


Demographic disparities in dental school selection: An analysis of current UK practices

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University Clinical Aptitude Test

Abstract

Introduction: Specific social groups remain under-represented within dentistry. While the University Clinical Aptitude Test (UCAT) aims to widen participation in under-represented social groups, there is no evidence in dental education that this aim is being met.

Materials and Methods: Data over two admission cycles (2012 and 2013), including 3246 applicants to 10 UK dental schools, were analysed. Applicant and selected pools were compared to the UK population. Multiple logistic regression was used to investigate the association between demographic variables and UCAT and receiving an offer of a place at dental school.

Results: Over-representation of Female, Asian, least deprived and grammar school groups were found in applicant and selected pools compared with the UK population. White ethnic applicants were significantly more selected than Black (OR 0.25), Asian (OR 0.57) and Mixed (OR 0.80) ethnicities, while least deprived applicants were significantly more selected than most deprived (OR 0.59). Grammar school education increased odds of selection by 1.8 when compared to state school. The addition of UCAT to the model for applicants reduced ethnic disparities but led to disparities between other groups.

Conclusion: Current widening participation practices focus on attracting applicants from lower socio-economic groups. However, this study showed that ethnicity, sex and educational background biases also affect demographic diversity in dentistry. The UCAT shows promise in levelling the playing field; however, widening access measures will only succeed if selection committees radically change selection processes to address the systemic biases, enabling the dentists of tomorrow to represent the society they serve.

KEYWORDS

dental education, selection, UCAT, widening access

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1 | INTRODUCTION

Certain social groups remain under-represented within medicine and dentistry.^{1,2} Compared with the higher education sector average, these highly competitive entry courses still show the lowest number of applicants and students from deprived backgrounds (5.8%, compared to 11.4% sector average).³ Furthermore, there is clear evidence that significant under-representation of some social, cultural and ethnic groups in dentistry persist despite a variety of national initiatives such as quota systems and political imperatives and local activities such as gateway programmes.⁴ Two main arguments are put forward in the literature as to why widening access to medical and dental education is important. First, in relation to social justice (the distribution of wealth, opportunities and privileges within a society) it is important that participation in higher education is not dictated by birth and social circumstance alone.^{2,5} Furthermore, a supply of doctors and dentists who understand the context and culture of the communities they serve is considered essential to improving healthcare quality.^{2,6-8}

One of the suggested ways to attract and widen medical or dental school access for students from under-represented groups involves using criteria other than grades for selection.⁹⁻¹¹ The rationale is that the use of grades has been shown—especially in the United Kingdom—to introduce a significant socio-economic bias.¹² In the United Kingdom, students sit a subject-based qualification at the end of secondary education called the A level (Advanced Level). UK figures show a marked ethnic disparity in school pupils achieving at least 3 A grades at A level, which is the current acceptance level for UK Dental schools. Of those gaining 3 A grades, 36.7% are Asian students, 21.4% Mixed and 'other ethnicities' combined, 11% White and 5.5% Black.¹³

The school a student attends also has an influence on attainment. In the United Kingdom, children mainly attend one of three types of school; State, Grammar or Independent. State schools are government-run and follow a national curriculum. Grammar schools are normally also government-run but they select their pupils based on academic ability. Independent schools charge fees to attend and pupils do not have to follow the national curriculum. Pupils at independent schools are predicted to achieve three As at A-level more often than pupils at state schools.¹⁴ However, this difference has been attributed to both material deprivation and the support independent schools give during the application process, rather than an accurate representation of student ability.¹⁵ Indeed, once students enter higher education evidence shows students from state schools out-perform those from the highest achieving schools.¹⁶⁻¹⁸ Furthermore, evidence also shows that grades do not predict clinical performance.^{19,20} These findings provide a strong rationale against relying solely on grades to predict a student's potential for future performance.

There are two widely accepted ways of counteracting grade inequalities: grade compensation, or the use of additional admissions tools such as a multi-mini interview (MMI) or an aptitude test. Grade compensation relates to adjusting the grade entry requirements to

students from low-performing schools. However, even when A-level grades are compensated for, students from state schools are under-represented in leading higher education institutions as a whole.²¹

The use of an aptitude test has also been employed to attempt to counteract grade inequality. However, the influence of aptitude tests on increasing diversity is mixed. Cleland et al.¹² concluded that aptitude tests are 'better' at widening access than grades, personal statements and references. Tiffin et al.²² reported that the negative effect of being a member of a widening participation group seemed to be mitigated by the admissions processes utilised by medical schools using the UCAT score as a threshold for interview or offer decisions. Others have indicated that socio-demographic factors determine performance in aptitude tests and that using them may not change the diversity of students selected.²³

All dental schools in the United Kingdom have introduced an entrance aptitude test; fourteen schools have adopted the UCAT (University Clinical Aptitude Test), one school the BMAT (BioMedical Admissions Test) and one school an individual entrance examination. The UCAT (previously known as UKCAT) was established in 2006 in response to university concerns about the difficulties of selecting fairly from increasing numbers of high-achieving applicants.²⁴ The UCAT aims to 'widen participation in medical, dental and clinical sciences training of under-represented social groups'; however, there is no current evidence in dental education that this aim is being met.

This study utilises data from UCAT over two admission cycles which includes applicants to 10 UK dental schools. Applicants typically apply for dental school in the preceding year to entry, therefore the application data analysed was for years 2012 and 2013 (for a 2013 and 2014 entry). This represented the most up-to-date data set that UCAT held at the time of study. There is no evidence that the applicant pool has changed significantly from this point. We investigate the demographic variance in those being offered a place at dental school compared to both the applicant pool and the general UK population. We also explore how ethnicity, gender, socio-economic variables and educational variables (specifically the UCAT) affect the probability of both an offer and acceptance of a place at dental school. The process employed mirrors a similar study completed for a review of medical admissions by Steven et al.²⁵ Interview scores, personal statement scores and referee scores are not be available and thus cannot be part of the analysis.

2 | METHODS

Applicants to UK dental schools apply through the Universities and Colleges Admission System (UCAS). Over the period examined, 10 dental schools also required applicants to take the aptitude test UCAT. Data from both UCAS and UCAT was linked, cleaned, managed and analysed to provide a single dataset which was accessed in a data safe haven hosted in the Health Informatics Centre, University of Dundee. One duplication was found, along with 46 applicants for which there was no UCAT or demographic data. These were deleted and this resulted in 3246 applicants for analysis. Access was

granted through application to the UCAT consortium. The data set includes the demographics, UCAT test scores of applicants and offer outcome from the 10 UCAT consortium schools. Data for 3246 applicants from two admission cycles (2012 and 2013) were examined. The UCAT introduced a situational judgement test (SJT) component in 2013, and this was only available for the 2013 cohort. The study was reviewed and approved by the University of Aberdeen Ethics committee (CERB/2019/5/1695). Data were analysed under data governance rules established by the UCAT consortium.

2.1 | Outcome variables and predictors

The primary outcome variables were the offer of a place to study dentistry (Offer=1, No offer=0), 2012 and 2013 UCAT score (Mean \pm SD), and 2013 SJT score (Mean \pm SD).

The secondary outcome variable was the number of offers received. The effect of sex, ethnicity, National Statistics Socio-Economic Classification (NSSEC), school type and domicile of each candidate, along with the number of attempts at UCAT were analysed for each outcome measure. The National Statistics Socio-Economic Classification (NSSEC) is the official socio-economic classification in the United Kingdom. It provides an indication of socio-economic position based on occupation. In this study we use the five-class version of the NSSEC, with one being least deprived and five being most deprived.

2.2 | Data analysis

The data were analysed descriptively to gain an understanding of differences in the numbers of applicants from different sex, ethnicity, NSSEC, school type and domicile.

To further investigate the demographic variables of those who applied we calculated the 'Standardised Application Ratio'. Seyan et al.²⁶ and Steven et al.²⁵ advised the use of the standardised application ratio for measuring widening participation for demographic variables. The 'application ratio' (AR) is a numerical description of the applicant population compared to the total population in a given country. It equals the percentage of applicants in a specific category (e.g. females) divided by the expected percentage of the population in that category. A number greater than 1 shows that the percentage of applicants in that category is larger than would be expected in the general population; less than one shows the opposite is true. As the data included applications to UK dental schools, we took the average UK population figures from the UK 2011 census²⁷ (sex and ethnicity), The Sutton Trust²¹ (school type) and Official labour market data²⁸ (NSSEC). Only applicants that were domiciled in the United Kingdom at the point of application were included in this part of the analysis.

As selection panels can only select from those who apply, we also calculated a 'selection ratio' to describe the difference between the applicant pool (every applicant) and the selected pool (all those

with an offer). A number higher than one shows the percentage of selected applicants is larger in the specific categories than would be expected based on the applicant pool; less than one shows the opposite is true. In addition to the demographic variables we also calculated the selection ratio for the 'number of UCAT attempts'.

The relationship between demographic variables and combinations of demographic variables (e.g. White female) on the offer of a place was analysed using a chi-squared test of independence. Multiple logistic regression of variables that achieved statistical significance was conducted to ascertain the adjusted effects on the odds of an offer. We analysed the association between demographic variables and both UCAT total score and SJT score using a two-sample *t*-test for sex and ANOVA for all other variables. The analysis was completed using IBM SPSS v11.

3 | RESULTS

There were 3246 applicants to one or more of the 10 UCAT consortium dental schools over the two admission cycles of 2012–2013 and 2013–2014. Females accounted for 60% of applicants and males 39% (Table 3). Most applicants were either White (42%) or Asian (41%) ethnicity, with Black and Mixed ethnic groups making up approximately 2% each. Applicants were mainly from the least deprived NSSEC 1 category (71%), with only 3% of applicants from the most deprived NSSEC 5. Most applicants had attended state schools (38%), followed by grammar schools (20%) or private education (18%). Three percent had attended higher education. Ninety-three percent were originally from the United Kingdom, 1% from EU countries and 6% from the rest of the world. Most applicants had only taken UCAT on one occasion (83%), although some applicants had attempted the test up to five times (0.01%).

3.1 | Application and selection ratios

As described above, 'application ratios' (AR) and 'selection ratios' (SR) were calculated for each category of the demographic variables. Compared with the average UK population, the applicant pool comprised a higher proportion of females (AR 1.17); this was also true for the selected pool (SR 1.03; Figure 1). Applicants from an Asian ethnic background were over six times the proportion in the UK population (AR 6.24). However, the proportion of Asians offered a place was lower than in the applicant pool (SR 0.86). The number of applications from all other ethnic groups was lower than expected in the UK population, with White applicants being half the expected proportion. Black ethnic groups were not only under-represented in the applicant population (AR=0.76) but further reduced once selected (SR=0.33; Figure 2). The proportion of applicants from the least deprived NSSEC category was more than double the proportion in the population, whereas the most deprived category was less than a fifth of the equivalent UK population. The selected applicants' deprivation categories

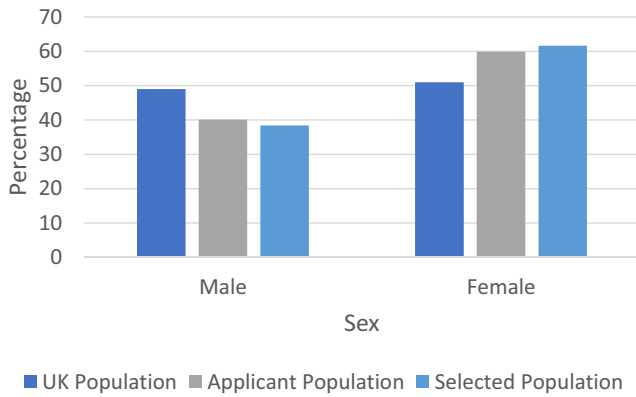


FIGURE 1 Sex.

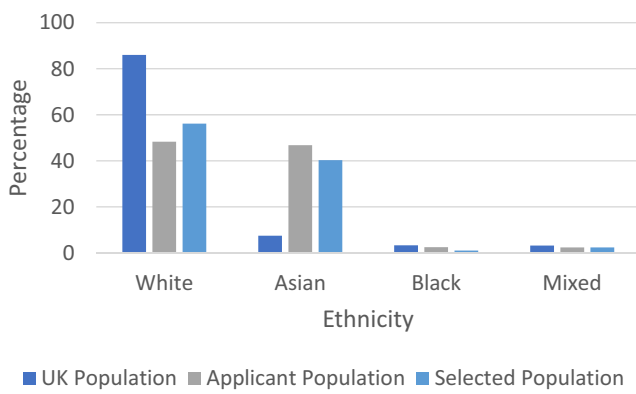


FIGURE 2 Ethnicity.

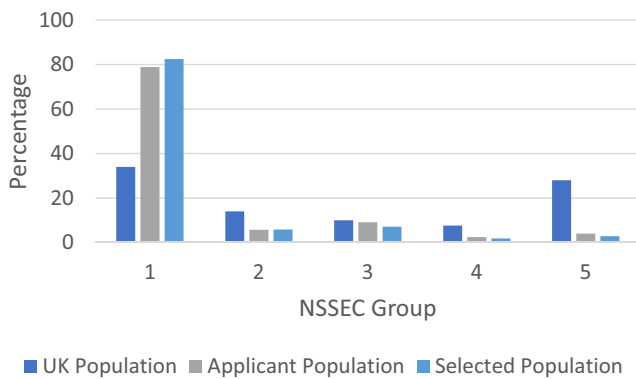


FIGURE 3 National Statistics Socio-Economic Classification (NSSEC).

remained in similar proportions to the applicant pool, with NSSEC 1 and 2 making up the majority (Figure 3). In the United Kingdom, almost 88% of the population attended a state school; however, less than half had attended a state school in the applicant pool. Grammar schools were over-represented by five times and private schools by three times the UK population's equivalent. These proportions remained similar in the selected pool (Figure 4). The application and selection ratios can be found in Table 1, and an

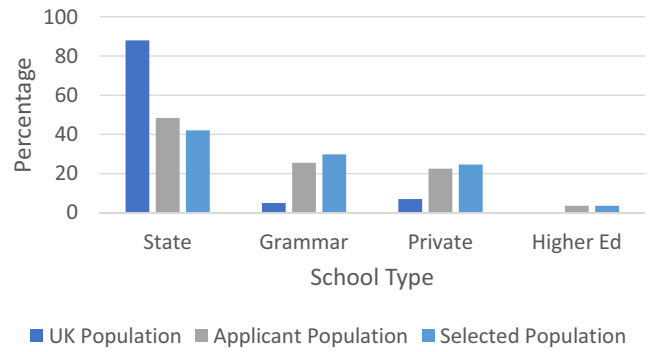


FIGURE 4 School type.

TABLE 1 Application and selection ratios.

Variable	Values	Application ratio	Selection ratio
Sex	Male	0.82	0.96
	Female	1.17	1.03
Ethnicity	Asian	6.24	0.86
	Black	0.76	0.33
	Mixed	0.75	1
	White	0.56	1.16
NSSEC	1	2.32	1.05
	2	0.41	1.02
	3	0.91	0.78
	4	0.32	0.75
	5	0.14	0.7
School type	State	0.55	0.87
	State/ability	5.1	1.17
	Private	3.21	1.09
	Higher education ^a		1
Domicile	UK		0.5
	EU (not UK)		0.4
	Not EU		0.61
UCAT attempt number	1		0.5
	2		0.53
	3		0.5
	4		0.46
	5		0

^aNo application ratio is available for Higher Education, Domicile or UCAT attempt number as these factors do not have an expected percentage in a UK population.

infographic showing the UK population, applicant population and selected population percentages is shown in Figure 6.

We also calculated the application and selection ratio for the combination of NSSEC and ethnicity as the expected proportions of these combined factors are available within the UK census data. White applicants in the most deprived group were 1/5th of the equivalent UK population both in the application and selection pools

while Asian applicants from NSSEC 4 and 5 were 14 times higher than expected in the average population and the selected population. Black applicants from all social classes except NSSEC 1 were under-represented. There were no Black applicants from NSSEC 3 or 4 in the 2012 and 2013 admission cycles. Black applicants from NSSEC 1 were selected around 50% less often than any other ethnicity NSSEC 1 (Table 2 and Figure 5).

3.2 | Offer or not offer

The unadjusted statistical significance of the relationship between the demographic variables and receiving an offer is shown in Table 3. Females had increased odds of an offer; however, it failed to reach significance. The number of attempts at UCAT did not explain differences in the selection outcome. All other demographic variables were significant and further analysed using a multiple logistic regression to ascertain their relationship with receiving an offer.

White ethnicity increased the odds of selection, when compared against all other ethnic groups, four times more than Black applicants, 1.8 times more than Asian, and 1.3 times more than Mixed ethnicity applicants. The odds of the least deprived group (NSSEC 1) being selected were 1.6 times more than NSSEC 3 and 1.7 times more than NSSEC 5 (most deprived) applicants. There were no significant differences between the other NSSEC categories. Concerning

TABLE 2 Combined NSSEC and ethnicity application and selection ratios.

NSSEC	Ethnicity	Application ratio	Selection ratio
1	White	0.6	1.1
	Asian	6.4	0.9
	Black	1.1	0.5
	Mixed	1.3	1
2	White	0.7	0.9
	Asian	7.2	1.1
	Black	0.5	1
	Mixed	1.2	1.3
3	White	0.3	1.4
	Asian	11.1	0.9
	Black	0	-
	Mixed	0.7	0.8
4	White	0.4	1.5
	Asian	14.4	0.8
	Black	0	-
	Mixed	0	-
5	White	0.2	1
	Asian	14.1	1
	Black	1.5	0.7
	Mixed	1.6	0.9

school type, attending a grammar school increased the odds of selection by 1.8 and attending a private school by 1.6 when compared to state school applicants. There was no significant difference found between the Domicile groups (Table 4).

A further logistic regression for UK applicants, including the UCAT total score as a variable in the model, was performed. The addition of UCAT to the model for UK applicants led to a significant difference in the odds of females being offered a place which were 1.5 times higher than males. The odds of White applicants being selected were more than twice the odds of Black applicants, and 1.7 times higher than Asian applicants. Mixed ethnicity failed to reach significance when compared to White. Odds of NSSEC 1 being selected were 1.8 times more than NSSEC 5 but there was no significant difference between the other NSSEC categories. Selection odds of applicants that attended a grammar school were 1.5 times higher than those who attended a state school. UCAT total score was a positive and significant predictor of selection. For every 100 unit increase in UCAT score, the odds of selection increased by 1.5 times (Table 5).

The addition of SJT to the model for the 2013–2014 UK applicants further increased the odds of female selection to 1.7 times that of males. White applicants' odds of being selected remained 1.7 times that of Asian applicants, and the odds of applicants from grammar school increased further to 1.6 times that of state school applicants (Table 6).

The unadjusted statistical significance of the relationship between combinations of the demographic variables and receiving an offer is shown in Table 7. All combinations showed significant differences in odds of selection except the combinations of 'male and domicile', 'ethnicity and Not EU domicile', 'ethnicity and NSSEC 2', 'ethnicity and NSSEC 5' and Black ethnicity and school type'.

3.3 | UCAT score and SJT score

An independent t-test compared the mean UCAT score and SJT score between sexes for the 2013–2014 cohort. There was a significant difference between males ($M=2631$ $SD=253$) and females ($M=2578$ $SD=252$), $p<.001$ UCAT scores, with males scoring higher. The reverse was true in SJT scores with males ($M=624$ $SD=56$) scoring lower than females ($M=623$ $SD=54$) $p<.001$.

A one-way independent samples analysis of variance (ANOVA) investigated the impact of ethnicity, NSSEC and school type on SJT and UCAT total scores. Ethnicity had a significant effect on both SJT ($p<.01$) and Total UCAT score ($p<.01$). Bonferroni post hoc comparisons revealed that White ethnicity had significantly higher SJT scores ($M=630$ $SD=48$) than Asian ethnicity ($M=608$ $SD=51$). White ethnicity also had significantly higher total UCAT scores ($M=2628.4$ $SD=227$) than Asian ($M=2597$ $SD=251$) and Black ($M=2448$ $SD=280$). There were no significant differences between the SJT and UCAT scores between NSSEC categories, school types or pairwise combinations of sex, ethnicity, NSSEC and school type.

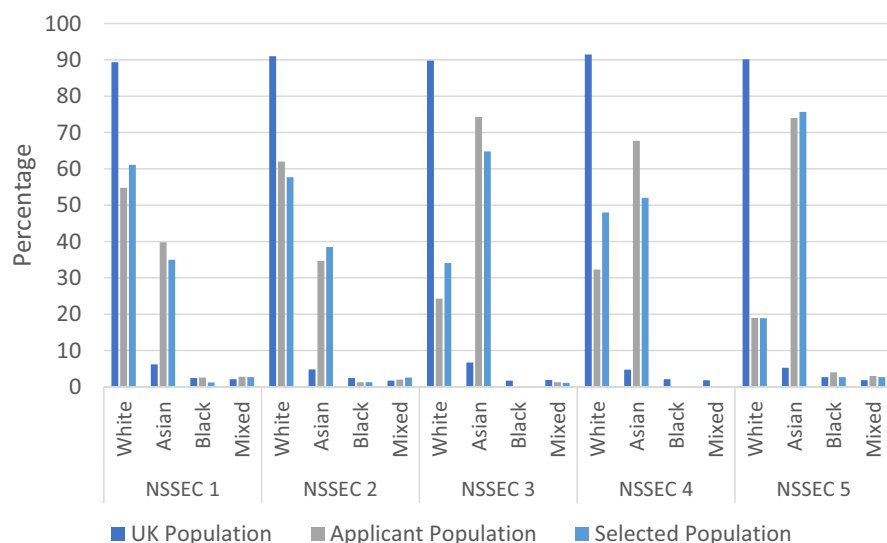


FIGURE 5 Combined National Statistics Socio-Economic Classification (NSSEC) and ethnicity.

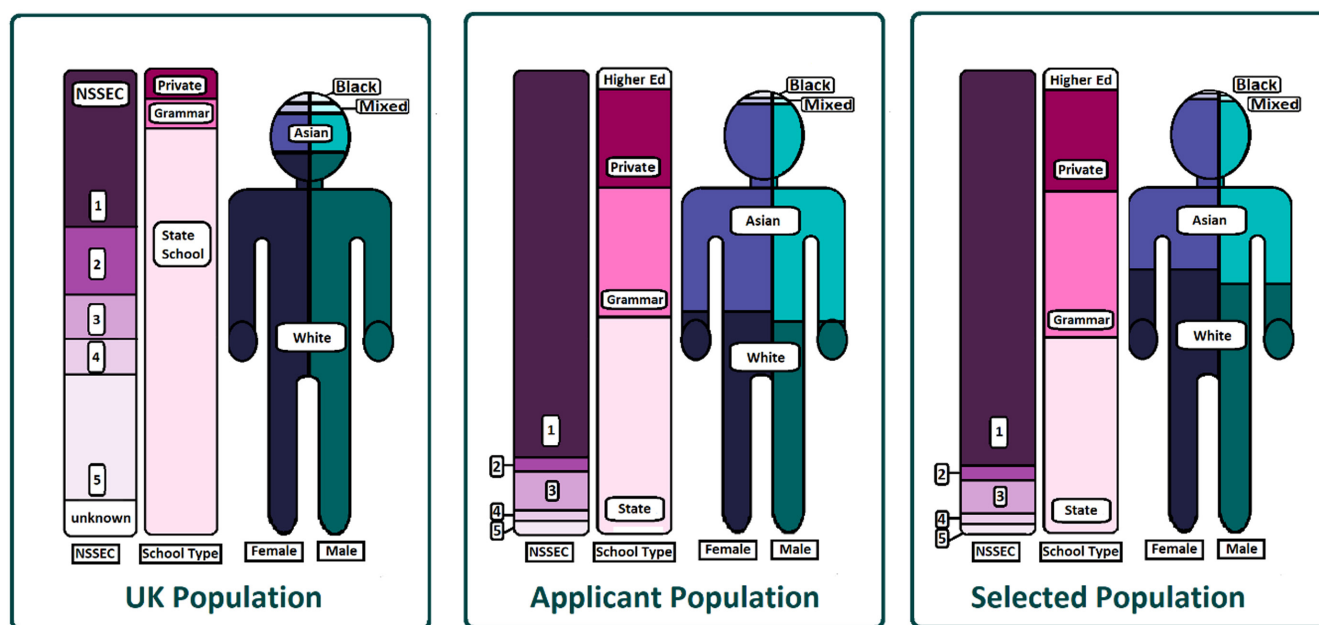


FIGURE 6 Infographic representation of average UK population, applicant population and selected population.

3.4 | Number of offers received

Pearson chi-squared analysis ascertained the relationship between applicant's demographic variables with the number of offers received. While domicile did not explain the number of offers ($p = .69$), sex, ethnicity, NSSEC and school type were all significant (Table 8) and further analysed using multinomial regression to ascertain their adjusted effect on the number of offers received (Table 9). As expected from our results above, receiving one offer was affected by ethnicity, NSSEC, and school type, but not sex. However, sex seemed to influence who would receive two offers, with females receiving 50% more than males. Two offers were also explained by ethnicity, NSSEC and school type, and ethnicity and school type continued to explain three offers. Only 15 of the 3246 applicants received four offers. Thirteen were female, 13 domiciled in the United Kingdom, seven White, 14 from

NSSEC 1, and five from grammar school. Nine of the 15 were female, domiciled in the United Kingdom and NSSEC 1.

4 | DISCUSSION

Despite significant initiatives aimed at widening participation, demographic disparities persist in dental school selection. In this study, disparity was found across all outcome measures: receiving an offer, UCAT and SJT score, and number of offers. In some ways, this is unsurprising given the traditional dominance of certain characteristics in the profession²⁹ and the relatively short time in which widening access initiatives have been in place.³⁰ However, systemic biases in selecting different groups must be addressed to ensure equity across the selection process.

TABLE 3 Chi-squared analysis of socio-demographic variables with offer or no offer (n=3264).

Variable	Values	No offer	Offer	Total	p-Value
Sex	Total	1602 (49%)	1644 (50%)	3246 (100%)	.05
	Female	943 (29%)	1023 (31%)	1966 (60%)	
	Male	659 (20%)	621 (19%)	1280 (39%)	
Ethnicity	Total	1403 (43%)	1449 (44%)	2852 (88%) Missing 394 (12%)	<.01
	Asian	748 (26%)	585 (21%)	1333 (41%)	
	Black	56 (2%)	16 (0.6%)	72 (2%)	
	Mixed	34 (1%)	35 (1%)	69 (2%)	
	White	565 (20%)	813 (29%)	1378 (42%)	
NSSEC	Total	1410 (43%)	1494 (45%)	2904 (89%) Missing 342 (11%)	<.01
	1	1066 (37%)	1239 (43%)	2305 (71%)	
	2	76 (3%)	83 (3%)	159 (5%)	
	3	158 (5%)	107 (4%)	265 (8%)	
	4	40 (1%)	26 (1%)	66 (2%)	
	5	70 (2%)	39 (1%)	109 (3%)	
School type	Total	1279 (39%)	1257 (39%)	2536 (78%) Missing 710 (22%)	<.01
	State	692 (27.3%)	527 (21%)	1222 (38%)	
	Grammar	270 (11%)	368 (15%)	638 (20%)	
	Private	270 (11%)	317 (13%)	587 (18%)	
	Higher education	47 (2%)	45 (2%)	92 (3%)	
Domicile	Total	1602 (49%)	1644 (50%)	3246 (100%)	<.01
	UK	1503 (46%)	1511 (47%)	3014 (93%)	
	EU (not UK)	25 (1%)	17 (0.5%)	42 (1%)	
	Not EU	74 (2%)	116 (4%)	190 (6%)	
UCAT attempt number	Total	1602 (49%)	1644 (50%)	3246 (100%)	.43
	1	1353 (41%)	1364 (41%)	2717 (83%)	
	2	217 (7%)	247 (8%)	464 (14%)	
	3	23 (1%)	27 (1%)	50 (1.5%)	
	4	7 (0.2%)	6 (0.2%)	13 (0.4%)	
	5		0		

Note: Empty cell denotes under five participants.

One of the most cited guidance documents, 'The Edinburgh Declaration',³¹ was released 30 years ago and while some criticism of its 'utopian' concepts³² exists, the overarching aim of 'medical (dental) education to produce doctors (dentists) who will promote the health of all people' seems ever more relevant from both a social justice and social accountability perspective.

Social justice and social accountability have gained importance in the ever-increasing complexity and interconnectivity of patient care, education and research that is the threefold mission of academic health science centres and networks.³³ Social justice (the distribution of wealth, opportunities and privileges within a society) is important from an equity standpoint in ensuring participation in higher education is not dictated by birth and social circumstance alone.^{2,5} Furthermore, social accountability suggesting a workforce

of doctors and dentists who understand the context and culture of the communities they serve, is essential to improving healthcare quality.^{2,6-8}

We observed some advances towards equity. For example, there is no longer a dominance of males within dentistry. In the 1980s, only 3% of dentists were female,²⁹ but now 60% of applicants and 62% of those selected for dentistry are female. Moreover, the use of UCAT increases females' odds of gaining entry.

We also found no evidence of the country of residence of applicants affecting the odds of selection. This may be, in part, due to the caps imposed on overseas student numbers by the UK government. Evidence from higher education as a whole (who typically do not have caps set) show a much higher percentage of overseas students, 14% in undergraduate programmes³⁴ compared with the

Variable	Categories	Odds ratio	95% CI		p-Value
			Low	High	
Sex (Male)	Female	1.17	0.98	1.39	.09
Domicile (UK)	EU	0.46	0.08	2.54	.38
Ethnicity (White)	Asian	0.57	0.48	0.69	<.01
	Black	0.25	0.13	0.49	<.01
	Mixed	0.80	0.46	1.39	<.01
NSSEC (1)	NSSEC 2	0.89	0.62	1.29	.55
	NSSEC 3	0.63	0.46	0.87	.01
	NSSEC 4	0.66	0.36	1.19	.17
	NSSEC 5	0.59	0.37	0.95	.03
School type (State)	Grammar	1.87	1.50	2.32	<.01
	Private	1.63	1.30	2.03	<.01
	HE	1.48	0.90	2.44	.12

TABLE 4 Multiple logistic regression of all applicant socio-demographic variables (included in the analysis 2153, missing 1093).

Variable	Category	Odds ratio	95% CI		p-Value
			Lower	Higher	
Sex (Male)	Female	1.47	1.21	1.78	<.01
Ethnicity (White)	Asian	0.59	0.48	0.72	<.01
	Black	0.42	0.2	0.89	.02
	Mixed	0.7	0.38	1.27	.24
NSSEC (1)	NSSEC 2	0.95	0.64	1.41	.78
	NSSEC 3	0.76	0.54	1.07	.11
	NSSEC 4	1.14	0.59	2.19	.7
	NSSEC 5	0.55	0.33	0.92	.02
School type (State)	Grammar	1.46	1.17	1.86	<.01
	Private	1.24	0.97	1.58	.08
	Higher Education	1.5	0.85	2.65	.16
UCAT total score (increments of 100)		1.49	1.42	1.57	<.01

TABLE 5 Multiple logistic regression results of UK applicants including UCAT total score (2012 and 2013; included in the analysis 2147, missing 867).

8% we found. An easing of caps would likely lead to a rise in international student numbers, which may increase the odds of selection for this group.

All other socio-economic background factors (ethnicity, NSSEC and school type) showed a large variance in odds of selection between groups. Reports from medical schools and higher education as a whole show a similar trend.^{21,35}

The proportion of applicant ethnicities varied significantly from the UK population, this is similar to findings by Seyan et al.²⁶ They found the standardised admission ratio (AR) varied in ethnicity from 6.07 in Asian to 0.73 in White and around 30-fold by social class from 6.76 in social class 1 to 0.20 in social class 2. However, when they calculated the ratios by ethnicity and social class combined, they varied 600-fold from the most over-represented group (Asian social class 1) to the most under-represented group with fewest admissions (Black social class 5). They also reported that White and Black pupils from social class 1 were around 100 times more likely to gain

entry to medical school than those from classes 4 or 5. Like Seyan, our results show an over-representation of Asian students across all social classes compared to an average UK population. Furthermore, as NSSEC increased (to less affluent), the percentage of applicants from an Asian ethnicity increased. The most disadvantaged groups had the largest variation in expected to actual proportions of Asian applicants. There was also considerable variation between ethnicities in these groups. In NSSEC 5, application ratios varied 70-fold between Asian applicants (AR 14.1) and White applicants (AR 0.2). In the period of study, there were no Black applicants from NSSEC 3 or 4 and no mixed ethnicity applicants from NSSEC 4. However, all non-white groups were over-represented in NSSEC 5 applicants. Current widening access initiatives would, therefore, only benefit White candidates. However, widening access to White applicants may further compound White applicants' over-selection across all social classes.

In 2012 and 2013, White applicants were selected more often than any other ethnic group. When ethnicity and social class were

TABLE 6 Multiple logistic regression results of UK applicants including SJT score and UCAT score (2013 only; included in the analysis 1040, missing 436).

Variable	Category	Odds ratio	95% CI		p-Value
			Lower	Higher	
Sex (Male)	Female	1.73	1.29	2.31	<.01
Ethnicity (White)	Asian	0.57	0.42	0.77	<.01
	Black	0.92	0.37	2.29	.86
	Mixed	0.79	0.32	1.94	.61
NSSEC (1)	NSSEC 2	0.78	0.43	1.39	.4
	NSSEC 3	0.94	0.55	1.59	.81
	NSSEC 4	2.03	0.87	4.77	.1
	NSSEC 5	0.63	0.32	1.24	.18
School type (State)	Grammar	1.58	1.11	2.24	<.01
	Private	1.29	0.91	1.84	.16
	Higher Education	1.16	0.53	2.57	.71
SJT (increments of 10)	1.04	1.01	1.07	<0.01	
UCAT total score (increments of 100)	1.48	1.38	1.59	<0.01	

combined, White applicants from NSSEC 1 were selected more often than any other NSSEC 1 ethnicity, including twice as often as Black applicants in this group with the multiple regression model highlighting ethnicity as the most significant factor influencing selection. White applicants gain a place to study dentistry in 59% of cases and Black applicants only 20%.

Like other health professions, Dentistry has struggled with the historical legacy of being conceptualised as a 'white' profession.³⁶⁻³⁸ Dental and Medical schools increasingly strive to achieve greater diversity among their students concerning ethnicity.^{12,23,30,39,40} There are many societal benefits to having a multicultural healthcare workforce, including ensuring that there is less of a barrier around access for under-represented groups.⁴¹

Regarding widening access, our results show that UCAT and the UCAT SJT increase selection rates for non-white applicants and decrease selection rates for grammar school applicants. However, the process between application (when UCAT and UCAT + SJT is assessed) and selection mitigates any potential benefit.

A review of the dental school websites revealed that after reviewing predicted grades and UCAT scores most schools review the personal statement, references and offer an interview, with candidates given a conditional acceptance provided they meet their predicted grades. Evidence shows that Dental Schools in the UK rely on sub-optimal heuristics, rather than utilising the extant evidence regarding the quality of different selection tools and that there is a need to explore solutions for selection practices in dental education.⁴²

The low validity of personal statements and references has been widely reported.⁴³⁻⁴⁷ Moreover, the use of personal statements has been shown to favour students from independent and grammar schools.⁴⁸ This is thought to be as a result of the support given by the school in the writing of the personal statement rather than any real difference in ability.⁴⁹ Wright⁴⁹ also highlighted an unintended link between a student's access to capital and ability

to demonstrate commitment and motivation on personal statements which leads to further bias towards more affluent applicants. Concerning interviews, most dental schools in the United Kingdom use a multiple mini-interview (MMI). Evidence is conflicting in terms of the impact of an interview on diversity. Some show it cannot counteract the diversity-limiting effect of grades as a criterion for selection to interview,⁵⁰ while others say it introduces further bias into the selection system.^{51,52} Therefore, using the UCAT before selection methods with questionable validity in increasing diversity may negate any positive impact, a finding also reported by Powis.³⁹

The position of the UCAT in the current selection process is not the only issue. Allowing multiple attempts can also cause problems. Although most applicants had applied on their first attempt of UCAT (83%), some applicants had taken the test five times. Several authors have reported the issues with multiple attempts at an aptitude test,⁵³⁻⁵⁵ particularly if candidates have an opportunity for coaching between tests,⁵⁴ and some question the practice of allowing candidates to repeat such tests.⁵⁵ Students who have been coached for an entrance examination have been shown to perform more poorly than non-coached students in every year of their degree⁵⁶ therefore the effect of coaching is only apparent in the aptitude test and does not translate to performance at a later date. In order for UCAT, or any other aptitude test, to reliably select those with the greatest potential to study dentistry there is a need to ensure the test is used in a way which maximises the validity of the test. Dental schools should endeavour to only use the first attempt of UCAT in the selection of dental students.

These findings indicate a need for schools to continue to examine biases inherent in the current selection process and address them so that current initiatives to widen participation in dental education can be more effective. Furthermore, there is a need for studies that explore both the individual selection criteria and different combinations to determine their respective effects

TABLE 7 Chi-squared analysis of combinations of socio-demographic variables with offer or no offer.

Variable	Values	No offer (n = 1602)	Offer (n = 1644)	Total (n = 3293)	p-Value
Female ethnicity	Female White	330 (40.5%)	515 (57.9%)	845 (49.6%)	>.001
	Female Asian	431 (52.9%)	345 (38.8%)	776 (45.5%)	
	Female Black	34 (4.2%)	8 (0.9%)	42 (2.5%)	
	Female Mixed	19 (2.3%)	22 (2.5%)	41 (2.4%)	
Male ethnicity	Male White	235 (39.9%)	298 (53.3%)	533 (46.4%)	>.001
	Male Asian	317 (53.8%)	240 (42.9%)	557 (48.5%)	
	Male Black	22 (3.7%)	8 (1.4%)	30 (2.6%)	
	Male Mixed	15 (2.5%)	13 (2.3%)	28 (2.4%)	
Female NSSEC	Female NSSEC 1	642 (77.8%)	787 (84%)	1429 (81.1%)	.003
	Female NSSEC 2	45 (5.5%)	54 (5.8%)	99 (5.6%)	
	Female NSSEC 3	81 (9.8%)	56 (6%)	137 (7.8%)	
	Female NSSEC 4	23 (2.8%)	18 (1.9%)	41 (2.3%)	
	Female NSSEC 5	34 (4.1%)	22 (2.3%)	56 (3.2%)	
Male NSSEC	Male NSSEC 1	424 (72.5%)	452 (81.1%)	876 (76.7%)	.004
	Male NSSEC 2	31 (5.3%)	29 (5.2%)	60 (5.3%)	
	Male NSSEC 3	77 (13.2%)	51 (9.2%)	128 (11.2%)	
	Male NSSEC 4	17 (2.9%)	8 (1.4%)	25 (2.2%)	
	Male NSSEC 5	36 (6.2%)	17 (3.1%)	53 (4.6%)	
Female school type	Female State School	398 (53%)	326 (41.3%)	724 (47%)	>.001
	Female Grammar School	157 (20.9%)	240 (30.4%)	397 (25.8%)	
	Female Private School	167 (22.2%)	199 (25.2%)	366 (23.8%)	
	Female Higher Ed	29 (3.9%)	25 (3.2%)	54 (3.5%)	
Male school type	Male State School	294 (55.7%)	201 (43%)	495 (49.7%)	.001
	Male Grammar School	113 (21.4%)	128 (27.4%)	241 (24.2%)	
	Male Private School	103 (19.5%)	118 (25.3%)	221 (22.2%)	
	Male Higher Ed	18 (3.4%)	20 (4.3%)	38 (3.8%)	
Female Domicile	Female UK	874 (92.7%)	931 (91%)	1805 (91.8%)	.029
	Female EU	18 (1.9%)	11 (1.1%)	29 (1.5%)	
	Female Not EU	51 (5.4%)	81 (7.9%)	132 (6.7%)	
Male Domicile	Male UK	629 (95.4%)	580 (93.4%)	1209 (94.5%)	.181
	Male EU	7 (1.1%)	6 (1%)	13 (1%)	
	Male Not EU	23 (3.5%)	35 (5.6%)	58 (4.5%)	
Ethnicity UK	White UK	562 (40.2%)	812 (56.2%)	1374 (48.3%)	>.001
	Asian UK	747 (53.4%)	582 (40.3%)	1329 (46.8%)	
	Black UK	55 (3.9%)	16 (1.1%)	71 (2.5%)	
	Mixed UK	34 (2.4%)	34 (2.4%)	68 (2.4%)	
Ethnicity EU	White EU				
Ethnicity not EU	White Not EU		0 (0%)		.113
	Asian Not EU				
	Black Not EU		0 (0%)		
	Mixed Not EU	0 (0%)			
Ethnicity NSSEC 1	White NSSEC 1	438 (47.3%)	670 (61.1%)	1108 (54.8%)	>.001
	Asian NSSEC 1	422 (45.6%)	384 (35%)	806 (39.8%)	
	Black NSSEC 1	40 (4.3%)	13 (1.2%)	53 (2.6%)	
	Mixed NSSEC 1	26 (2.8%)	30 (2.7%)	56 (2.8%)	

TABLE 7 (Continued)

Variable	Values	No offer (n = 1602)	Offer (n = 1644)	Total (n = 3293)	p-Value
Ethnicity NSSEC 2 (n = 150)	White NSSEC 2	48 (66.7%)	45 (57.7%)	93 (62%)	.7
	Asian NSSEC 2	22 (30.6%)	30 (38.5%)	52 (34.7%)	
	Black NSSEC 2				
	Mixed NSSEC 2				
Ethnicity NSSEC 3 (n = 230)	White NSSEC 3	25 (18%)	31 (34.1%)	56 (24.3%)	.021
	Asian NSSEC 3	112 (80.6%)	59 (64.8%)	171 (74.3%)	
	Black NSSEC 3	0	0	0	
	Mixed NSSEC 3				
Ethnicity NSSEC 4 (n = 65)	White NSSEC 4	9 (22.5%)	12 (48%)	21 (32.3%)	.032
	Asian NSSEC 4	31 (77.5%)	13 (52%)	44 (67.7%)	
	Black NSSEC 4	0	0	0	
	Mixed NSSEC 4	0	0	0	
Ethnicity NSSEC 5 (n = 100)	White NSSEC 5	12 (19%)	7 (18.9%)	19 (19%)	.962
	Asian NSSEC 5	46 (73%)	28 (75.7%)	74 (74%)	
	Black NSSEC 5				
	Mixed NSSEC 5				
White ethnicity school type (n = 1136)	State School	285 (60%)	313 (47.4%)	598 (52.6%)	>.001
	State/Ability School	83 (17.5%)	187 (28.3%)	270 (23.8%)	
	Private School	87 (18.3%)	131 (19.8%)	218 (19.2%)	
	Higher Ed	20 (4.2%)	30 (4.5%)	50 (4.4%)	
Asian ethnicity school type (n = 1125)	State School	321 (50.2%)	177 (36.4%)	498 (44.3%)	>.001
	State/ Ability School	157 (24.6%)	152 (31.3%)	309 (27.5%)	
	Private School	142 (22.2%)	148 (30.5%)	290 (25.8%)	
	Higher Ed	19 (3%)	9 (1.9%)	28 (2.5%)	
Black ethnicity school type (n = 55)	State School	21 (48.8%)	6 (50%)	27 (49.1%)	.997
	State/Ability School	12 (27.9%)		15 (27.3%)	
	Private School	7 (16.3%)		9 (16.4%)	
	Higher Ed				
Mixed ethnicity school type (n = 57)	State School	14 (50%)	8 (27.6%)	22 (38.6%)	.025
	State/Ability School		10 (34.5%)	12 (21.1%)	
	Private School	12 (42.9%)	9 (31%)	21 (36.8%)	
	Higher Ed	0			

Note: Empty cell denotes under five candidates.

on student diversity. For dental schools in the United Kingdom, this would require a change in the current practice of sandwiching aptitude and personal attributes between academic measures to explore this fully. This could mean moving the assessment of personal values or attributes from its typical position as the last hurdle to the forefront of the process.⁵⁷ Other authors suggest that medical or dental schools would not embrace this, many of which struggle to see how this would fit their culture, ethos and aspirations.^{5,42}

There is also a need to explore current widening participation practices, many of which focus on attracting applicants from lower socio-economic groups. While admirable, we have shown that socio-economic status is not the only factor we should explore when addressing demographic diversity in dentistry.

4.1 | Improving dental selection and opportunities for future research

As is clear from the discussion above, there is a need to improve current selection for undergraduate dental education. Sustainable progress will only be possible through a multiorganisational approach. Dental education providers all have a common goal to select candidates who can be shaped into the future dental workforce. Therefore, opportunities exist for a collaborative approach to dental selection.

Dental schools should also explore alternative selection policies that investigate the impact of weighting selection processes in favour of selection tools with known validity in other fields. Tools such as the MMI⁵⁸⁻⁶³ and situational judgement tests⁶⁴⁻⁶⁶

TABLE 8 Chi-squared analysis of the number of offers.

Variable	Categories	No offer	1 offer	2 offers	3 offers	4 offers	Total	p-Value
UCAT attempt number	Total	1602 (49%)	1112 (34.3%)	411 (12.7%)	106 (3%)	15 (0.5%)	3246 (100%)	.51
	1	1353 (42%)	908 (28%)	348 (10.7%)	97 (3%)	11 (0.3%)	2717 (83.7%)	
	2	217 (7%)	178 (5.5%)	56 (1.7%)	9 (0.3%)	0	464 (14.3%)	
	3	23 (1%)	22 (0.7%)	5 (0.2%)	0	0	50 (1.5%)	
	4	7 (0.2%)	0	0	0	0	0	
Sex	Total	1602 (49%)	1112 (34.3%)	411 (12.7%)	106 (3.3%)	15 (0.5%)	3246 (100%)	.179
	Female	684 (21.1%)	428 (13.2%)	151 (4.7%)	39 (1.2%)	12 (0.4%)	1280 (39.4%)	
	Male	918 (28.2%)	684 (21.1%)	260 (8%)	67 (2.1%)	3 (0.1%)	1966 (60.6%)	
	Total	1403 (49%)	980 (34.4%)	372 (13%)	85 (3%)	12 (0.4%)	2852 (87.9%)	<.01
	Asian	748 (26.2%)	416 (14.6%)	133 (4.7%)	32 (1.1%)	0	1333 (46.7%)	
Ethnicity	Total	56 (2%)	10 (0.4%)	5 (0.2%)	0	0	72 (2.5%)	
	Black	34 (1%)	19 (0.7%)	16 (0.6%)	0	0	69 (2.4%)	
	Mixed	565 (20%)	535 (18.8%)	218 (7.6%)	53 (1.9%)	7 (0.2%)	1378 (48.3%)	
	White	1410 (49%)	1004 (35%)	378 (13%)	97 (3%)	15 (0.5%)	2904 (89.5%)	<.01
	Total	1066 (37%)	823 (28.3%)	317 (10.9%)	85 (2.9%)	14 (0.5%)	2305 (79.4%)	
NSSEC	1	76 (3%)	55 (1.9%)	22 (0.8%)	5 (0.2%)	0	159 (5.5%)	
	2	158 (5%)	80 (2.8%)	21 (0.7%)	6 (0.2%)	0	265 (9.1%)	
	3	40 (1%)	18 (0.6%)	8 (0.3%)	0	0	66 (2.3%)	
	4	70 (49%)	28 (1%)	10 (0.3%)	0	0	109 (3.8%)	
	Total	1279 (50%)	841 (33.2%)	331 (13.1%)	76 (3%)	9 (0.4%)	2536 (78.1%)	<.01
School type	Total	384 (15.1%)	227 (9%)	105 (4.1%)	31 (1.2%)	5 (0.2%)	638 (25.2%)	
	State	191 (7.5%)	99 (3.9%)	25 (1%)	0	0	587 (23.1%)	
	State/Ability	39 (1.5%)	5 (0.2%)	0	0	0	92 (3.6%)	
	Private	1112 (34.3%)	411 (12.7%)	106 (3.3%)	15 (0.5%)	15 (0.5%)	3246 (100%)	<.01
	Higher Education	1503 (46%)	1024 (31.5%)	383 (11.8%)	91 (2.8%)	13 (0.4%)	3014 (92.9%)	
Domicile	Total	25 (1%)	15 (0.5%)	0	0	0	42 (1.3%)	
	UK	74 (2%)	73 (2.2%)	26 (0.8%)	15 (0.5%)	0	190 (5.9%)	
	EU (Not UK)	0	0	0	0	0	0	
	Not EU	0	0	0	0	0	0	

Note: Empty cell denotes under 5.

TABLE 9 Multinomial regression of socio-demographic factors and number of offers

Number of offers (n = 3246; missing = 1093)	Variable	Odds ratio	95% CI		p-Value
			Lower	Higher	
1 (n = 732)	Sex	1.09	0.90	1.326	.38
	Ethnicity	0.7	0.6	0.81	<.01
	NSSEC	0.85	0.77	0.93	<.01
	School type	1.20	1.07	1.33	<.01
2 (n = 296)	Sex	1.5	1.14	1.98	<.01
	Ethnicity	0.75	0.61	0.92	<.01
	NSSEC	0.81	0.70	0.94	<.01
	School type	1.35	1.17	1.55	<.01
3 (n = 63)	Sex	0.99	0.6	1.66	.97
	Ethnicity	0.53	0.33	0.83	<.01
	NSSEC	0.69	0.48	1.01	.05
	School type	1.56	1.19	2.05	<.01
4 (n = 9)	Sex	2.44	0.50	11.8	.27
	Ethnicity	0.85	0.32	2.27	.75
	NSSEC	0.47	0.11	1.99	.31
	School type	1.38	0.67	2.82	.38

have shown validity within medicine, therefore in the short term these should be given a higher priority in the selection process. Dental schools should stop using selection tools, such as personal statements, that may be adding unintended bias into the selection process as they also use valuable resources that could be directed more usefully.

5 | LIMITATIONS

This work was carried out in one context, the United Kingdom, and hence the findings may not be generalisable across contexts. However, the combination of prior attainment (school exit examinations, grade point average or specific knowledge-based examinations), aptitude test and either a traditional or MMI is typical of many country's selection processes.^{12,67}

Further to this, our conclusions are based on demographic data and the results of UCAT and UCAT +SJT across two admission cycles for UCAT consortium schools. As a result, we do not know how independent or otherwise the UCAT is from various selection tools, such as the MMI. Nor do we understand the relationships between each selection tool. We can also only make our conclusions based on the data that we have analysed, which only includes schools that used the UCAT in 2012 or 2013.

6 | CONCLUSION

Demographic disparities persist in Dental School selection despite the introduction of widening access initiatives. The UCAT shows promise in levelling the playing field; however, widening access

measures will only see fruition if selection committees radically change their selection approach. Systemic biases in selecting different groups must be addressed to ensure equity across the selection process to enable the dentists of tomorrow to represent the society they serve.

CONFLICT OF INTEREST STATEMENT

A grant was received from the University Clinical Aptitude Test during the conduct of this study.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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