REVIEW

Mentoring in Academic Medicine
A Systematic Review

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Context Mentoring, as a partnership in personal and professional growth and development, is central to academic medicine, but it is challenged by increased clinical, administrative, research, and other educational demands on medical faculty. Therefore, evidence for the value of mentoring needs to be evaluated.

Objective To systematically review the evidence about the prevalence of mentorship and its relationship to career development.

Data Sources MEDLINE, Current Contents, Cochrane Database of Systematic Reviews, Database of Abstracts of Reviews of Effects, Cochrane Central Register of Controlled Trials, PsycINFO, and Scopus databases from the earliest available date to May 2006.

Study Selection and Data Extraction We identified all studies evaluating the effect of mentoring on career choices and academic advancement among medical students and physicians. Minimum inclusion criteria were a description of the study population and availability of extractable data. No restrictions were placed on study methods or language.

Data Synthesis The literature search identified 3640 citations. Review of abstracts led to retrieval of 142 full-text articles for assessment; 42 articles describing 39 studies were selected for review. Of these, 34 (87%) were cross-sectional self-report surveys with small sample size and response rates ranging from 5% to 99%. One case-control study nested in a survey used a comparison group that had not received mentoring, and 1 cohort study had a small sample size and a large loss to follow-up. Less than 50% of medical students and in some fields less than 20% of faculty members had a mentor. Women perceived that they had more difficulty finding mentors than their colleagues who are men. Mentorship was reported to have an important influence on personal development, career guidance, career choice, and research productivity, including publication and grant success.

Conclusions Mentoring is perceived as an important part of academic medicine, but the evidence to support this perception is not strong. Practical recommendations on mentoring in medicine that are evidence-based will require studies using more rigorous methods, addressing contextual issues, and using cross-disciplinary approaches.

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MEDICAL SCHOOLS AND residency and fellowship programs are charged with training health care professionals and with advancing clinical care, research, and education.[1,2] Mentoring has been considered to be a core component of the duties of medical school faculty to facilitate successful fulfillment of this academic mission. It has been recognized as a catalyst for career success, and mentoring relationships have been cited as important in facilitating career selection, advancement, and productivity.[3,4] However, mentor-mentee relationships are challenged by increased clinical, research, and administrative demands.[3,4] Moreover, mentorship is often undervalued by academic institutions.[5]

To enhance the development of mentorship within academic institutions and to prevent further erosion of these vital relationships, it is important to understand the effect of mentorship on the mentees (and mentors), the variables associated with mentoring success, and the impact of mentoring interventions on career satisfaction and productivity. The purpose of this systematic review was to evaluate the evidence about the prevalence of mentorship and its effect on career development.

METHODS

Relevant studies were identified by searching the following databases: (1) all EBM Reviews on Ovid-ACP Journal Club (1991-March/April 2006), Cochrane Database of Systematic Reviews, Database of Abstracts of Reviews of Effects, and Cochrane Central Register of Controlled Trials (1st Quarter 2006); (2) Ovid Current Contents, all editions (July 4, 1993–May 14, 2006); (3) Ovid PsycINFO (1967-May 7, 2006); (4) Ovid MEDLINE (1966-April 30, 2006); and (5) Scopus, an Elsevier abstract and citation database (1996-May 14, 2006). To increase the sensitivity of the search strategy, we searched MEDLINE using the term *Mentor*. Other databases were searched using the following key words or their combinations: *Mentor; Mentoring; Medicine; Career Mobility; Leadership; Teaching; Preceptorship; Interpersonal Relations; Students; Re-*

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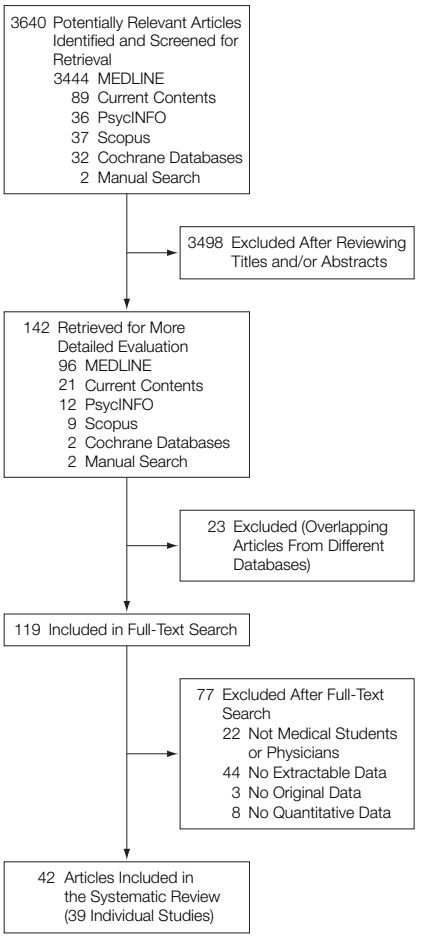
Figure. Selection of the Articles for the Systematic Review



search; Schools, Medical; Academic Medical Centers; Education, Medical; and Faculty, Medical. To identify additional studies, we searched the bibliographies of those studies found by electronic searches, contacted experts in the field for potential unpublished studies, and completed a manual search of relevant library journals. There were no language restrictions.

We identified all studies evaluating the impact of mentoring on career choices and academic advancement among medical students, residents, fellows, and staff physicians. We included all study designs except qualitative studies. For this study, mentorship was defined as "a dynamic, reciprocal relationship in a work environment between an advanced career incumbent (mentor) and a beginner (protégé), aimed at promoting the development of both".[6] The definition included distance mentorship. We did not include studies evaluating the impact of role models, who were defined as persons "who serve as a model in particular behavioral or social role for another person to emulate."[7]

Two of the authors independently reviewed the titles and abstracts of retrieved publications and selected relevant articles for possible inclusion in the review. In the case of disagreement, the third author was consulted and a decision was made by consensus of all authors. In cases of doubt, full-text articles were retrieved for review and discussion.

Minimum inclusion criteria were a description of the study population and availability of extractable data. Two of the authors independently reviewed all full-text articles that met these criteria. The agreement of the raters was very good ($\kappa = 0.78$). A data collection form was used to extract study type, intervention, setting, participant demographics, and outcome measures. Disagreements in assessment and data extraction were resolved by consensus of all authors.

Since most included studies were surveys with heterogeneous measurements, statistical pooling of the results or assessment of publication bias was not possible. Instead, we tried to discern areas in which the impact of mentorship has been found, and to provide a narrative description of the results using a strategy suggested by the Best Evidence Medical Education Collaboration[8] and based on the validity of the individual studies. Study quality was assessed on the basis of study design, validation of survey questionnaires, sample size and sampling frame, response rate, and outcome measures.

Two authors developed a categorization of themes arising from the study results, and independently assigned the studies to these defined categories. Where possible, the association between the mentorship and academic or professional choices was calculated as the odds ratio (OR) and its 95% confidence intervals (CI), using MedCalc version 8.0 (MedCalc Software, Mariakerke, Belgium).

RESULTS

We retrieved 3640 citations from the literature search. Review of abstracts led to retrieval of 142 full-text articles for assessment, and 42 articles were subsequently identified for inclusion in the study (FIGURE). Original data were available on 39 studies, described in 42 articles[9-50]; 2 studies were reported in 5 published articles[40-44] (TABLE 1). Most of the studies (n=33) were performed in the United States. Among these, 2 included respondents from Canada,[15,32] and 1 from Puerto Rico.[26] Three studies were performed exclusively in Canada,[18,49,50] 2 in Great Britain,[17,49] and 1 in Germany.[48] The design of 34 (87%) of the 39 studies was cross-sectional survey, with response rates ranging from 5% to 99%. Three studies were before and after case series,[10-12] 1 was a case-control study nested in a survey,[42-44] and 1 was a cohort study.[9]

Many of the studies had methodological limitations. Twelve studies reported details on survey development or testing. The cohort study had a small number of participants, unaccounted crossover between the groups, and large loss to follow-up, which may have affected the validity of the results. The nested case-control study was performed within a self-reporting survey, with a 65% response rate.

Only 5 studies provided details on how the mentorship relationship was formed.[9,11,12,22,45] Two studies described voluntary mentorship programs in which mentors were selected by mentees,[9,11] and 1 study described a program with a formal arranged mentorship relationship.[12] A survey of obstetrics/gynecology fellows showed that both the mentor and the mentee initiated most of the clinical mentoring relationship.[22] Of 279 child and adolescent psychiatrists, 117 (42%) reported being assigned a mentor, 86 (31%) reported requesting a specific

Table 1. Description of Studies Included in the Systematic Review

Source	Study Design*	Study Population and Setting †	Sample Size	Response Rate, %	Age, y	Percentage of Women	Methodological Limitations
Benson et al,[9] 2002	Cohort	Junior faculty, Medical College of Pennsylvania, Hahnemann University School of Medicine	33, Preceptoring; 18, mentoring‡	23, Preceptoring; 13, mentoring	NA	39	Small number of participants, cohorts not clearly defined, crossover between the groups, large loss to follow-up
Fried et al,[10] 1996	Before and after case series	Faculty, Department of Medicine, The Johns Hopkins University School of Medicine	43 Women, 145 men at baseline; 59 women, 209 men at postintervention	70 Women, 67 men, at baseline; 80 women, 60 men, at intervention	NA	38, Baseline evaluation; 22, postintervention evaluation	No control group, mentoring was a part of a multifaceted intervention
Illes et al,[11] 2000	Before and after case series	Junior faculty, Department of Radiology, School of Medicine, Stanford University	23§	83§	NA	35§	Small number of participants, no control group, retrospective analysis of publications
Wingard et al,[12] 2004	Before and after case series	Junior faculty, University of California San Diego School of Medicine	223	30	NA	55	No control group
Aagaard and Hauer,[13] 2003	Cross-sectional	Third- and fourth-year medical students, University of California San Francisco	302	77	Mean, 28 (SD, 3)	56	‖
Caiola and Litaker,[14] 2000	Cross-sectional	General internal medicine fellows	146	75	NA	42	No details on whether the questionnaire was pretested
Caniano et al,[15] 2004	Cross-sectional	Women pediatric surgeons who were members of at least 1 of the 3 major professional organizations in North America (the American Pediatric Surgical Association, the Canadian Association of Paediatric Surgeons, the Section on Surgery of the American Academy of Pediatrics)	95	79	≤44 (41%), 45-54 (37%), ≥55 (21%)	100	‖
Coleman et al,[16] 2005	Cross-sectional	US residents in obstetrics/gynecology who took the Council on Resident Education in Obstetrics and Gynecology in-training examination	4721	97	NA	75	‖
Donaldson and Cresswell,[17] 1996	Cross-sectional	Health medicine trainees, Northern Region, England, United Kingdom	51	75	NA	NA	Small sample size, no details on how the questionnaire was constructed or whether it was pretested, no independent validation of publications or grants
El-Guebaly and Atkinson,[18] 1996	Cross-sectional	Faculty of all university departments of psychiatry in Canada	2484	27 Among clinical and adjunct faculty; 65 among full-time faculty	NA	24.8, Total sample; 22.6, full-time faculty	No details on questionnaire construction, no objective validation of grants received
Genuardi and Zenni,[19] 2001	Cross-sectional	Adolescent medicine faculty	1884	23	Mean, 45 (SD, 11)	50	Low response rate, no details on how the questionnaire was constructed or whether it was pretested
Hueston and Mainous,[20] 1996	Cross-sectional	Community-based family medicine researchers selected among the authors of articles published in 5 US family medicine journals	74	74	NA	18	No details on how the questionnaire was constructed, whether it was pretested, or when the survey was performed
Ko et al,[21] 1998	Cross-sectional	Senior surgeons of regional and national surgical societies	850	41	Mean, 64 (range, 41-92)	NA	Low response rate, no details on how the questionnaire was constructed or whether it was pretested

(continued)

Table 1. Description of Studies Included in the Systematic Review (cont)

Source	Study Design*	Study Population and Setting †	Sample Size	Response Rate, %	Age, y	Percentage of Women	Methodological Limitations
Leppert and Artal,[22] 2002	Cross-sectional	Obstetrics /gynecology research fellows	107	62	Mean, 32.8	33	‖
Levinson et al,[23] 1991	Cross-sectional	Women aged 50 y and younger, departments of medicine, US medical colleges	862	64	Mean, 38	100	No details on how the questionnaire was constructed or whether it was pretested
Lukish and Cruess,[24] 2005	Cross-sectional	Members of the Resident and Associate Society, American College of Surgeons	4700	5	NA	30	Web survey, very low response rate
McGuire et al,[25] 2004	Cross-sectional	Women faculty, Stanford University School of Medicine	309	53	Mean, 42.5 (SD, 7.4)	100	No information about pretesting the questionnaire, no independent validation of promotion or rank
Medina et al,[26] 1998	Cross-sectional	Physicians who completed geriatric fellowships in the United States and Puerto Rico	787	62	Median, 34 (range, 28-67)	50	No independent validation of research activities
Miller et al,[27] 2006	Cross-sectional	Fellows in Mohs micrographic surgery	58	72	NA	NA	Low number of participants, no details on how the questionnaire was constructed or whether it was pretested
Mills et al,[28] 1995	Cross-sectional	Family practice residency directors	226	68	NA	NA	No independent validation of publications or grants
Osborn et al, [29] 1992	Cross-sectional	Medical students, housestaff, postdoctoral fellows, and junior faculty, University of California, San Francisco	430 Students, 1239 housestaff, 830 fellows, 200 junior faculty	58 Students, 15 housestaff, 21 fellows, 58 faculty	NA	No significant differences between the proportions of men and women in any category	Low response rate for housestaff and fellows, few details on construction of questionnaire
Osborn,[30] 1993	Cross-sectional	Graduating students at the University of California, San Francisco, School of Medicine	142	72	NA	47	No details on how the questionnaire was constructed or whether it was pretested
Palepu et al,[31] 1998	Cross-sectional	Full-time faculty of randomly selected US medical schools	3013	60	NA	54	No details on how the questionnaire was constructed or whether it was pretested
Pearlman et al,[32] 2004	Cross-sectional	Second- and third-year neonatology fellows in US and Canada	304	66	31-35, Most common age group	45	No details on how the questionnaire was constructed or whether it was pretested
Pincus et al,[33] 1995	Cross-sectional	Full-time, doctoral-level faculty in departments of psychiatry	5624	55	NA	19, Physicians; 24, total sample	No independent validation of publications or grants
Polsky and Warner,[34] 2004	Cross-sectional	Physicians enrolled in child neurology residency programs	152	53	Mean, 33.3 (SD, 4.6),	41.6	No details on how the questionnaire was constructed or whether it was pretested
Ramondetta et al,[35] 2003	Cross-sectional	Gynecologic oncology fellows	95	64	31-35 (75%)	30	‖
Rivera et al,[36] 2005	Cross-sectional	Internal medicine residents who completed a scholarly project during residency training	138	53	NA	NA	No details whether the questionnaire was pretested
Rubeck et al,[37] 1995	Cross-sectional	Graduates of the University of Kentucky College of Medicine, working in primary care practices or in academic medicine	561, Nonacademic primary care; 143, academic medicine	44, Nonacademic primary care; 63, academic medicine	NA	NA	No details on how the questionnaire was constructed or whether it was pretested
Sciscione et al,[38] 1998	Cross-sectional	Maternal/fetal medicine fellows registered with the US Society of Perinatal Obstetricians	138	99	31-35 (63%), Most common age group	49	‖

(continued)

Table 1. Description of Studies Included in the Systematic Review (cont)

Source	Study Design*	Study Population and Setting †	Sample Size	Response Rate, %	Age, y	Percentage of Women	Methodological Limitations
Scribner et al,[39] 2005	Cross-sectional	Members of the US Society of Gynecologic Oncologists	156	47	Mean, 38.1 (range, 31-48)	57	Low response rate, no details whether the questionnaire was pretested
Shapiro et al,[40] 1991¶	Cross-sectional	Faculty in all approved child and adolescent programs functioning at the US medical colleges	622	79	30-39 (33%); 40-49 (41%); ≥50 (26%)	29	No independent validation of publications
Steiner et al, [44] 2004#	Cross-sectional study with nested case-control	Graduates, National Research Service Award Program for Research in Primary Medical Care	215	65	Mean, 38 (SD, 5)	49	Case-control study nested within a survey, no details whether the questionnaire was pretested
Stubbe,[45] 2002	Cross-sectional	Child and adolescent psychiatrists	797	49	Mean, 35.3 (range, 29-63)	47	Low response rate, no details regarding whether the questionnaire was pretested
Thakur et al,[46] 2001	Cross-sectional	Graduates, general surgery program, University of California, Los Angeles	86	65	NA	4	No details on how the questionnaire was constructed, whether it was pretested, or when the survey was performed
Wakeford et al,[47] 1985	Cross-sectional	Clinical university professors, career Medical Research Council clinicians, ex-Wellcome fellows, and doctors in research-oriented posts in the United Kingdom	378	69	47	10	No details whether the questionnaire was pretested
Weber et al,[48] 2005	Cross-sectional	Female academic surgeons in Germany	261	51	Mean 35.1 (range, 27-54)	100	No details on how the questionnaire was constructed or whether it was pretested
Wise et al,[49] 2004	Cross-sectional	Obstetrics/gynecology faculty from 15 medical schools in Canada	522	72	Mean, 43.4 (SD, 7.9)	37	Assessed self-reported time to promotion, no independent validation of this outcome
Yu,[50] 2003	Cross-sectional	Students who completed the training requirements for adult cardiology at the University of Toronto, Canada	45	51	NA	NA	Small sample size, no details regarding whether the questionnaire was pretested

Abbreviation: NA, not available.
*Cross-sectional studies include surveys done at one point in time; the cohort study identifies individuals with a defined exposure to mentorship; before and after case series include those studies that report on a select population without a comparison group.
†Settings are in the United States unless specifically noted.
‡The preceptoring program lasted for 1 year and had a goal of orienting new faculty; the mentoring program continued as long as the participants desired and had the goal of career development and progression.
§Mean response rate following 5 evaluation rounds.
‖No methodological deficits were identified.
¶Shapiro[40] and Mrazek[41] report on the same study.
#Steiner,[42] Curtis,[43] and Steiner[44] report on the same study.

mentor, and 75 (27%) described independently initiating the mentor-mentee relationship.[45]

Prevalence and Perceived Importance of Mentorship

Fifteen studies examined the prevalence of mentorship among medical students and physicians (TABLE 2).* The prevalence ranged from 19% of adolescent medicine faculty who reported currently having a mentor[19] to 93% of primary care research fellows who reported having a mentor.[42] In 1 study that focused on the prevalence of mentorship at the undergraduate level, 36% of the third- and fourth-year medical students reported having a mentor.[13]

Four studies described the general importance of mentorship (TABLE 3).[19,25,45,46] Of surveyed child and adolescent psy-

*References 13, 15, 16, 19, 22, 29, 31, 32, 35, 36, 38, 39, 42, 45, 49.

Table 2. Self-reported Prevalence of Mentorship in Academic and Health Institutions

Source	Study Population	Outcome	Prevalence, %
Aagaard and Hauer,[13] 2003	Third- and fourth-year medical students	Had a mentor	36
Caniano et al,[15] 2004	Women pediatric surgeons	Had a senior faculty mentor Never had a mentor	84 16
Coleman et al,[16] 2005	Obstetrics/gynecology residents	Had a mentor in first postgraduate year Had a mentor in fourth postgraduate year	50 67
Genuardi and Zenni,[19] 2001	Adolescent medicine faculty	Had a mentor during their adolescent medicine training Currently with a mentor	59 19
Leppert and Artal,[22] 2002	Obstetrics/gynecology research fellows	Had a mentor during first 5 years after fellowship Had a mentor 6 or more years after fellowship	60 51
Osborn et al,[29] 1992	Postdoctoral fellows	Had a mentor at some point in their career	86
Palepu et al,[31] 1998	Full-time faculty of medical schools	Junior faculty received mentoring	54
Pearlman et al,[32] 2004	Second- and third-year neonatology fellows	Had a mentor Felt they had a "strong mentorship" relationship Believed that there were members of the faculty who could provide good mentorship	80 66 95
Ramondetta et al,[35] 2003	Gynecologic oncology fellows	Had a clinical mentor Had a basic science mentor Had both a clinical and a basic science mentor	66 75 51
Rivera et al,[36] 2005	Internal medicine residents	Worked with a mentor during their training	77
Sciscione et al,[38] 1998	Maternal/fetal medicine fellows	Had a mentor	68
Scribner et al,[39] 2005	Gynecologic oncologists	Reported adequate mentorship	80
Steiner et al,[42] 2002	Primary care research fellows	Had a mentor Had a "particularly influential mentor"	93 73
Stubbe,[45] 2002	Child and adolescent psychiatrists	Had a mentor during their training	75
Wise et al,[49] 2004	Obstetricians/ gynecologists	Women who had someone they considered a mentor Men who had someone they considered a mentor	42 46

Table 3. General Importance of Mentorship Perceived by Respondents

Source	Study Population	Outcome	Result (Prevalence or Score)
Genuardi and Zenni,[19] 2001	Adolescent medicine faculty	Described their mentor as important	95%
McGuire et al,[25] 2004	Women faculty at medical school	Rated departmental mentoring as the most important resource and support Mean (SD) rating of importance of departmental mentoring*	21% 4.13 (1.16)
Stubbe,[45] 2002	Child and adolescent psychiatrists	Identified faculty and mentors as the most important aspect of training experience	16%
Thakur et al,[46] 2001	Graduates from general surgery program	Identified mentor guidance as important in personal development	40%

*On a 5-point scale from 1 = not important at all to 5 = very important.

chiatrists, 16% identified mentors as the most important aspect of their training experience.[45] Among adolescent medicine faculty, 95% of the respondents described their mentor as important to them.[19]

Perceived importance of mentorship was related to career satisfaction. In a study of maternal/fetal medicine fellows in the United States,[38] the presence of a mentor was associated with satisfaction with their fellowship (OR, 5.83; 95% CI, 2.42-14.08). In a survey of faculty from 24 US medical schools,[31] faculty members with mentors had significantly higher career-satisfaction scores than those without mentors (mean score, 62.6 vs 59.5 on a scale range from 20-100; $P<.003$).

Impact of Mentorship on Personal Development and Career Guidance

Eight studies reported the influence of mentorship on personal development and career guidance.[11-13,16,22,45,49,50] Five studies found that mentors were seen as an important career-enhancing factor for medical students, fellows, and staff physicians in various disciplines (TABLE 4).[13,16,22,45,50] A study of Canadian obstetrics/gynecology fellows found that those who reported they had a mentor were more likely to achieve a promotion (hazard ratio, 2.33; 95% CI, 1.36-3.99).[49]

Two studies described the effect of academic mentoring programs on professional development.[11,12] Illes et al[11] assessed a mentoring program for radiology junior faculty at the Stanford University School of Medicine in their before and after case series. The program was voluntary with formal mentoring meetings every 6 months. Participants rated their satisfaction with mentoring meetings and the relative importance of major professional issues that emerged in their discussions (Table 4). Annual review of junior faculty performance in the areas of research, teaching, and patient care showed improvement in 52% of program participants in research, 26% in teaching, and 6% in patient care from first monitoring meeting to either promotion or end of study.[11] However, no con-

trol group was available for comparison. Wingard et al[12] evaluated a structured mentoring program for junior faculty at the University of California San Diego in a before and after study. The program was multifaceted and included professional development workshops, career planning, counseling sessions, formal mentoring, and community network building. The program significantly increased self-assessed confidence in participants' academic roles and skills in several areas including professional development, education, and administration, with increase in self-efficacy scores of 52%, 33%, and 76%, respectively.

Impact of Mentorship on Specialty Choice, Academic Career Choice, and Retention

Nine studies described the impact of mentorship on specialty choice, 4 on academic career choice,[27,32,35,38] and 2 studies focused on retention in academic medicine (TABLE 5).† Mentorship was reported to be an influential factor in the selection of specialty. Respondents working in academic medicine rated the importance of the mentor in their career choices higher than respondents working in nonacademic primary care settings (mean score 2.36 vs. 1.82 on a 5-point scale; $P<.001$).[37]

Four studies explored the relationship between mentorship and the mentees' interest in entering academic medicine. Pearlman et al[32] found a significant correlation between the presence of a mentor and a plan to enter academics among neonatal/perinatal fellows ($P=.01$). In a study of the US maternal/fetal medicine fellows,[38] the presence of a mentor was associated with a fellow's desire to enter academic practice (41.8% vs. 21.5%; calculated OR, 2.81; 95% CI, 1.21-6.51). However, expectation about future practice type among US gynecologic oncology fellows was not associated with having a clinical or research mentor.[35] Miller et al[27] found that whether entering academics or private practice, dermatology micrographic surgery fellows placed equivalent importance on the influence of mentorship from the fellowship director on their career choice.

Two studies explored the association between mentorship and faculty retention. Benson et al[9] reported on a 2-tiered program consisting of 1 year of preceptoring with the goal of orienting new faculty, and mentoring for junior faculty who had been with the organization for at least a year. The study showed that 38% of junior faculty who did not form preceptoring partnerships left the organization, compared with 15% of those who formed preceptoring partnerships ($P=.12$). The report did not provide any data on the retention of those who formed mentoring partnerships. At the University of California San Diego, 85% of mentoring program participants remained at their home institution, and 93% remained in academic medicine,[12] but there was no control group available for comparison.

Impact of Mentorship on Research Development and Productivity

Twenty-one studies described the impact of mentoring on research devel-

Table 4. Impact of Mentorship on Personal Development and Career Guidance

Source	Study Population	Outcome	Result (Prevalence, Evaluation Score, *P* Value, or Hazard Ratio)
Illes et al,[11] 2000	Junior faculty from radiology department	Range of median ratings for overall value of mentoring meetings*	8-10
		Range of median ratings for importance of academic progress and research in mentoring discussions*	8.5-10
Wingard et al,[12] 2004	Junior faculty at medical school	Increased confidence in professional development†	19.9 (52%); $P<.001$
		Increased confidence in education†	14.1 (33%); $P<.001$
		Increased confidence in administration†	22.1 (76%); $P<.001$
Aagaard and Hauer,[13] 2003	Third- and fourth-year medical students	Identified mentors as providers of opportunities aiding in career advancement	83%
Coleman et al,[16] 2005	Obstetrics/gynecology residents	Reported that their mentor actively advised and fostered their independent career goals intermittently	45%
		Reported that their mentor consistently critiqued their scientific or clinical/teaching work	23%
		Reported that their mentor never critiqued their work	19%
Leppert and Artal,[22] 2002	Obstetrics/gynecology research fellows	Indicated that the most career-enhancing factor was mentoring	40%
Stubbe,[45] 2002	Child and adolescent psychiatrists	Identified mentor as the most helpful in career guidance and support	30%
Wise et al,[49] 2004	Obstetrician/gynecologists at medical facilities	Likelihood of achieving promotion‡	Hazard ratio, 2.33; 95% confidence interval, 1.36-3.99
Yu,[50] 2003	Students who completed training requirements for adult cardiology	Mean rating (SD) of the importance of mentor support and guidance in the development of a career in cardiovascular research§	4.26 (0.89)

*On a scale from 1 = not important to 10 = extremely important; range of data from 5 evaluation rounds.
†Mean difference (percentage change) of self-efficacy scores (all scales were 7-point Likert scales: for professional development 10 items, score range, 10-70; for confidence in education and for confidence in administration 8 items, score range, 8-56) before and after mentoring program.
‡Respondents with mentor vs those without mentor.
§On a 5-point scale from 1 = strong disagreement to 5 = strong agreement.

†References 9, 12, 13, 14, 21, 24, 26, 27, 30, 32, 34, 35, 37, 38, 46.

opment and productivity. An apparent effect of mentoring was observed on research career guidance, productivity, and success (TABLE 6).‡ Mentors increased mentees' self-confidence[12] and provided support and resources for research activities.[13,31,45] Respondents who had a mentor were more likely to allocate more time to research[23,31,44]; they were more productive in research in terms of number of publications and grants,[11,23,32,35,43,44] and were more likely to complete their thesis.[38] Lack of mentorship was identified as a specific barrier to completing scholarly projects and publication.[17,36,39] A survey with a nested case-control study found an association between having a mentor and having a research grant as a principal investigator (OR range, 2.1-3.1).[43,44] The influence of a mentor was an important motivating factor in pursuing research training or career.[18,20,33,40,47] Research fellows who had had a mentor were more likely to provide mentorship to others (multivariate OR, 8.9; 95% CI, 1.8-42.4).[44]

‡References 11-13, 17, 18, 20, 23, 31-33, 35, 36, 38-41, 43-47.

Differences by Sex in the Mentorship Experience

Three studies explored mentorship experiences of women physicians,[15,23,48] 6 studies explored differences between sexes in the mentorship experience,[13,16,29-31,49] and 1 study evaluated an intervention to eliminate some of these

Table 5. Impact of Mentorship on Specialty and Academic Career Choice

Source	Study Population	Outcome	Result (Prevalence, Score, or *P* Value)
		Impact on Specialty Choice	
Aagaard and Hauer,[13] 2003	Third- and fourth-year medical students	Advised by a mentor on specialty choice Advised by a mentor on residency choice	98% 78%
Caiola and Litaker,[14] 2000	General internal medicine fellows	Availability of mentor as most important selection factor Availability of mentor as 1 of 3 most important selection factors Availability of mentor as "important" or "very important" selection factor Mean score (SD) of importance*	15% 45% 85% 4.37 (0.84)
Ko et al,[21] 1998	Surgeons	Influenced by a mentor in their specialty choice	56%
Lukish and Cruess,[24] 2005	Resident surgeons	Reported that mentorship played an important role in their decision to pursue surgical training	49%
Medina et al,[26] 1998	Physicians who completed geriatric fellowships	Influenced by a role model or mentor in their specialty choice	48%
Osborn,[30] 1993	Students graduating from medical school	Rating of importance of mentor in specialty choice†	1.95
Polsky and Werner,[34] 2004	Physicians enrolled in child neurology residency programs	Indicated mentor as the most influential exposure to child neurology	20%
Rubeck et al,[37] 1995	Medical school graduates	Rating of influence of mentor on career choices in academic medicine vs nonacademic primary care‡	2.36 vs 1.82; $P<.001$
Thakur et al,[46] 2001	Graduates from general surgery program	Influenced by a mentor in specialty choice Influenced by a mentor in subspecialty choice Influenced by a mentor in career choice	45% 44% 65%
		Impact on Academic Career Choice and Retention	
Benson et al,[9] 2002	Junior faculty at medical school	Left their organization§	15% vs 38%; $P = .12$
Wingard et al,[12] 2004	Junior faculty at medical school	Retention of junior faculty at their home institution Retention of junior faculty in academic medicine	85% 93%
Miller et al,[27] 2006	Fellows in micrographic surgery	Difference between fellows who entered academia and private practice in rating of importance of influence of mentorship from their fellowship director	Not statistically significant‖
Pearlman et al,[32] 2004	Second- and third-year neonatology fellows	Correlation between presence of a mentor and plans for beginning an academic career	$P = .01$¶
Ramondetta et al,[35] 2003	Gynecologic oncology fellows	Association between having a clinical or research mentor and expectation about future type of practice	Not statistically significant‖
Sciscione et al,[38] 1998	Maternal/fetal medicine fellows	Expressed desire to enter academic practice#	41.8% vs 21.5%; $P = .01$; odds ratio, 2.81; 95% confidence interval, 1.21-6.51

*On a 5-point scale from 1 = not very important to 5 = very important.
†On a 5-point scale from 1 = very important to 5 = unimportant; results presented as mean value, SD not stated.
‡On a 5-point scale from 0 = not important to 4 = critically important, results presented as mean values, SD not stated.
§Respondents who formed a preceptorship relationship vs those who did not form one (the preceptoring program lasted for 1 year and had a goal of orienting new faculty).
‖Study provided neither exact *P* value nor numerical results.
¶Study provided only *P* values without a numerical result.
#Respondents with mentor vs those without mentor.

Table 6. Impact of Mentoring on Research Development and Research Career Guidance, and Research Productivity and Success

Source	Study Population	Outcome	Result (Prevalence, Score, *P* Value, or OR)
		Impact on Research Development and Career Guidance	
Wingard et al,[12] 2004	Junior faculty of medical school	Reported increased confidence in research after mentoring program	20%
Aagaard and Hauer,[13] 2003	Third- and fourth-year medical students	Identified mentors as providing research opportunities	60%
		Identified mentors as providing collaboration on research projects	58%
		Identified mentors as providing resources	39%
El-Guebaly and Atkinson,[18] 1996	Academic faculty at departments of psychiatry	Mean rating (SD) of "time with mentor" as a factor influencing desire for research training*	2.54 (0.61)*
Hueston and Mainous,[20] 1996	Community-based family medicine researchers	Identified availability of mentoring as motivating/encouraging factor in research	42%
Palepu et al,[31] 1998	Full-time faculty of medical schools	Mean rating (SD) adequacy of institutional support for research†	3.4 (1.4) vs 2.7 (1.4); *P*<.001
		Mean rating (SD) research preparation and research skills†	3.8 vs 2.9 (SD not stated); *P*<.001
Pincus et al,[33] 1995	Full-time, doctoral-level faculty in psychiatry departments	Identified "outstanding professor or mentor" as most influential factor in decision to obtain research training	37.9% MDs; 26.2% MD/PhDs
		Scored "time with mentor" as "extremely important" or "important" characteristic of research training	94.8%
Shapiro et al,[40] 1991	Faculty in child and adolescent programs at medical colleges	Identified "outstanding professor or mentor" as most influential factor in pursuing research career	38%
Stubbe,[45] 2002	Child and adolescent psychiatrists	Reported that promoting research was the way in which the mentor was most helpful	12%
Thakur et al,[46] 2001	Graduates from general surgery program	Identified mentor guidance as important for research development	38%
Wakeford et al,[47] 1985	Clinical professors, career clinicians, fellows in research-oriented posts	Reported that mentor "greatly" influenced them towards research	27%
		Reported that mentor influenced them "quite a lot"	32%
		Impact on Research Productivity and Success	
Illes et al,[11] 2000	Junior faculty from radiology department	Increase in research performance from first monitoring meeting at first-year evaluation point	35%‡
		Increase in research performance from first monitoring meeting at promotion or end of follow-up	52%‡
Aagaard and Hauer,[13] 2003	Third- and fourth-year medical students	Association between having a mentor and conducting research before medical school	OR, 4.8; 95% CI, 1.4-16.7
		Association between having a mentor and conducting research during medical school	OR, 2.4; 95% CI, 1.1-5.6
Donaldson and Cresswell,[17] 1996	Public health trainees	Identified lack of mentor as specific barrier to publication	58%
Levinson et al,[23] 1991	Women in departments of medicine	Influence of mentor:	
		Mean number of publications§	13.1 vs 10.3; *P*<.05
		Estimated time allocated to research§	26% vs 21%; *P*<.01
Palepu et al,[31] 1998	Full-time faculty of medical schools	Influence of mentor:	
		Estimated time allocated to research§	28% vs 15%; *P*<.001
		Mean number of peer-reviewed publications§	12.5 vs 13.5 (NS)‖
		Likelihood of getting a research grant§	OR, 1.5; 95% CI, 1.1-2.0
Pearlman et al,[32] 2004	Second- and third-year neonatology fellows	Correlation between presence of a mentor and successful completion of research requirement	*P* = .09¶
Ramondetta et al,[35] 2003	Gynecologic oncology fellows	Association between having mentor and number of projects undertaken	*P* = .19¶
		Association between having mentor and the expectation of completing the thesis	*P* = .43¶
		Association between having mentor and expectation of submitting the thesis for publication prior to the completion of fellowship	*P* = .67¶
		Association between having mentor and expectation of completing the thesis prior to finishing the fellowship	*P* = .002¶

(continued)

Table 6. Impact of Mentoring on Research Development and Research Career Guidance, and Research Productivity and Success (cont)

Source	Study Population	Outcome	Result (Prevalence, Score, *P* Value, or OR)
		Impact on Research Productivity and Success (cont)	
Rivera et al,[36] 2005	Internal medicine residents	Identified lack of mentor as a barrier to completing scholarly project	25%
Sciscione et al,[38] 1998	Maternal/fetal medicine fellows	Likelihood of predicted thesis completion§	83.5% vs 52.3%; *P*<.001
Scribner et al,[39] 2005	Gynecologic oncologists	Cited lack of mentorship as primary reason for not publishing in spite of having done laboratory research	47%
Mrazek et al,[41] 1991	Faculty in child and adolescent programs at medical colleges	Identified a relationship with a mentor as "strongly important" for research success	70%
Curtis et al,[43] 2003	Participants of a fellowship program in primary care research	Association between having an influential mentor and publishing more than 1 research paper per year	OR, 4.0; 95% CI, 1.1-4.1
		Association between having an influential mentor and having any grant as a principal investigator	OR, 3.1; 95% CI, 1.3-7.6
Steiner et al,[44] 2004	Primary care research fellows	Association between receipt of influential and sustained mentorship and spending 40% or more effort on research	OR, 2.7; 95% CI, 1.0-7.5
		Association between receipt of influential and sustained mentorship and providing research mentorship to others	OR, 8.9; 95% CI, 1.8-42.4
		Association between receipt of influential and sustained mentorship and publishing 1 or more papers per year	OR, 5.2; 95% CI, 1.5-18.4
		Association between receipt of influential and sustained mentorship and having a federal grant as a primary investigator	OR, 2.1; 95% CI, 0.7-6.1

Abbreviations: CI, confidence interval; NS, not significant; OR, odds ratio.
*Rated on a 4-point scale from 1 = not important at all to 4 = extremely important.
†Respondents with a mentor vs those without a mentor, on a 6-point scale from 1 = very poor to 6 = exceptional.
‡Proportion of junior faculty with increase in research performance greater than 0.5 points on a scale from 1 = low to 5 = high.
§Respondents with a mentor vs those without mentor.
‖Study did not provide the exact *P* value.
¶Study provided only *P* values without a numerical result. Relationships between variables of interest were assessed by *t* test for continuous variables for the association between having a mentor and the number of projects undertaken, and by χ^2 test for continuous variables for the associations between having a mentor and the expectations of completing the thesis, submitting the thesis for publication prior to the completion of fellowship, and completing the thesis prior to finishing the fellowship.

differences.[10] A survey of third- and fourth-year medical students at the University of California San Francisco[13] found that 40% of men and 33% of women had mentors (calculated OR, 1.32; 95% CI, 0.77-2.27). Graduating students from the same school rated having a research mentor as the most important factor that influenced their specialty choice (1.95 on a 5-point scale ranging from 1 [very important] to 5 [unimportant]), but there was no difference between men and women.[30]

In a survey of medical students, housestaff, fellows, and junior faculty at the University of California San Francisco,[29] 22% of women junior faculty and 21% of women on housestaff had never had a professional mentor; the same was true for 9% of men junior faculty and 16.5% of men on housestaff. There was no mentor reported in their current position at the university for 43% of the housestaff (same for men and women) and 45% of the women junior faculty; the result for men junior faculty was not given. Men were 3 times as likely as women to describe a relationship with a mentor as a positive experience that influenced their careers. Negative experiences most often mentioned by both sexes were lack of funding and lack of a mentor: 24% of the women identified the lack of a mentor as 1 of the 2 most negative experiences they had in their careers.

Coleman et al[16] explored differences in perceptions of mentoring by surveying US obstetrics/gynecology residents by race and sex in a survey study. White women reported that they did not currently have a mentor more often than any other group of residents (59.8% vs 68.1% reported by white men; *P*<.001). Among Hispanic and African American residents, men reported more active and consistent advising than women (30.3% vs 27%; *P* value not stated).

There were some differences by sex among faculty in perception of the impact of mentorship on success. In a survey of obstetricians/gynecologists on Canadian medical faculties,[49] women were more likely than men to indicate that they perceived a lack of a mentor to be a barrier to their promotion (42% vs 24%; *P*<.001), although there was no difference by sex in prevalence of having a mentor (42% of women vs 46% of men). Having a mentor was associated with a higher likelihood of promotion to professor (HR, 2.33; 95% CI, 1.36-3.99). However, a study of US women faculty aged 50 years or younger did not find a correlation between having a mentor during training and academic rank.[23] Women pediatric surgeons in both the United States and Canada identified lack of appropriate mentorship as a major obstacle to a suc-

cessful academic career (mean score, 2.71 [SD,1.17] on a scale of 1 [not important] to 4 [very important]).[15] A similar finding was reported in a survey of US medical faculty[31]: more women than men believed that inadequate mentoring had impeded their career growth (48% vs 36%; $P=.01$). Lack of mentoring was also recognized in a survey of female academic surgeons in Germany, where 70% of respondents identified absence of mentoring programs as an obstacle in academic surgery, and 80% thought that better mentoring would improve the position of female academic surgeons.[48]

The survey of US medical faculty[31] found that mentors were predominantly white men, although women were more likely to have women mentors (23% vs 10%; $P=.001$). A similar result was reported by Coleman et al[16] with the majority of mentors for both men and women residents being men, although women were significantly more likely than men to have a woman mentor ($P<.001$). These 2 studies had different findings about the importance of concordance of sex. In the study of faculty, 80% of the women reported that it was not important to have a mentor of the same sex, while in the study of residents, women were more likely than men to state that a same-sex mentor would be more understanding (41.4% vs 33.4%; *P<.001)*. Another study found that the mentor's sex was not a significant influence on either the number of publications or the percentage of time spent on research.[23]

In a before and after case series, Fried et al[10] described a multifaceted intervention to correct career obstacles based on sex that were reported by women faculty in the Department of Medicine at the Johns Hopkins University School of Medicine. Prior to implementation of the intervention, a faculty survey found that 44% of women and 59% of men expected to be promoted; 58% of women and 71% of men wanted to be in academic medicine in 10 years; 23% of women and 47% of men expected to be in academic medicine in 10 years; and 63% of women and 43% of men seriously considered leaving academic medicine (all $P<.001$). There were no differences by sex in prevalence of having a mentor. However, more women than men (32% vs 10%; $P=.004$) reported that their mentor used their work to advance their own career rather than that of the mentee. A 3-year intervention period followed the survey and included problem identification; leadership; education of faculty; and interventions to improve faculty development, mentoring, and rewards, as well as to reduce isolation and structural career impediments. Interventions were evaluated using a modified baseline questionnaire and found an increase in the percentage of women who had a mentor (31% vs 65%; $P=.005$) and expected to be promoted (44% vs 73%; $P<.001$), and a smaller percentage of women who seriously considered leaving academic medicine (63% vs 28%; $P<.001$). Both sexes reported that mentoring had improved (25% women, 22.5% men, difference not significant, exact *P* value not stated). Among men, the proportion who expected to be promoted increased from 59% to 76%. An increase in the proportion of men who expected to remain in academic medicine was also found, but it was smaller than in women (183% in women vs 57% in men).

COMMENT

To our knowledge, this is the first systematic review of the evidence of the relationship between mentorship and career choice, career progression, and scholarly productivity. The review of 39 studies reported in 42 articles revealed an absence of experimental research about mentoring, but it does outline current knowledge about mentorship. The available evidence showed that fewer than 50% of medical students and in some fields fewer than 20% of faculty members had a mentor. There was a perception that women had more difficulty finding mentors than their colleagues who were men. Mentorship was reported to be an important influence on personal development, career guidance, career choice, and productivity. Respondents identified mentoring to have an important effect on research productivity, including publication and grant success.

However, the poor quality of these studies does not allow conclusions to be made on the effect size of mentoring on any aspect of academic and professional development. Of the 39 studies, 34 (87%) were based on cross-sectional self-report surveys and did not utilize a comparison group without mentoring or with standard care. The median sample size of surveys selected for the review was 219 (range, 18-5624) and the median response rate was 62% (range, 5%-99%), with larger studies having smaller response rates. Many studies provided little detail on how the surveys were constructed or on the study sampling frame. The role of the mentor and content of mentorship greatly differed among the studies, ranging from an informal personal support to formalized mentorship relations. The majority of the studies did not mention if a mentor was assigned or self-identified. Moreover, none commented on how frequently mentors and mentees met or on the intensity of their interaction. There was little mention of potential adverse outcomes associated with mentoring other than one study that identified the perception that mentors used the mentees' work to advance their own career. All of the studies were completed in North America, the United Kingdom, and Germany, and may not accurately reflect developing and other countries.[5] The limitations of this evidence preclude its use to suggest mentorship strategies that should be implemented at academic institutions.

Systematic reviews on the effects of mentorship in other fields, such as nursing[51] and business,[52] also show lack of valid evidence for the effectiveness of mentoring, indicating a general need for clarification of theoretical and conceptual perspectives in order to increase our knowledge of mentorship, particularly its traditional career and psychosocial functions. Understanding mentorship in medicine

would benefit from assessing theories and evidence from other fields, such as social sciences, education, and business research.[53-55]

Two of the 4 intervention studies reported multifaceted interventions[9,10] but it was unclear which elements had an effect on career advancement. Also, the studies in this review were not able to differentiate if the observed outcomes were the result of receipt of mentoring or the individual characteristics of the mentee. Management research has shown that personality characteristics can influence a person's likelihood of receiving mentoring.[56] Individuals with good internal control, high self-monitoring skills, and emotional stability were more active in seeking a mentoring relationship, which in turn contributed to receiving actual mentoring and career success.[56] Similar research is needed in medical settings to address the importance of personality traits in receiving and providing mentoring.

Despite the limitations of the evidence, some suggestions can be made regarding mentorship. Given that mentorship can have an effect on personal development, career choice, and research productivity, administrators, program directors, and mentors should encourage mentorship activities focusing on these areas. For example, guidance around research and access to relevant resources enhance productivity and should be regarded as key features of a mentorship relationship. It is not clear if mentors should be assigned or self-identified; this represents an area for future research. Mentorship should be available throughout training and career establishment, although different mentorship qualities may be required at these stages. Mentees should strive to find a mentor who can provide them with the required support for their career and personal development, including research resources where relevant. Efforts need to be made to ensure that mentorship opportunities are provided to women and individuals representing diverse ethnicities. However, it is not clear that mentors and mentees need to be of the same sex.

The results of this review provide an outline of common themes for future research: (1) the effect of mentorship on those interested in education-based careers; (2) the effect of strategies to enhance mentorship for women; and (3) the effects on career development and productivity of formal mentoring vs informal mentoring, personality and behavioral constructs, and multifaceted programs vs single component strategies. However, the quality of evidence does not allow practical recommendations to guide mentors in doing a better job and mentees in selecting a mentor. Research on the effects of mentoring on career choice and advancement must address contextual issues and use cross-disciplinary approaches and robust study designs, ideally including randomized trials. If it is not practical to randomize participants to a mentorship program vs usual practice, alternatives include randomizing to a multifaceted intervention or a single-component intervention. A prospective cohort study design could be used to identify those trainees or faculty with and without mentors and follow their cases forward to assess career choice and development, personality and social issues related to the mentorship process, and time requirements and costs of mentorship.

All of these study designs could be performed at single sites but would be more powerful if they were conducted across multiple sites. This would require collaboration under the leadership of the deans of medicine and organizations such as the Association of Professors of Medicine and other individuals and organizations interested in preserving academic medicine. Given the responsibility of medical schools and graduate programs for training health care professionals and for advancing clinical care, research, and education, these organizations should feel compelled to stimulate interest in mentorship and to evaluate such efforts. Education and faculty development initiatives should be subjected to the same valid forms of evaluation expected for interventions such as drug therapy.

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Study concept and design: Straus, Marušić.
Acquisition of data: Sambunjak, Straus.
Analysis and interpretation of data: Sambunjak, Straus, Marušić.
Drafting of the manuscript: Sambunjak, Straus, Marušić.
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