

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

Laurel D Edmunds PhD^{1*}, Pavel V Ovseiko DPhil^{1*}, Sasha Shepperd DPhil², Trisha Greenhalgh MD³, Peggy Frith MD^{4,5}, Nia W Roberts MSc⁶, Linda H Pololi MBBS⁷, Alastair M Buchan DSc^{1,5}

¹ Radcliffe Department of Medicine, Medical Sciences Division, University of Oxford, John Radcliffe Hospital, Oxford OX3 9DU, UK

² Nuffield Department of Population Health, Medical Sciences Division, University of Oxford, Richard Doll Building, Oxford, OX3 7LF, UK

³ Nuffield Department of Primary care Health Sciences, New Radcliffe House, Walton Street, Oxford OX2 6GG

⁴ University of Oxford Medical School, John Radcliffe Hospital, Headington, Oxford, OX3 9DU, UK

⁵ Oxford University Hospitals NHS Trust, John Radcliffe Hospital, Headington, Oxford, OX3 9DU, UK

⁶ Bodleian Health Care Libraries, University of Oxford, Old Road Campus Research Building, Oxford, OX3 7LF, UK

⁷ National Initiative on Gender, Culture and Leadership in Medicine: C-Change, Brandeis University, Women's Studies Research Center, 415 South Street, MS 079, Waltham, MA 02454, USA

Correspondence to: Prof Alastair M Buchan

Medical Sciences Division, University of Oxford, John Radcliffe Hospital, Oxford OX3 9DU, UK
alastair.buchan@medsci.ox.ac.uk

*Contributed equally

Key words

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Summary

Women are under-represented in academic medicine. We aimed to review the empirical evidence base focusing on the reasons for women's choice or rejection of careers in academic medicine. Using a systematic search strategy, we identified 52 studies published between 1985 and 2015. Over a half had methodological limitations and most were from North America. Eight main themes had been explored in these studies. There was consistent evidence for four of these: 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 context. 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.

Introduction

Since Elizabeth Blackwell became the first woman to receive a medical degree in the USA in 1849 and the first to be admitted to the medical register in the United Kingdom 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 reached 40% in admissions to medical schools in 1980 in the UK and in 1992 in the USA, and by 2013 constituted 55% and 47% of students entering medical schools in the UK and the USA.⁴⁻⁶ However, despite recent increases in the percentage of women faculty from 21% in 2004 to 28% in 2014 in the UK⁷ 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 last 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 allows 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 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, a number of professional and scientific bodies, among others 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's government 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 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 specifically on women's choice or rejection of academic medicine during medical school and residency, whereas two previous reviews were based primarily on studies which 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 interpretive 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 US 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).

Panel: Search strategy and methods

Search strategy

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 search 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*”).

Methods

Following a systematic review, two reviewers, working independently, selected studies that reported results by gender for reasons associated with medical students and/or residents 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 (CASP) tools (<http://www.casp-uk.net/>), and deemed quantitative studies with a response rate of 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).

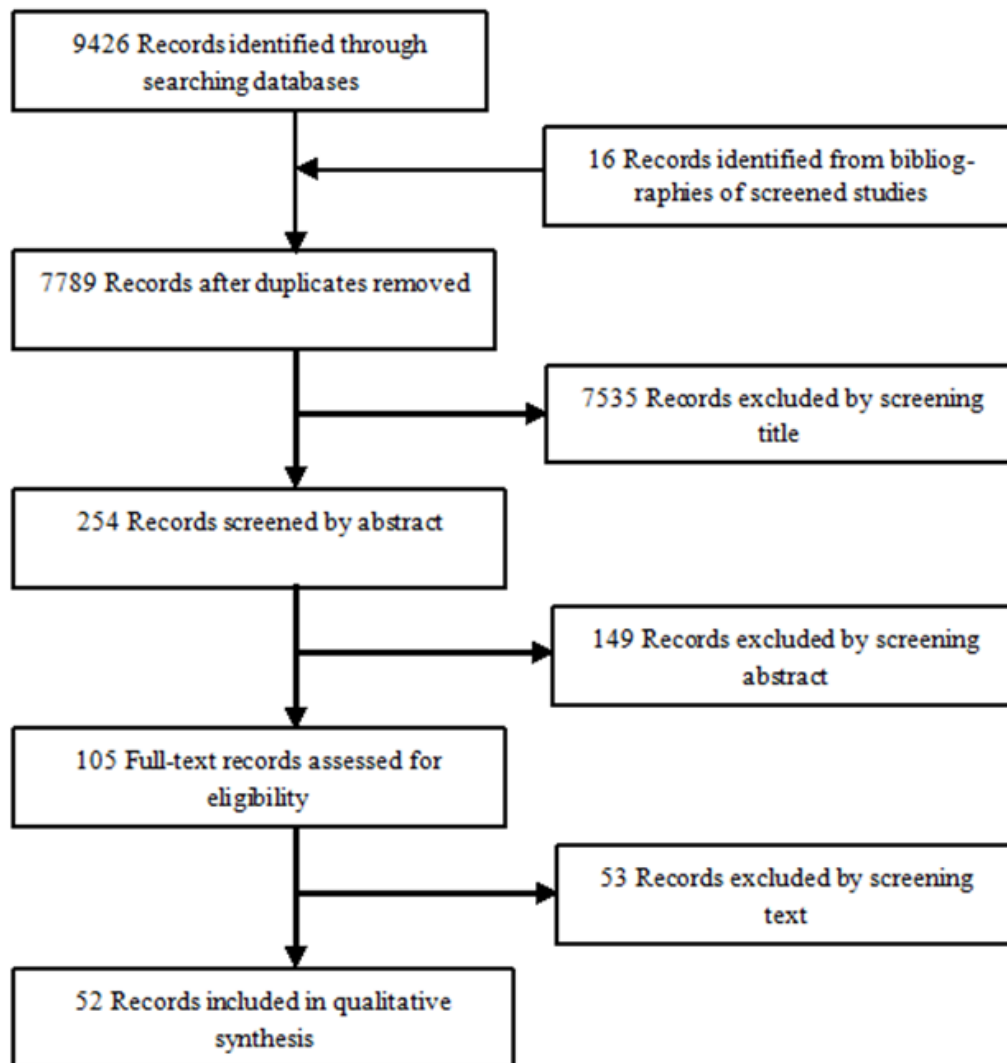


Figure 1: Literature search and study selection

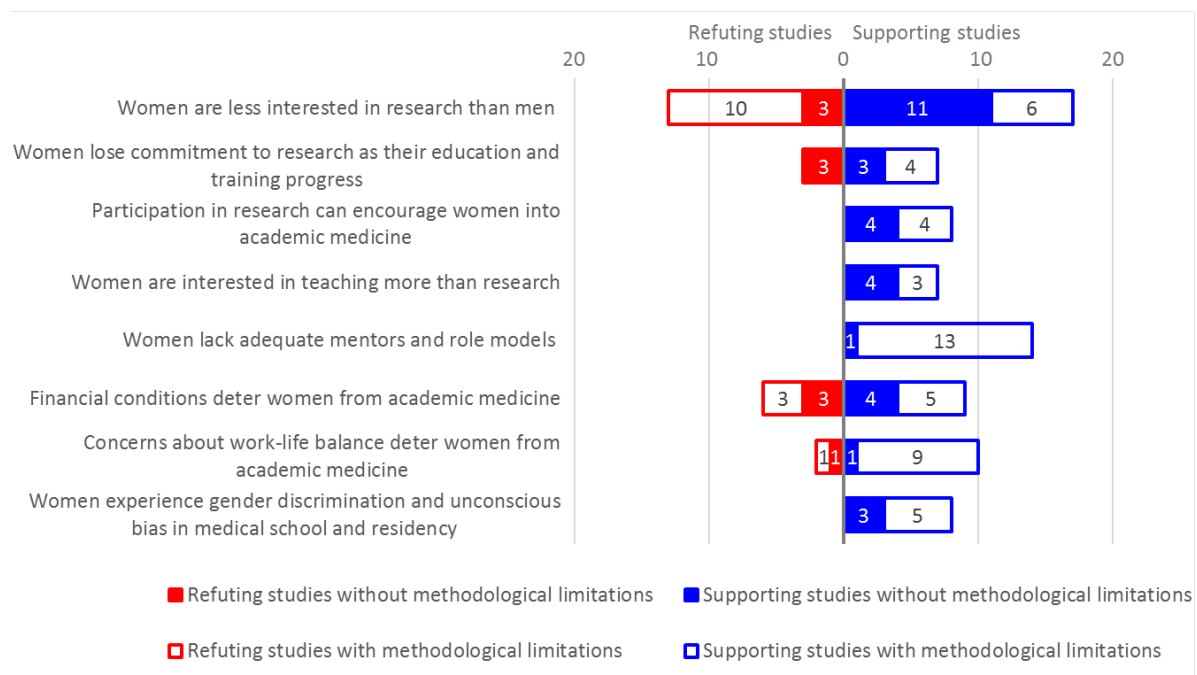


Figure 2: Theme summary statements regarding women's choice or rejection of careers in academic medicine by number of supporting and refuting studies.

Study	Study design	Study population and setting	Sample/ population size	Response rate*	Women number (%)*	Methodological limitations†
Abu-Zaid et al. 2014 ²³	Survey	Students, 1 school, Saudi Arabia	116/171	68%	116 (100%)	Questionnaire not validated
Andriole et al. 2008 ²⁴	Cohort	Graduates (2000-2006), AAMC, USA	79104/ 88 575	89%	36023 (46%)	
Andriole et al. 2010 ²⁵	Cohort	Graduates (1997-2002), 6 schools, USA	1965/4678	42%	853 (43%)	Low response rate
Andriole et al. 2012 ²⁶	Cohort	Graduates (1998-2004), AAMC, USA	66889/85035	79%	30914 (46%)	
Benson et al. 1985 ²⁷	Survey	Paediatrics/internal medicine residents, 5 schools, USA	299/387	77%	84 (28%)	Small sample of women
Bickel et al. 1995 ²⁸	Cohort	Matriculants (1993) and graduates (1994), AAMC, USA and Canada	n/a	80-94%	n/a	
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	n/a	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	n/a	749 trainees (37%)	
Bright et al. 1998 ³²	Survey	4 th -year students members of AMSA, 25 schools, USA	564/2128	27%	271 (48%)	Questionnaire development not reported, low response rate
Buddeberg-Fischer et al. 2008 ³³	Survey	Residents, 3 schools, Switzerland	406	n/a	210 (52%)	
Burgoyne et al. 2010 ³⁴	Survey	Students, 1 school, Ireland	317	60%	184 (58%)	

Cain et al. 2001 ³⁵	Survey	Obstetrics and gynaecology residents and ACOG 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, 8 schools, USA	85 residents; 69 faculty	74% residents; 37% faculty	70 (45%)	Small sample of women
Coleman et al. 2005 ³⁷	Survey	Obstetrics and gynaecology residents, 2004, US and Canada	3969/4721	84%	2935 (74%)	
Corrigan et al. 2007 ³⁸	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	Survey	Vascular surgery residents, USA	128/295	43%	34 (27%)	Questionnaire development not reported, low response rate
Donovan 2010 ⁴⁰	Survey	Directors of radiology programmes, APDR, 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), 1 school, USA	68/78	87%	27 (40%)	Questionnaire development not reported, small sample of women
Fang et al. 2003 ⁴²	Cohort	Awardees/non-awardees of 2 HHMI research training programmes, multiple schools, USA	1231	n/a	352 (295)	
Freiman et al. 2005 ⁴³	Survey	Dermatology residents, Canada	48/48	100%	31 (65%)	Small sample of women
Galletly et al. 2009 ⁴⁴	Survey	6 th -year students, 1 school, Australia	105/130	81%	52 (50%)	Questionnaire development not reported, small sample of women
Gerson et al. 2007 ⁴⁵	Survey	Gastroenterologists, AGA, USA	457/>2856	<16%	262 (57%)	Low response rate
Golub et al. 2011 ⁴⁶	Survey	Otolaryngology residents, AAO-HNS, USA	5311364	40%	114 (21%)	Low response rate
Gordon et al. 2009 ⁴⁷	Cohort	Paediatric residents applicants to internal research grant fund (2003-2008), 1 school, USA	64	n/a	39 (61%)	Small sample of women
Guelich et al. 2002 ⁴⁸	Cohort	Matriculants and graduates (1987- 1997), AAMC, USA	10168	62-65%	4015 (39%)	
Haviland et al. 2011 ⁴⁹	Cohort	Graduates (2000-2004), all schools, AAMC, USA and Canada	66394	n/a	29616 (45%)	
Heathcote et al. 1997 ⁵⁰	Case-control	Gastroenterologists, CAG, Canada	108/150	72%	38 (35%)	Questionnaire development not reported, small sample of women
Jeffe et al. 2008 ⁵¹	Cohort	Graduates (1997– 2004), AAMC, USA	87763/126325	69%	39039 (44%)	
Jeffe et al. 2011 ⁵²	Cohort	MD-PhD graduates (1993– 2000), AAMC, USA	3142/3180	99%	948 (30%)	
Jeffe et al. 2014a ⁵³	Cohort	MD/PhD matriculants (1995-2000), AAMC, USA	2582/2627	98%	853 (33%)	
Jeffe et al. 2014b ⁵⁴	Cohort	Matriculants (2001-2006), AAMC, USA	207436/262672	79%	112351 (54%)	
Komaromy et al. 1993 ⁵⁵	Survey	Internal medicine residents, 1 school, USA	82/133	62%	33 (40%)	Questionnaire development not reported, small sample of women
Kong, 2014 ⁵⁶	Cohort	Graduates (2005-2011), AAMC, USA	39839	n/a	20464 (51%)	
Lanzon et al. 2012 ⁵⁷	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	Survey	Undergraduate and doctoral students, 1 school, Sweden	840/1348	62%	476 (57%)	

Leonard et al. 1996 ⁵⁹	Survey	1st- and 3rd-year residents, 1 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 data sets, all schools, USA	n/a	n/a	n/a	
McDonald et al., 2012 ⁶¹	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	Survey	Psychiatry residents, 3 schools, USA	38/68	56%	38 (100%)	Questionnaire development not reported, low response rate, small sample of women
Nikkar-Esfahani et al. 2012 ⁶³	Survey	Final-year students, 1 school, UK	238/318	75%	149 (63%)	Questionnaire not validated
Nomura et al. 2010 ⁶⁴	Survey	2 nd -year resident physicians, all schools, Japan	1120/1880	60%	344 (31%)	
Osborn et al. 1992 ⁶⁵	Survey	Students, residents, postdocs, and junior faculty, 1 school, USA	720/2692	27%	282 (39%)	Questionnaire development not reported, low response rate
Pincus et al. 1994 ⁶⁶	Survey	Professors of dermatology, APD, USA	95/113	84%	n/a	Questionnaire development and delivery not reported
Primack et al. 2010 ⁶⁷	Survey	Trainees, 1 school, USA	179/188	95%	89 (50%)	Questionnaire development not reported, small sample of women
Salgueira et al. 2012 ⁶⁸	Survey	Students, 1 school, Portugal	465/527	88%	321 (69%)	
Silberman et al. 2012 ⁶⁹	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, APS-SPR (1991-2000), multiple schools, USA and Canada	1159	n/a	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	Survey	Students, 1 school, USA	96/167	57%	38 (40%)	Questionnaire development not reported, low response rate, small sample of women
Yamazaki et al. 2012 ⁷³	Survey	Physicians in basic science departments, 1 school, Japan	26/30	87%	7 (27%)	Questionnaire development not reported, small sample of women
Yang et al. 2012 ⁷⁴	Cohort	Urology residents (2002-2008), USA	543	n/a	84 (15%)	Small sample of women

Table: Characteristics of included studies.

* Reported or calculated from data presented in paper

†Methodological limitations appraised based on the relevant elements of the Critical Appraisal Skills Programme (CASP) tools (<http://www.casp-uk.net/>), and response rate and female sample size cut-points (60% and 100 respectively) for quantitative studies (appendix).

Abbreviations: Survey = Cross-sectional survey; AAMC = Association of American Medical Colleges; AMSA = American Medical Student Association; ACOG = American College of Obstetricians and Gynecologists; APDR = Association of Program Directors in Radiology; HHMI = Howard Hughes Medical Institute; AGA = AGA American Gastroenterological Association; AAO-HNS = American Academy of Otolaryngology–Head and Neck Surgery; CAG = Canadian Association for Gastroenterology; APD = Association of Professors of Dermatology; APS-SPR = American Pediatric Society–Society for Pediatric Research; n/a = not applicable.

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) found that during different stages of education and training women appeared to show less interest in research than men. This 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.^{43,59,64,68,69,24,28,33,42,65}

For example, one small survey 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 and 24% of the high interest groups.⁶⁹ Also, fewer women enrolled in research fellowships⁴² 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 found 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-PhD students in the USA, from 27% in 1997 to 43% in 2004 and 36% in 2012,^{53,60} indicating that women’s level of 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 reported 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 training women were similarly or more interested in research and academic careers than men, gender differences were eliminated or reversed as training progressed;^{35,46,59} In a large survey of obstetrics and gynaecology residents, 20% women and 28% 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.³⁵ Additionally, one large cohort study (2000-2006) showed that women were less likely than men to graduate from an MD-PhD programme.²⁴ Large variation among the studies suggested that waning in women’s “commitment” to research may also be due to other personal and/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) used multivariable logistic regression models to show that women graduates were more likely to have emerging intent to pursue academic medicine careers than men.⁵¹ Two further 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 was reiterated in a small study of vascular surgeon 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 relationship 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 academic clinical teaching careers.⁶² Similarly, a qualitative study of female physicians showed that receiving training in a teaching hospital environment 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 conducted 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 (from 1998-2004) showed that during medical school, a higher proportion of women had participated in an education elective (60% vs 50% of men) than in a research elective (48% vs 57% of men).²⁶ Similarly, a UK national cohort study of medical graduates (from 2005-2012) reported that among those who intended to pursue careers in academic medicine, women were more interested in posts focussed on teaching than on research;⁷¹ and two small specialty surveys of US⁶² and Canadian⁴³ 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, 7 from elsewhere)

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 appeared 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 academic medicine careers 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 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;⁶² and a 2010 study of radiology residency programme directors showed that women may have specific mentoring needs.⁴⁰ 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 women and men residents felt that other genders 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 Australia⁴⁴ and Japan,⁷³ and financial needs in North America⁶⁹ were deterrents to academic medicine careers for both men and women. By contrast, two small recent 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 men in Ireland and the UK³⁸ 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 from 2013 showed that female surgical residents and faculty members had significantly higher educational debt (43% vs 27% men).³⁶ 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 programmes²⁴ 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 academic medicine careers;^{25,39} or faculty appointments for women.²⁶

Theme summary statement 7: “Concerns about work-life balance deter women from academic medicine”

Evidence for work-life balance concerns, which typically affects women more than men, was mildly conflicting with ten studies supporting and two refuting. Nine supporting and one refuting studies 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 reported that women 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 (14% vs 2% men).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 of resident physicians, 13% of women compared with 30% of men reported that they were more work-oriented than life-oriented.⁶⁴ 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 (response rate 95%; 89 women) showed that work-related burnout was more prevalent among women than men (22% vs 10%).⁶⁷ 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 conducted 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 subject to both physical gender-based harassment and unwanted sexual advances and non-physical gender-based harassment such as offensive remarks, behaviours which result in a hostile environment, and being ignored or not being treated with respect.^{28,55,58} In particular, a Swedish survey study, 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 subject 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 study from Canada, women perceived that they had more difficulties being taken seriously than did men (22% vs 6% men).⁵⁰ A small US study published in 2013 suggested that women were more likely than men to be treated differently because of their sex (54% vs 16% men), and that they were excluded from the dominant culture, i.e. one that establishes values, rules, and norms of behaviour.³⁶ In a multicentre survey 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 an equal counterpart to their male counterparts (30% compared with 7% of men).³² A single-centre US study with methodological limitations from 1992 reported sexism as one the most common disadvantages to an academic career.⁶⁵ A national US cohort study (from 2000-2004) demonstrated a lower likelihood of planning a career in academic medicine for students reporting mistreatment in medical school.⁴⁹ Given that much of the above evidence came from studies conducted in the 1990s, there might have been recent improvements in addressing gender discrimination and unconscious bias.

Strengths and limitations of the study

To our knowledge, this is the first review 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, which did not analyse results by gender, and highlight important gender differences and similarities. Our search strategy 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 bias. 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 subjects. We identified only two qualitative studies, which limited our ability to identify new (hypothesis-generating) theoretical perspectives. We judged that at least 29 [56%] studies 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 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”.²³ Additionally, a qualitative study 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 US.³⁰

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 may subsequently become discouraged and abandon it. Medical and research training tends to coincide with women’s child-bearing and early child-rearing years, and although some women chose to forgo parenthood, and gender roles within the family may be changing, the decision-making processes for women during this period are likely to be extremely complex.⁷⁸ Whatever their level of interest in an academic career, the choice has 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 may 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 may lack enthusiasm or resources for supporting student research, suggesting that both cultural change and dedicated resources may be needed.^{34,35} Students and residents at more research-intensive medical schools are more likely to retain strong interests in research and academic medicine careers.^{48,71}

Because women generally seem to be more interested in teaching than research, increasing the status of teaching and allow 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 of attracting 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, the evidence base for the effectiveness of different kinds of mentoring intervention is weak and several questions have not been addressed.⁸¹ Should mentees choose mentors or be assigned them? Does the gender of a 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, we know little about how these concerns play out, or what organisational measures might improve work-life balance, in different settings. Likewise, the finding from studies in 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 developed countries, (the US Family Medical Leave Act allows for up to 12 weeks of unpaid leave only). This regrettable distinction may 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 childrearing 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 childcare roles within the family have been more equal for many years and there is a “woman-friendly” welfare state with generous maternal leave, and high 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 childcare, 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 care givers, particularly for children. For example, in a nationwide survey of US general surgeons, 63% of men academic surgeons reported their spouses as primary childcare 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 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, medical schools and teaching hospitals might consider the introduction of unconscious bias training and addressing “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 a number of potential explanations for women's under-representation in academic medicine. Some of those explanations are well supported by the empirical literature whereas others, despite being widely cited as reasons, lack a 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 experimentally 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 conducted literature searches, and SS provided methodological input. LDE and PVO analysed and interpreted the results. LDE and PVO drafted the manuscript. SS, PF, and LP critically commented on and revised the manuscript. TG critically commented on, revised, and co-wrote parts of the final version of the manuscript. All authors contributed to and approved the final version of the manuscript.

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 (REF); 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 REF. All other authors declare no competing interests.

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