

RESEARCH

Open Access



Differential attainment within medical education: a systematic review

C. Cunningham^{1*} , L. Thong¹, D. Mockler², M. Hayes³, C. Ní Cheallaigh⁴ and S. M. Smith⁵

Abstract

Background Differential attainment describes the systemic differences in outcomes when grouping cohorts by protected characteristics and socioeconomic backgrounds. To date, most research studies have focused on a small number of characteristics and outcomes. This systematic review aimed to explore the association between a range of student/trainee characteristics and differential attainment in undergraduate and postgraduate medical education.

Methods A systematic review was conducted and reported using the Preferred Reporting Items for Systematic Reviews and Meta Analyses (PRISMA) guidelines with searches conducted in May 2023. Outcome measures were assessment, progression through training, and qualification in medical students or trainee doctors. Specific characteristics included were age, disability, entry route to medicine, ethnicity, gender, religion and socio-economic status. The Cochrane RoB tool, the Newcastle-Ottawa Scale and the GRADE approach were applied. A narrative synthesis was conducted due to heterogeneity between studies.

Results Ninety-five studies were included. The majority were observational. There were over 381,815 medical student and 395,191 trainee doctor participants across all studies. The certainty across included studies was low and results were heterogeneous. Most results focused on assessment, followed by progression, then qualification. Gender, ethnicity and age were most commonly studied. Mixed results were noted for gender with results suggesting an advantage for undergraduate females however, females took longer to complete postgraduate training, and males were more likely to be on a specialist register. Minoritised ethnicity was consistently associated with lower attainment across a large number of studies. Younger doctors consistently did better in postgraduate assessments. Only 32 studies examined other characteristics with mixed results for disability and entry routes to medicine. The impact of socioeconomic status varied, but lower status was associated with lower attainment at later career stages.

Conclusion Differential attainment is a complex, context-dependent phenomenon with multiple contributory factors that are challenging to disentangle. Despite low certainty of evidence, this review suggests that many characteristics do impact on outcomes in medical education. This warrants further investigation and indicates a need for monitoring and targeted differential attainment interventions to ensure equitable outcomes for medical students and doctors in training.

Registration This systematic review is registered on PROSPERO, accessible at https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42023426933. PROSPERO has been updated to reflect the progression of this review.

*Correspondence:
C. Cunningham
cunninc7@tcd.ie

Full list of author information is available at the end of the article



© The Author(s) 2026. **Open Access** This article is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License, which permits any non-commercial use, sharing, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if you modified the licensed material. You do not have permission under this licence to share adapted material derived from this article or parts of it. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by-nc-nd/4.0/>.

Keywords Differential attainment, Medical education, Medical students, Trainee doctors

Background

Differential attainment describes the differences in outcomes between groups with certain characteristics [1]. Attainment gaps based on group characteristics (instead of individual ability) have the potential to contribute to unfair outcomes [2]. Age, disability, entry route to medicine, ethnicity, gender, religion and socio-economic status (SES) are examples of characteristics that may be associated with differential attainment [3, 4]. Regulatory bodies have heightened their focus on this phenomenon in recent years and have instructed medical education institutions to research it [5–8]. Differential attainment is a product of a complex interplay of factors within the educational environment [9]. Unequal and unjust experiences/outcomes within educational settings may occur at both personal and structural levels. As an example, minoritised groups may experience unfair treatment via ‘*stereotype threat*’ or microaggression at the personal level, and via biased curriculum design and unfamiliar assessment methods at an institutional level [7]. The concept of ‘*academic backbone*’ is also relevant to attainment gap analysis. It is true that past academic achievement predicts future success in medicine. However, the potentially unjust impact of characteristics unrelated to individual academic ability on this attainment trajectory warrants attention. Differential attainment is a justified source of concern as it negatively impacts on educational experience, impedes workplace diversity, and ultimately may affect patient care through hindering progress of highly competent individuals [7, 10]. It is worth highlighting that a nuanced analysis is required in this area, as associations between characteristics and attainment may emerge in the literature due to confounding factors which are unrelated to unfair systems or treatment. Pinpointing cause and effect relationships is challenging, and multivariate analysis is required.

Differential attainment is a complex issue and addressing it through educational and workplace policy and interventions can only be achieved following an understanding of the full extent of the problem itself [11]. Several studies on this topic have been published and for the most part they have focused on small numbers of important characteristics in relation to single outcomes, with a focus on ethnicity and gender [12]. In reality differential attainment exists across a very wide range of demographic profiles linked to multiple attainment indices, with intersectionality playing a role. Therefore, capturing the totality of the issue is important but challenging. Intersectionality theory is based on the interconnected categorisations that create overlapping systems of disadvantage [13].

This paper examined a broader range of characteristics compared to previous studies. Owing to the necessary breadth of information to be covered, a systematic review was chosen as the methodology. It is intended that a thorough review of available literature will serve educators and policymakers with a knowledge reservoir that may inform support services and interventions aimed at tackling differential attainment.

Methods

This systematic review was conducted and reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis Statement [14]. This systematic review aimed to explore the association between a range of student/trainee characteristics and differential attainment in undergraduate and postgraduate medical education.

Included characteristics

Age, disability, entry route to medicine, ethnicity, gender, religion and SES were chosen as the group characteristics to examine (see Additional file 1). This is not an exhaustive list of potentially relevant contributors to differential attainment, but it was deemed sufficiently broad to offer a comprehensive examination of the topic. Disability is defined as ‘*substantial restriction in the capacity of the person to carry on a profession, business or occupation in the State...by reason of an enduring physical, sensory, mental health or intellectual impairment.*’ [15] In medical education literature, disability includes learning disabilities, mental health conditions, physical disabilities and medical conditions. Entry route to medicine can be direct (following completion of high school or equivalent, also known as UG entry and school leavers), graduate (those who already have a degree) and via access programmes (also referred to as gateway or widening participation courses, designed to help students from underrepresented backgrounds enter medical school) [16]. Ethnicity is defined as ‘*group identity based on culture, religion, traditions, and customs.*’ [17] In the medical education literature, ethnicities are often grouped for analysis. Disadvantaged SES is defined as ‘*a socially identifiable status of social or economic disadvantage resulting from poverty, level or source of income, homelessness, place of residence, or family background.*’ [18] Country of primary medical qualification characteristic is relevant to PG attainment as doctors often move abroad after UG studies and their country of qualification may be a contributor to differential attainment. However, this is not the case in UG education where students typically remain in one location. This review considered factors common

to both UG and PG settings, and therefore this characteristic was not included.

Outcome measures

Attainment in medical education includes assessment outcomes, successful progression through a degree/training programme, and qualification from the degree/training programme. These three markers of attainment carry high stakes and exist universally at various stages of medical education and training across the world. Failure to clear these hurdles is often a barrier to successful career advancement in medicine.

Eligibility criteria

Full text studies with quantitative study designs, populations of medical students or trainee doctors and an exploration of the association between one or more of the specified characteristics and one or more of the three outcome measures (assessment, progression and qualification) were included. Based on the aim of our review, qualitative studies were not included. The fundamental role played by qualitative research in defining and understanding the phenomenology of differential attainment is acknowledged. However, the goal of this review was to gauge the associations between specified factors on attainment and assessment outcomes. There were no restrictions placed on article language or on publication date (see Additional file 2). Studies did not need to explicitly state that they were looking for differential attainment. Any studies which considered the specified group characteristics in relation to the relevant outcome measures were eligible for inclusion, and the potential presence of differential attainment could be inferred from data.

Search strategy and study selection

A search strategy was developed by a medical librarian (DM) in Embase.com, optimized for sensitivity, and translated to other databases. The search was carried out in Embase.com, Medline ALL via Ovid, Web of Science Core Collection, ERIC via EBSCOhost, SCOPUS, and Google Scholar on 9th May 2023. The search strategies for Embase and Medline used relevant thesaurus terms from Emtree and Medical Subject Headings, respectively. Terms were searched in the titles and abstracts of references (see Additional file 3). Studies from the database search were imported to EndNote 20, and duplicates removed. Ten studies were piloted to ensure consistent application of eligibility criteria by two reviewers (CC, LT). Screening was independently completed on Covidence [19]. A third reviewer (SS) was consulted for disagreements. The grey literature search involved a search engine search of key terms, this and the mining of reference lists was completed by one reviewer, and results

were screened independently by two reviewers (CC, SS). Studies excluded after full text review have a documented reason for exclusion. Access to full texts could not be obtained for two studies; the authors were contacted but no responses were received, and these studies were excluded. Google translate was used to translate one study to English [20, 21].

Data extraction

Details of included studies and extracted data are presented in Additional files 4 and 5. Data extraction was piloted independently by two reviewers (CC and LT) at the commencement to ensure consistent application of the data extraction form. Data extraction was completed by CC and checked by a second author (MH).

Risk of bias and certainty of evidence

The Newcastle Ottawa scale (NOS) was applied to cohort and case-control studies and an adapted form was applied to cross-sectional studies [22]. This scale is used to evaluate the quality of non-randomised studies based on the domains of selection, compatibility and outcome [22]. The NOS for cohort and case control studies awards a maximum of nine stars over three domains. Studies awarded seven to nine stars are judged to be at 'low' risk of bias, while a score of five or six was deemed a 'medium' risk of bias [22]. The adapted form of the NOS for cross-sectional studies had a maximum score of 10 over the same domains and for the purposes of this review seven to ten was deemed 'low' risk of bias, and five to six 'medium' risk. The Cochrane Risk of Bias (ROB) Tool was applied to randomised controlled trials (RCTs) [23]. This tool evaluates the risk of bias in RCTs by assessing bias in relation to randomisation, deviations from intended interventions, missing outcome data, measurement of the outcome and in reported results [23]. The application of these tools was piloted across five studies. The process was completed by CC and checked by a second author (MH).

Grading of Recommendations Assessment, Development and Evaluation (GRADE) was applied to score the certainty of included evidence for the primary outcomes by one reviewer (CC) [24]. The GRADE approach bases judgement on consideration of risk of bias, precision, consistency, and directness of the findings to rate 'high,' 'moderate,' 'low,' or 'very low' certainty. RCTs start as 'high' and observational studies start as 'low'. Limitations in study quality, inconsistency of results, or uncertainty about the directness of the evidence resulted in down-grading of evidence [24]. As the starting point observational studies is 'low,' once one indication for downgrading was noted, no further assessment was undertaken, given the lowest rating possible is 'very low'. This was a pragmatic approach given the large number

of studies included in this review. This process was completed by CC and checked by a second author (MH).

Synthesis methods

Meta-analysis was identified in the protocol as a potential method of analysis. Previous meta-analysis in differential attainment research has been performed, but with consideration of a smaller number of characteristics and outcomes [12]. Due to the broadness of our research question and the consequent heterogeneity and disparate nature of methods and statistical analyses used across included studies, a meta-analysis was not appropriate. Instead, a narrative synthesis was undertaken with intention to explore the relationships between a range of student/trainee characteristics and study outcomes [25, 26]. This synthesis was led by one reviewer with feedback and discussion with other authors. A direction of effect method of synthesis was used. The limitations of this option are also acknowledged; however, it was the most appropriate option for this review given the inconsistent effect estimates and limited statistical information available in many of the included studies. The conceptual framework of the synthesis centred on whether certain group characteristics confer advantage or disadvantage in relation to specified attainment outcomes. Studies were grouped according to three markers of attainment: assessment, progression, and qualification. Within these groupings it was then determined whether any of the specified characteristics (age, disability, entry route to medicine, ethnicity, gender, religion and SES) had significant impacts on outcomes. For assessment, associations between examination results and characteristics were used to inform the synthesis. For progression, markers of positive progression (e.g. advancement through a degree and annual review of competency progression assessments) were evaluated. For qualification, completion of a degree or training programme, and association with characteristics was determined. These associations were analysed in both undergraduate (UG) and postgraduate (PG) settings, where PG refers to the education that takes place after qualification from a medical degree.

Results

Overview of included studies

The study selection process is summarised in Fig. 1 [14], showing that 138 full texts were reviewed and 95 were included in the final synthesis.

Included studies and participants

Ninety-two of the 95 included studies were observational and three were RCTs. Studies were published in 42 journals; the majority of which were medical education journals. Publication dates ranged from 1982 to 2023, with 59% (56/95) of the publications taking place since 2015.

Most studies were from the UK followed by the United States of America (USA) (28%), and then Australia (4%) (Table 1).

There were more than 381,815 medical student participants across the included studies, with sample sizes ranging from 135 to 76,711 [27, 28]. One study did not detail the number of participants [29]. There were 395,191 trainee doctor participants, ranging from ten to 90,452 [30, 31]. The potential for participant overlap was noted in seven of the studies [32–38]. Studies with trainee participants included trainees in anaesthetics, emergency medicine, general practice, medicine, obstetrics and gynaecology, paediatrics, psychiatry, public health, radiology and surgery.

Reporting, risk of bias and certainty of the evidence

The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement was designed to improve the reporting of observational studies [39]. Of the 92 observational studies, three utilised STROBE [30, 40, 41] and one refers to STROBE in their supplemental material [42]. The Consolidated Standard of Reporting Trials (CONSORT) guideline was designed to improve the quality of reporting in RCTs [43]. Out of the three RCTs, CONSORT was used in one [44] and the CONSORT flow diagram was used in two [45, 46].

For the three included RCTs there was a 'low' risk of bias across the majority of the domains for one of the studies [45] and the other two studies had 'some concerns' in relation to attrition and performance bias (see Additional file 6) [44, 46]. Eighty-one of the 92 observational studies were assessed as having a rating of seven or more, indicating a 'low' risk of bias on assessment. Eight cohort [47–54] and one cross-sectional study [30] scored six. One cohort and one cross sectional study scored 5 [55, 56]. Down-scoring was most often due to comparability. The observational studies tested for associations and most involved analysis for potential confounding factors (see Additional file 7). The GRADE approach was used to assess the certainty of evidence in this review for the primary outcomes, and the certainty of evidence across all study types was 'very low' (see Additional file 8).

Findings

The review outcomes of assessment, progression and qualification are reported individually in relation to the specified differential attainment characteristics of age, disability, entry route to medicine, ethnicity, gender, religion and SES and these are presented in sequence in each section for UG and PG settings (Table 2).

Assessment

Assessment refers to the process of evaluating individuals' knowledge, skills and professional attributes.

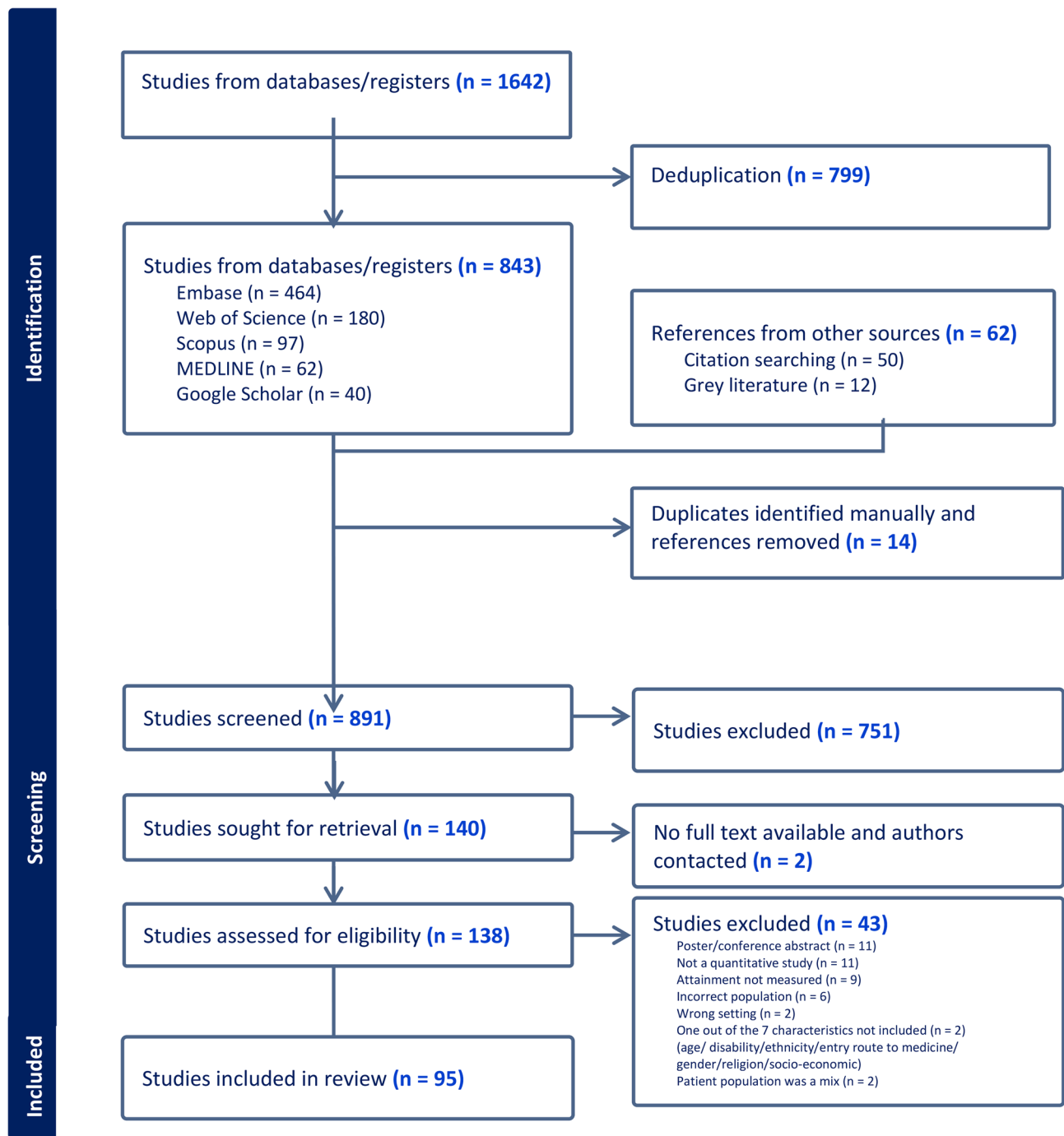


Fig. 1 Preferred reporting items for systematic reviews and meta-analyses flowchart

Commonly used assessment methods include written examinations, clinical examinations, workplace-based assessments and portfolios. Eighty-three studies reported on assessment in relation to one or more of the specified characteristics.

Sixty-one studies reported on assessment and gender. There were mixed results across 30 studies for UG assessment and gender, though more studies suggested an

advantage for females. Twenty-one studies reported better assessment outcomes for females [27, 29, 38, 47, 50, 51, 57–69, 72, 73]. In contrast, ten studies reported better assessment outcomes for males [20, 29, 52, 53, 55, 66, 67, 70–72]. Five studies reported no difference between genders [47, 53, 66, 74, 75].

For PG assessment there was no consistent pattern for gender across 33 studies. Fourteen studies reported no

Table 1 Summary of included studies

Domain	Study characteristic	Number (%) of studies (total = 95)
Country of origin	UK	55 (58%)
	USA	27 (28%)
	Australia	4 (4%)
	Austria	3 (3%)
	The Netherlands	2 (2%)
	UK and Ireland	1 (1%)
	Norway	1 (1%)
	Canada	1 (1%)
	Sri Lanka	1 (1%)
Types of studies	Cohort	70 (74%)
	Cross sectional	21 (22%)
	Randomised controlled trial	3 (3%)
	Case-control	1 (1%)
Study population	Medical students	45 (47%)
	Trainee doctors	50 (53%)
Outcomes*	Assessment	
	- Gender	61 (64%)
	- Ethnicity	48 (50%)
	- Age	20 (21%)
	- Disability	10 (11%)
	- Socioeconomic Status	10 (11%)
	- Entry route	7 (7%)
	- Religion	1 (1%)
	Progression	
	- Gender	14 (15%)
	- Ethnicity	10 (11%)
	- Age	6 (6%)
	- Entry route	3 (3%)
	- Socioeconomic Status	2 (2%)
	- Disability	2 (2%)
	- Religion	1 (1%)
	Qualification	
	- Gender	5 (5%)
	- Ethnicity	2 (2%)
	- Age	2 (2%)
	- Entry route	1 (1%)
	- Disability	1 (1%)

*Some studies included multiple characterises and/or multiple outcomes

significant difference between males and females [30, 44, 46, 48, 54, 67, 77–84]. Ten studies reported that female trainees received higher marks [31, 38, 40, 54, 56, 77, 78, 85–87] and ten reported that males received higher marks [34–36, 88–94].

The impact of ethnicity on UG assessment was reported in 25 studies. In general, white students received higher marks than non-white students [27, 28, 37, 38, 51, 57, 59–62, 64, 65, 67, 70, 72, 74, 75, 105–107, 109] and not being white was associated with being in the ‘struggling’ category [73].

PG assessment and ethnicity were reported in 25 studies. In general, white candidates received higher marks [31–36, 40, 41, 67, 77, 79, 84, 85, 87, 88, 91–93, 111, 112]. There were exceptions; one study found that minority ethnic doctors did better compared with majority ethnic (white) doctors in the AKT [86]. Another study found no association between ethnicity and assessment [82].

UG assessment and age were reported in 12 studies. These studies were undertaken in the USA, UK, Austria and Australia. Findings were conflicting. Five studies reported that younger medical students received higher marks [37, 53, 60, 70, 75]. However, three studies reported that older age was linked to higher marks [59, 62, 74]. In contrast, older age was more common in the ‘strugglers’ group in a different study [73]. Two studies found no age-related difference in assessment outcomes [27, 55].

PG assessment and age were reported in eight studies and all showed that younger age was associated with more success in assessments [33, 34, 80, 81, 83, 85, 92, 93].

UG assessment and disability were reported in six studies with mixed results. There were variations in disabilities in the studies. Two studies reported no association [72, 116], but two other studies reported that students with disability-related examination adjustments had lower pass rates [117, 118]. A third study reported that students with dyslexia received lower marks in OSCEs [49]. In another study the presence of ‘medical problems’ was significantly more prevalent among students in the ‘struggling’ category [73]. While many medical problems are not disabilities, some medical conditions are considered to be a disability due to their impact on function.

PG assessment and disability were reported in four studies. Disability was not significantly associated with assessment outcomes in three studies [36, 85, 86]. However, two reported that those declaring a learning difficulty were more likely to receive lower marks in the CSA exam [86, 119].

UG assessment and SES were reported in eight studies. In general, SES was not found to be associated with outcome differences [27, 55, 61, 62, 120] and postcode-based measures of disadvantage were not associated with significant differences in attainment [57]. However, one study found that students with professional parents were more likely to be in the top educational performance measure quartile (these are decile scores are calculated for each medical school’s graduating cohort) [59] and in another study medical students with a father in a low socioeconomic group were more likely to fail (5.1 versus 1.8%). This was a univariate analysis and the contributory role of other demographic factors towards this association must be considered [37].

Table 2 Summary of results

CHARACTERISTIC	OUTCOME MEASURES					
	ASSESSMENT		PROGRESSION		QUALIFICATION	
	UNDERGRADUATE OR POSTGRADUATE SETTING					
	UNDERGRADUATE	POSTGRADUATE	UNDERGRADUATE	POSTGRADUATE	UNDERGRADUATE	POSTGRADUATE
GENDER	Eighteen studies reported that female students received higher marks [27, 29, 50, 57–69]. In contrast, nine studies reported that males received higher marks in assessments [20, 37, 52, 53, 55, 66, 67, 70, 71]. One study found that males scored higher at the start of medical school but lower marks by final assessment [72]. One study found that male sex was a risk factor for being part of the ‘struggling’ medical students’ group [73]. Two studies reported no significant difference between genders [74, 75]. Women authored 50.9% of Thesis but earned only 30.9% of highest honours awards [76].	Fourteen studies reported no significant difference between males and females. [30, 44, 46, 48, 54, 67, 77–84]. Eleven studies reported that female trainees were scored better. [31, 38, 40, 54, 56, 77, 78, 85–88] Ten studies reported that male trainees were scored better [34–36, 88–94]. Despite starting residency with standardised exam scores that were comparable to their peers, female under-represented in medicine orthopaedic surgery residents scores became progressively worse on in service training exams and had lower first pass rates on board exams than their male majority counterparts [95]. Male and female MD-PhD students were equally likely to present at the annual program symposium, female students asked fewer seminar questions, and female speakers received more questions [96]. Academic profiles of men were stronger than women [48].	One study found that males were more likely to seek advice from an academic progress committee (APC) [65].	In general females were more successful in application to training schemes [42, 56, 97, 98]. One study found that men were 1.6 times more likely to be rejected than females for residency in family medicine, psychiatry and emergency medicine [99]. Male gender was associated with lower likelihood of success at ICU training interviews [100]. Mixed results were found in relation to success at ARCP [33, 79, 82, 84, 91]. Core training programs for surgery, medicine, and anaesthesia maintain higher proportions of female trainees than their cardiovascular subspecialties [101]. In orthopaedic training, Males scored higher than females on CV score and on referee reports. There were no differences between males and females on interview scores and no difference in the proportion of interviewed females and males that were offered a training programme [102].	No data.	In general, females took longer to qualify [48, 103, 104] with maternity leave [48], childbirth [103] and family [104] cited as reasons. Males were more likely to be on the specialist register [38], with an increase in females on the specialist register for renal medicine [84].

Table 2 (continued)

	OUTCOME MEASURES					
	ASSESSMENT		PROGRESSION		QUALIFICATION	
	UNDERGRADUATE OR POSTGRADUATE SETTING					
ETHNICITY	In general, white students received higher scores than non-white students [27, 28, 37, 38, 51, 57, 59–62, 64, 65, 67, 70, 72, 74, 75, 105–107]. Not being white was associated with ‘struggling’ [73]. Ethnicity-related differences in clinical grades were smaller in broadly sampled than in global assessment [108]. For multiple choice question (MCQ) exams the overall mean score was lower for URIM (African Americans, Latino, Native Americans, Alaska Natives) than not UIM students [109]. Compared with Dutch students, Surinamese and Antillean students specifically scored lower in the Year 1 course and the pre-clinical course [110]. In an intervention study involving an OSCE, both white and ethnic minority intervention groups outperformed controls [45].	In general, white candidates scored better than non-white candidates. [31–36, 38, 40, 41, 67, 77, 79, 84, 85, 87, 88, 91–93, 111, 112] One study found that minority ethnic doctors did significantly better compared with white doctors in the applied knowledge test (AKT) [86]. Two studies found no difference related to ethnicity and assessment [38, 82]. In the membership of the royal college of general practitioner (MRCGP) examination Asians doctors score lower than non-Asian doctors in written components [113]. Female underrepresented in medicine orthopaedic surgery residents scored progressively worse on in service training exams with lower board exam first pass rates than their male majority counterparts [95].	A significant association was found between non-white ethnicity and attendance at an APC [65].	White candidates were more likely to be successful in applications to higher training and were less likely to receive an unsatisfactory outcome in formal training assessments [33, 56, 84, 91, 97, 114]. Two studies showed ARCP outcomes related to ethnicity were similar (with the exception of general surgery) [79, 82]. Asian UK graduates’ success rate at ICU training interviews was comparable to the national average the Asian international medical graduates success rate was significantly lower [100].	A higher percentage of white students had graduated in five years compared to Black and Latino students [28].	Non-white doctors were equally as likely to be on the specialist register [38].

Table 2 (continued)

OUTCOME MEASURES						
	ASSESSMENT		PROGRESSION		QUALIFICATION	
	UNDERGRADUATE OR POSTGRADUATE SETTING					
AGE	In general, younger medical students received higher scores in assessments. [37, 53, 60, 70, 75] Three studies found that being older was related to high performance [59, 62, 74]. Older age was more common in the 'strugglers' group [73]. Two studies found no age-related difference [27, 55]. Younger men were least likely to have academic difficulty, and younger women were most likely to have academic difficulty. Older women achieved better than both older men and younger women in 3 classes of medical students at one medical school [50].	Younger age was associated with success. [33, 34, 80, 81, 83, 85, 92, 93]	No data.	A larger proportion of mature students were allocated to their first choice foundation school [97]. Applicants younger in age were more likely to be offered a PG training programme in anaesthesia [98] and intensive care medicine [100]. Doctors ≥ 29 years at graduation were more likely to have problems at their ARCP than their younger colleagues [115]. Trainees released from general practitioner training in the UK were on average older [33]. The median age for joining the specialist register is increasing [84].	No data.	There has been an increase in the age at which doctors complete specialist training [84]. Starting specialization at an older age reduced the time taken to complete training [103].
DISABILITY	Two studies found that disability was not associated with a difference in UG student performance [72, 116]. Two studies found students with examination adjustments had lower pass rates [117, 118]. One found that students with dyslexia scored relatively poorly in practical OSCE stations [49]. One found that medical problems were more common among 'struggling' students [73].	Disability was not significantly associated with variability in examination rates in three studies [36, 85, 86]. Those declaring a learning difficulty were significantly more likely to fail the CSA exam. [86, 119].	Acceptance rates to medical school were not significantly different for applicants who had Medical College Admissions Test (MCAT) scores obtained with standard vs. extra time [118].	There were no significant differences regarding disability for success at intensive care medicine training interviews [100].	Students who had taken the MCAT with extra time had significantly lower medical school graduation rates within four to eight years, compared to those without extra time [118].	No data.

Table 2 (continued)

	OUTCOME MEASURES					
	ASSESSMENT		PROGRESSION		QUALIFICATION	
	UNDERGRADUATE OR POSTGRADUATE SETTING					
SES	SES was not found to affect performance in medical school [27, 55, 61, 62, 120]. Postcode-based measures of disadvantage were not associated with significant differences in university attainment [57]. However, one study found that students with professional parents were more likely to be represented in the top educational performance measure quartile [59]. One study reported that medical students with a father in a low socioeconomic group were more likely to fail than those with a father in a high socioeconomic group [37].	Membership of the Royal College of Surgeons (MRCS) candidates from lower SES were less likely to pass the MRCS [91]. MRCS candidates from fee-paying schools had a lower fail rate compared to state funded schools, and fail rates were higher for candidates whose parents received income support [34].	No data.	A significantly larger proportion of applicants coming from families that were recipients of income support, and those entitled to free school meals did not get a place in a higher choice foundation school [97]. UK surgical trainees from lower socioeconomic group had a significantly greater proportion of unsatisfactory ARCP outcomes [91].	No data.	No data.
ENTRY ROUTE	Two studies found that standard entry students (SES) achieved better in earlier stages of the degree [74, 121]. One study found that graduate entry scored better but this gap closed over time [122]. One study found that graduate entry scored less well [37]. One study found that mature entry had higher scores than their peers in a year 3 OSCE [61]. Mature or graduate entrants were less likely to be successful at passing the medical degree [70].	Graduate entry medical students were significantly less likely to pass MRCS Part A than standard entry medical students [35].	Gateway entry students were more likely to repeat a year. [121] Graduate entry were more likely to withdraw than school lever entry [122].	Students who entered medical school as graduates were significantly more likely to be allocated to a higher choice foundation school than students who attended privately funded school or those who came into medical schools as typical school leavers vs. graduates [97].	More standard entry medical students completed their degrees in five years compared to gateway students [121].	No data.

Table 2 (continued)

OUTCOME MEASURES						
ASSESSMENT			PROGRESSION		QUALIFICATION	
UNDERGRADUATE OR POSTGRADUATE SETTING						
RELIGION	Muslim medical students had a lower mean rank than their peers [105].	No data.	No data.	Buddhism, Islam and Hinduism were associated with lower success rates in the selection process for intensive care medicine UK training, compared to Christian counterparts [100].	No data.	No data.

PG assessment and SES were reported in two studies with both reporting an association between markers of higher SES and success in assessments [34, 91].

UG assessment and entry route to medicine were reported in six studies, with mixed results. Two studies found that standard entry medical students received higher marks in earlier stages [74, 121], but this advantage was not sustained in later stages in one of the studies [74]. One found that graduate entry received higher marks, with most advantage conferred by prior health-care studies [122]. One study found that mature students did better than school leavers in a year 3 OSCE, however a separate study found that mature students did worse in a final year OSCE compared to younger classmates [37, 61]. Mature or graduate entrants were less likely to be successful at passing the medical degree in one study [70].

One study included data on entry route to medicine and PG assessment, noting that standard entry students were significantly more likely to pass the Membership of the Royal College of Surgeons (MRCS) Part A examination than graduate entry [35].

One UK study reported on religion and UG assessments. Muslim medical students had a lower mean rank than their non-Muslim peers (no religion, Christian, other, unknown) when ranked according to achievement [105].

Progression

In this context, progression refers to an individual proceeding from each year of their medical degree to the next, moving from medical school to employment and moving into a training scheme. Twenty studies reported on progression in relation to one or more of the specified characteristics.

UG progression and gender was reported in one study that found that males were more likely to meet an academic progress committee, which is an indicator of 'struggling' [65].

Thirteen studies reported on gender and PG progression. In general females were more successful, which was indicated by higher success in applications to training schemes [42, 56, 97–100]. Mixed results were found in relation to success at Annual Review of Competency Progression [33, 56, 79, 82, 84, 91].

Ethnicity and UG progression was reported in one study, which found a significant association between non-white ethnicity and need for engagement with an academic progress committee, which is a marker of 'struggling' [65].

Nine studies reported on ethnicity and PG progression. In general, white candidates were more likely to be successful in applications to training and were less likely to receive an unsatisfactory outcome in formal training assessments [33, 56, 84, 91, 97, 114]. As exceptions, two studies showed that annual review outcomes related to ethnicity and specialty were similar [79, 82] with the exception of general surgery trainees, where non-white trainees encountered more difficulty with progression [79].

Six studies reported on age and PG progression, and results were mixed. There is a suggestion that older doctors are more likely to encounter problems during training assessments. In one study a larger proportion of mature students (age 21 +) were allocated to their first choice foundation school compared to school leavers [97]. In another study applicants younger in age were more likely to be offered a PG training programme in anaesthesia [98] and intensive care medicine [100]. Doctors 29 years old or older at graduation were more likely to have problems with progression than their younger colleagues [115]. Trainees failing to progress in UK general practitioner training were on average older [33].

UG progression and entry route to medicine was reported in two studies. Gateway entry students (gateway courses aim to offer entry to medical school for under-represented communities, with less stringent academic requirements for entry) were more likely to repeat a year

[121] and graduate entry were more likely to withdraw than school leaver entry [122].

In the PG setting, students who entered medical school as previous university graduates were more likely to be allocated to a higher choice foundation training program compared to students who attended privately funded school [97].

Two studies reported PG progression and SES, finding that applicants coming from families receiving income support were less likely to get a place in a higher choice foundation school [97], and that UK surgical trainees from lower SES had more unsatisfactory annual progressions [91].

Disability and UG progression was reported in one study which reported no association with acceptance rates to medical school obtained with standard versus extra time [118]. For PG progression, one study reported no significant differences regarding disability for success at intensive care medicine training interviews [100].

One study examined PG progression and religion, finding that Buddhism, Islam and Hinduism were associated with lower success rates in the selection process for intensive care medicine UK training, compared to Christian groups [100].

Qualification

Qualification refers to completion of the medical degree and completion of specialist training programmes. Eight studies reported on qualification in relation to one or more of the specified characteristics.

Five studies reported on gender and PG qualification. In general, females took longer to qualify [48, 103, 104] with maternity leave [48], childbirth [103] and family [104] cited as reasons. Males were more likely to be on the specialist register [38]. There has been an increase in the number of female doctors on the specialist register [84].

Two studies reported PG qualification and age, and found that there had been an increase in the age at which doctors completed specialist training [84] and that starting specialization at an older age reduced the time taken to complete training [103].

Two studies reported on ethnicity and qualification with one reporting that a higher percentage of white students had graduated over a five year period compared to Black and Latino students [28], and the other reporting that non-white trainees were equally as likely as white trainees to be on the specialist register [38].

One study reported on entry route to medicine and qualification and found that more standard entry medical students completed their degrees in five years compared to gateway students [121].

One study reported disability and UG qualification and reported that students who had taken the MCAT with

extra time had significantly lower medical school graduation rates within four to eight years, compared to those without extra time [118].

Summary by characteristic

Differential attainment literature has focused on gender, ethnicity and age, with less evidence relating to other characteristics. Gender was reported in 72 studies, with mixed findings. There is a signal that females have better outcomes in UG assessment and PG progression domains, but encounter more difficulties with qualification, with maternity leave and childcare requirements cited as reasons for longer time to completion of training. Two RCTs have highlighted the importance of stereotype threat among surgical female trainees. In one RCT exposure to a source of stereotype threat activation was associated with lower performance in a technical skill [44]. In another RCT a positive value affirmation intervention improved female clinical evaluation scores, but did not impact male evaluation scores [46]. Ethnicity was reported in 52 studies and there are consistent findings in UG and PG settings that white medical students and doctors had better outcomes in attainment indices compared to non-white students. Differential attainment relating to age was reported in 26 studies. Younger doctors received higher grades in PG assessments, but results are conflicting among medical students doing UG assessments. In general, older doctors are more likely to encounter difficulty with PG progression as evidenced by problems with advancement through training schemes, however one study showed that commencing training at an older age led to a quicker completion time for training. SES was reported in 11 studies and in the UG setting there was no clear association between higher SES and higher assessments scores. In the PG setting there was an association between higher SES and higher pass rates in examinations. Higher SES was also associated with less difficulty in PG progression. Disability was reported in 11 studies. Students with examination adjustments due to disability had lower pass rates in two studies. Disability also associated with poorer OSCE scores in a single study and another study identified students with disability as more likely to be in the '*struggling*' category. The impact of disability on PG assessment outcomes was less apparent, with only one study showing a negative impact on examination results. No relationship was found between disability and UG or PG progression outcomes, although very few studies were available. One study showed that students were less likely to graduate from medical school if they had MCAT time allowances due to disability. Entry route to medicine was reported in eight studies and there was no clear trend favouring one particular group (standard entry/gateway entre/mature entry) in UG assessment outcomes. However, the subgroup of

students who completed prior healthcare studies appear to have an advantage in UG assessments. There was an indication that students who took non-standard entry routes encounter more academic difficulty and problems with UG progression. At PG level, doctors who completed degrees before medicine were allocated higher choice foundation training programs. A single study also reported that students who entered medicine via standard entry routes were more likely to finish the degree within five years compared to gateway entry students. Limited data was available on the correlation between religion and attainment. One study showed that Muslim medical students had lower mean assessment scores than non-Muslim peers. Another study on progression showed that non-Christian religions were less likely to be selected for intensive care medicine training in UK.

Discussion

Given the variety of societal and educational contexts as well as the variety of timepoints and definitions included, it is unsurprising that the studies in this review offered mixed results.

In summary, we identified gender was not consistently associated with differential attainment across all domains, whereas other personal characteristics commonly associated with discrimination (older age, minoritised religion and ethnicity) were consistently associated with reduced attainment. Differential attainment associated with lower SES increased in later stages of medical education (postgraduate training) at a time when assessments are more likely to be in-person and with a heavier emphasis on global impressions and subjective comments from evaluators. Qualitative research has identified that significant gender disparities exist within evaluators' narrative comments about trainees [123, 124]. It may be the case that the often subjective nature of the PG evaluation format carries a broad predisposition towards bias, which also disadvantages trainees from lower SES backgrounds. Specifically, oral examinations have been reported to be particularly prone to unconscious bias [125]. Non-standard entry routes are associated with difficulties in progression in UG stages. The reasons behind this are unclear, but the potential for a link to other factors such as age and SES, and the role of unconscious biases at UG level needs to be considered. A small number of studies found an association between disability and lower attainment in UG settings; reasonable adjustment to examination times was used as a marker for disability in these studies. While this is an important issue to study in its own right, it is a suboptimal marker of disability as students with a disability may not require or request additional time and this definition may have led to underreporting of disability.

It is difficult to draw conclusions on whether associations between particular characteristics and poorer outcomes are products of unfair treatment, or whether other hidden factors within the studied cohorts also contributed to outcomes. Although overall the quality of evidence was low, the majority of studies did control for confounding factors which may influence attainment (see Additional file 7), suggesting a true association between these characteristics and worse outcomes. The underlying systemic reasons that drive these phenomena are not fully understood. As mentioned at the beginning, unfair treatment may be a product of structural or personal biases. Identifying exactly where these biases lie is challenging. As examples, at a personal level an awareness of a perception of a lower ability (stereotype threat) might engender higher stress levels among certain groups, which can negatively affect performance. At a structural level, biased educational and assessment formats which favour certain groups over others may be relevant.

Differential attainment is a social phenomenon, and as such can be viewed through the lens of intersectionality [126]. Intersectionality refers to the concept of human experience being shaped by multiple social positions, each of which cannot be considered independently [127]. Characteristics may combine to create a unique vulnerability to unfair treatment, which goes beyond the additive effect of individual characteristics. Seven studies in this review offered information on particular characteristic combinations and their associations with attainment [50, 51, 53, 57, 80, 95, 120]. Older females achieved better than older males and younger women [50, 53]. Younger men were least likely to have academic difficulty, and younger women were most likely to have academic difficulty [50]. White females achieved best in OSCEs [51]. Asian men achieved slightly less well than Asian women compared to their white counterparts [57]. These studies offer valuable information about attainment outcomes among potentially vulnerable groups, but equally important are the perceptions and lived experiences of students and doctors. This is challenging to capture with quantitative data alone, and in this regard the importance of qualitative research cannot be overemphasised.

As mentioned above, the '*Academic Backbone*' refers to how past outcomes predict future outcomes in medical education [38]. It is a critical concept, as it underpins the rationale for granting medical student admission based on secondary school academic results [73]. Analysis of landmark cohort studies have shown that a '*backbone*' forms at early stages (GCSEs, undergraduate medical examinations) and its predictive power persists throughout the stages of postgraduate examinations through to specialist registration [38]. While it is true that 'the past predicts the future' in medical education, a challenge exists in teasing out what confounding ingredients

explain the variations in different ‘backbones’ i.e. does it go beyond individual academic ability? As differential attainment research typically commences at the stage of UG medical school or later, it is difficult to retrospectively figure out if the same systemic or personal factors that drive inequality in medical school and PG settings also drive inequality in the very different setting of secondary school. Some studies looking at the predictive power of prior academic performance did not consider potential confounding factors [73]. An ethnicity effect has been well described with minority groups having worse outcomes throughout each stage of the medical education journey [38]. The academic backbone model describes a relatively early and complex acquisition of medical and cognitive capital with lasting effects on attainment, and the extent to which the trajectory of outcome can be readily altered later on in the journey is unclear. This ought to further stress the need to identify and address unfair drivers of attainment gaps at all stages of the education journey in order to ensure students have the best chance to maximise their own individual potential.

Strengths

The search strategy and inclusion criteria were intended to be broad in order to provide confidence that the relevant body of research was included. The results were presented by outcomes pre-specified in the protocol and the quality of this review was assessed by PRISMA-P (see Additional file 9) [14]. A thorough risk of bias assessment was conducted on all studies. Two reviewers completed screening, data extraction and application of NOS, Cochrane ROB and GRADE.

Limitations

This review focuses on differential attainment after admission to medical education and does not include initial access to medical education, as this was outside the scope of this review but relevant in the broader medical education viewpoint. Given the heterogeneity of studies in terms of participant characteristics, outcomes and study design, a narrative synthesis was undertaken, rather than a meta-analysis. A limitation of this approach is that the ability to offer detailed interpretations of effect sizes is compromised and some studies may be overrepresented. There were no restrictions placed on article language, however the limitation of an English-language search is acknowledged. A further limitation relates to the search dates. Searches were conducted across multiple databases in May 2023. The volume of titles retrieved and the ultimate inclusion of 95 studies led to a prolonged period to conduct the review, and it was not feasible to update searches more recently.

Comparison with the existing literature

A 2015 rapid review reported that differential attainment in relation to ethnicity dominated the research [2]. Our review finds that gender-related research has now surpassed ethnicity-related research in terms of number of studies. Our review also aligns with most previous research which shows mixed results regarding the impact of gender on outcomes. Our findings show that minoritised ethnic groups are disadvantaged broadly across several attainment indices, and this corroborates the findings those reported in a 2021 review [7]. Our findings are also consistent with a 2024 scoping review on surgical trainees that reported correlations between lower MRCS success and older age, having a disability, taking graduate entry route, and coming from lower SES [4].

Implications for practice and research

Differential attainment is a relatively newly recognised issue in medical education and available research does not span a wide timeframe. As research in this area continues over the next decade, a future comparison of attainment outcomes over time would be interesting, to see if there has been any change in patterns as targeted interventions become commonplace.

Heterogeneity of outcome and characteristic definitions makes comparative analysis challenging. Standardised definitions in medical education literature would facilitate future research in this area- for example, the definitions of entry routes to medicine, ‘mature students’, and disability vary between studies.

More widespread sharing of data between institutions, as is done with the UKMED database, would offer a greater depth of information regarding the extent of differential attainment [128]. Provision of a unique identifier at entry to medical education with a centralised registry would allow a streamlined, longitudinal approach to the assessment and monitoring of differential attainment. A centralised database would also allow more exploration of the role played by intersectionality, which is recognised as an area in its own right that needs more study in general in medical education.

Targeted interventions aimed at tackling differential attainment will likely feature more in medical education. Re-examining outcomes after these interventions to assess their impact will be imperative in the future.

Conclusion

While there are mixed findings in results, our review has shown that certain group characteristics are associated to varying degrees with differential attainment at UG and PG level, and the role played by systemic biases in these results needs to be considered. In particular, minority ethnic groups consistently have lower attainment demonstrated across a large body of research. Implementation

of targeted interventions and collaboration between institutions to examine their impact would allow a deeper understanding of how to address this issue.

Abbreviations

ACGME	Accreditation Council for Graduate Medical Education
AD	Academic difficulty
AKT	Applied knowledge test
AOA	Alpha Omega Alpha Honour Medical Society
AP	Academic performance
ARCP	Annual Review of Competency Progression
BME	Black and Minority Ethnic
CASC	Technical Assessment of Skills and Competencies
CCC	Clinical Competency Committee
CS	Clinical Skills
CSA	Clinical Skills Assessment
CST	Completion of Specialist Training
DA	Differential Attainment
DQ	Deprivation Quintile
EM	Emergency Medicine
FLS	Fundamentals of Laparoscopic Surgery
FRCA	Fellowship of The Royal College of Anaesthetists
FRCR	Fellowship of The Royal College of Radiologists
FRCS	Fellowship of The Royal College of Surgeons
GAMSAT	Graduate Medical School Admissions Test
GMC	General Medical Council
GP	General Practitioner
GPA	Grade Point Average
HST	Higher Specialist Training
ICU	Intensive Care Medicine
IMG	International Medical Graduate
iMRCS	Intercollegiate Membership of The Royal College of Surgeons
MRCS	Membership of The Royal College of Surgeons
MCAT	Medical Colleges Admissions Test
MCQ	Multiple Choice Question
MRCGP	Membership of The Royal College of General Practitioners
MRCOG	Membership of The Royal College of Obstetrics and Gynaecology
MRCP	UK Membership of The Royal College of Physicians United Kingdom
MRCS	Membership of The Royal College of Surgeons
MSRA	Multi-Specialty Recruitment Assessment
MSPE	Medical Student Performance Evaluation
NSE	Non-Standard Entry
NTN	National Training Number
O&G	Obstetrics and Gynaecology
OR	Odds Ratio
OSCE	Observes Structured Clinical Examination
PACES	Practical Assessment of Clinical Examination
PG	Postgraduate
PMQ	Primary Medical Qualification
PSA	Prescribing Safety Assessment
RA	Reasonable Adjustments
RCA	Recorded Consultation Assessment
RCOG	Royal College of Obstetrics and Gynaecology
RCGP	Royal College of General Practitioners
SAQ	Short answer question
SEMD	Standard Entry Medical Degree
SES	Socioeconomic status
SJT	Situational Judgement Test
SLE	School Leaver Entry
SOE	Structured Oral Examination
SST	Subspecialty training
TEF	Trainee Evaluation Form
TFA	True False answers
UK	United Kingdom
UKG	United Kingdom Graduate
UKCAT	United Kingdom Clinical Aptitude Test
URIM	Underrepresented In Medicine
USA	United States of America
USMLE	United States Medical Licensing Exam
WPBA	Workplace Based Assessment

WUKG White United Kingdom Graduate

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s12909-025-08197-1>.

Additional file 1. Characteristics included in this review.

Additional file 2. Summary of eligibility criteria.

Additional file 3. Search strategy.

Additional file 4. Studies that met inclusion criteria.

Additional file 5. Summary of results.

Additional file 6. Cochrane risk of bias tool.

Additional file 7. Newcastle-Ottawa Scale.

Additional file 8. Grading of Recommendations, Assessment, Development, and Evaluations.

Additional file 9. Preferred reporting items for systematic reviews and meta-analyses (PRISMA) checklist.

Acknowledgements

Not applicable.

Clinical trial number

Not applicable.

Authors' contributions

CC: Conceptualization, data curation, analysis, investigation, methodology, project administration, visualisation, writing (original draft), writing (review and editing). LT: Data curation, investigation, writing (original draft), writing (review and editing). DM: Data curation, investigation, writing (original draft), writing (review and editing). MH: Data curation, writing (review and editing). SS: Conceptualization, methodology, investigation, supervision, visualisation, writing (original draft), writing (review and editing). CNC: Conceptualization, methodology, supervision, visualisation, writing (original draft), writing (review and editing). CC, LT, DM, MH, SS, CNC: Final review and approval of the manuscript.

Funding

CC is a member of staff and a part time PhD student in the School of Medicine in TCD, and the School of Medicine covers the cost of her PhD fees, there was no specific funding for this review.

Data availability

Data is provided within the manuscript or supplementary information files.

Declarations

Ethics approval and consent to participate

The local ethics committee confirmed that ethical approval was not required for this systematic review.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Author details

¹School of Medicine, Trinity College Dublin, Dublin, Ireland

²Faculty of Health Sciences, Trinity College Dublin, Dublin, Ireland

³Royal College of Physicians, Dublin, Ireland

⁴St James' Hospital and Associate Professor Department of Medicine, Trinity College Dublin, Dublin, Ireland

⁵Discipline of Public Health and Primary Care, Trinity College Dublin, Dublin, Ireland

Received: 3 June 2025 / Accepted: 22 October 2025

Published online: 01 December 2025

References

- Faculty of Biology, Medicine and Health. Addressing differential attainment. The University of Manchester; Available from: <https://www.bmh.manchester.ac.uk/about/equality/addressing-differential-attainment/#:~:text=Differential%20attainment%20%28DA%29%20is%20the%20variation%20in%20attainment,and%20without%20disabilities.%20The%20variation%20is%20often%20unexplained.>
- de Bere R, Nunn S, Nasser M. Understanding differential attainment across medical training pathways: A rapid review of the literature. 2015; Available from: https://www.gmc-uk.org/-/media/documents/gmc-understanding-differential-attainment_pdf-63533431.pdf.
- Ellis R, Knapton A, Cannon J, Lee AJ, Cleland J. Differential attainment in UK postgraduate medical examinations: examining the relationship between sociodemographic differences and examination performance. BMC Med. 2025;23(1):216.
- Jones RL, Prusmetikul S, Whitehorn S. Differential attainment in assessment of postgraduate surgical trainees: a scoping review. BMC Med Educ. 2024;24(1):597.
- General Medical Council. General Medical Council Outcomes for Graduates. 2018. Available from: <https://www.gmc-uk.org/education/standards-guidance-and-curricula/standards-and-outcomes/outcomes-for-graduates/>.
- Gonzaga AMR, Appiah-Pippim J, Onumah CM, Yialamas MA. A framework for inclusive graduate medical education recruitment strategies: meeting the ACGME standard for a diverse and inclusive workforce. Acad Med. 2020;95(5):710–6.
- Fyfe M, Horsburgh J, Blitz J, Chiavaroli N, Kumar S, Cleland J. The do's, don'ts and don't knows of redressing differential attainment related to race/ethnicity in medical schools. Perspect Med Educ. 2021;11(1):1–14.
- The Forum of Irish Postgraduate Medical Training Bodies. A Strategic Framework for Postgraduate Medical Training in Ireland, 2021–2030. 2021. Available from: <http://www.theforum.ie/wp-content/uploads/2021/11/Strategy-22-10.pdf>. Cited 2023 Oct 24.
- Ilyzoba-Ebozue Z, Fatimilehin A, Kayani M, Khan A, McMahon M, Stewart S, et al. Unveiling disparities: exploring differential attainment in postgraduate training within clinical oncology. Clin Oncol. 2024;36(6):e119–27.
- Shen MJ, Peterson EB, Costas-Muñiz R, Hernandez MH, Jewell ST, Matsoukas K, et al. The effects of race and racial concordance on patient-physician communication: a systematic review of the literature. J Racial Ethn Health Disparities. 2018;5(1):117–40.
- General Medical Council. Evaluating the impact of interventions aimed at addressing variation in progression associated with protected characteristics known as 'Differential Attainment'. 2018. Available from: https://www.gmc-uk.org/-/media/documents/gmc-differential-attainment-final-report-13_08_18-76652679.pdf. Cited 2025 May 22.
- 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(mar08 1):d901–901.
- Oxford English Dictionary. Intersectionality. In 2023. Available from: <https://doi.org/10.1093/OED/8904687553>.
- Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ. 2021;372:n71.
- Government of Ireland. Disability Act 2005. 2005. Available from: <https://www.irishstatutebook.ie/eli/2005/act/14/enacted/en/print>. Cited 2024 Feb 21.
- Patterson R, Price J. Widening participation in medicine: what, why and how? MedEdPublish. 2017;6:184.
- Oxford English Dictionary. Ethnicity definition. In 2023. Available from: <https://www.oxfordreference.com/display/10.1093/oi/authority.20110803095759525>. Cited 2023 Oct 24.
- Section 2 of the Equality. (Miscellaneous Provisions) Bill. 2017. Available from: <https://www.oireachtas.ie/en/bills/bill/2017/131/>. Cited 2024 Feb 21.
- Covidence. Available from: <https://www.covidence.org/home>.
- Haidinger G, Mitterauer L, Rimroth E, Frischenschlager O. Learning strategy or strategic learning? Gender-dependent success in medical studies at the Medical University of Vienna. Wien Klin Wochenschr. 2008;120(1–2):37–45.
- Google Translate. Available from: <https://translate.google.com/>.
- Wells G, Shea B, O'Connell D, Peterson J, Welch V, Losos M et al. The Newcastle-Ottawa Scale (NOS) for assessing the quality of nonrandomised studies in meta-analyses. Available from: https://www.ohri.ca/programs/clinical_epidemiology/oxford.asp. Cited 2023 Oct 30.
- Chandler J, McKenzie J, Boutron I, Welch V. Cochrane Methods 2016. Wiley. 2016. Available from: <http://doi.wiley.com/10.1002/14651858.CD201601>. Cited 2023 Nov 25.
- Guyatt GH, Oxman AD, Vist GE, Kunz R, Falck-Ytter Y, Alonso-Coello P. GRADE: an emerging consensus on rating quality of evidence and strength of recommendations. BMJ. 2008;336(7650):924–6.
- Popay J, Roberts H, Sowden A, Petticrew M, Arai L, Rodgers M et al. Guidance on the Conduct of Narrative Synthesis in Systematic Reviews. 2006. Available from: <https://www.lancaster.ac.uk/media/lancaster-university/content-assets/documents/fhm/dhr/chir/NSsynthesisguidanceVersion1-April2006.pdf>. Cited 2023 Nov 25.
- Cook DA, West CP. Conducting systematic reviews in medical education: a stepwise approach: conducting systematic reviews. Med Educ. 2012;46(10):943–52.
- Fernandez A, Wang F, Braveman M, Finkas LK, Hauer KE. Impact of student ethnicity and primary childhood language on communication skill assessment in a clinical performance examination. J Gen Intern Med. 2007;22(8):1155–60.
- Davis D, Dorsey JK, Franks RD, Sackett PR, Searcy CA, Zhao XH. Do racial and ethnic group differences in performance on the MCAT exam reflect test bias? Acad Med. 2013;88(5):593–602.
- Kelly S, Dennick R. Evidence of gender bias in true-false-abstain medical examinations. BMC Med Educ. 2009;9(1):32.
- See A, Pallaci M, Aluisio AR, Beck-Esmay J, Menchine M, Weinstock M et al. Assessment of Implicit Gender Bias during Evaluation of Procedural Competency among Emergency Medicine Residents. JAMA Netw Open. 2022; Available from: <https://www.embase.com/search/results?subaction=viewrecord&id=L637223211&from=export>.
- Royal College of Anaesthetists. Differential attainment in curricular components of the FRCA - an observational study. 2017. Available from: <https://www.rcoa.ac.uk/sites/default/files/documents/2019-09/Differential%20attainment-FRCA-curricular%20components.pdf>.
- Esmail A, Roberts C. Academic performance of ethnic minority candidates and discrimination in the MRCP examinations between 2010 and 2012: analysis of data. BMJ. 2013;347(sep26 2):f5662–5662.
- Esmail A, Roberts C. Independent Review of the Membership of the Royal College of General Practitioners (MRCP) examination. 2013. Available from: https://www.gmc-uk.org/-/media/documents/mrcgp_final_report__18th_september_2013.pdf_53516840.pdf.
- Ellis R, Brennan PA, Lee AJ, Scrimgeour DSG, Cleland J. Differential attainment at MRCS according to gender, ethnicity, age and socioeconomic factors: a retrospective cohort study. J R Soc Med. 2022;115(7):257–72.
- Ellis R, Brennan PA, Scrimgeour DSG, Lee AJ, Cleland J. Does performance at the intercollegiate membership of the Royal colleges of surgeons (MRCS) examination vary according to UK medical school and course type? A retrospective cohort study. BMJ Open. 2022. <https://doi.org/10.1136/bmjopen-2021-054616>.
- Ellis R, Cleland J, Scrimgeour D, Lee A, Brennan P. The impact of disability on performance in a high-stakes postgraduate surgical examination: a retrospective cohort study. J R Soc Med. 2022;115(2):58–68.
- Woolf K, McManus IC, Potts HWW, Dacre J. The mediators of minority ethnic underperformance in final medical school examinations. Br J Educ Psychol. 2013;83(1):135–59.
- McManus I, Woolf K, Dacre J, Paice E, Dewberry C. 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(1):242.
- Vandenbroucke JP, Von Elm E, Altman DG, Gøtzsche PC, Mulrow CD, Pocock SJ, et al. Strengthening the reporting of observational studies in epidemiology (STROBE): explanation and elaboration. PLoS Med. 2007;4(10):e297.
- Unwin E, Potts HWW, Dacre J, Elder A, Woolf K. Passing MRCP (UK) PACES: a cross-sectional study examining the performance of doctors by sex and country. BMC Med Educ. 2018;18(1):70.
- Boatright D, Anderson N, Kim JG, Holmboe ES, McDade WA, Fancher T, et al. Racial and ethnic differences in internal medicine residency assessments. JAMA Netw Open. 2022;5(12):e2247649.

42. Woolf K, Jayaweera H, Unwin E, Keshwani K, Valerio C, Potts H. Effect of sex on specialty training application outcomes: a longitudinal administrative data study of UK medical graduates. *BMJ Open*. 2019;9(3):e025004.
43. The CONSORT, Group, Schulz KF, Altman DG, Moher D. CONSORT 2010 statement: updated guidelines for reporting parallel group randomised trials. *BMC Med*. 2010;8(1):18.
44. Myers SP, Dasari M, Brown JB, Lumpkin ST, Neal MD, Abebe KZ, et al. Effects of gender bias and stereotypes in surgical training: a randomized clinical trial. *JAMA Surg*. 2020;155(7):552–60.
45. Woolf K, McManus IC, Gill D, Dacre J. The effect of a brief social intervention on the examination results of UK medical students: a cluster randomised controlled trial. *BMC Med Educ*. 2009. <https://doi.org/10.1186/1472-6920-9-35>.
46. Salles A, Mueller CM, Cohen GL. A values affirmation intervention to improve female residents' surgical performance. *J Grad Med Educ*. 2016;8(3):378–83.
47. Bienstock JL, Martin S, Tzou W, Fox HE. Medical students' gender is a predictor of success in the obstetrics and gynecology basic clerkship. *Teach Learn Med*. 2002;14(4):240–3.
48. Brown C, Harries RL, Abdelrahman T, Thomas C, Pollitt MJ, Lewis WG. Surgical gender gap: a curriculum concordance and career vector perspective. *Postgrad Med J*. 2018;94(1115):483–8.
49. Gibson S, Leinster S. How do students with dyslexia perform in extended matching questions, short answer questions and observed structured clinical examinations? *Adv Health Sci Educ Theory Pract*. 2011;16(3):395–404.
50. Haist SA, Wilson JF, Elam CL, Blue AV, Fosson SE. The effect of gender and age on medical school performance: an important interaction. *Adv Health Sci Educ Theory Pract*. 2000;5(3):197–205.
51. Haq I, Higham J, Morris R, Dacre J. Effect of ethnicity and gender on performance in undergraduate medical examinations. *Med Educ*. 2005;39(11):1126–8.
52. Mitterauer L, Frischenschlager O, Haidinger G. Sex differences in study progress at medical university of Vienna. *GMS J Med Educ*. 2007;24(2):Doc111.
53. Ramsbottom-Lucier M, Johnson MM, Elam CL. Age and gender differences in students' preadmission qualifications and medical school performances. *Acad Med*. 1995;70(3):236–9.
54. Sulistio MS, Khara A, Squiers K, Sanghavi M, Ayers CR, Weng W, et al. Effects of gender in resident evaluations and certifying examination pass rates. *BMC Med Educ*. 2019;19(1):10.
55. Frischenschlager O, Haidinger G, Mitterauer L. Factors associated with academic success at Vienna medical school: prospective survey. *Croat Med J*. 2005;46(1):58–65.
56. Akinola L, Khan R. Royal College of Obstetricians and Gynaecologists Differential Attainment Report. Available from: <https://www.rcog.org.uk/media/ctalnj3f/tef-2021-report-differential-attainment.pdf>.
57. Thiele T, Pope D, Singleton A, Stanistreet D. Role of students' context in predicting academic performance at a medical school: a retrospective cohort study. *BMJ Open*. 2016. <https://doi.org/10.1136/bmjopen-2015-010169>.
58. Silva ND, Thabrew M, Saparamadu P, Jayawardena D, Arachchige A, Weerawardhane M, et al. Gender differences in undergraduate medical examination results in Sri Lanka. *Ceylon Med J*. 2000;45(3):119.
59. Kumwenda B, Cleland JA, Walker K, Lee AJ, Greatrix R. The relationship between school type and academic performance at medical school: A national, multi-cohort study. *BMJ Open*. 2017;7(8). Available from: <https://www.embase.com/search/results?subaction=viewrecord&id=L623794399&from=export>.
60. Low D, Pollack SW, Liao ZC, Maestas R, Kirven LE, Eacker AM, et al. Racial/ethnic disparities in clinical grading in medical school. *Teach Learn Med*. 2019;31(5):487–96.
61. Lumb AB, Vail A. Comparison of academic, application form and social factors in predicting early performance on the medical course. *Med Educ*. 2004;38(9):1002–5.
62. McManus IC, Dewberry C, Nicholson S, Dowell JS. 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(1):244.
63. Riese A, Rappaport L, Alverson B, Park S, Rockney RM. Clinical performance evaluations of third-year medical students and association with student and evaluator gender. *Acad Med*. 2017;92(6):835–40.
64. Woolf K, Haq I, McManus IC, Higham J, Dacre J. Exploring the underperformance of male and minority ethnic medical students in first year clinical examinations. *Adv Health Sci Educ Theory Pract*. 2008;13(5):607–16.
65. Yates J, James D. Risk factors for poor performance on the undergraduate medical course: cohort study at Nottingham university. *Med Educ*. 2007;41(1):65–73.
66. Bibbo C, Bustamante A, Wang L, Friedman F, Chen KT. Toward a better understanding of gender-based performance in the obstetrics and gynecology clerkship: women outscore men on the NBME subject examination at one medical school. *Acad Med*. 2015;90(3):379–83.
67. Rubright JD, Jodoin M, Barone MA. Examining, Demographics. Prior academic Performance, and United States Medical Licensing Examination Scores. *Acad Med*. 2019;94(3):364–70.
68. Cuddy MM, Swygert KA, Swanson DB, Jobe AC. A multilevel analysis of examinee gender, standardized patient gender, and United States medical licensing examination step 2 clinical skills communication and interpersonal skills scores. *Acad Med*. 2011;86:517–20.
69. Swygert KA, Cuddy MM, Van Zanten M, Haist SA, Jobe AC. Gender differences in examinee performance on the step 2 clinical skills® data gathering (DG) and patient note (PN) components. *Adv Health Sci Educ Theory Pract*. 2012;17(4):557–71.
70. James D, Chilvers C. Academic and non-academic predictors of success on the Nottingham undergraduate medical course 1970–1995. *Med Educ*. 2001. Available from: <https://onlinelibrary.wiley.com>, <https://doi.org/10.1111/j.1365-2923.2001.01042.x>. Cited 2023 Nov 1.
71. Cuddy MM, Swanson DB, Clauser BE. A multilevel analysis of examinee gender and USMLE step 1 performance. *Acad Med*. 2008;83(Supplement):S58–62.
72. Hope D, Dewar A, Hothersall EJ, Leach JP, Cameron I, Jaap A. Measuring differential attainment: A longitudinal analysis of assessment results for 1512 medical students at four Scottish medical schools. *BMJ Open*. 2021;11(9). Available from: <https://www.embase.com/search/results?subaction=viewrecord&id=L635907681&from=export>.
73. Yates J, James D. Predicting the strugglers: a case-control study of students at Nottingham university medical school. *BMJ*. 2006;332(7548):1009–13.
74. Kay-Lambkin F, Pearson SA, Rolfe I. The influence of admissions variables on first year medical school performance: a study from Newcastle University, Australia: the influence of admissions variables on first year medical school performance. *Med Educ*. 2002;36(2):154–9.
75. Spielvogel R, Stednick Z, Beckett L, Latimore D. Sources of variability in medical student evaluations on the internal medicine clinical rotation. *Int J Med Educ*. 2012;3:245–51.
76. King JT, Angoff NR, Forrest JN, Justice AC. Gender disparities in medical student research awards: a 13-year study from the Yale school of medicine. *Acad Med*. 2018;93(6):911–9.
77. Dewhurst NG, McManus C, Mollon J, Dacre JE, Vale AJ. Performance in the MRCP(UK) examination 2003–4: analysis of pass rates of UK graduates in relation to self-declared ethnicity and gender. *BMC Med*. 2007;5(1):8.
78. Rushd S, Landau AB, Khan JA, Allgar V, Lindow SW. An analysis of the performance of UK medical graduates in the MRCOG part 1 and part 2 written examinations. *Postgrad Med J*. 2012;88(1039):249–54.
79. Luton OW, Mellor K, Robinson DBT, Barber Z, James OP, Powell AGMT et al. Differential attainment in higher surgical training: scoping pan-specialty spectra. *Postgrad Med J*. 2022. Available from: <https://www.embase.com/search/results?subaction=viewrecord&id=L2021953519&from=export>.
80. Menzies L, Minson S, Brightwell A, Davies-Muir A, Long A, Fertleman C. An evaluation of demographic factors affecting performance in a paediatric membership multiple-choice examination. *Postgrad Med J*. 2015;91(1072):72–6.
81. Tyrer SP, Leung WC, Smalls J, Katona C. The relationship between medical school of training, age, gender and success in the MRCPsych examinations. *Psychiatr Bull*. 2002;26(7):257–63.
82. Robinson DBT, Hopkins L, James OP, Brown C, Powell AGMT, Abdelrahman T, et al. Egalitarianism in surgical training: let equity prevail. *Postgrad Med J*. 2020;96(1141):650–4.
83. Patterson F, Tiffin PA, Lopes S, Zibarras L. Unpacking the dark variance of differential attainment on examinations in overseas graduates. *Med Educ*. 2018;52(7):736–46.
84. Graham-Brown MPM, Beckwith HK, O'Hare S, Trewartha D, Burns A, Carr S. Impact of changing medical workforce demographics in renal medicine over 7 years: analysis of GMC national trainee survey data. *Clin Med J R Coll Physicians Lond*. 2021;21(4):E363–70.
85. Asghar ZB, Siriwardena AN, Elfes C, Richardson J, Larcombe J, Neden KA, et al. Performance of candidates disclosing dyslexia with other candidates in a UK medical licensing examination: cross-sectional study. *Postgrad Med J*. 2018;94(1110):198–203.

86. Siriwardena AN, Botan V, Williams N, Emerson K, Kameen F, Pope L, et al. Performance of ethnic minority versus white Doctors in the MRCGP assessment 2016–2021: a cross-sectional study. *Br J Gen Pract.* 2023;73(729):E284–93.
87. Hawtin KE, Williams HRT, McKnight L, Booth TC. Performance in the FRCR (UK) part 2B examination: analysis of factors associated with success. *Clin Radiol.* 2014;69(7):750–7.
88. Richens D, Graham TR, James J, Till H, Turner PG, Featherstone C. Racial and gender influences on pass rates for the UK and Ireland specialty board examinations. *J Surg Educ.* 2016;73(1):143–50.
89. Bowhay AR, Watmough SD. An evaluation of the performance in the UK Royal college of anaesthetists primary examination by UK medical school and gender. *BMC Med Educ.* 2009;9(1):38.
90. Dayal A, O'Connor DM, Qadri U, Arora VM. Comparison of male vs female resident milestone evaluations by faculty during emergency medicine residency training. *JAMA Intern Med.* 2017;177(5):651.
91. Vinnicombe Z, Little M, Super J, Anakwe R. Differential attainment, socioeconomic factors and surgical training. *Ann R Coll Surg Engl.* 2022;104(8):577–82.
92. Scrimgeour DSG, Cleland J, Lee AJ, Brennan PA. Prediction of success at UK specialty board examinations using the mandatory postgraduate UK surgical examination. *BJS Open.* 2019;3(6):865–71.
93. Scrimgeour DSG, Cleland J, Lee AJ, Brennan PA. Which factors predict success in the mandatory UK postgraduate surgical exam: the intercollegiate membership of the Royal college of surgeons (MRCS)? *Surgeon.* 2018;16(4):220–6.
94. Santen SA, Yamazaki K, Holmboe ES, Yarris LM, Hamstra SJ. Comparison of male and female resident milestone assessments during emergency medicine residency training: a national study. *Acad Med.* 2020;95(2):263–8.
95. Foster N, Price M, Bettger JP, Goodwin CR, Erickson M. Objective test scores throughout orthopedic surgery residency suggest disparities in training experience. *J Surg Educ.* 2021;78(5):1400–5.
96. Heffron AS, Braun KM, Allen-Savietta C, Filut A, Hanewall C, Huttenlocher A, et al. Gender can influence student experiences in MD-PhD training. *J Womens Health.* 2021;30(1):90–102.
97. Kumwenda B, Cleland JA, Prescott GJ, Walker K, Johnston PW. Relationship between sociodemographic factors and selection into UK postgraduate medical training programmes: a national cohort study. *BMJ Open.* 2018;8(6):e021329.
98. de Oliveira GS, Akikwala T, Kendall MC, Fitzgerald PC, Sullivan JT, Zell C, et al. Factors affecting admission to anesthesiology residency in the United States. *Anesthesiology.* 2012;117(2):243–51.
99. Baerlocher MQ. Are applicants to Canadian residency programs rejected because of their sex? *Can Med Assoc J.* 2005;173(12):1439–40.
100. Tridente A, Parry-Jones J, Chandrashekariah S, Bryden D. Differential attainment and recruitment to intensive care medicine training in the UK, 2018–2020. *BMC Med Educ.* 2022;22(1):672.
101. Capdeville M. Gender disparities in cardiovascular fellowship training among 3 specialties updates from 2007 to 2017. *J Cardiothorac Vasc Anesth.* 2019;33(3):604–20.
102. Incoll IW, Atkin J, Frank JR, Vrancic S, Khorshid O. Gender associations with selection into Australian orthopaedic surgical training: 2007–2019. *ANZ J Surg.* 2021;91(12):2757.
103. Johannessen KA, Hagen TP. Individual and hospital-specific factors influencing medical graduates' time to medical specialization. *Soc Sci Med.* 2013;97:170–5.
104. Magennis P, Begley A, Douglas J, Dhariwal DK. Duration of specialty training in oral and maxillofacial surgery in the United Kingdom for trainees joining the OMFS specialist list between 2002 and 2019. *Br J Oral Maxillofac Surg.* 2020;58(10):1282–U14.
105. Vaughan S, Sanders T, Crossley N, O'Neill P, Wass V. Bridging the gap: the roles of social capital and ethnicity in medical student achievement. *Med Educ.* 2015;49(1):114–23.
106. Wass V. Effect of ethnicity on performance in a final objective structured clinical examination: qualitative and quantitative study. *BMJ.* 2003;326(7393):800–3.
107. Mukherji P, Adas MA, Clarke B, Galloway JB, Mulvey T, Norton S et al. Changing trends in ethnicity and academic performance: observational cohort data from a UK medical school. *BMJ Open.* 2022;12(12). Available from: <https://www.embase.com/search/results?subaction=viewrecord&id=L2021854383&from=export>.
108. Van Andel CEE, Born MP, Themmen APN, Stegers-Jager KM. Broadly sampled assessment reduces ethnicity-related differences in clinical grades. *Med Educ.* 2019;53(3):264–75.
109. Teherani A, Hauer KE, Fernandez A, King TE, Lucey C. How small differences in assessed clinical performance amplify to large differences in grades and awards: a cascade with serious consequences for students underrepresented in medicine. *Acad Med.* 2018;93(9):1286–92.
110. Stegers-Jager KM, Steyerberg EW, Cohen-Schotanus J, Themmen APN. Ethnic disparities in undergraduate pre-clinical and clinical performance: ethnic disparities in pre-clinical and clinical performance. *Med Educ.* 2012;46(6):575–85.
111. Wakeford R, Denney M, Ludka-Stempien K, Dacre J, McManus IC. Cross-comparison of MRCGP & MRCP(UK) in a database linkage study of 2,284 candidates taking both examinations: assessment of validity and differential performance by ethnicity. *BMC Med Educ.* 2015;15(1):1.
112. Tiffin PA, Paton LW. Differential attainment in the MRCPsych according to ethnicity and place of qualification between 2013 and 2018: a UK cohort study. *Postgrad Med J.* 2021;97(1154):764–76.
113. Wakeford R, Farooqi A, Rashid A, Southgate L. Does the MRCGP examination discriminate against Asian doctors? *BMJ.* 1992;305(6845):92–4.
114. Pinder RJ, Bury F, Sathyamoorthy G, Majeed A, Rao M. Differential attainment in specialty training recruitment in the UK: an observational analysis of the impact of psychometric testing assessment in public health postgraduate selection. *BMJ Open.* 2023;13(3):e069738.
115. Pyne Y, Ben-Shlomo Y. Older doctors and progression through specialty training in the UK: a cohort analysis of general medical council data. *BMJ Open.* 2015;5(2):e005658–005658.
116. McKendree J, Snowling MJ. Examination results of medical students with dyslexia: examination results of students with dyslexia. *Med Educ.* 2011;45(2):176–82.
117. Hutchinson K, Ricketts WM, Maxwell S, Ng FL. Candidates registered for reasonable adjustments underperform compared to other candidates in the National undergraduate prescribing safety assessment: retrospective cohort analysis (2014–2018). *Br J Clin Pharmacol.* 2021;87(3):946–54.
118. Searcy CA, Dowd KW, Hughes MG, Baldwin S, Pigg T. Association of MCAT scores obtained with standard vs extra administration time with medical school admission, medical student performance, and time to graduation. *JAMA.* 2015;313(22):2253.
119. Asghar Z, Williams N, Denney M, Siriwardena AN. Performance in candidates declaring versus those not declaring dyslexia in a licensing clinical examination. *Med Educ.* 2019;53(12):1243–52.
120. Griffin B, Hu W. The interaction of socio-economic status and gender in widening participation in medicine. *Med Educ.* 2015;49(1):103–13.
121. Curtis S, Smith D. A comparison of undergraduate outcomes for students from gateway courses and standard entry medicine courses. *BMC Med Educ.* 2020;20(1):4.
122. Puddey IB, Mercer A, Carr SE. Relative progress and academic performance of graduate vs undergraduate entrants to an Australian medical school. *BMC Med Educ.* 2019;19(1):159.
123. Gerull KM, Loe M, Seiler K, McAllister J, Salles A. Assessing gender bias in qualitative evaluations of surgical residents. *Am J Surg.* 2019;217(2):306–13.
124. Mamtani M, Shofer F, Scott K, Kaminsin D, Eriksen W, Takacs M, et al. Gender differences in emergency medicine attending physician comments to residents: a qualitative analysis. *JAMA Netw Open.* 2022;5(11):e2243134.
125. Roberts C. Oral examinations—equal opportunities, ethnicity, and fairness in the MRCGP commentary: oral exams—get them right or don't bother. *BMJ.* 2000;320(7231):370–5.
126. Lopez N, Gadsden VL. University of Pennsylvania. Health Inequities, Social Determinants, and Intersectionality. *NAM Perspect.* 2016;6(12). Available from: <https://nam.edu/health-inequities-social-determinants-and-intersectionality/>. Cited 2024 Dec 6.
127. Bauer GR, Churchill SM, Mahendran M, Walwyn C, Lizotte D, Villa-Rueda AA. Intersectionality in quantitative research: a systematic review of its emergence and applications of theory and methods. *SSM.* 2021;14:100798.
128. UK Medical Education Database (UKMED). 2025. Available from: <https://www.ukmed.ac.uk/>. Cited 2025 Feb 3.

Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.