The change from UMAT to UCAT for undergraduate medical school applicants: impact on selection outcomes

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The known: The UMAT, the test for selecting interviewees for undergraduate medical degrees, was replaced by the UCAT for the 2020 intake.

The new: Mean UCAT scores for women were lower than for men. Mean scores for applicants from lower socio-economic status areas and from outside major cities were also lower. The influence of sex on total score was greater with the UCAT than the UMAT.

The implications: UCAT subtest weightings for selection decisions should be reviewed, and interview-based assessments incorporated to increase the selection of women. Pathways and quotas for applicants from rural and disadvantaged areas should be retained.

Abstract

Objectives: To assess whether the change from the Undergraduate Medical and Health Sciences Admissions Test (UMAT; 1991–2019) to the University Clinical Aptitude Test (UCAT) for the 2020 New South Wales undergraduate medical degree intake was associated with changes in the impact of sex, socio-economic status and remoteness of residence, and professional coaching upon selection for interview.

Design, setting, participants: Cross-sectional study of applicants for the three NSW undergraduate medical programs for entry in 2019 (4114 applicants) or 2020 (4270); 703 people applied for both intakes. Applicants selected for interview were surveyed about whether they had received professional coaching for the selection test.

Main outcome measures: Scores on the three sections of the UMAT (2019 entry cohort) and the five subtests of the UCAT (2020 entry); total UMAT and UCAT scores.

Results: Mean scores for UMAT 1 and 3 and for all four UCAT cognitive subtests were higher for men than women; the differences were statistically significant after adjusting for age, socio-economic status, and remoteness. The effect size for sex was 0.24 (95% CI, 0.18–0.30) for UMAT total score, 0.38 (95% CI, 0.32–0.44) for UCAT total score. For the 2020 intake, 2303 of 4270 applicants (53.9%) and 476 of 1074 interviewees (44.3%) were women. The effect size for socio-economic status was 0.47 (95% CI, 0.39–0.54) for UMAT, 0.43 (95% CI, 0.35–0.50) for UCAT total score; the effect size for remoteness was 0.54 (95% CI, 0.45–0.63) for UMAT, 0.48 (95% CI, 0.39–0.58) for UCAT total score. The impact of professional coaching on UCAT performance was not statistically significant among those accepted for interview.

Conclusions: Women and people from areas outside major cities or of lower socio-economic status perform less well on the UCAT than other applicants. Reviewing the test and applicant quotas may be needed to achieve selection equity.

Applicants for the 2020 intake into undergraduate medical school programs in Australia and New Zealand were the first to sit the University Clinical Aptitude Test (UCAT), which replaced the Undergraduate Medical and Health Sciences Admissions Test (UMAT) used since 1991. Test scores are used to select entrance interviewees from the large number of applicants for admission.

The UCAT is based on the United Kingdom Clinical Aptitude Test (UKCAT). The reliability and validity of the UKCAT has been reported,[1-3] but its performance in Australia and New Zealand has not been assessed. The UCAT is a timed (two hours), computer-based test comprising five subsets of multiple choice questions. Four subsets assess cognitive ability: verbal reasoning, decision making, quantitative reasoning, and abstract reasoning. The fifth, a situational judgement test, assesses the "capacity to understand real world situations and to identify critical factors and appropriate behaviour in dealing with them."[4]

Test bias — limitations of the test instrument, rather than differences in applicant ability, that cause a particular subgroup of applicants to perform less well than others — can impede their selection.[5] There is a global push to increase the participation of groups under-represented in medicine,[6,7] including people from lower socio-economic status and rural areas, and, in the past, women.

Professional coaching in completing selection tests may further disadvantage applicants from lower socio-economic status and rural areas, as cost and distance may restrict their access to such assistance. Coaching can even undermine the validity of selection tests.[8] Evidence regarding the effect of coaching for the UKCAT is limited; a 2012 study[2] found that 9% of applicants for one medical undergraduate course had attended professional coaching, but it was not associated with improved performance. In contrast, reported rates of coaching are considerably higher in Australia; more than half the applicants selected for interview by the University of Western Sydney in 2008 had been coached for the UMAT.[9]

The aim of our study was to identify whether the change in selection test for undergraduate medical study for the 2020 intake was associated with changes in the influence of sex, socio-economic and remoteness of residence, and coaching on interviewee selection in New South Wales. Our study is the first to assess Australian data for evidence of test bias and an effect of professional coaching on UCAT performance.

Methods

We analysed data for 7691 domestic applicants for the three undergraduate medical training programs in New South

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Wales (University of Newcastle/University of New England, University of New South Wales, Western Sydney University) who sat the UMAT (2019 intake; 4114 applicants) or UCAT (2020 intake; 4270 applicants), including 703 people who applied in both years.

Applicants were selected for admission interview according to scores on the three UMAT sections (2019 intake) or the four UCAT cognitive subtests (2020 intake). Certain applicants (eg, those with rural backgrounds) were ranked separately to meet participation targets and government quotas. For the 2019 intake, 927 applicants were interviewed by at least one university, and 1074 were interviewed for the 2020 intake. After being interviewed, interviewees were invited to complete a survey (on paper or online) about their motivation for studying medicine and prior interview and testing experience; only the responses regarding test coaching item were included in this study.

Applicant information

Demographic data (age, sex, residential location) and test data (UMAT/UCAT, Australian Tertiary Admission Rank [ATAR] ranking) were provided for the study by the university admissions offices. Socio-economic status was determined by residential address, using the Australian Bureau of Statistics Index of Relative Socioeconomic Advantage and Disadvantage (IRSAD),[10] based on residents' income, home ownership, and unemployment rates; we defined deciles 1–5 as lower and deciles 6–10 as higher socio-economic status. Remoteness was also determined by residential address, using the 2016 Australian Bureau of Statistics remoteness structure;[11] we classified remoteness as major cities or rural (inner regional, outer regional, remote, very remote area; combined because the individual category numbers were low).

For the 2019 intake, we analysed scores on the three UMAT subtests: UMAT 1 (problem solving), UMAT 2 (understanding people), and UMAT 3 (non-verbal reasoning). For the 2020 intake, standardised UCAT scores (range, 300–900) were available for the four cognitive subtests and scaled scores for the situational judgement test.

Interviewee information

ATAR ranking was available only for interviewees (88% in 2019, 53% in 2020). Coaching attendance was assessed with the survey item, "Did you attend UMAT/UCAT coaching?"

Statistical analysis

All analyses were conducted in SPSS 25 (IBM). We assessed the influence of socio-demographic factors and coaching on UMAT and UCAT scores in four analyses:

- We compared mean scores for men and women, for people from lower and higher socio-economic status areas, for people from major cities and rural areas, and for applicants who were or were not coached. For these comparisons, we employed independent t tests, with $P < 0.001$ deemed statistically significant (Bonferroni correction for multiple comparisons).
- Total UMAT and UCAT scores and subtest scores (for all applicants) were separately assessed in multiple regression analyses adjusted for age (as it was negatively correlated with most subtest scores), sex, socio-economic status, and remoteness. For multiple regression analyses of interviewee data, age, sex, socio-economic status, remoteness, and ATAR ranking were included as variables; for multiple regression analyses of survey respondent data, age, sex, ATAR ranking, and coaching were included. For these comparisons, $P < 0.05$ was deemed statistically significant.
- The effect sizes (Cohen's d) for t test results were calculated for the total UMAT and UCAT cognitive subtest scores, to allow comparison of effect sizes in the two tests. Effect sizes were calculated separately for all applicants and for those who completed both the UMAT in 2019 and the UCAT in 2020. Effect sizes of 0.10 are interpreted as very small, 0.20 as small, 0.50 as medium, 0.80 as large, and 1.20 as very large.
- Differences in the proportions of applicants and interviewees, by sex, socio-economic status, and remoteness, were assessed in χ^2 tests.

Ethics approval

The Macquarie University Human Research Ethics Committee approved our study, including our merging selection data (including demographic information), UMAT/UCAT scores (all applicants), and ATAR ranking (interviewees), as well as survey responses from consenting interviewees (reference, 5201836024731).

Results

The demographic characteristics and educational profiles of applicants are summarised in Box 1. The coaching question in the survey was completed by 636 of 927 interviewees (69%) for the 2019 intake and 624 of 1074 interviewees (58%) for the 2020 intake.

Sex

Mean scores for UMAT 1 and 3 and for all four UCAT cognitive subtests were higher for men than for women; mean UMAT 2 and UCAT situational judgement test scores were higher for women than men (Box 2, Box 3). All differences remained statistically significant after adjusting for age, socio-economic status, and remoteness (all applicants; Supporting Information, table 1) or age, socio-economic status, remoteness, and ATAR ranking (interviewees; Supporting Information, table 2).

The effect size for sex was 0.24 (95% CI, 0.18–0.30) for UMAT total score and 0.38 (95% CI, 0.32–0.44) for UCAT total score (all applicants). For applicants who sat both tests, the effect size was 0.24 (95% CI, 0.09–0.39) for UMAT total score and 0.41 (95% CI, 0.26–0.56) for UCAT total score. With the UMAT, 2279 of 4080 applicants (55.9%) and 438 of 926 interviewees (47.3%) were women ($P < 0.001$). With the UCAT, 2303 of 4270 applicants (53.9%) and 476 of 1074 interviewees (44.3%) were women ($P < 0.001$). Among applicants from major cities for the 2020 intake, the difference was particularly marked: 1889 of 3583 applicants (52.7%) and 300 of 749 interviewees (40.1%) were women.

Socio-economic status

Mean UMAT and UCAT subtest scores were all higher for people living in higher socio-economic status areas (IRSAD deciles 6–10) than for those from lower status areas (deciles 1–5) (Box 2, Box 3). All differences remained statistically

1 Demographic information and education profile of applicants for the 2019 and 2020 intakes into Australian and New Zealand undergraduate medical school programs

	2019 intake (UMAT)	2020 intake (UCAT)	Applied in both years (UMAT and UCAT)*
Number of applicants	4114	4270	703
Women	2279 (55.4%)	2303 (53.9%)	367 (52.2%)
Men	1801 (43.8%)	1967 (46.1%)	336 (47.8%)
Missing data	34 (0.8%)	0	0
Age at first application (years), mean (SD)	19.1 (3.5)	19.6 (4.0)	19.4 (4.0)
New South Wales residents	2421 (58.8%)	2615 (61.2%)	523 (74.4%)
Socio-economic status (IRSAD)			
Deciles 1–5 (low)	890 (21.6%)	1031 (24.1%)	174 (24.8%)
Deciles 6–10 (high)	2939 (71.4%)	3035 (71.1%)	499 (71.0%)
Missing data†	285 (6.9%)	204 (4.8%)	30 (4.3%)
Remoteness			
Major cities	3382 (82.2%)	3583 (83.9%)	591 (84.1%)
Rural	525 (12.8%)	497 (11.6%)	81 (11.5%)
Missing data†	207 (5.0%)	190 (4.4%)	31 (4.4%)
High school education			
Government school	1791 (43.5%)	2044 (47.9%)	368 (52.3%)
Independent school	1169 (28.4%)	1258 (29.5%)	182 (25.9%)
Catholic school	528 (12.8%)	647 (15.2%)	106 (15.1%)
Overseas school	199 (4.8%)	255 (6.0%)	42 (6.0%)
Missing data†	427 (10.4%)	66 (1.5%)	5 (0.7%)

IRSAD = Index of Relative Socioeconomic Advantage and Disadvantage; SD = standard deviation; UMAT = Undergraduate Medical and Health Sciences Admissions Test; UCAT = University Clinical Aptitude Test. * Also included in the two individual intake years. † Applicant supplied no or ambiguous information that did not permit classification; eg, postcode or "Sydney" for residential location, or "university" for education.

significant after adjusting for age, sex, and remoteness (all applicants: Supporting Information, table 1). After adjusting interviewee scores for ATAR ranking, the influence of IRSAD was still significant for UMAT 1 and 2, UCAT verbal reasoning and decision making, and both total scores (Supporting Information, table 2).

The effect size for socio-economic status was 0.47 (95% CI, 0.39–0.54) for UMAT total score and 0.43 (95% CI, 0.35–0.50) for UCAT total score (all applicants); for those who sat both tests, it was 0.40 (95% CI, 0.22–0.57) for UMAT total score and 0.24 (95% CI, 0.06–0.41) for UCAT total score. For the 2019 intake, 890 of 3829 applicants (23.2%) and 164 of 899 interviewees (18.2%) were from lower socio-economic status areas ($P < 0.001$); for the 2020 intake, 1031 of 4066 applicants (25.4%) and 299 of 1052 interviewees (28.4%) were from lower socio-economic status areas ($P = 0.005$). For applicants from major cities in the 2020 intake, 762 of 3574 applicants (21.3%) and 132 of 749 interviewees (17.7%) were from were from lower socio-economic status areas ($P = 0.006$).

Remoteness (rurality)

All mean UMAT and UCAT subtest scores for applicants with home addresses in rural areas were lower than for those from major cities (Box 2, Box 3). All differences remained statistically significant after adjustment for sex, age, and IRSAD (all applicants: Supporting Information, table 1). After adjustment of interviewee scores for ATAR ranking, the influence of IRSAD was still significant for UMAT 1 and 3, UCAT quantitative reasoning and abstract reasoning, and both total scores (Supporting Information, table 2).

The effect size for remoteness was 0.54 (95% CI, 0.45–0.63) for UMAT total score and 0.48 (95% CI, 0.39–0.58) for UCAT total score (all applicants); for applicants who sat both tests, it was 0.71 (95% CI, 0.47–0.95) for UMAT total score and 0.59 (95% CI, 0.35–0.83) for UCAT total score.

Professional coaching (survey respondents only)

A total of 303 of 636 surveyed interviewees for the 2019 intake (47.6%) attended coaching before the UMAT exam; 291 of 624 surveyed interviewees (46.6%) for the 2020 intake attended coaching for the UCAT. In each year, similar proportions of men and women (2019: 52% *v* 48%, $P = 0.93$; 2020: 46% *v* 49%; $P = 0.45$) and of applicants from major cities and rural areas (2019: 49% *v* 38%; $P = 0.07$; 2020, 48% *v* 47%; $P = 0.84$) were coached. For the 2020 intake, a larger proportion of applicants from higher socio-economic status areas (225 of 449, 50%) were coached than of those from lower socio-economic status areas (59 of 147, 40%; $P = 0.036$).

For the UMAT, the only significant difference between coached and non-coached applicants was for mean UMAT 3 score (Box 2); there were no significant differences for UCAT scores (Box 3). The effect size for coaching on total UMAT score was 0.25 (95% CI, 0.09–0.40) and 0.13 for total UCAT score (95% CI, –0.03 to 0.29). After adjusting for age, sex, and ATAR ranking, coaching had no significant on any UCAT subtest scores, but its effect was significant for UMAT 2 and 3 scores (Supporting Information, table 3).

Discussion

We report the first assessment of the impact of the change from the UMAT to the UCAT for selecting students for undergraduate medical programs in Australia and New Zealand. Our findings indicate that the difference in overall test scores between male and female applicants is greater with the UCAT than it was with the UMAT, while the influence of socio-economic status areas and remoteness of residential address were similar for the two tests. Professional coaching did not markedly improve performance in UCAT among those accepted for interview.

Avoiding selection bias is critical for equity in high stake tests. It had previously been reported that women performed less well than men on the UMAT,[12,13] and this difference was also evident in the 2019 intake UMAT data. We found that women performed less well than men in all UCAT cognitive tests, and that the differences appeared larger than for the UKCAT,[1] but they performed better than men in the UCAT situational judgement test. Further, the size of the effect of sex on UCAT total cognitive test score was greater than for the UMAT, although still small (0.38 *v* 0.24). However, the proportion of women selected for interview following the UCAT was significantly lower than that of

2 Undergraduate Medical and Health Sciences Admissions Test (UMAT) scores (2019 intake), by sex, socio-economic status and remoteness of residence, and coaching (interviewees only)

Applicant category	Number of applicants	UMAT 1: problem solving		UMAT 2: understanding people		UMAT 3: non-verbal reasoning		UMAT total score		
		Mean (SD)	Mean difference (95% CI)	Mean (SD)	Mean difference (95% CI)	Mean (SD)	Mean difference (95% CI)	Mean (SD)	Mean difference (95% CI)	Cohen's *d* (95% CI)
Sex										
Men	1801	57.3 (10.1)	5.1* (4.5–5.7)	52.4 (8.7)	−2.6* (−3.2 to −2.0)	57.2 (9.6)	3.1* (2.5–3.7)	166.8 (22.8)	5.5* (4.1–6.9)	0.24 (0.18–0.30)
Women	2279	52.2 (9.1)		55.0 (9.4)		54.1 (9.5)		161.4 (22.8)		
Socio-economic status†										
Higher	2939	55.4 (9.7)	3.8* (3.1–4.5)	54.7 (8.9)	3.0* (2.3–3.7)	56.4 (9.5)	3.6* (2.9–4.3)	166.5 (22.0)	10.5* (8.8–12.2)	0.47 (0.39–0.54)
Lower	890	51.7 (10.0)		51.7 (9.8)		52.8 (10.1)		156.0 (24.4)		
Remoteness										
Major cities	3382	55.2 (9.8)	4.8* (3.9–5.7)	54.3 (9.1)	2.3* (1.5–3.2)	56.3 (9.6)	5.2* (4.3–6.1)	165.6 (22.7)	12.2* (10.1–14.3)	0.54 (0.45–0.63)
Rural	525	50.4 (9.2)		52.0 (9.7)		51.1 (9.3)		153.4 (12.2)		
Interviewees										
Coached	303	64.6 (7.9)	0.0 (−1.2 to 1.3)	61.1 (7.8)	0.7 (−0.5 to 1.9)	63.5 (8.3)	3.0* (1.6–4.3)	189.3 (15.2)	3.6 (1.3–5.9)	0.25 (0.03–0.29)
Not coached	333	64.6 (8.0)		60.4 (7.6)		60.5 (8.7)		185.7 (14.1)		

CI = confidence interval; SD = standard deviation. * $P < 0.001$. † Australian Bureau of Statistics Index of Relative Socioeconomic Advantage and Disadvantage (IRSAD):[10] deciles 1–5 = lower, deciles 6–10 = higher socio-economic status.

applicants (47% *v* 56%), and the difference was particularly large for applicants from large cities (40% *v* 53%).

A subgroup of applicants consistently receiving significantly lower scores than other applicants may reflect genuine differences in ability. Although men generally perform better than women on mathematical tests, women typically perform better in tests of verbal ability (especially those in high performing groups).[14] Moreover, the academic performance of girls in high school is equivalent to or better than that of boys,[15] and they typically achieve higher academic grades than men in medical school.[16] Nevertheless, after adjusting for high school performance (ATAR ranking), women's scores on UCAT cognitive ability tests were lower than those of men; the reasons for this discrepancy require further research. The UCAT tests may include indirect or unintended mathematical requirements, or the time-limited, online tests may influence results. In view of the apparent sex-related differences we have identified, medical programs should incorporate situational judgement test scores into assessments; several institutions are considering this for future intakes. The inclusion of interviews (in which women typically perform better than men) as well as cognitive tests in selection processes may also reduce the risk of sex-related disadvantage in selecting candidates for the medical workforce.[17]

Our findings also suggest that applicants from rural or lower socio-economic status areas performed less well on both the UMAT and UCAT. The small to medium effect sizes were similar for the two tests, and larger than for sex. The UCAT may limit the selection of applicants from outside major cities and from low socio-economic status areas unless additional opportunities are provided by specific pathways and quotas. Quotas for rural students have been justified by the argument that they are more likely to later practise in underserviced rural areas.[18,19] As women are more likely to choose careers in underserviced areas and in specialities with workforce shortages, such as general practice,[20-22] a sex quota may also be appropriate.[23]

In Australia, large numbers of applicants for undergraduate medical programs believe they need commercial coaching to be competitive.[24] The rate of coaching attendance in a 2008 University of Western Sydney study (51%)[9] was similar to those for interviewees for the 2019 (48%) and 2020 intakes (47%) in our study. However, the effect sizes for coaching on overall score were small for the UMAT and statistically non-significant for the UCAT. Even after adjusting for ATAR ranking and sex, UCAT scores were no higher for coached than uncoached interviewees. The novelty of the UCAT may have contributed to the low effectiveness of coaching, but our finding should assure applicants that the considerable financial and indirect costs of coaching, including lost opportunities for academic study not relevant to selection, is unnecessary.

Limitations

Although we included applicants for all three undergraduate medical programs in the most populous Australian state, our findings may not be generalisable to other parts of Australia or New Zealand with more rural applicants and fewer from academically selective schools. Other limitations were the broad measures of socio-economic status and remoteness. The IRSAD allows area-based socio-economic comparisons, but areas are likely to include people of a range of wealth and advantage. We based remoteness on residence at the time of application, as we did not have access to more detailed information, such as time lived in rural areas. Although some interviewees may have not reported their attendance at coaching, published coaching rates have been fairly consistent in analyses of data collected before and after selection for interview, and the reported effectiveness of UMAT coaching has also been consistent.[9,25]

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3 University Clinical Aptitude Test (UCAT) scores (2020 intake), by sex, socio-economic status and remoteness of residence, and coaching (interviewees only)

		Verbal reasoning		Decision making		Quantitative reasoning		Abstract reasoning		UCAT total score (cognitive tests)			Situational judgment	
Applicant category	Number of applicants	Mean (SD)	Mean difference (95% CI)	Mean (SD)	Mean difference (95% CI)	Mean (SD)	Mean difference (95% CI)	Mean (SD)	Mean difference (95% CI)	Mean (SD)	Mean difference (95% CI)	Cohen's *d* (95% CI)	Mean (SD)	Mean difference (95% CI)
Sex														
Men	1967	609.4 (75.6)	14.8* (10.2–19.4)	662.4 (77.0)	15.5* (10.8–20.2)	721.2 (87.1)	38.9* (33.8–43.9)	686.8 (96.2)	27.4* (21.8–33.0)	2680 (259.8)	96.5* (81.0–112)	0.38 (0.32–0.44)	618.1 (60.9)	−6.2* (−9.8 to −2.5)
Women	2302	594.5 (75.6)		646.9 (77.9)		682.3 (80.8)		659.5 (96.2)		2583 (255.0)			624.3 (60.5)	
Socio-economic status†														
Higher	3035	607.4 (74.7)	24.2* (18.8–29.5)	660.8 (75.7)	28.0* (22.5–33.5)	707.6 (83.6)	29.9* (23.9–36.0)	679.0 (94.2)	27.6* (21.0–34.3)	2655 (253.9)	110* (91.3–128)	0.43 (0.35–0.50)	626.2 (58.3)	17.6* (13.3–21.9)
Lower	1031	583.2 (77.3)		632.9 (81.2)		677.7 (89.7)		651.4 (91.6)		2545 (271.8)			608.6 (66.2)	
Remoteness														
Major cities	3583	604.1 (75.6)	22.6* (15.4–29.7)	656.5 (78.4)	21.6* (14.3–29.0)	705.4 (86.2)	43.7* (35.6–51.7)	676.6 (94.8)	36.3* (27.4–45.2)	2643 (263.2)	124* (99.5–102)	0.48 (0.39–0.58)	623.2 (60.7)	12.2* (6.5–18.0)
Rural	497	581.5 (76.5)		634.9 (72.5)		661.7 (75.4)		640.3 (85.6)		2518 (234.3)			610.9 (62.6)	
Interviewees														
Coached	291	671.3 (69.5)	−6.6 (−18.1 to 5.0)	725.2 (58.6)	0.6 (−9.1 to 10.3)	794.8 (4.4)	11.7 (−0.2 to 23.5)	757.9 (90.2)	19.8 (5.4–34.2)	2949 (184.3)	25.5 (−4.8 to 55.9)	0.13 (−0.03 to 0.29)	653.0 (43.4)	6.0 (−1.4 to 13.3)
Not coached	333	677.8 (75.6)		724.6 (63.3)		783.2 (75.2)		738.1 (90.9)		2924 (197.6)			647.1 (48.3)	

CI = confidence interval; SD = standard deviation. *$P < 0.001$. † Australian Bureau of Statistics Index of Relative Socioeconomic Advantage and Disadvantage (IRSAD):[10] deciles 1–5 = lower, deciles 6–10 = higher socio-economic status.

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Supporting Information

Additional Supporting Information is included with the online version of this article.