline were created, and because the '26 and over' age category overlapped considerably with the 'graduate' variable, the latter was excluded from multivariate analyses].

Adding in the distal factors except ethnicity in Model 2 explained another 12% of the variance in written scores and was a significantly better fit (r squared change $p<.001$). The largest effects were having higher A Level grades ($\beta=.20$; $p<.001$) and being an Oxbridge

transfer student ($\beta=.19$; $p<.001$), both of which predicted higher final year scores. More conscientious students also achieved higher scores ($\beta=.11$; $p=.035$). Having lived at home at the start of Year 3 ($\beta=-0.09$; $p=.035$) and being 25 ($\beta=-.09$; $p=.034$) were still significant predictors of lower score; but strategic study habits and the effects of being 24 and 26 or over were no longer significant once the distal factors were included in the equation.

In Model 3 ethnicity explained an additional 1% of the variance in written scores and was a significantly better fit than Model 2 (r squared change $p<.001$). Minority ethnicity was related to lower final year written score ($\beta=-.17$; $p=.001$) with a similar effect size to the effects of A level grades and being an Oxbridge transfer student.

Diagnostic testing of the final model suggested a good fit. Residuals showed one outlier. Removing this individual from the analysis had no significant effect. Leverage values were all moderate ($<.10$).

Regression of ethnicity and questionnaire variables onto OSCE scores

The proximal factors in Model 1 explained 6% of the variance in final year OSCE score. The largest effect was having lived at home at the start of Year 3, which predicted lower final year OSCE scores ($\beta=-.13$; $p=.001$). Students who were 26 or older achieved lower scores than those who were 23 or under ($\beta=-.10$; $p=.021$). Strategic learners ($\beta=.10$; $p=.039$) and students who had said in Year 3 that they were motivated to become doctors for financial and status reasons achieved slightly higher scores ($\beta=.10$; $p=.029$).

Adding the distal factors except ethnicity in Model 2 explained a further 11% of the variance in OSCE score and the model was a significantly better fit (r squared change

$p < .001$). The largest effect was being an Oxbridge transfer student, which predicted higher scores ($\beta = .15$; $p < .001$). Higher conscientiousness also predicted higher scores ($\beta = .13$; $p = .002$), as did having been to secondary school in the UK ($\beta = .12$; $p = .004$), and having higher A level ($\beta = .11$; $p = .013$) and GCSE grades ($\beta = .10$; $p = .021$). Students with a father in socio-economic group 1 achieved slightly higher OSCE scores ($\beta = .09$; $p = .033$). The positive effect of being motivated for financial and status reasons remained, but the effects of strategic learning and age disappeared.

Adding ethnicity into the equation in Model 3 explained an additional 2% of the variance in final year OSCE scores and was a significantly better fit than Model 2 (r squared change $p < .001$). Minority ethnicity was independently negatively related to final year OSCE score, with the largest effect size of all the variables in the regression ($\beta = -.21$; $p < .001$). See Tables 7 and 8.

Diagnostic testing of the final model suggested a good fit. Residuals showed no outliers.

Leverage values were all moderate: all were less than 0.10, except one value of 0.11.

Repeating both OSCE and written regression analyses without GCSE results, where there was most missing data, did not alter which variables were statistically significant in the final model.

Table 7 about here

Table 8 about here

Discussion and conclusions

This study of two cohorts of UK students from one medical school showed that minority ethnic students performed more poorly than their white colleagues in final year practical (OSCE) and written examinations. This ethnic gap in attainment could not be explained by students' self-reported motivation for becoming a doctor, whether they completed their secondary education in the UK, how well they did in their examinations prior to medical school, how conscientious they were, how old they were, or what their father's socioeconomic status was, or whether they transferred to UCL from Oxford or Cambridge - despite those factors themselves all significantly predicting final year exam scores. Other factors such as having parents who are medical doctors, speaking English as a first language, having a parent who speaks English as a first language, living at home during term time, study habits, desire to drop out of medical school, desire to practice medicine upon qualifying, experiences of negative events, stress (all measured in Year 3), did not explain the ethnic attainment gap, nor did they predict final year performance in the final multivariate model.

This study is the first to explore in depth a large number of possible psychological and demographic reasons for the ethnic difference in attainment frequently found in medical education at both undergraduate and postgraduate levels. The longitudinal study design allowed causal inferences to be made between questionnaire variables (measured in Year 3) and examination performance (measured in Year 5 – final year). The relatively large sample size provided sufficient statistical power to minimise type II errors. The multivariate analysis allowed us to show that, for example, although speaking English as a first language predicted performance, this was not the reason that minority ethnic students underperformed.

Although the sample size was fairly large, it was not large enough to distinguish the performance of students from the different minority groups in the regression analyses. It is known that differences in the educational attainment of various minority ethnic groups exist. For example, at GCSE Indian students achieve higher grades than white and than other minority ethnic groups (DfES, 2006; Strand, 2008). By the time students reach higher education, the picture has changed slightly with all minority groups having lower attainment than the white British group, despite minority ethnic groups varying in the proportions attending HE, in the types of university they attend, and in the courses they study (Fielding, 2008). The white/non-white distinction in our study therefore appears to be of some importance and have some validity. We did also however conduct some sub-analyses, which showed the white British group achieved higher scores than the Indian, 'white other' and 'all other minority ethnic' groups on the practical OSCE exam, whereas on the written exam the difference between the white British and Indian groups was non-significant. This suggests research to explore differences in medical school attainment between various minority ethnic groups is worthwhile.

Students who did not respond to the questionnaire in Year 3 had significantly worse final year examination performance and were significantly more likely to be from minority ethnic groups, and those two factors were probably confounded. It is probable that the non-respondents were also different in ways we could not measure. For example, the administration of the questionnaires in lectures meant no distinction could be made between non-respondents who chose not to participate and those who did not attend the lectures. Those who did not attend the lectures are likely to have been disorganised and/or lower on conscientiousness, which are themselves predictors of lower examination

performance (Ferguson et al., 2002; Wright & Tanner, 2002; Stanley, Khan, Hussein & Tweed, 2006). All that being said, the pattern of ethnic differences in OSCE and written examinations was similar in the respondent sample as in the total sample indicating that non-responder bias was not too much of a problem.

All of the measured variables in this study explained only 18-19% of the variance in final year exam results. While we included A level and GCSE scores, we did not include medical school examination results from before final year, which almost certainly reduced the amount of variance explained. The reason for excluding previous examination data was their complexity (due to the structure of the course, retakes and interruptions, a student in a particular Year 3 cohort could be in a different Year 1, Year 2, Year 4 and Year 5 cohort from his or her colleagues and in addition, Year 1 and Year 2 exam data were not available for Oxbridge transfer students). The questionnaire was also unable to measure more subtle psychological processes around identity and stereotyping, or perceptions of institutional climate, all of which may contribute to ethnic differences in attainment (e.g. Steele & Aronson, 1995; Cohen et al., 2006; Steele, 2010). In addition, the timing of the questionnaire administration meant that many of the psychological factors were measured at the start of Year 3, which was several years before students sat their final year examinations. For the stable “facts” about students such as their first language, or their GCSE results, this was not a problem; but for the more changeable factors such as stress or experience of negative events, the time lag may have meant that any effects relating to these factors were not observed.

This study was conducted with two cohorts at a single London medical school, which limits its generalisability, although multivariate analyses from two other UK medical schools

(Lumb & Vail, 2004; Yates & James, 2007; Yates & James, 2010) have also shown ethnic in medical student attainment persist after controlling for socio-demographic factors and previous attainment. Results from a third UK medical school however found that adjusting for sex, disability, year and interaction effects removed a previously-significant effect of ethnicity on performance in a progress test taken by medical students every year (Ricketts, Brice & Coombes, 2009). Studies from the US have found that minority ethnic students underperform in national licensing examinations compared to their performance in the medical college admissions test and in medical school examinations (Xu et al; 1993; Koenig et al, 1998; Veloski et al, 2000; Kleshinski Khuder, Shapiro & Gold, 2007; White, Dey & Fantone, 2007).

This study found that speaking English as a first language, being schooled in the UK, and having at least one parent who speaks English as a first language were all predictors of good performance. It may be that students born and brought up outside the UK find medical school more difficult; however, being schooled outside the UK was a significant predictor only for the practical OSCE examination and not for the written exam. The OSCE requires communication skills whereas the written exam does not, so country of schooling may be a proxy for communication or cultural differences. Student support programmes in many medical schools help students manage issues of fitting in, while also not assuming that everyone from outside the UK struggles with these problems (Hawthorne, Minas & Singh, 2004; Yates & James, 2006; Winston, van der Vleuten & Scherpbier, 2010). More research is required to establish the long term effectiveness of such programmes in reducing ethnic differences in attainment.

Having a father from the top socioeconomic group had a small but significant positive effect on final OSCE, but not written scores. As mentioned previously, few studies have analysed the effect of socioeconomic group on medical student academic attainment, and those that have generally find it does not predict performance. However, this may reflect that medical students from lower socioeconomic groups are underrepresented in medicine. There is a strong drive to widen access to students from non-traditional backgrounds (Powis, Hamilton & McManus, 2007; Mathers & Parry, 2009) which makes it important to monitor attainment by socioeconomic background to discover whether those from lower socioeconomic groups are disadvantaged in the medical educational process.

Having studied medicine at Oxford or Cambridge universities was one of the strongest predictors of good performance in our sample. Oxford and Cambridge students tend to transfer to another medical school for their later medical school training, but we are not aware of any other studies that have included 'Oxbridge' as a predictor of undergraduate exam results, although one study found Oxford and Cambridge graduates achieved the highest scores of all UK medical schools on the postgraduate Membership of the Royal College of Physicians (UK) examination (McManus, Elder, de Champlain et al., 2008). In many ways this is unsurprising. The fact that the 'Oxbridge' variable remained statistically significant after controlling for GCSE and A level results however shows that prior school attainment was not sufficient to explain this difference. An analysis of earlier medical school performance would help disentangle the effects of pre-medical school factors and differences in teaching and learning during the early years of medical school.

Interestingly, being motivated to study medicine for financial and status reasons was a positive predictor of good performance on the OSCE. This was an unexpected finding

because being a “good doctor” is generally perceived to be related to altruistic motivations. The finding requires replication, but it perhaps underlines that being good at exams is not necessarily the same thing as being a good doctor (Taylor, 2006).

In summary, the results of this study clearly show that ethnic group had an independent and negative effect on final year examination performance, and although ethnic differences existed on a number of demographic variables, the relationships between ethnic group and examination performance was found to be virtually unmediated by age, socioeconomic group, sex, schooling, parents’ education, language, personality, study habits or motivation. The study focussed on mainly stable, student-related variables, and many of them were found to predict performance. However together they explained less than 20% of the variance in scores, meaning that many unmeasured variables played a large and significant part in the examination performance of our sample.

Having ruled out many possible explanations for the ethnic attainment gap, we are left still with the task of explaining this phenomenon. The list of contenders is long, possibly endless; but in studying both what predicts performance and what explains the ethnic gap in performance, medical education researchers could take their lead from the wealth of research on school examination performance (e.g. Burgess & Greaves, 2009). If similar large-scale datasets existed in medicine in the UK, it would make it easier to disentangle the student-related, teacher-related, and medical school-related factors influencing students’ performance and in particular, the factors influencing the ethnic gap in medical students’ performance. Another approach would be to examine the issue in more detail at different medical schools using qualitative research techniques. For example, previous qualitative research on the same population (Woolf et al., 2008) has highlighted the

importance of the student-teacher relationship to learning and the possible contributory effects of social psychological phenomena such as stereotyping on the ethnic attainment gap.

Finally, although understanding how demographic and other stable student-related factors correlate with performance is interesting and useful, for the benefit of those teaching our future doctors it is arguably more important that researchers strive to understand the micro-structure, as well as the macro-structure of medical education. By understanding how day-to-day occurrences in seminars, lectures and on the wards influence the learning, academic attainment, and clinical performance of students, we may also discover what is responsible for the ethnic attainment gap.

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Table 1. Participants by ethnic group

Ethnic group	Frequency	Percent
white British	269	38
white Irish	11	2
white other	49	7
black Caribbean	3	<1
black African	13	2
Asian Indian	121	17
Asian Pakistani	35	5
Asian Bangladeshi	21	3
Chinese	53	8
Asian other	59	8
mixed white and black Caribbean	5	1
mixed white and black African	3	<1
mixed white and Asian	9	1
mixed other	15	2
other	25	4
unknown/missing	12	2
Total	703	100

Table 2: Questionnaire respondents were significantly more female and white, had higher final year exam scores, and fewer failed final year. 12 non-respondents and 2 respondents were missing ethnicity data.

	Non-respondent	Respondent	Test	p value
Percentage male	48.3% (56/116)	37.1% (218/587)	Fisher's exact	.029
Percentage female	51.7% (60/116)	62.9% (369/587)		
Percentage white	29.8% (31/104)	50.6% (296/585)	Fisher's exact	<.001
Percentage minority ethnic	70.2% (73/104)	49.4% (289/585)		
Mean final year OSCE z-score (standard deviation)	-0.18 (1.1)	0.11 (0.9)	t(701)=-3.02	.001
Mean final year written z-score (standard deviation)	-0.23 (1.0)	0.09 (0.9)	t(701)=-3.29	.003
Percentage failed final year	6.9% (8/116)	2.7% (16/587)	Fisher's exact	.043

Table 3. Rotated Component Matrix for the factor analysis of items relating to motivation for studying medicine. Weights below 0.3 not shown. Participants were asked to rate each statement on a 4-point scale to indicate how important it was to their desire to become a doctor

	Financial rewards	Help others	Free- thinking	Lead under pressure
Ability to exercise leadership				.56
Opportunity to be original and creative			.69	
Freedom from supervision at work			.49	
Achieving high social status	.64			.41
Desire to work under pressure				.81
Being helpful to others and useful to society		.79		
Advancing medical knowledge through research		.31		.31
Financial rewards	.78			
Working with people rather than things		.69		
Living and working in the world of ideas			.59	
Wanting an economically secure occupation	.83			
Wishing to express own values and interests			.69	
Involvement in a really challenging occupation		.44		.41
Helping towards improving society		.79		
A job with steady progress and promotion	.75			
Flexible working patterns	.43		.49	

Table 4: Demographic and psychological questionnaire variables, and the method for scoring each. *stress was measuring using the GHQ-12 which can be scored as a continuous or a categorical variable. See text for a description of the scoring of the continuous stress variable.

	Questionnaire variables	Categorical/ continuous	Scoring method
Demographic variables	Ethnic group	categorical	white and minority ethnic OR white British; Indian; other white; all other minority ethnic
	Sex	categorical	male; female
	Age at entry to final year	categorical	23 & under; 24;25; 26 and over
	Father's socio-economic group	categorical	Collapsed into 1 vs 'other'.
	Type of secondary school	categorical	non-fee paying; fee-paying
	UK vs non-UK secondary schooling	categorical	UK; non-UK
	Oxbridge transfer	Categorical	UCL; Oxbridge
	Graduate status	categorical	non-graduate; graduate
	Whether living at or away from home	categorical	away; home
	First language	categorical	not English; English
	Parents' first language	categorical	not English; English
	Parents' education	categorical	no degree; at least one with degree
	Doctor parents	categorical	no doctor; at least one doctor
Psychological variables	Big 5 personality	continuous	5-15 on each factor
	Study habits	continuous	6-30 on each factor
	Stress*	continuous	0-36 in total
		categorical	no case; probable case
	Negative life events	categorical	last 3 years; >3 years or never
	Age first thought of becoming a doctor	continuous	age in years
	Age decided to definitely become a doctor	continuous	age in years
	Desire to practice medicine on qualification	categorical	never considered not practicing; considered
	How often think of leaving medical school	categorical	never considered leaving; considered
	Motivation for wanting to be a doctor	continuous	Items factor-analysed to produce scores

Table 5. Descriptive statistics for the psychological questionnaire variables

Psychological questionnaire variable	n	Range	Mean (SD)
Study process: Surface	571	6.00 to 27.00	14.66 (3.69)
Study process: Deep	565	8.00 to 30.00	19.30 (3.84)
Study process: Strategic	572	6.00 to 30.00	17.97 (4.78)
Personality: Neuroticism	579	3.00 to 15.00	7.93 (2.24)
Personality: Extraversion	581	5.00 to 15.00	11.33 (1.87)
Personality: Openness	581	4.00 to 15.00	10.82 (2.23)
Personality: Agreeableness	572	7.00 to 15.00	13.16 (1.59)
Personality: Conscientiousness	580	5.00 to 15.00	11.29 (2.09)
Stress: GHQ-12 case	555	1.00 to 2.00	1.23 (.42)
Stress: GHQ-12 score	555	.00 to 12.00	2.36 (2.21)
Motivation for being a doctor: Finance	586	-2.89 to 2.58	.00 (1.10)
Motivation for being a doctor: Help others	586	-4.77 to 1.73	.00 (1.10)
Motivation for being a doctor: Free thinking	586	-3.28 to 3.07	.00 (1.10)
Motivation for being a doctor: Lead under pressure	586	-2.88 to 3.13	.00 (1.11)

Table 6: Demographic and questionnaire variables associated with failing or with achieving a merit or distinction in final year. Percentages and frequencies reported for categorical variables. Means and standard deviations reported for continuous variables.

	Fail	Pass	Merit /dist	p value (fail vs rest)	p value (merit/dist vs rest)
Strategic learner	18.7 (4.8)	17.5 (4.7)	19.5 (4.4)	ns	<.001
Lived at home in Year 3	7.1% (11/154)	76.0% (117/154)	16.9% (26/154)	<.001	ns
Did not live at home in Year 3	1.2% (5/430)	74.0% (318/430)	24.8% (107/430)		
UCL	3.3% (16/492)	78.9% (388/492)	17.9% (88/492)	ns	<.001
Oxbridge transfer	0.0% (0/94)	52.1% (49/94)	47.9% (45/94)		
Mean A level points (max 10)	8.7 (1.9)	9.4 (0.9)	9.8 (0.5)	<.001	<.001
Mean GCSE points (max 6)	5.0 (0.8)	5.3 (0.5)	5.5 (0.4)	.003	<.001
Conscientious (min 5- max 15)	11.2 (2.1)	11.1 (2.1)	12.0 (1.7)	ns	<.001
English first language	1.7% (8/481)	74.8% (360/481)	23.5% (113/481)	.003	ns
English not first language	7.7% (8/140)	73.1% (76/140)	19.2% (20/140)		
Parent English first language	4.3% (10/348)	78.6% (184/348)	17.1% (40/348)	ns	.004
Parent English not first language	1.7% (6/234)	71.6% (249/234)	26.7% (93/234)		
Father socioeconomic group 1	1.8% (7/397)	71.8% (285/397)	26.4% (105/397)	ns	.002
Father not socioeconomic group 1	5.1% (9/178)	79.8% (142/178)	15.2% (27/178)		
White	0.7% (2/295)	69.5% (205/295)	29.8% (88/295)	.002	<.001
Minority ethnic	4.8% (14/289)	79.6% (230/289)	15.6% (45/289)		

Table 7: The variance in final year OSCE and written scores explained by the predictor variables (model fit). Model 1 contains the proximal variables; Model 2 the proximal and distal variables excluding ethnicity; and Model 3 the proximal and distal variables including ethnicity.

Model	<u>Final year OSCE</u>			<u>Final year written</u>		
	Adjusted R Square	F change	p value of change	Adjusted R Square	F change	p value of change
1	.06	4.1	<.001	.05	4.847	<.001
2	.17	7.2	<.001	.17	8.531	<.001
3	.19	18.3	<.001	.18	11.263	.001

Table 8. Hierarchical multiple linear regression of final year written and final year OSCE on the proximal and distal predictor variables including ethnicity (model 3). Variables significant at $p < .05$ in bold. Beta weights indicate the strength of the association, with higher scores being more strongly related. Positive beta weights are associated with higher exam scores and negative beta weights are associated with lower exam scores. Missing values replaced with mean substitution.

<u>Questionnaire or demographic predictor variable</u>	<u>Final year written</u>		<u>Final year OSCE</u>	
	<i>Beta</i>	<i>p value</i>	<i>Beta</i>	<i>p value</i>
Age 24 at start final year	-.06	.135	-.05	.196
Age 25 at start final year	-.10	.019	-.06	.170
Age 26+ at start final year	-.02	.703	-.01	.946
Surface learner	.01	.891	.03	.442
Deep learner	.04	.456	.06	.239
Strategic learner	.06	.285	-.01	.905
Financial motivation for being a doctor	n/a	n/a	.11	.008
Lived at home start of Year 3	-.06	.121	-.05	.253
Experienced relationship difficulties by the start of Year 3	-.02	.590	-.02	.531
Oxbridge transfer	.18	<.001	.14	<.001
Went to secondary school in UK	n/a	n/a	.11	.005
Higher mean A level points	.20	<.001	.12	.010
Higher mean GCSE points	.07	.102	.09	.033
Neurotic	.01	.939	-.04	.303
Extraverted	-.07	.097	.02	.631
Open to experience	.01	.748	.01	.862
Agreeable	-.06	.134	-.06	.141
Conscientious	.10	.037	.12	.013
Father from socio-economic group 1	n/a	n/a	.09	.038
At least one doctor parent	.06	.108	.04	.295
At least one parent with English as a first language	.03	.532	.03	.641
Own first language is English	.08	.074	.06	.179
Minority Ethnic	-.17	.001	-.21	<.001

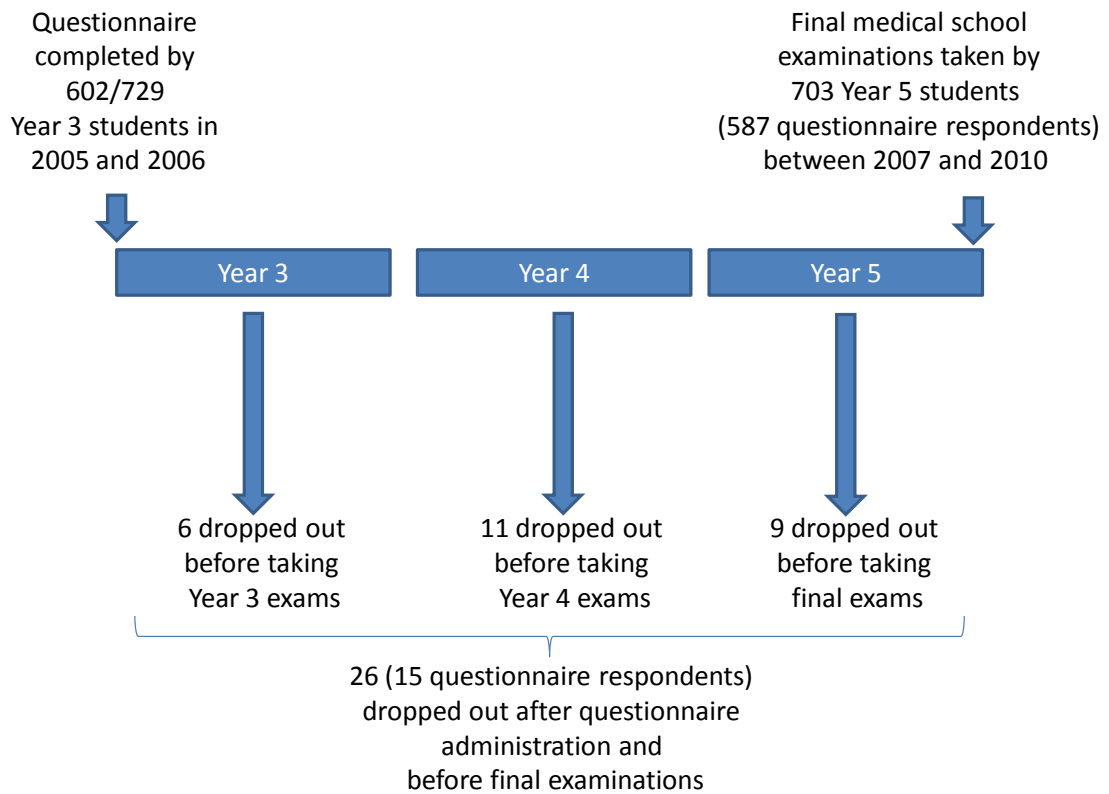


Figure 1: Diagram showing the study sample, which consisted of 703 final year (Year 5) UCL medical students, 587 of whom had previously completed a questionnaire in Year 3.

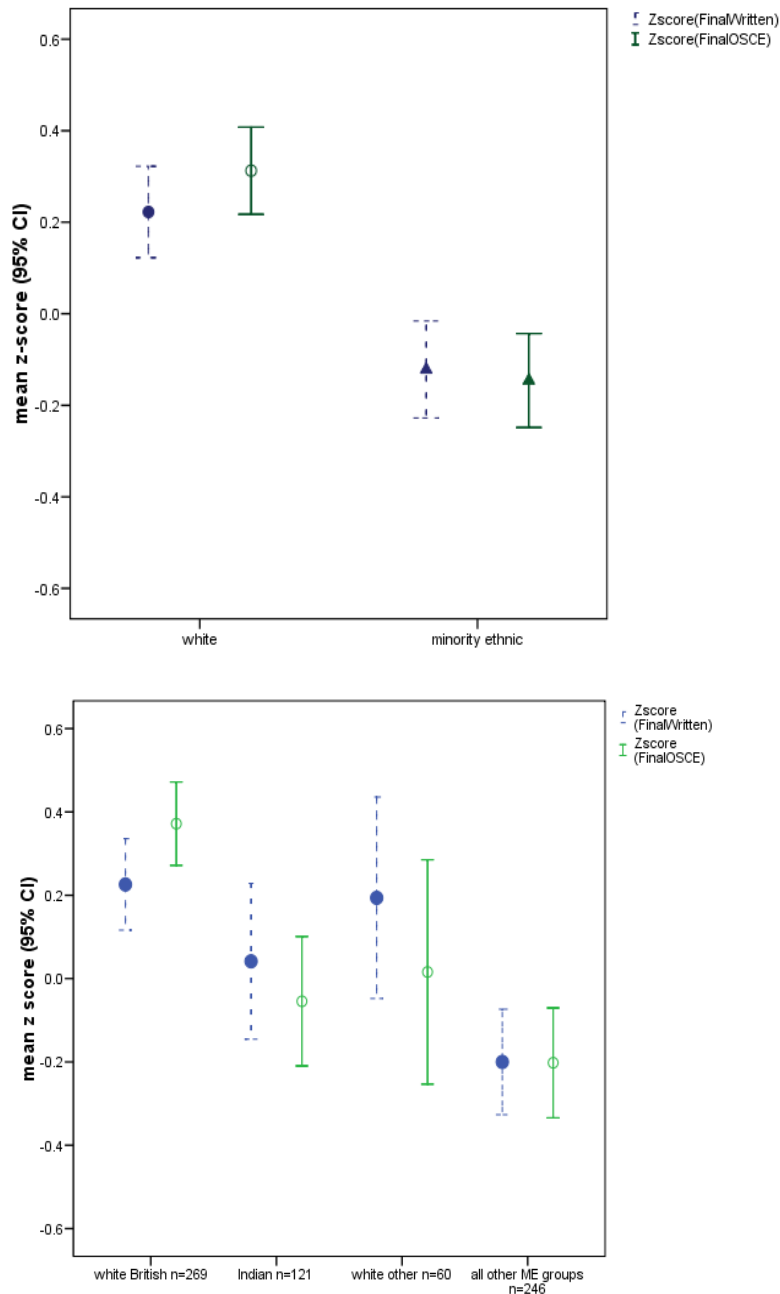


Figure 2: The white group (n=329) achieved statistically significantly higher scores in final year written ($p<.001$) and practical OSCE ($p<.001$) examinations compared to the minority ethnic group (n=362). Sub analyses showed that on the OSCE, the white British group (n=269) achieved higher scores than the Indian group (n=121), the 'white other' group (n=60) and the 'all other minority ethnic' group (n=246). On the written examination, white British students achieved statistically significantly higher written scores than the 'all other minority ethnic' group, but differences between the white British and Indian groups on the written examination were not statistically significant

