Why do women choose or reject careers in academic medicine? A narrative review of empirical evidence

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Women are under-represented in academic medicine. We reviewed the empirical evidence focusing on the reasons for women's choice or rejection of careers in academic medicine. Using a systematic search, we identified 52 studies published between 1985, and 2015. More than half had methodological limitations and most were from North America. Eight main themes were explored in these studies. There was consistent evidence for four of these themes: women are interested in teaching more than in research; participation in research can encourage women into academic medicine; women lack adequate mentors and role models; and women experience gender discrimination and bias. The evidence was conflicting on four themes: women are less interested in research than men; women lose commitment to research as their education and training progress; women are deterred from academic careers by financial considerations; and women are deterred by concerns about work–life balance. Inconsistency of findings across studies suggests significant opportunities to overcome barriers by providing a more enabling environment. We identified substantial gaps in the scientific literature that could form the focus of future research, including shifting the focus from individuals' career choices to the societal and organisational contexts and cultures within which those choices are made; extending the evidence base to include a wider range of countries and settings; and testing the efficacy of interventions.

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Introduction

Since Elizabeth Blackwell became the first woman to receive a medical degree in the USA in 1849 and the first to be recorded on the medical register in the UK in 1859, societies on both sides of the Atlantic have achieved gender equity in admissions to medical schools, but women remain significantly under-represented in academic medicine.[1–3] Women constituted 40% of admissions to medical schools in 1980 in the UK and in 1992 in the USA, and by 2013 constituted 55% of students entering medical schools in the UK and 47% in the USA.[4–6] However, despite increases in the percentage of women faculty from 21% in 2004, to 28% in 2014, in the UK,[7] and from 30% in 2004, to 38% in 2014, in the USA,[3] gender equity in academic medicine has not yet been achieved. The disadvantages of fewer women choosing careers in academic medicine include a waste of intellectual capital,[8] and a potential lack of diversity in the research agenda and future health practices.[9,10] Given international concern about the need to revitalise academic medicine and its leadership,[11] a better understanding of how to enhance the recruitment and optimal contributions of women in academic roles might improve the likelihood of accomplishing academic medicine's missions.

In the past decade, gender equity in science, technology, engineering, mathematics, and medicine has received significant attention in policy. In the USA, the National Science Foundation has launched the ADVANCE programme to increase the representation and advancement of women, promote gender equity, and develop a more diverse science and engineering workforce.[12] The Association of American Medical Colleges convened the Group on Women in Medicine and Science, which advocates for women's advancement and leadership through various initiatives, including a tool that enables medical schools to compare how well they advance women.[3] The National Initiative on Gender, Culture and Leadership in Medicine: C-Change has benchmarked the culture and faculty perspectives on gender equity in US medical schools and internationally.[13] The US National Institutes of Health has appointed the first Chief Officer for Scientific Workforce Diversity to "[lead] NIH's effort to diversify the national scientific workforce and expand recruitment and retention".[14]

In the UK, several professional and scientific bodies, including the Medical School Council,[15] the British Medical Association,[16] the Royal College of Physicians,[2] and the Academy of Medical Sciences,[17,18] have reviewed the situation of women in academic medicine and suggested measures to improve it. Most notably, Professor Dame Sally Davies, the UK Government's Chief Medical Officer and Director General of the National Institute for Health Research, has challenged academic and clinical leaders to improve support for women's advancement in clinical academia through participation in the Athena SWAN Charter for Women in Science.[19] The Charter encourages and recognises

Search strategy and selection criteria

We searched MEDLINE, CINAHL, ERIC, and dissertations and theses for peer-reviewed studies published from Jan 1, 1985, to Jan 1, 2015, using the following terms: ("gender" OR "women" OR "female") AND ("academic medicine" OR "physician scientist" OR "physician researcher" OR "clinician scientist" OR "clinical researcher" OR "clinical academic" OR "sex factors" OR "research personnel" OR "biomedical researcher") AND ("aspirations" OR "career" OR "advance*" OR "development" OR "disadvantages" OR "discrimination" OR "barrier*" OR "facilitator*").

Panel: Methods

Following a systematic review, two reviewers, working independently, selected studies that reported results by gender for reasons associated with medical students or resident doctors choosing or rejecting careers in academic medicine (figure 1). Because of the heterogeneity in study designs, variables, and outcome definitions, we did a qualitative synthesis to analyse recurrent patterns and themes, with studies reread several times by two reviewers to ensure fidelity of classification. Given that the study period spanned 30 years, we paid close attention to publication dates and possible changes over time. We assessed methodological quality using the relevant elements of the Critical Appraisal Skills Programme tools, and deemed quantitative studies with a response rate less than 60% or with fewer than 100 women of lower methodological quality (appendix). We also developed and used a graphical method for visualising supporting and refuting evidence of variable methodological quality (figure 2).

For the **Critical Appraisal Skills Programme** see http://www.casp-uk.net/

See Online for appendix

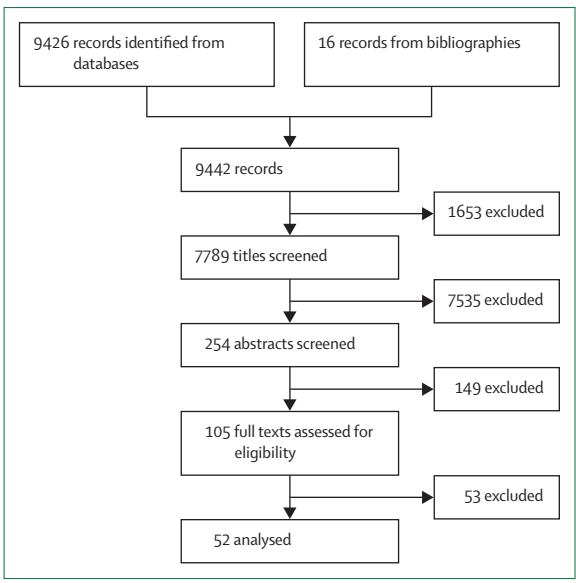

Figure 1: **Literature search and study selection**

institutional commitment to advancing the careers of women in science, technology, engineering, mathematics, and medicine.[20]

Our study extends two reviews about the career choice of academic medicine. We focus on women's choice or rejection of academic medicine during medical school and residency, whereas two previous reviews were based primarily on studies that did not report results by gender.[21,22] Straus and colleagues' review was based on international empirical studies from 1990 to 2005 (n=25),[21] whereas Borges and colleagues' was restricted to US journals and included both opinion pieces and empirical studies from 1960 to 2006 (n=41).[22] Neither review specifically investigated women's career choices during education and training. We have produced an interpretative synthesis of evidence based on eight theme summary statements, and within each statement we have analysed both supporting and refuting studies and assessed their methodological quality (panel).

Description of dataset

We did a systematic review to identify empirical evidence that focuses on the reasons for women's choice or rejection of careers in academic medicine, to encourage and support more women to pursue an academic path if they choose so. Our findings are based on 52 studies published between 1985 and 2015 (table). They had participants from 13 countries, including 39 (75%) from the USA and Canada. They consisted of 29 questionnaire surveys, 19 cohort studies, two case-control studies, and two qualitative studies. Of the 52 included studies, we judged 29 (56%) to have methodological limitations; namely, a lack of information about the questionnaire development, validation, and delivery; small sample size; and low response rate (table).

Theme summary statement 1: women are less interested in research than men

Evidence for women being less interested in research than men was highly conflicting, with 17 studies supporting and 13 refuting. Six supporting and ten refuting studies had methodological limitations. Eight cohort studies and nine cross-sectional surveys from North America, Switzerland, Portugal, and Japan (1992–2012) showed that during different stages of education and training women appeared to show less interest in research than men. This finding was evidenced by women entering medical school with lower levels of planned career involvement in research;[26,48,56] and men being more interested in research or academic careers during medical school and residency than women.[24,28,33,42,43,59,64,65,68,69] For example, one small survey[69] of psychiatry residents in the USA and Canada categorised participants as having high, medium, or low interest in research and showed that women constituted 68% of the low interest group and 24% of the high interest group.[69] Also, fewer women enrolled in research fellowships[42] and MD PhD programmes;[53,54,60] and, after graduation, were less interested in pursuing a career in research.[72]

However, 13 studies from the USA, UK, Ireland, Australia, and New Zealand (1985–2014) did not support the hypothesis that women were less interested in research than were men. Eight mostly small surveys together with five cohort studies reported that during medical school and residency women were equally or more interested in research and academic careers.[27,34,35,39,41,44,53,57,61,63,74] Additionally, two cohort studies showed that after graduation women were more likely than men to hold faculty appointments.[25,26] There was also evidence of longitudinal changes in the percentage of women MD

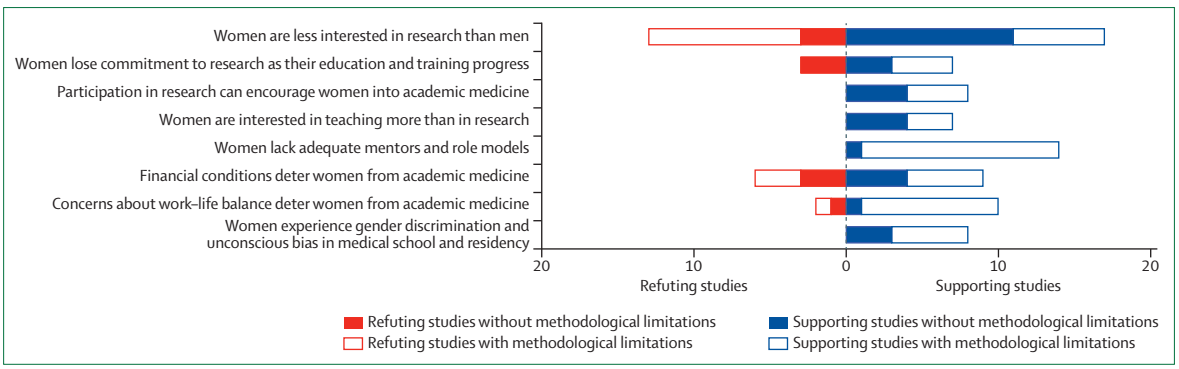

Figure 2: **Theme summary statements regarding women's choice or rejection of careers in academic medicine by number of supporting and refuting studies**

PhD students in the USA, from 27% in 1997, to 43% in 2004, and 36% in 2012,[53,60] indicating that women's interest in research can change over time, perhaps as a result of changing access criteria and, possibly, less discrimination.

Theme summary statement 2: women lose commitment to research as their education and training progress

Evidence for women losing commitment to research was also conflicting, with seven studies supporting and three refuting. Four supporting studies had methodological limitations. Both cross-sectional and cohort studies from the USA and UK, published between 1996 and 2014, found that women were more likely than men to lose commitment to research and academic careers before entering medical school,[56] during medical school,[48] and during residency.[35,46,59,71] The greatest attrition in commitment appeared to occur during residency. For example, a UK cohort study of medical graduates showed that among those who wanted an academic career 1 year after graduation, 44% (19/43) of men and 12% (4/33) of women maintained their choice for an academic career 5 years after graduation.[71]

There was also some evidence from the USA that, although at the beginning of their residency women were similarly or more interested in research and academic careers as men, gender differences were eliminated or reversed as training progressed.[35,46,59] In a large survey of obstetrics and gynaecology residents,[35] 20% of women and 28% of men in their first year agreed or strongly agreed with the statement "I would never consider a career in academic medicine", but by their fourth year, these percentages rose to 34% for both. Additionally, one large cohort study[24] (2000–06) showed that women were less likely than men to graduate from an MD PhD programme. Large variation among the studies suggested that waning in women's commitment to research might also be due to other personal or cultural circumstances (and a concomitant lack of support in the workplace—such as opportunities to convert to part-time study or support for returners after career breaks), rather than a loss of interest in research per se.

Moreover, three methodologically robust studies refuted that women lose commitment to research. One US cohort study (1997–2004)[51] used multivariable logistic regression models to show that women graduates were more likely to have an emerging intent to pursue academic medicine careers than men. Two other US cohort studies from 2010 and 2014 showed no association between attrition from MD PhD programmes and gender.[31,53]

Theme summary statement 3: participation in research can encourage women into academic medicine

Evidence from eight North American studies (1994–2012), four of which had methodological limitations, consistently demonstrated that participation in research can encourage women into academic medicine. The most substantive evidence came from investigations of cohorts of US medical graduates[25,26] and research programme participants.[42,70] Participation in formal research training during medical school and residency was associated with decisions to pursue academic medicine and increased the likelihood of full-time faculty appointments for both genders.[25,42,70] This finding was repeated in a small study of vascular surgical residents.[39] Publishing research during residency was also associated with future academic inquiry for both men and women in a small cohort study of neurology residents, but men were nearly twice as likely as women to publish.[41] A larger US national cohort study (from 1998–2004) showed that the relation between participation in research during residency and future faculty appointment was stronger among women than among men.[26] Participation in research during residency also correlated with 38 female psychiatry residents' decisions to pursue careers in academic clinical teaching.[62] Similarly, a qualitative study of female physicians showed that receiving training in a teaching hospital where research and teaching were experienced on a daily basis provided a formative experience for their decisions to enter academic medicine.[29]

Theme summary statement 4: women are interested in teaching more than in research

Evidence across seven studies done in North America, the UK, Australia, and internationally (1994–2014) consistently showed that women considering careers in academic medicine were more interested in opportunities to teach than to conduct biomedical research. Three of these studies had methodological limitations. One large US national cohort study (1998–2004) showed that, during medical school, a higher proportion of women had participated in an education elective (60%, compared with 50% of men) than in a research elective (48%, compared with 57% of men).[26] Similarly, a UK national cohort study of medical graduates (2005–12) showed that, among those who intended to pursue careers in academic medicine, women were more interested in posts focused on teaching than in those focused on research;[71] and two small specialty surveys of US[62] and Canadian[43] resident doctors also showed that women were more interested in teaching than in research. An Australian survey from 2009 of final year students showed that both genders expected more involvement in teaching than in research in their careers.[44] In two qualitative studies, female physicians (53 from the USA, seven from elsewhere)

	Study design	Study population and setting	Sample/ population size	Response rate	Women (n, %)	Methodological limitations
Abu-Zaid et al (2014)[23]	Cross-sectional survey	Students, one school, Saudi Arabia	116/171	68%	116 (100%)	Questionnaire not validated
Andriole et al (2008)[24]	Cohort	Graduates (2000–06), Association of American Medical Colleges, USA	79 104/88 575	89%	36 023 (46%)	..
Andriole et al (2010)[25]	Cohort	Graduates (1997–2002), six schools, USA	1965/4678	42%	853 (43%)	Low response rate
Andriole et al (2012)[26]	Cohort	Graduates (1998–04), Association of American Medical Colleges, USA	66 889/85 035	79%	30 914 (46%)	..
Benson et al (1985)[27]	Cross-sectional survey	Paediatrics and internal medicine residents, five schools, USA	299/387	77%	84 (28%)	Small sample of women
Bickel et al (1995)[28]	Cohort	Matriculants (1993) and graduates (1994), Association of American Medical Colleges, USA and Canada	NA	80–94%	NA	..
Borges et al (2012)[29]	Qualitative	Academic physicians, multiple schools, USA	53/81	65%	53 (100%)	..
Borges et al (2013)[30]	Qualitative	International academic physicians, Canada, Pakistan, Mexico, Sweden	7	NA	7 (100%)	..
Brass et al (2010)[31]	Cohort	MD PhD trainees, graduates, and alumni, 24 MD PhD programmes, USA	2023 trainees, 1143 graduates, 2803 alumni	NA	749 trainees (37%)	..
Bright et al (1998)[32]	Cross-sectional survey	4th year students, members of American Medical Student Association, 25 schools, USA	564/2128	27%	271 (48%)	Questionnaire development not reported, low response rate
Buddeberg-Fischer et al (2008)[33]	Cross-sectional survey	Residents, three schools, Switzerland	406	NA	210 (52%)	..
Burgoyne et al (2010)[34]	Cross-sectional survey	Students, one school, Ireland	317	60%	184 (58%)	..
Cain et al (2001)[35]	Cross-sectional survey	Obstetrics and gynaecology residents and American Congress of Obstetricians and Gynecologists fellows, USA	811/2000 fellows; 4659/4814 residents	41% fellows; 97% residents	282 (35%) fellows; 2996 (64%) residents	Questionnaire delivery not reported
Cochran et al (2013)[36]	Case-control	Surgical residents and early-career surgical faculty, eight schools, USA	85 residents; 69 faculty	74% residents; 37% faculty	70 (45%)	Small sample of women
Coleman et al (2005)[37]	Cross-sectional survey	Obstetrics and gynaecology residents, 2004, USA and Canada	3969/4721	84%	2935 (74%)	..
Corrigan et al (2007)[38]	Cross-sectional survey	Doctors and students, multiple schools, UK and Ireland	222/450	49%	78 (35%)	Questionnaire development not reported, low response rate, small sample of women
Danczyk et al (2012)[39]	Cross-sectional survey	Vascular surgery residents, USA	128/295	43%	34 (27%)	Questionnaire development not reported, low response rate
Donovan (2010)[40]	Cross-sectional survey	Directors of radiology programmes, Association of Program Directors in Radiology, USA and Canada	70/156	45%	29 (41%)	Questionnaire not validated, low response rate, small sample of women
Dorsey et al (2006)[41]	Cohort	Neurology residents (1986–2001), one school, USA	68/78	87%	27 (40%)	Questionnaire development not reported, small sample of women

(Table continues on next page)

	Study design	Study population and setting	Sample/ population size	Response rate	Women (n, %)	Methodological limitations
(Continued from previous page)						
Fang et al (2003)[42]	Cohort	Awardees and non-awardees of two Howard Hughes Medical Institute research training programmes, multiple schools, USA	1231	NA	352 (29%)	..
Freiman et al (2005)[43]	Cross-sectional survey	Dermatology residents, Canada	48/48	100%	31 (65%)	Small sample of women
Galletly et al (2009)[44]	Cross-sectional survey	6th year students, one school, Australia	105/130	81%	52 (50%)	Questionnaire development not reported, small sample of women
Gerson et al (2007)[45]	Cross-sectional survey	Gastroenterologists, American Gastroenterological Association, USA	457/>2856	<16%	262 (57%)	Low response rate
Golub et al (2011)[46]	Cross-sectional survey	Otolaryngology residents, American Academy of Otolaryngology–Head and Neck Surgery, USA	531/1364	39%	114 (21%)	Low response rate
Gordon et al (2009)[47]	Cohort	Paediatric residents applicants to internal research grant fund (2003–08), one school, USA	64	NA	39 (61%)	Small sample of women
Guelich et al (2002)[48]	Cohort	Matriculants and graduates (1987–97), Association of American Medical Colleges, USA	10 168	62–65%	4015 (39%)	..
Haviland et al (2011)[49]	Cohort	Graduates (2000–04), all schools, Association of American Medical Colleges, USA and Canada	66 394	NA	29 616 (45%)	..
Heathcote et al (1997)[50]	Case-control	Gastroenterologists, Canadian Association of Gastroenterology, Canada	108/150	72%	38 (35%)	Questionnaire development not reported, small sample of women
Jeffe et al (2008)[51]	Cohort	Graduates (1997–2004), Association of American Medical Colleges, USA	87 763/126 325	69%	39 039 (44%)	..
Jeffe et al (2011)[52]	Cohort	MD PhD graduates (1993–2000), Association of American Medical Colleges, USA	3142/3180	99%	948 (30%)	..
Jeffe et al (2014)[53]	Cohort	MD PhD matriculants (1995–2000), Association of American Medical Colleges, USA	2582/2627	98%	853 (33%)	..
Jeffe et al (2014)[54]	Cohort	Matriculants (2001–06), Association of American Medical Colleges, USA	207 436/262 672	79%	112 351 (54%)	..
Komaromy et al (1993)[55]	Cross-sectional survey	Internal medicine residents, one school, USA	82/133	62%	33 (40%)	Questionnaire development not reported, small sample of women
Kong (2014)[56]	Cohort	Graduates (2005–11), Association of American Medical Colleges, USA	39 839	NA	20 464 (51%)	..
Lanzon et al (2012)[57]	Cross-sectional survey	Oral and maxillofacial surgery residents, multiple schools, USA	256/484	53%	38 (15%)	Questionnaire development not reported, low response rate, small sample of women
Larsson et al (2003)[58]	Cross-sectional survey	Undergraduate and doctoral students, one school, Sweden	840/1348	62%	476 (57%)	..
Leonard et al (1996)[59]	Cross-sectional survey	1st and 3rd year residents, one school, USA	180/308	58%	81 (45%)	Questionnaire development not reported, low response rate, small sample of women
Ley et al (2005)[60]	Cohort	Students and physician-scientists, multiple datasets, all schools, USA	NA	NA	NA	..
McDonald et al (2012)[61]	Cross-sectional survey	Obstetrics and gynaecology residents, all schools, New Zealand	58/108	54%	46 (79%)	Questionnaire development lacked description, low response rate, small sample of women
McGinty et al (1994)[62]	Cross-sectional survey	Psychiatry residents, three schools, USA	38/68	56%	38 (100%)	Questionnaire development not reported, low response rate, small sample of women
Nikkar-Esfahani et al (2012)[63]	Cross-sectional survey	Final-year students, one school, UK	238/318	75%	149 (63%)	Questionnaire not validated
Nomura et al (2010)[64]	Cross-sectional survey	2nd year resident physicians, all schools, Japan	1120/1880	60%	344 (31%)	..
Osborn et al (1992)[65]	Cross-sectional survey	Students, residents, postdocs, and junior faculty, one school, USA	720/2692	27%	282 (39%)	Questionnaire development not reported, low response rate
Pincus et al (1994)[66]	Cross-sectional survey	Professors of dermatology, Association of Professors of Dermatology, USA	95/113	84%	NA	Questionnaire development not reported
Primack et al (2010)[67]	Cross-sectional survey	Trainees, one school, USA	179/188	95%	89 (50%)	Questionnaire development and delivery not reported, small sample of women

(Table continues on next page)

	Study design	Study population and setting	Sample/ population size	Response rate	Women (n, %)	Methodological limitations
(Continued from previous page)						
Salgueira et al (2012)[68]	Cross-sectional survey	Students, one school, Portugal	465/527	88%	321 (69%)	..
Silberman et al (2012)[69]	Cross-sectional survey	Senior psychiatry residents, multiple schools, USA and Canada	127/189	67%	66 (52%)	Questionnaire not validated, small sample of women
Smith et al (2009)[70]	Cohort	Paediatric student research programme applicants, American Pediatric Society/Society for Pediatric Research (1991–00), multiple schools, USA and Canada	1159	NA	688 (59%)	..
Smith et al (2014)[71]	Cohort	Graduates of 2005, 2009, and 2012, all schools, UK	7623	46–63%	4891 (64%)	..
Watt et al (2005)[72]	Cross-sectional survey	Students, one school, USA	96/167	57%	38 (40%)	Questionnaire development not reported, low response rate, small sample of women
Yamazaki et al (2012)[73]	Cross-sectional survey	Physicians in basic science departments, one school, Japan	26/30	87%	7 (27%)	Questionnaire development not reported, small sample of women
Yang et al (2012)[74]	Cohort	Urology residents (2002–08), USA	543	NA	84 (15%)	Small sample of women

NA=not applicable.

Table: **Included studies**

reflecting on their career choices reported that they were attracted to academic medicine by opportunities to teach, but with experience they also came to appreciate research more.[29,30] Women's greater preference for teaching rather than research seemed to be consistent over different investigation periods, but this might also be a result of a greater flexibility and availability of teaching roles, rather than a lack of interest in research primarily.

Theme summary statement 5: women lack adequate mentors and role models

14 studies (1992–2014), predominantly North American, consistently reported that women lack adequate mentors and role models. 13 of these studies had methodological limitations. The most robust evidence came from a large survey of US and Canadian obstetrics and gynaecology residents in 2005, with 37% of women not having a mentor.[37] A lack of adequate mentors and role models for women considering careers in academic medicine was also supported by nine smaller and less methodologically robust surveys from North America and Saudi Arabia, five of which were published in the 1990s.[23,32,37,45,47,50,59,62,65] In most of these studies, fewer women than men had mentors and role models during medical school and residency.[32,37,45,50,59,65] Women also had difficulty in finding same-sex mentors and role models,[23,32,62] and, according to one small cohort study of academic paediatric residents, women tended to choose mentors of lower rank than did men.[47] A survey[62] published in 1994 showed that, in choosing a mentor, female psychiatry residents valued their ability to establish a supportive and nurturing relationship most, and national recognition least; and a 2010 study[40] of radiology residency programme directors showed that women might have specific mentoring needs. A further five studies with varying methodological limitations and populations from North America and Australia showed a lack of adequate mentoring for both genders.[35,40,43,44,66] In particular, a 2001 study of obstetrics and gynaecology residents found that both female and male residents felt that the other gender had better mentoring, suggesting possibly that neither had adequate mentoring to sustain their interest in academic medicine.[35]

Theme summary statement 6: financial considerations deter women from academic medicine

Evidence on financial considerations directing women's research careers was highly conflicting, with nine studies supporting and six refuting. Five supporting and three refuting studies had methodological limitations. Three small surveys showed that perceptions of academics' lower salaries in Australia[44] and Japan,[73] and financial needs in North America[69] were deterrents to careers in academic medicine for both men and women. By contrast, two small surveys and a national cohort study from 1995 showed that salary expectations did not influence career choice in the USA,[39] and that financial rewards were less significant in influencing career choices of women than of men in Ireland and the UK,[38] and the USA.[28] Six US studies, including four national cohort studies, showed that educational debt is another important financial consideration. A cohort study (1993–2000) found that women were more likely than men to enrol in funded MD PhD programmes,[52] and a small case-control study[36] from 2013 showed that female surgical residents and faculty members had significantly

higher educational debt than men (43% *vs* 27% had >US$150 000). For both genders, debt was associated with the consideration of students leaving MD PhD training,[72] diminished intent to pursue a career in academic medicine,[51] lower likelihood of graduation from MD PhD programmes,[24] and loan repayment programmes were likely to encourage indebted students to enter careers in clinical research.[60] However, in other US studies, mainly national cohorts, there were no gender differences for debt, and debt was not independently associated with MD PhD programme attrition,[53] choice of careers in academic medicine,[25,39] or faculty appointments for women.[26]

Theme summary statement 7: concerns about work–life balance deter women from academic medicine

Evidence for concerns about work–life balance, which typically affects women more than men, was mildly conflicting, with ten studies supporting and two refuting. Nine supporting studies and one refuting study had methodological limitations. Eight studies from the USA, Canada, Japan, and Saudi Arabia (1992–2014) indicated that women were concerned about work–life balance in academic medicine.[23,35,45,50,59,62,64,65] Female medical students and residents believed that it would be difficult to balance academic commitments with home and family life,[23,35,59,62] with few able to identify role models who had achieved this.[45,59,62] North American surveys from the 1990s showed that female medical students considered family commitments as a barrier to an academic career (33%, compared with 10% of men)[65] and that parenthood had interrupted residency training more often for women than for men (14% *vs* 2%).[59] In another small US study, a female psychiatric resident remarked: "I am not sure I can do this—clinics, teaching, research, babies, and all".[62] Although a smaller proportion of women than men prioritised work over personal life, a greater proportion of women than men felt that they had to make a choice between a career in academic medicine and having children.[45,64,65] In a Japanese study[64] of resident physicians, 13% of women compared with 30% of men reported that they were more work-oriented than life-oriented. In two US surveys with low response rates, resident doctors of both genders considering academic medicine were less likely to be married and have children than were those considering private practice (17% *vs* 40%),[57] and during their fellowship training, more women than men reported deferring having children (43% *vs* 21%).[45] Moreover, a small US survey[67] showed that work-related burnout was more prevalent among women than men (22% *vs* 10%). By contrast, a Japanese survey and a qualitative study of seven international female physicians reflecting on their career choices suggested that careers in academic medicine could also be attractive to women because of flexible working hours and opportunities to align work and family considerations.[30,73] Such flexibility would be influenced by the nature of the research and attitudes towards flexible working within an institution.

Theme summary statement 8: women experience gender discrimination and unconscious bias in medical school and residency

Eight studies, done predominantly in North America in the 1990s, consistently reported that women experience gender discrimination and unconscious bias in medical school and residency. Five of these studies had methodological limitations. Three studies, from 1993, 1995, and 2003, showed that female students and residents had been subjected to both physical gender-based harassment and unwanted sexual advances and non-physical gender-based harassment such as offensive remarks, behaviours that result in a hostile environment, and being ignored or not being treated with respect.[28,55,58] In particular, in a Swedish survey, 36% of female undergraduate students (compared with 17% of male students) and 18% of female doctoral students (compared with 16% of male students) reported at least one instance of being subjected to unwanted sexual advances, such as obtrusive touching as well as comments about clothes and appearance, private life, and sexuality.[58] In a small 1997 survey from Canada,[50] women perceived that they had more difficulties in being taken seriously than did men (22% *vs* 6%). A small US study[36] published in 2013 suggested that women were more likely than men to be treated differently because of their sex (54% *vs* 16%), and that they were excluded from the dominant culture—ie, the one that establishes values, rules, and norms of behaviour. In a multicentre survey[32] of US fourth-year medical students from 1998, women were often mistaken for non-physicians (92%, compared with 3% of men) and felt that they had to be twice as good to be treated as equal to their male counterparts (30%, compared with 7% of men). A single-centre US study[65] with methodological limitations from 1992 reported sexism as one of the most common disadvantages to an academic career. A national US cohort study[49] (2000–04) demonstrated a lower likelihood of planning a career in academic medicine for students reporting mistreatment in medical school. Much of this evidence came from studies done in the 1990s, and there might have been subsequent improvements in addressing gender discrimination and unconscious bias.

Strengths and limitations of this study

To our knowledge, this review is the first to investigate the empirical evidence focusing on the reasons for women's choice or rejection of careers in academic medicine. We specifically focused on empirical studies with results reported by gender for medical students and residents. Some of our findings parallel two previous reviews,[21,22] which did not analyse results by gender, and highlight important gender differences and similarities.

Our search was extensive, sensitive, and thorough. Of the 52 included studies (1985–2015), 43 were published in or after 2000, and 26 from 2010 onwards. This increase in scholarly attention shows the growing importance of gender equality in higher education policy.

Nevertheless, our review is limited by the type and quality of studies we identified. Included studies had heterogeneous study designs, variables, and outcome definitions, precluding us from producing a quantitative synthesis of the evidence. Most included studies used cross-sectional or cohort designs, were based on self-reported perceptions rather than objectively verified data, and were subject to response and recall biases. The overwhelming majority of included studies were based on atheoretical approaches from practitioners' experience and previous empirical studies. Study populations were often small, or had limited numbers of potential participants. We identified only two qualitative studies, which limited our ability to identify new (hypothesis-generating) theoretical perspectives. We judged that at least 29 studies (56%) had methodological limitations that could have affected the trustworthiness of the findings.

Another limitation was that the studies focused on choices of individual students or residents. Although this is an important topic to study, it is only one part of the picture. Reflecting the primary studies on which it is based, our review could only provide an indirect and indistinct picture of the organisational, professional, and societal structures within which individual choices are made. We have uncovered a broader (and more richly theorised) literature on gender imbalance in science, technology, engineering, mathematics, and medicine in the disciplines of social studies of science and higher education studies.[75,76] A further review of this broader literature is planned.

Finally, the distribution of included studies by region and country income was highly skewed. Only one small qualitative study included participants from different regions and country income groups.[30] Three-quarters were done in North America and the rest in Europe (UK, Ireland, Sweden, Switzerland, Portugal), Asia Pacific (Australia, New Zealand, and Japan), and the Middle East (Saudi Arabia; table). All of these countries are classified by the World Bank as high-income countries.[77] This limitation could reduce the generalisability of findings beyond the populations and countries studied. There is a clear need for high-quality studies in settings beyond North America and high-income countries, for which findings from our review can provide plausible initial hypotheses, as shown by two studies in our review. A cross-sectional survey study[23] from Saudi Arabia showed that the perceived barriers to physician-scientist careers among female undergraduate medical students "were largely identical to the Western literature with few differences and more influence of cultural reasons". Additionally, a small qualitative study[30] of female physicians reflecting on their career choices, including participants from two middle-income countries (Mexico and Pakistan), identified similar themes to those found in the USA.

Implications for the strategic development of academic medicine

Our findings are consistent with the conclusion that, unless exposed to hands-on research experience and positive role models in their medical education and training, women are unlikely to consider seriously a research career. Furthermore, even women who commence such a career might subsequently become discouraged and abandon it, unless positively supported. Medical and research training tends to coincide with women's childbearing and early child-rearing years, and although some women chose to forgo parenthood, and gender roles within the family might be changing, the decision-making processes for women during this period are likely to be extremely complex.[78] Whatever their interest in an academic career, women's choices have to be weighed against longer times to qualify[53,72] and delayed career advancement due to having and raising children.[79,80] As a result, women in academic careers are typically over-represented in lower ranks and under-represented in higher ones.[80] Thus, we consider several specific measures to improve gender equity in academic medicine, some of which might be tested in intervention studies.

Exposure to research is beneficial, especially to women taking up academic medicine. Given that women might have less interest in research than men, even before entering medical school,[56] medical schools might consider developing community outreach strategies to interest secondary school pupils in research or linking with school-based initiatives to promote research, for example through the existing science curriculum. At medical school, faculty might lack enthusiasm or resources for supporting student research, suggesting that both cultural change and dedicated resources might be needed.[34,35] Students and residents at research-intensive medical schools are more likely to retain strong interests in research and careers in academic medicine.[48,71]

Because women generally seem to be more interested in teaching than in research, increasing the status of teaching and allowing greater crossover between teaching and research could help to encourage women into careers in academia. Although academic medicine is characterised by the tripartite mission of patient care, research, and education, many senior physician-scientists avoid teaching and some consider it low-status. Even so, teaching enables greater flexibility and work–life balance than research and thus does not disadvantage women. The status of teaching could be improved by increasing the contribution of teaching to academic appointments and promotions. Another way to attract more women into academic careers could be to increase

investment in research and scholarship that focuses on medical education and also to encourage those who began their careers by researching education to transfer subsequently to other research fields.

Although evidence suggests that adequate mentoring and suitable role models were lacking when the studies were done, evidence for the effectiveness of different kinds of mentoring interventions is weak, and several questions have not been addressed.[81] Should mentees choose mentors or be assigned them? Does the gender of the mentor matter? How and how often should mentoring occur? Providing a choice of different mentoring options might be preferable. Although concerns about work–life balance seem to deter women from academic medicine in some (although not all) settings, little is known about how these concerns play out, or what organisational measures might improve work–life balance in different settings. Likewise, the finding from some studies that financial considerations might be significant and over-riding concerns suggests a subject for research to identify further and address particular financial constraints.

US legislation does not mandate paid maternity leave, in distinction from all other high-income countries (the US Family Medical Leave Act allows for up to 12 weeks of unpaid leave only). This regrettable distinction could account for some of women's perspectives on work–life balance in US studies. Moreover, the changing policies in other countries towards men's involvement in early child-rearing have received little attention. Most of the studies summarised in this review were undertaken before it became possible for parents to share leave after an addition to the family. Few studies were from Scandinavia, where distribution of child-care roles within the family have been more equal for many years and there is a woman-friendly welfare state with generous maternal leave and strong job protection for people returning to work.[82] New family-friendly policies that encourage men as well as women to take career breaks, or work part-time to share child care, could have an indirect effect of encouraging their female partners to enter, and remain in, an academic career.

Another consideration for women and families is the occupation of their spouses. Women generally remain the primary caregivers, particularly for children. For example, in a nationwide survey of US general surgeons, 63% of men reported their spouses as the primary child-care providers, compared with only 5% of women.[83] Limitations on women's time are further exacerbated when their spouses also have demanding careers. A small study of Canadian gastroenterologists[50] found that women's spouses were more likely to be physicians or other professionals, whereas men's spouses were more likely to be homemakers.[50]

Finally, there is much scope for medical schools and teaching hospitals to implement measures to understand where gender discrimination and unconscious bias occur, and to eliminate them. Given that the greatest attrition in commitment to research seems to occur during residency, it is imperative that medical schools and teaching hospitals work in partnership to improve gender climate and culture at the interface between the medical school and teaching hospitals.[84] To ensure that students of both genders have an equal opportunity to become the next generation of leaders and innovators in academic medicine, medical schools and teaching hospitals might consider the introduction of unconscious bias training and addressing so-called stereotype threat[85] by promoting a more inclusive and supportive culture. As shown by the outcomes of a specific culture change intervention at five US medical schools, cultural change in academic medicine can be achieved.[86,87]

Conclusions

This review has revealed several potential explanations for women's under-representation in academic medicine. Some of those explanations are well supported by empirical evidence whereas others, despite being widely cited as reasons, lack decisive evidence. Published studies are conflicting and of variable methodological quality. They support the need for more theory-driven, methodologically robust, and carefully conducted studies, especially outside North America and high-income countries, to understand better why women choose or reject careers in academic medicine, and to monitor and evaluate experimental strategies and interventions that encourage and effectively support women's interest in academic careers. Significant gaps in the evidence base also suggest the need to shift the focus of future research from individuals' career choices to the societal and organisational contexts and cultures within which those choices are made.

Contributors

AMB, PVO, and LDE conceived and designed the study. LDE and NWR searched the literature, SS provided methodological input. LDE and PVO analysed and interpreted the results. LDE and PVO drafted the report. SS, PF, and LHP critically commented on and revised the report. TG critically commented on, revised, and wrote parts of the final version of the report. All authors contributed to and approved the final version.

Declaration of interests

AMB is dean of medicine and head of the Medical Sciences Division (University of Oxford, UK), a member of the UK's Medical Schools Council, and a fellow of the UK's Academy of Medical Sciences. PF is recent deputy director of clinical studies of the University of Oxford Medical School. TG represented medicine on the Equality and Diversity Panel for the 2014 Research Excellence Framework; in that role, she was involved in assessing universities' procedures for assuring equality (by gender, ethnicity, disability, and sexual orientation) in their decisions on which individuals to submit to the Research Excellence Framework. The other authors declare no competing interests.

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