

BMJ Open Is the awarding gap at UK medical schools influenced by ethnicity and medical school attended? A retrospective cohort study

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ABSTRACT

Objectives To better characterise the Awarding Gap (AG) between black, Asian and other minority ethnic (BAME) and white students in UK undergraduate medical education by examining how it affects eight minority ethnicity subgroups (Bangladeshi, black, Chinese, Indian, Pakistani, mixed, other Asian background and other ethnic background) and whether the AG varies by medical school attended.

Design Retrospective cohort study.

Setting Data extracted from the UK Medical Education Database on students enrolled at 33 UK medical schools in the academic years starting 2012, 2013 and 2014.

Participants 16 020 'Home' tuition fee status students who sat the University Clinical Aptitude Test on entry to university and obtained a UK Foundation Programme (UKFP) application score on exit.

Primary outcome measure UKFP Z-scores on exit from medical school.

Results There were significant differences in UKFP Z-scores between ethnicity subgroups. After white students, mixed ethnicity students performed best (coefficient -0.15 standard deviations [SD]) compared with white students, (95% confidence interval [CI] -0.23 to -0.08 , $p<0.001$) and Pakistani students scored lowest (coefficient -0.53 SD, 95% CI -0.60 to -0.46 , $p<0.001$). In pairwise comparisons of scores between all nine individual ethnicity subgroups, 15/36 were statistically significant. The AG varied considerably across medical schools. The largest gap showed the coefficient for BAME was -0.83 SD compared with white students (95% CI -1.18 to -0.49 , $p<0.001$), while the smallest demonstrated no statistically significant difference in performance between BAME and white students ($+0.05$ SD, 95% CI -0.32 to 0.42 , $p=0.792$).

Conclusions BAME students are significantly disadvantaged by the current UK medical education system. There are clear differences in medical school outcomes between students from different ethnicity subgroups, and the size of the AG also varies by medical school attended. Urgent and effective action must be taken to address the AG and achieve an equal learning environment for our future doctors.

INTRODUCTION

Data from medical schools in the UK demonstrate a clear Awarding Gap (AG) between

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ This is the largest single study to date investigating the Awarding Gap (AG) in UK undergraduate medical education.
- ⇒ The study tests whether there is significant variation in the way individual ethnic minorities are affected by the AG, and whether the medical school attended also has an impact.
- ⇒ Using UK Foundation Programme application scores to assess the AG provides a universal outcome measure that is applicable to all students at medical schools across the UK.
- ⇒ The study is sufficiently powered to detect small effects within the national cohort.
- ⇒ The methodology used cannot determine the underlying cause of the AG.

students from black, Asian and other minority ethnic (BAME) groups and their white peers.¹ The term AG, also referred to as 'differential attainment' and 'the attainment gap', describes the difference in academic performance between white students and those from BAME backgrounds.²⁻⁴ Across all subject areas, white students are more likely to obtain higher degree classifications than those from other ethnic backgrounds.^{1 5 6} UK studies have shown that an AG is present at entry to medical school, and persists throughout undergraduate medical education and postgraduate clinical training.^{1 2 7-12} Relative to their white peers, students from BAME groups enter medical school with lower A-level grades and aptitude test scores (on average), and continue to score lower in assessments throughout medical school.^{1 2 7-11} At postgraduate level, fewer UK BAME doctors receive postgraduate employment offers, they have lower pass rates in postgraduate specialty examinations, a higher proportion receive unsatisfactory outcomes in annual reviews of competence and progression (which UK doctors are required to pass in

order to progress to the next year or stage of training) and they are more likely to have their training programmes extended.¹² A meta-analysis which included 36 datasets of both undergraduate and postgraduate assessments found that being 'non-white' has a significant negative effect on performance (Cohen's $d = -0.42$, 95% confidence interval [CI] -0.49 to -0.34 , $p < 0.001$).¹ This suggests that the current UK medical training system is failing to provide our future doctors with access to fair and equal education, leaving those from a BAME background in a position of career-long disadvantage. Despite a growing body of literature on the AG within UK medical education, there is a deficit of large studies using national data and outcome measures that are universally applicable across all medical schools; thus, our understanding of this complex problem and how to address it is still limited.^{3 8 10 13–15}

One important question to consider is the appropriateness of using an 'umbrella' categorisation of grouping students from any minority background into a single 'BAME' cohort. This umbrella categorisation is often used as the small numbers of students in some minority ethnic groups render it hard to perform meaningful statistical analyses. However, it is a major limitation of much of the research on the AG in medicine. When the academic performance of prospective medical and dental students is analysed by individual ethnicity subgroups, Chinese students repeatedly outperform white students, achieving higher mean A-level grades and higher scores in the cognitive components of the University Clinical Aptitude Test (UCAT; an admissions aptitude test used by many UK medical schools as part of their selection processes).^{11 16–23}

A second important area of consideration is whether the AG varies between medical schools. Large studies have demonstrated how the curricula, teaching methods and programmes of assessment vary widely across UK institutions.²⁴ Furthermore, the extent to which universities adopt an intersectional mindset and the level of diversity among senior faculty have been linked to the size of the AG.^{25 26} It is therefore highly plausible that the size of the AG varies between medical schools, but this hypothesis is yet to be tested. If studies can identify differences in the AG across medical schools and subsequently explore the underlying reasons for these, we should start to make progress towards developing effective approaches to reduce the AG.

The purpose of this study was to better characterise the AG by expanding on previous models of 'white versus BAME' and to examine how the AG affects students from individual minority ethnicity subgroups. Using data from the UK Medical Education Database (UKMED; <https://www.ukmed.ac.uk/>), we investigated the AG in a national cohort of 16 020 students on entry to, and exit from, 33 medical schools across the UK. We identified the input and outcome measures that were most universally applicable to all students at UK medical schools. Most UK medical schools now require prospective students to sit admissions aptitude tests, and the results of these tests are predictive of undergraduate

performance.^{7 8 10 13 14 27–31} We chose UCAT scores for our input measure as it is the most widely used aptitude test.³² Although UCAT is not required for entry to all medical schools, many students entering schools that do not use it will still sit the test as they usually apply to more than one medical school. We considered the most pertinent exit outcome measure to be students' UK Foundation Programme (UKFP) application scores. The UKFP is the first stage of postgraduate clinical training in the UK and completion of the programme is compulsory for medical school graduates wishing to work as doctors in the UK. Until recently, final-year medical students had to apply for the programme through a national application system, which generated a UKFP score. Candidates were ranked nationally by their UKFP score (explained in the Methods section below), and jobs were allocated in order of candidate ranking and preference. Those who had a high UKFP score were more likely to get their first-choice clinical training post.³³ This process was the same for all students, regardless of medical school attended. Across 2016–2020 inclusive, 97.4% of eligible students applied to enter the UK Foundation Programme on exit from medical school.³⁴ The UKFP score could therefore be considered as a national benchmark of attainment on exit from medical school, providing a universal exit outcome for students across *all* schools, which cannot be achieved through use of examination results due to the idiosyncrasy of assessments across institutions. Our primary objective was to better characterise the AG on exit from medical school by investigating whether there are significant differences between the UKFP scores of students from eight ethnic minority subgroups and those of white students. We also sought to establish whether the AG varies in relation to the specific UK medical school attended. This study is the first in its field to examine the AG with this extent of ethnicity subcategorisation and perform analyses across medical schools spanning all four nations of the UK.

METHODS

Study design and population inclusion criteria

In this retrospective cohort study, we analysed data extracted from the UKMED provided to us on 17 May 2021. This extract (UKMEDP121) contained anonymised data for a cohort of 20 525 medical students in the UK who were classified as having 'Home' tuition fee status and started a UK medical school in the academic years beginning 2012, 2013 or 2014 (inclusive). This cohort was selected because these students would have had at least 6 years to graduate. We only included students with 'Home' tuition fee status to reduce potential sociocultural confounders, including disparity in English proficiency.¹¹

Patient and public involvement

There was no patient or public involvement in this study.

Exclusion criteria

We excluded students who had missing vital data for our analysis: ethnicity not stated (recorded as ‘information refused’, ‘not known’, ‘not stated’ or was missing entirely), no UCAT score (ie, did not sit the test or data were absent) and/or no UKFP score. Any students who transferred to a different medical school during their studies (whether it be for transfer between institutions for preclinical and clinical studies or any other reason, either within the UK or transferring to the UK from overseas) were also excluded. As the Universities of St Andrew’s and Durham provide only preclinical education and *all* students must transfer schools for their clinical training, all students initially enrolled at these universities were excluded and these medical schools do not appear in our results. We also excluded data for students whose primary medical qualification (PMQ) was validated outside the UK, international students who were included in the initial dataset despite extraction criteria for ‘Home’ tuition fee status only, and those who were registered for and/or graduated with an alternative qualification after 3 years (with 4 years being the minimum time required to graduate with a UK PMQ). **Figure 1** demonstrates the process of exclusion used to select the final study cohort.

Independent variables

Our key independent variable was ethnicity. To ensure our analysis controlled for key demographic and medical school variables, we also included gender, socioeconomic status, UCAT Z-score, year of commencement of medical school, medical school attended and type of medical degree course. Gender identity is not binary; however, the UKMED currently only includes options for male, female and missing/not stated. We were therefore limited to these variable values in our analyses.

Ethnicity data were based on self-reported student information collected by the Higher Education Statistics Agency (HESA) and the UCAT Consortium. We sought to analyse ethnicity as broadly as possible, thus using the nine ethnicity subgroupings defined by the UCAT Consortium: Bangladeshi, black, Chinese, Indian, Pakistani, mixed, other Asian background, other ethnic background and white.^{17–23} While we were able to perform total cohort data analysis at this level, when comparing between medical schools it was necessary to generate a binary ethnicity variable (white or BAME) to maintain anonymity of students from less widely represented ethnic groups.

Socioeconomic status was determined using the Index of Multiple Deprivation (IMD). This index is based on UK census data regarding residential postcodes and local socioeconomic information (37 indicators reflecting seven domains such as crime levels and unemployment). All postcodes are allocated to one of five quintiles based on their scores across all indicators, with quintile 1 (Q1) comprising the 20% most deprived residential areas and Q5 the 20% least deprived. A student’s quintile is based

on the residential postcode recorded on their Universities and Colleges Admissions Service application.³⁵

We included students with UCAT scores from 2010 to 2013 inclusive to accommodate deferred 2012 entry. Data were included for all students who sat the UCAT, regardless of whether they ultimately attended a medical school where it was a prerequisite for admission. The UCAT scores used in our analysis were derived from Z-scores for each test year, generated by UKMED from a conversion of the sum of scores in the cognitive components of the UCAT (Verbal Reasoning, Decision Making, Quantitative Reasoning and Abstract Reasoning), as detailed in the UCAT technical report for each test year.^{17–20} A Z-score is used to standardise scores and measures how many standard deviations (SD) a specific data point is from the mean, thus it can be either positive (greater than the mean) or negative (below the mean). The Z-scores provided by UKMED are based on data collected from all candidates who sat the UCAT in the same year, regardless of whether they subsequently enrolled at a university. We therefore restandardised these scores within our study population to generate new Z-scores so that results were more easily interpretable. We did not include scores from the situational judgement component of the test as this was introduced in 2013 and would only apply to our 2014 entry cohort.

Due to collinearity between ‘type of programme’ and ‘graduate on entry’, we created a new ‘course type’ variable to identify those enrolled on standard entry medicine (5 years’ duration or 6 years with an intercalation year; SEM), extended medical degree programmes with a foundation or gateway year (6 years’ duration; EMDPs) and graduate entry programmes (4 years’ duration; GEPs). GEPs were merged to include both graduate entry medicine and MaxFax medicine, a postgraduate course for dentists to also become medically qualified to pursue higher training in maxillofacial surgery.

Outcome variable

To measure the AG at exit from medical school, we used UKFP application total score (range 34–100 points). During the application years included in this study, the total UKFP score was based on the student’s Educational Performance Measure (EPM) and their Situational Judgement Test score (SJT; a separate examination to the situational judgement component of the UCAT). The EPM was a measure of academic performance prior to graduation and was awarded to students by their medical school. It had three components: where the student was ranked academically within their cohort, with further points for additional degrees and publications. The academic ranking placed students into one of ten groups, termed deciles. The scores ranged from 34 to 43 points, with 34 points awarded to a student in the lowest decile (decile 10, lowest academic performance), increasing by 1 point per decile increment, up to 43 points for students in the top decile (decile 1, highest academic performance). Students could then be awarded up to 5 points for

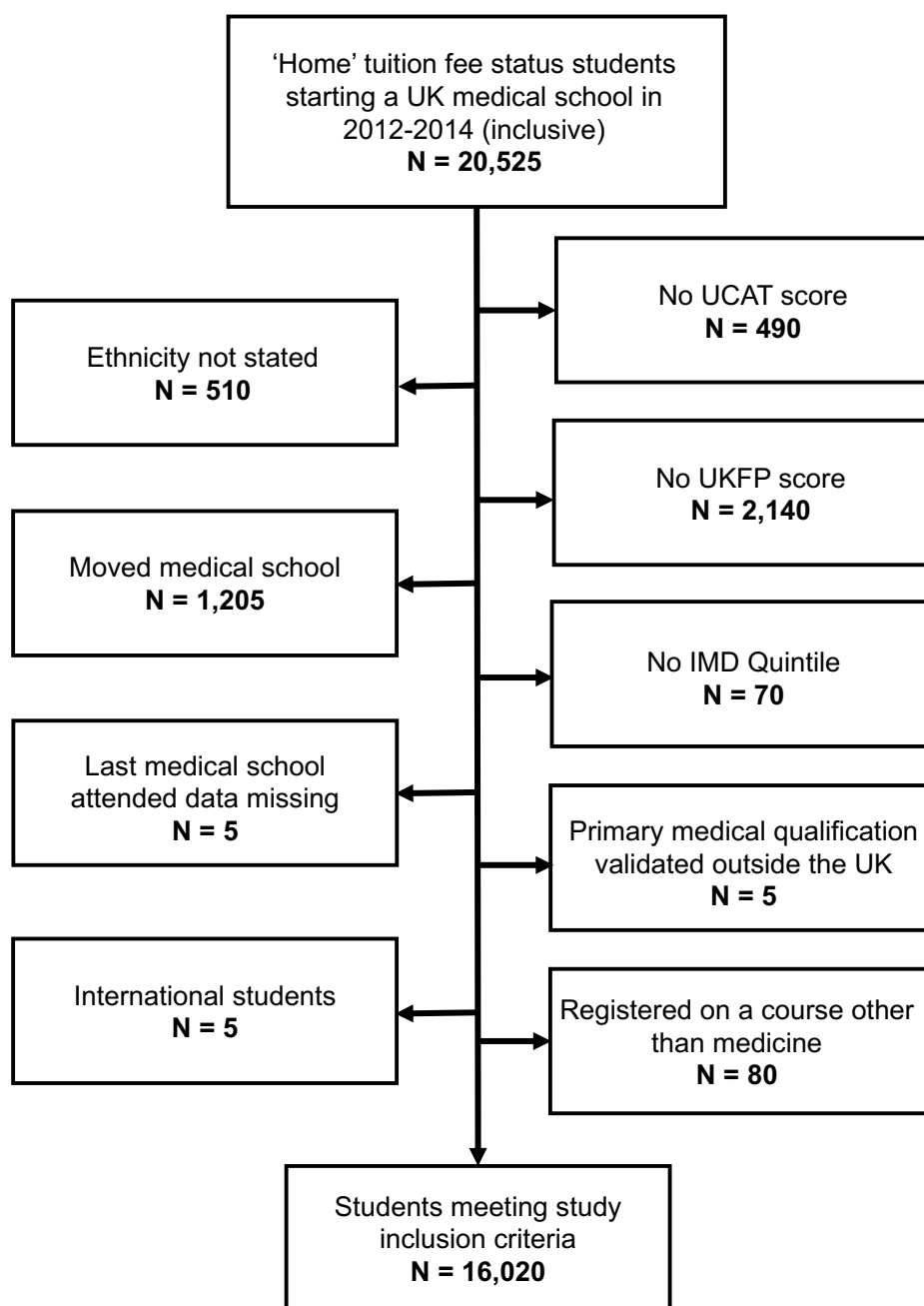


Figure 1 Flow diagram demonstrating the numbers of students excluded from our analysis at each step, reaching a final cohort of 16 020 students. All numbers are rounded to the nearest five to comply with HESA statistical disclosure requirements, so do not appear to sum correctly to 16 020. HESA, Higher Education Statistics Agency; IMD, Index of Multiple Deprivation; UCAT, University Clinical Aptitude Test; UKFP, UK Foundation Programme; UKMED, UK Medical Education Database.

additional degrees, and up to 2 points for publications, giving a possible range of 34–50 points for the EPM. SJT scores ranged from 0 to 50 points. We used first-sit SJT scores, equated at each sitting, as described in the respective SJT technical reports.^{36–40} As with UCAT scores, we standardised UKFP total scores within our study population to generate a UKFP Z-score.

Data analysis

We used Stata V.15.1 (StataCorp, College Station, Texas, USA) for data management and analysis. Data were

checked throughout to identify any potential invalidities and erroneous values. In accordance with the HESA statistical disclosure controls used by UKMED as part of their agreement with HESA for data access (<https://www.hesa.ac.uk/about/regulation/data-protection/rounding-and-suppression-anonymise-statistics>), all presented data has frequencies rounded to the nearest multiple of five, and percentages based on fewer than 22.5 individuals or averages based on fewer than seven individuals are suppressed. Percentages are expressed to one decimal

place in the tables and two significant figures in the text, with coefficients, 95% CIs and p values expressed to three decimal places unless otherwise stated.

We produced summary statistics for all independent variables, including UCAT Z-scores, comparing white and BAME students using appropriate statistical tests (X^2 for categorical variables and unpaired t-test for continuous variables).

The impact of ethnicity on the size of the AG

The size of the AG was assessed by comparing UKFP Z-scores for all BAME students versus white students, and for each of the eight individual BAME subgroups versus white students, using ordinary least squares (OLS) regression. We controlled for UCAT Z-score, gender, IMD quintile and course type.

To compare the ethnicity subgroups with one another, we conducted a series of 36 ordinary least squares regressions for the UKFP Z-score outcome, comparing each individual ethnicity subgroup with each of the others (not just vs white), again controlling for UCAT Z-score, gender, IMD quintile and course type. We produced a bubble plot of the adjusted coefficients on ethnicity to enable comparisons to be made, using the Bonferroni adjustment to determine statistical significance while accounting for multiple comparisons ($0.05/36$ to give a critical p value of <0.0014).

The impact of medical school attended on the size of the AG

We sought to determine if the impact of being from a BAME background had a different effect on UKFP Z-scores at different medical schools. To do this, we undertook a series of ordinary least squares regressions, one for each medical school. The outcome variable was UKFP Z-score, and we were interested in the coefficient on BAME at the medical school in question. This coefficient shows the mean difference in UKFP Z-score for BAME students compared with white students, after controlling for UCAT score, gender, IMD quintile and, where appropriate, course type. The coefficient on BAME at each school and its 95% CI were plotted on a forest plot. The critical p value for statistical significance was set at $p<0.0015$, again using the Bonferroni adjustment with 33 tests.

Power calculation

Our primary analysis was to examine the effect of ethnicity subgroup on UKFP Z-scores. We undertook a sample size calculation for a one-way analysis of variance using G*Power V.3.1.9.2. While this is a simpler model than would be used in the main analysis, it provides a useful guide to sample size requirements. We considered a small effect size ($f=0.06$), equivalent to one BAME subgroup having a mean UKFP Z-score of 0.2 SD above the grand mean of 0 and the others being equal to the grand mean. Using an alpha of 0.05, we had 80% power to detect this small effect size with a sample size of 4000 BAME students, assuming equal group sizes. While this assumption would

not be met in practice, our study sample of 4950 BAME students gives sufficient leeway to ensure we can detect small effects.

RESULTS

Study participants

The initial extract from the UKMED contained anonymised data for 20 525 UK medical students who were identified as having 'Home' tuition fee status and enrolled at medical school in the academic years starting in 2012–2014 inclusive. The dataset was screened to ensure we excluded any students who did not meet all inclusion criteria described above (figure 1). Our analysis included 16 020 UK medical students who met all inclusion criteria for the study, comprising 78% (16 020/20 525) of those included in the initial extract.

Descriptive data

Total cohort

Table 1 contains descriptive statistics for the total cohort, with a breakdown of data for students from all BAME backgrounds combined, white students and the results of statistical significance testing to compare the two groups. Online supplemental table 1 provides data on the percentage of BAME students at each medical school and online supplemental table 2 provides descriptive statistics for each ethnicity subgroup. Of the 16 020 medical students included in our study, 56% were female and 87% were enrolled on SEM. There was an inverse relationship between number of students and deprivation index, with the number in each quintile decreasing from IMD Q5 (least deprived) to IMD Q1 (most deprived).

Ethnicity subgroups

The nine ethnicity subgroups in descending size order were: white, Indian, Pakistani, mixed, other Asian background, black, other ethnic background, Chinese and Bangladeshi (table 1). The percentage of BAME students at individual medical schools ranged from 9.1% ($n=30$) at Dundee to 60% ($n=400$) at Imperial, with a mean across schools of 29% (online supplemental table 1). All five medical schools in London had more than 50% BAME students; this percentage was lower than 40% at all other schools.

BAME students were statistically significantly more likely to be male, from more deprived IMD quintiles and on SEM or EMDPs rather than GEPs. BAME students also had statistically significantly lower mean UCAT Z-scores on entry to medical school than their white peers (table 1). This difference in mean Z-scores was small (0.18 SD) and is equivalent to approximately 45 points on the UCAT scoring scale (which has a possible range of 1200–3000 points). There was considerable variation in mean UCAT Z-scores between individual ethnicity subgroups (online supplemental table 2).

The impact of ethnicity on the size of the AG

Table 2 shows the results of the multivariate analyses assessing the impact of ethnicity on the size of the

Table 1 Descriptive statistics by umbrella ethnicity groups (BAME and white)

Variable	BAME	White	Total cohort	Comparison of BAME and white students
Number of students, N (% of total cohort)	4950 (30.9)	11 070 (69.1)	16 020 (100.0)	–
Ethnicity subgroups, N (% of all BAME students or total cohort)				
Bangladeshi	180 (3.6)	N/A	180 (1.1)	N/A
Black	470 (9.5)		470 (2.9)	
Chinese	250 (5.1)		250 (1.6)	
Indian	1635 (33.0)		1635 (10.2)	
Mixed	670 (13.5)		670 (4.2)	
Other Asian background	625 (12.6)		625 (3.9)	
Other ethnic background	350 (7.1)		350 (2.2)	
Pakistani	770 (15.6)		770 (4.8)	
Male, N (% of ethnicity group or total cohort)	2290 (45.3)	4710 (42.5)	7000 (43.6)	$\chi^2=19.0$, $p<0.001$
Index of Multiple Deprivation, N (% of ethnicity group or total cohort)				
Quintile 1 (most deprived)	745 (15.1)	390 (3.5)	1135 (7.1)	$\chi^2=1\times 10^3$, $p<0.001$
Quintile 2	850 (17.2)	1050 (9.5)	1900 (11.9)	
Quintile 3	925 (18.7)	1895 (17.1)	2820 (17.6)	
Quintile 4	985 (19.9)	2995 (27.1)	3980 (24.8)	
Quintile 5 (least deprived)	1445 (29.2)	4745 (42.9)	6190 (38.6)	
Year of entry, N (% of ethnicity group or total cohort)				
2012	1600 (32.3)	3765 (34.0)	5365 (33.5)	$\chi^2=5.89$, $p<0.001$
2013	1615 (32.6)	3625 (32.7)	5240 (32.7)	
2014	1735 (35.1)	3680 (33.2)	5415 (33.8)	
Course type, N (% of ethnicity group or total cohort)				
SEM	4535 (91.6)	9405 (85.0)	13 950 (87.1)	$\chi^2=232$, $p<0.001$
EMDP	100 (2.0)	100 (0.9)	200 (1.2)	
GEP	310 (6.3)	1560 (14.1)	1870 (11.7)	
Mean UCAT Z-score (SD)	−0.123 (1.055)	0.055 (0.969)	0.000 (1.000)	$t=10.5$, $p<0.001$

All numbers are rounded to comply with HESA statistical disclosure requirements, so may not sum to 100%. Percentages are presented to two decimal places (d.p.), with UCAT Z-scores presented to three d.p. Data for all ethnicity subgroups are presented in online supplemental table 2.
BAME, black, Asian and other minority ethnic; EMDP, extended medical degree programme; GEP, graduate entry programme; HESA, Higher Education Statistics Agency; N, number; N/A, not applicable; SEM, standard entry medicine; UCAT, University Clinical Aptitude Test.

AG between BAME and white students, measured by UKFP Z-score. R^2 values increased when using ethnicity subgroups rather than simply BAME versus white.

In the umbrella analysis of all BAME versus white students, the multivariate coefficient on BAME for UKFP Z-score was -0.36 (95% CI -0.39 to -0.32 , $p<0.001$), suggesting that, on average, BAME students had UKFP Z-scores 0.36 SD lower than white students (table 2). This is equivalent to around 2 of 100 UKFP points, or two EPM deciles. When including individual ethnicity subgroups in the model predicting UKFP Z-scores (with white as the control variable), there was considerable subgroup variation. The coefficients for ethnicity subgroups ranged from -0.15 SD (approximately 0.8 deciles) for students of mixed ethnicity (95% CI -0.23 to -0.08 , $p<0.001$) to -0.53 SD (approximately three deciles) for Pakistani students (95% CI -0.60 to -0.46 , $p<0.001$).

Figure 2 shows the results of the 36 pairwise comparisons between all nine ethnicity subgroups. Fifteen of

the 36 comparisons were statistically significant after controlling for multiple comparisons. White students had significantly higher UKFP Z-scores in all comparisons with the eight ethnic minority subgroups. Five of the statistically significant comparisons include mixed ethnicity students, who also had relatively high UKFP Z-scores and the remaining two include Indian students (again with higher scores). Three coefficients for both Chinese and Pakistani students were statistically significant, with these students having lower relative UKFP Z-scores.

The impact of medical school attended on the size of the AG

Figure 3 shows the difference in mean UKFP Z-score for BAME students compared with white students at each medical school, controlling for UCAT Z-score, gender, IMD quintile and course type. The coefficients for BAME were statistically significantly negative for 22 of 33 medical schools after controlling for multiple comparisons. At these schools, BAME students had lower UKFP Z-scores

Table 2 Impact of ethnicity and control variables on the size of the Awarding Gap on exit from medical school (as measured by UKFP Z-score)

All BAME (cf. white)		Ethnicity subgroups (cf. white)	
R ²	0.129	R ²	0.133
BAME	−0.357 (−0.390 to −0.324)	Bangladeshi	−0.490 (−0.631 to −0.350)
		Black	−0.501 (−0.589 to −0.413)
		Chinese	−0.476 (−0.594 to −0.359)
		Indian	−0.284 (−0.333 to −0.235)
		Mixed	−0.154 (−0.227 to −0.082)
		Other Asian background	−0.432 (−0.508 to −0.356)
		Other ethnic background	−0.338 (−0.437 to −0.238)
		Pakistani	−0.525 (−0.595 to −0.455)
Control variables and impact on UKFP Z-score		Control variables and impact on UKFP Z-score	
UCAT Z-score*	0.232 (0.218 to 0.247)	UCAT Z-score*	0.228 (0.213 to 0.243)
Female	0.229 (0.200 to 0.258)	Female	0.226 (0.197 to 0.255)
IMD quintile		IMD quintile	
2	0.161 (0.092 to 0.231)	2	0.132 (0.063 to 0.202)
3	0.216 (0.150 to 0.281)	3	0.177 (−0.111 to 0.243)
4	0.208 (0.145 to 0.272)	4	0.169 (0.104 to 0.233)
5	0.230 (0.168 to 0.291)	5	0.188 (0.126 to 0.250)
Course type		Course type	
EMDP	−0.296 (−0.427 to −0.165)	EMDP	−0.282 (−0.413 to −0.151)
GEP	0.362 (0.316 to 0.407)	GEP	0.356 (0.310 to 0.401)

Total number of students in analysis: 16 020. The results shown are the regression coefficient with 95% CIs expressed in parentheses. All coefficients are statistically significant at $p < 0.001$, so p values are not shown in this table. The control variables shown are compared against: male, IMD quintile 1 (most deprived) and standard entry medicine course type, respectively.

*For every 1 SD increase in UCAT Z-score.

BAME, black, Asian and other minority ethnic; CI, confidence interval; EMDP, extended medical degree programme; GEP, graduate entry programme; IMD, Index of Multiple Deprivation; UCAT, University Clinical Aptitude Test; UKFP, UK Foundation Programme.

than white students (white squares in figure 3). Across all medical schools combined, the coefficient for BAME is equivalent to approximately -2 UKFP points/deciles, but figure 3 suggests that there is variation between individual medical schools. The coefficients for BAME varied from -0.83 SD, approximately -4.5 deciles, at Plymouth (95% CI -1.18 to -0.49, $p < 0.001$) to +0.05 SD, approximately +0.3 deciles, at Dundee (95% CI -0.32 to 0.42, $p = 0.792$).

DISCUSSION

Principal findings

This study represents the largest single national cohort study to date on the AG between BAME and white students in UK undergraduate medical education. Our results demonstrate two key findings: there are important differences in the academic outcomes of students from BAME subgroups, and the academic outcomes of BAME students vary between medical schools.

The largest previous study in this field is a 2011 systematic review and meta-analysis by Woolf *et al*, which included data on 13 193 medical students across 16 studies.¹ While this review clearly demonstrates an AG, the data were gathered from a limited number of largely London-based universities, with outcome

measures focused on performance in assessments idiosyncratic to those schools. Our use of the UKFP Z-score provides a universal exit outcome measure which is applicable to all students at medical schools across the UK. Our study also constitutes an important development in the field as it highlights how using an umbrella classification for BAME students may hide significant differences between subgroups. As previously shown by Hope *et al*, the AG grows for all BAME subgroups at medical school.³ However, in conducting our analysis for eight minority ethnicity subgroups, we have identified that the effect is particularly severe for Chinese and mixed ethnicity students, who have higher UCAT Z-scores than white students on entry to medical school, but lower UKFP Z-scores on exit. Furthermore, the fact that the AG varies by medical school attended suggests that the undergraduate performance of BAME students is additionally susceptible to impact from their specific educational environment.

Our strict inclusion criteria mean that 22% ($n = 4030$) of students in the initial dataset were excluded. We only included students with a UCAT score, excluding those sitting only the BioMedical Admissions Test (BMAT) and/or Graduate Medical School Admissions Test. This may have caused a slight downwards bias in the overall

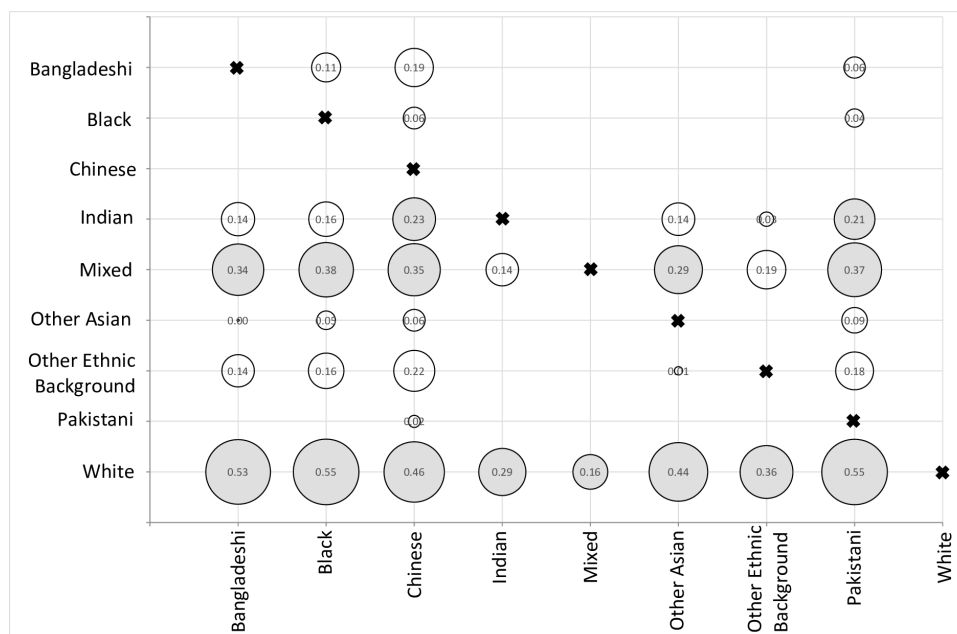


Figure 2 Bubble plot to show the results of pairwise comparisons between ethnicity subgroups (outcome: UKFP Z-scores). The bubbles show the mean difference in UKFP Z-scores between the two ethnicities in the pair, after controlling for UCAT Z-score, gender, socioeconomic status (IMD quintile) and course type. The size of each bubble is proportional to the effect size (difference in means), which is shown in each bubble. The result for each pairwise comparison is shown once, where the ethnicity subgroup on the y-axis has a higher mean score than the ethnicity subgroup on the x-axis. For example, Indian students have a higher mean UKFP Z-score than Bangladeshi students, so the bubble is on the (x=Bangladeshi, y=Indian) coordinate and not the (x=Indian, y=Bangladeshi) coordinate. General positive trends for a subgroup can be established by reading across the figure and general negative trends by reading up. The critical p value for statistical significance is $p < 0.05/36 = p < 0.0014$, with statistically significant results shown in grey and non-statistically significant results in white. IMD, Index of Multiple Deprivation; UCAT, University Clinical Aptitude Test; UKFP, UK Foundation Programme.

ability of the cohort, as the BMAT is used by some of the most selective medical schools. We were limited to the use of predefined ethnicity categories and self-reported ethnicity data, which rendered us unable to identify specific ethnicities represented within the 'mixed' subgroup. There may be differences in attainment between students of, for example, mixed white and Asian versus mixed white and black ethnicity. Given that we have identified the importance of performing analyses at the level of individual ethnicity subgroups rather than an umbrella BAME grouping, analysis at medical school level may be similarly limited. As deciles were awarded internally by each medical school, there are potential issues related to non-comparability of deciles across schools. Within each medical school, there may also be differences in the mix of individual ethnicity subgroups: if students choose schools where they perceive students from the same background perform well, true differences in the AG between white and BAME students may be masked. The results for medical schools where the UCAT is not mandatory may not be generalisable to their entire student cohort if students who took the UCAT differ from those who did not. Lastly, multiple imputation could have been used to mitigate any missing data.

Potential mechanisms of action, implications and future work

When addressing differences in outcomes across medical schools, the proportion of BAME students at each

university is an obvious factor to consider (online supplemental table 1). Students are more likely to establish friendships with people of the same ethnicity, and friendships make a positive impact on examination performance.⁴¹ However, our analysis shows no relationship between the size of the AG (figure 3) and the proportion of BAME students at a medical school. Other differences between medical schools, for example, variable curricula, teaching methods and assessment, and institutional factors such as attitudes and faculty diversity, may also explain differences in outcomes for BAME students between medical schools.^{24–26} Further work to identify causal pathways is essential, although it is likely that many factors will be at play.^{3 12}

One further potential explanation for the size of the AG in UKFP Z-scores is the relative weight that was given to the SJT in these students' total application scores (50%), as white students scored significantly higher on this assessment.^{36–40} From 2024, the SJT and EPM will no longer contribute to the allocation of postgraduate training posts.⁴² The new system of 'preference informed allocation' may, therefore, result in some mitigation of the AG at exit.^{33 42}

Although the underlying causes of the AG remain elusive, many medical schools are already implementing strategies to address it.⁴³ All schools should be supported to evaluate any such interventions, including a process

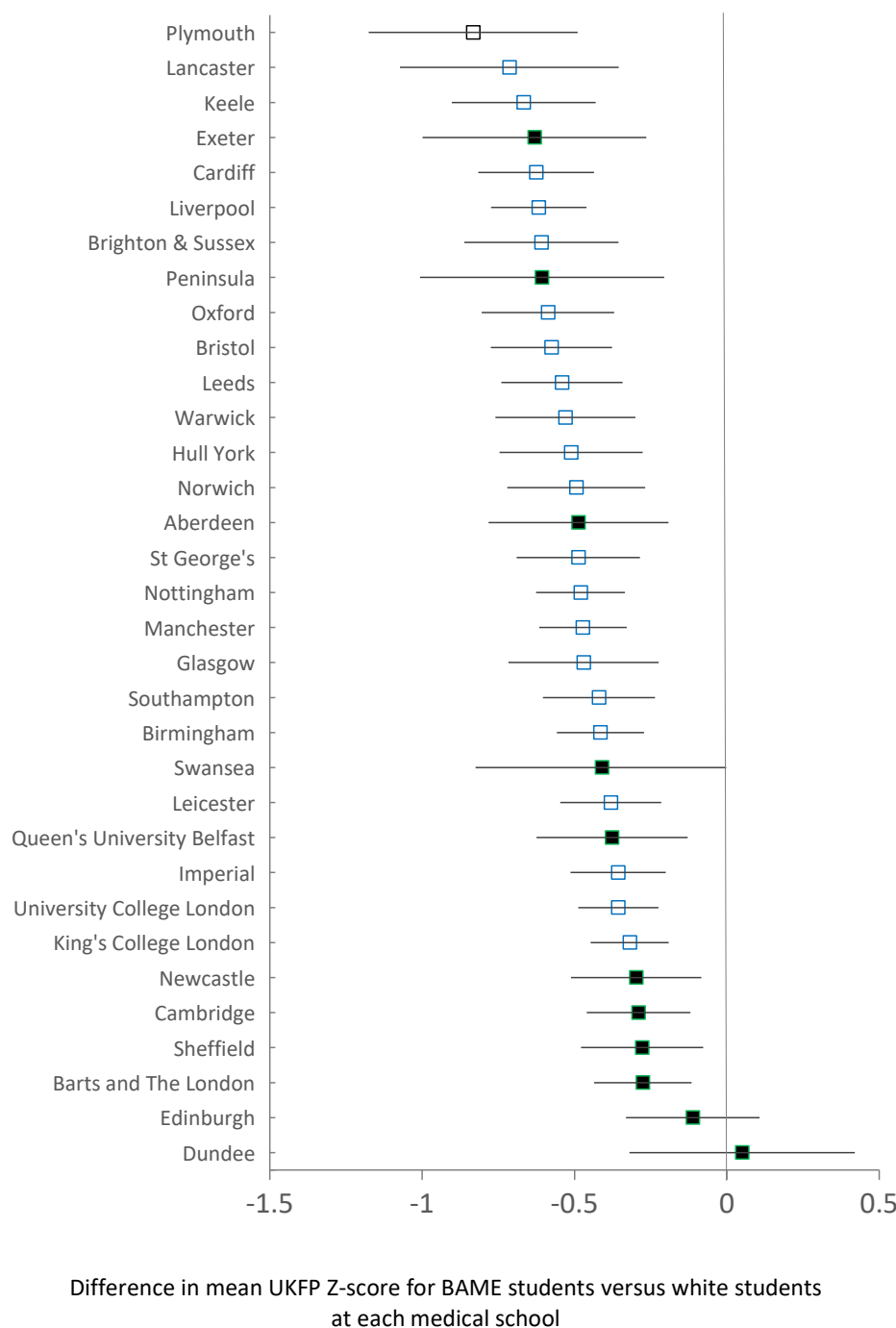


Figure 3 The Awarding Gap between BAME and white students at individual medical schools (as measured by UKFP Z-scores). Analyses control for UCAT Z-score, gender, IMD quintile and, where appropriate, course type. A negative coefficient implies that BAME students have lower UKFP Z-scores than white students at that medical school. White squares indicate that the coefficient is statistically significant at $p < 0.0015$; black squares are not statistically significant; horizontal black lines demonstrate the 95% CI. BAME, black, Asian and other minority ethnic; IMD, Index of Multiple Deprivation; UCAT, University Clinical Aptitude Test; UKFP, UK Foundation Programme; CI, confidence interval.

evaluation that will enable mechanisms of action to be identified.⁴⁴ Further work to investigate why there are differences between schools is necessary, and should facilitate the development of interventions to close the gap.

CONCLUSION

Our principal findings demonstrate that the AG between BAME and white students at UK medical schools remains even after controlling for aptitude on entry. Our results serve to highlight the importance of conducting highly powered studies and incorporating analysis by individual

BAME subgroups if we are to accurately characterise and tackle the AG. Our findings suggest that the current teaching and assessment systems are disadvantageous to BAME students, and further work is needed to explore exactly what these differences are, why they occur and how they impact individual student groups. There is evidence of an AG on exit at almost every medical school, and there is variation in the size of the gap between institutions. Medical schools must, therefore, take action to identify and mitigate the reasons for any AG within their schools if we are to achieve an equal learning environment for our future doctors.

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Patient consent for publication Not required.

Ethics approval UKMED states on their website (<https://www.ukmed.ac.uk/faq>) that 'The Medical Schools Council agreed that all approved applications for research projects using data exclusively held by UKMED would meet the criteria for a blanket exemption from the need to apply for ethics approval and that would be recognised by ethics committees relevant to UK medical schools'.

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REFERENCES

- 1 Woolf K, Potts HWW, McManus IC. Ethnicity and academic performance in UK trained doctors and medical students: systematic review and meta-analysis. *BMJ* 2011;342:d901.
- 2 General Medical Council. Tackling differential attainment. 2023. Available: <https://www.gmc-uk.org/education/standards-guidance-and-curricula/projects/differential-attainment>
- 3 Hope D, Dewar A, Hotherhall EJ, et al. Measuring differential attainment: a longitudinal analysis of assessment results for 1512 medical students at four Scottish medical schools. *BMJ Open* 2021;11:e046056.
- 4 Claridge H, Stone K, Ussher M. The Ethnicity attainment gap among medical and BIOMEDICAL science students: a qualitative study. *BMC Med Educ* 2018;18:325.
- 5 Richardson JTE. Degree attainment, Ethnicity and gender: a literature review. Higher Education Academy; 2008. Available: <https://oro.open.ac.uk/11535/1/11535.pdf> [Accessed 2 Sep 2023].
- 6 Fielding A, Charlton C, Kounali D, et al. Degree attainment, Ethnicity and gender: interactions and the modification of effects. A quantitative analysis. Higher Education Academy; 2008. Available: <https://www.bristol.ac.uk/media-library/sites/cmm/migrated/documents/degree-eth-gender.pdf>
- 7 McManus IC, Woolf K, Dacre J. The educational background and qualifications of UK medical students from ethnic minorities. *BMC Med Educ* 2008;8:21.
- 8 McManus IC, Woolf K, Dacre J, et al. The academic backbone: longitudinal continuities in educational achievement from secondary school and medical school to MRCP(UK) and the specialist register in UK medical students and doctors. *BMC Med* 2013;11:242.
- 9 James D, Yates J, Nicholson S. Comparison of a level and UKCAT performance in students applying to UK medical and dental schools in 2006: cohort study. *BMJ* 2010;340:c478.
- 10 McManus IC, Dewberry C, Nicholson S, et al. The UKCAT-12 study: educational attainment, aptitude test performance, demographic and socio-economic contextual factors as predictors of first year outcome in a cross-sectional collaborative study of 12 UK medical schools. *BMC Med* 2013;11:244.
- 11 Tiffin PA, McLachlan JC, Webster L, et al. Comparison of the sensitivity of the UKCAT and a levels to sociodemographic characteristics: a national study. *BMC Med Educ* 2014;14:7.
- 12 General Medical Council. Tackling disadvantage in medical education analysis of postgraduate outcomes by Ethnicity and the interplay with other personal characteristics. 2023. Available: https://www.gmc-uk.org/-/media/documents/96887270_tackling-disadvantage-in-medical-education-020323.pdf [Accessed 3 Sep 2023].
- 13 MacKenzie RK, Cleland JA, Ayansina D, et al. Does the UKCAT predict performance on exit from medical school? A national cohort study. *BMJ Open* 2016;6:e011313.
- 14 Sartania N, McClure JD, Sweeting H, et al. Predictive power of UKCAT and other pre-admission measures for performance in a medical school in Glasgow: a cohort study. *BMC Med Educ* 2014;14:116.
- 15 Kumwenda B, Cleland JA, Walker K, et al. The relationship between school type and academic performance at medical school: a national, multi-cohort study. *BMJ Open* 2017;7:e016291.
- 16 University Clinical Aptitude Test Consortium. UCAT test format. Available: <https://www.ucat.ac.uk/about-ucat/test-format/> [Accessed 23 Jan 2022].
- 17 University Clinical Aptitude Test Consortium. UKCAT examination technical report. 2010. Available: https://www.ucat.ac.uk/media/1051/ukcat-2010-technical-report_abridged.pdf [Accessed 23 Jan 2023].
- 18 University Clinical Aptitude Test Consortium. UKCAT examination technical report 2011. Available: <https://www.ucat.ac.uk/media/1052/ukcat-2011-technical-report-abridged.pdf> [Accessed 23 Jan 2022].
- 19 University Clinical Aptitude Test Consortium. UKCAT examination technical report 2012. Available: https://www.ucat.ac.uk/media/1053/ukcat-2012-technical-report_abridged.pdf [Accessed 23 Jan 2022].
- 20 University Clinical Aptitude Test Consortium. UKCAT examination technical report 2013. Available: <https://www.ucat.ac.uk/media/1054/ukcat-2013-technical-report.pdf> [Accessed 23 Jan 2022].
- 21 University Clinical Aptitude Test Consortium. UKCAT examination technical report 2018. Available: <https://www.ucat.ac.uk/media/1306/ukcat-2018-technical-report-summary.pdf> [Accessed 22 Jan 2022].

- 22 University Clinical Aptitude Test Consortium. UCAT examination technical report 2019. 2022. Available: https://www.ucat.ac.uk/media/1416/ucat-2019-technical-report-exec-summary_v1.pdf [Accessed 22 Jan 2022].
- 23 University Clinical Aptitude Test Consortium. UCAT examination technical report 2020. Available: <https://www.ucat.ac.uk/media/1479/ucat-2020-executive-summary-v2.pdf> [Accessed 22 Jan 2022].
- 24 Devine OP, Harborne AC, Horsfall HL, *et al.* The analysis of teaching of medical schools (atoms) survey: an analysis of 47,258 timetabled teaching events in 25 UK medical schools relating to timing, duration, teaching formats, teaching content, and problem-based learning. *BMC Med* 2020;18:126.
- 25 Forrest D, George S, Stewart V, *et al.* Cultural diversity and inclusion in UK medical schools. *Clin Teach* 2022;19:213–20.
- 26 Hoque S, Baker EH, Milner A. A quantitative study of race and gender representation within London medical school leadership. *Int J Med Educ* 2021;12:ijme.12.94100:94–100..
- 27 Emery JL, Bell JF. The predictive validity of the BIOMEDICAL admissions test for pre-clinical examination performance. *Med Educ* 2009;43:557–64.
- 28 Puddey IB, Mercer A. Predicting academic outcomes in an Australian graduate entry medical programme. *BMC Med Educ* 2014;14:31.
- 29 Greatrix R, Nicholson S, Anderson S. Does the UKCAT predict performance in medical and dental school? A systematic review. *BMJ Open* 2021;11:e040128.
- 30 Yates J, James D. The value of the UK clinical aptitude test in predicting pre-clinical performance: a prospective cohort study at Nottingham medical school. *BMC Med Educ* 2010;10:55.
- 31 Bala L, Pedder S, Sam AH, *et al.* Assessing the predictive validity of the UCAT- A systematic review and narrative synthesis. *Med Teach* 2022;44:401–9.
- 32 University Clinical Aptitude Test Consortium. UCAT universities. 2022. Available: <https://www.ucat.ac.uk/about-ucat/universities> [Accessed 23 Jan 2022].
- 33 Sam AH, Fung CY, Reed M, *et al.* Time for preference-informed foundation allocation *Clin Med (Lond)* 2022;22:590–3.
- 34 UK Foundation Programme. 2020 recruitment Stats and facts report. 2020. Available: https://jchui.github.io/fpas-calc/data/2020%20Recruitment%20Stats%20and%20Facts%20Report_FINAL.pdf [Accessed 23 Aug 2022].
- 35 Smith D, Twigg E, Gurusamy G, *et al.* UK medical education database data dictionary. 2021. Available: https://www.ukmed.ac.uk/documents/UKMED_data_dictionary.pdf [Accessed Jul 2021].
- 36 Patterson F, Aitkenhead A, Rosselli A, *et al.* Analysis of the Situational Judgement Test for Selection to the Foundation Programme 2016 Technical Report, Available: https://isfporguk.files.wordpress.com/2018/06/fy1-sjt-technical-report_2015_16.pdf [Accessed 23 Jan 2022].
- 37 Patterson F, Aitkenhead A, Rosselli A, *et al.* Analysis of the Situational Judgement Test for Selection to the Foundation Programme 2017 Technical Report, Available: <https://isfporguk.files.wordpress.com/2018/06/fy1-sjt-technical-report-2016-17-final.pdf> [Accessed 23 Jan 2022].
- 38 Patterson F, Aitkenhead A, Sheridan S, *et al.* Analysis of the Situational Judgement Test for Selection to the Foundation Programme 2018 Technical Report, Available: <https://isfporguk.files.wordpress.com/2018/06/fy1-sjt-technical-report-2017-18-23-05-18.pdf> [Accessed 23 Jan 2022].
- 39 Patterson F, Sheridan S, Kinirons T, *et al.* Analysis of the Situational Judgement Test for Selection to the Foundation Programme 2019 Technical Report, Available: <https://isfporguk.files.wordpress.com/2019/07/fy1-sjt-technical-report-2018-19-final.pdf> [Accessed 23 Jan 2022].
- 40 Patterson F, Sheridan S, Laidler S, *et al.* Analysis of the Situational Judgement Test for Selection to the Foundation Programme 2020 Technical Report, Available: <https://isfporguk.files.wordpress.com/2020/06/fy1-sjt-technical-report-2019-20-final.pdf> [Accessed 23 Jan 2022].
- 41 Woolf K, Potts HWW, Patel S, *et al.* The hidden medical school: a longitudinal study of how social networks form, and how they relate to academic performance. *Med Teach* 2012;34:577–86.
- 42 Rimmer A. Situational judgment test is scrapped under new system for allocating foundation training places. *BMJ* 2023;1269.
- 43 Linton S. Taking the difference out of attainment. *BMJ* 2020;368.
- 44 PawsonR, TilleyN. An introduction to scientific realist evaluation. In: Chelimsky E, ShadishWR, eds. *Evaluation for the 21st century: A Handbook*. London: sage publications Inc, 1997: 405–18.