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Factors associated with physicians' choice of a career in research: A retrospective report 15 years after medical school graduation

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Abstract

Relatively little is known regarding factors associated with the choice of a research career among practicing physicians, and most investigations of this issue have been conducted in the absence of a theoretical/conceptual model. Therefore we designed a survey to identify the determinants of decisions to pursue a biomedical research career based upon the Theory of Planned Behavior and the concept of stereotype threat. From October 2012 through January 2014 electronic surveys were sent to four consecutive Harvard Medical School graduating classes, 1996-1999. Respondents provided demographic information, indicated their current research involvement, and provided retrospective reports of their experiences and attitudes when they were making career choices as they completed medical school. Multivariable ordinal regression was used to identify factors independently associated with current research involvement. Completed questionnaires were

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received from 358 respondents (response rate 65%). In unadjusted analyses, variables associated with more extensive research involvement included non-minority status, male gender, lower debt at graduation, strong attitudes toward research at time of graduation, and greater social pressures to pursue research (all P<.001). These associations remained significant in multivariable regression analysis (all P<0.01). However, an interaction between sex and prior research publications was also detected, indicating that more extensive research involvement during medical school doubled the likelihood of a research career for women (OR 2.53, 95%CI 1.00-6.40; P=0.05). Most of the factors predicting research career choice involve factors that are potentially modifiable, suggesting that appropriately designed behavioral interventions may help to expand the size and diversity of the biomedical research community.

Factors that influence medical school graduates' selection of a medical specialty are well documented (Van der Horst, Siegrist, Orlow, and Giger, 2010; Newton Grayson, and Thompson, 2005; Dorsey, Jarjoura, and Rutecki, 2003), as are the factors that support a decision to pursue a primary care career (Erickson, Danish, Jones, Sandberg, and Carl, 2013; Connelly et al, 2003; Bennett and Phillips, 2010) and a career in academic medicine (Greenberg et al, 2013; Andriole and Jeffe, 2012; Borges, Navarro, Grover, and Hoban, 2010). A number of other studies document the career paths of MD-PhD students (Andriole, Whelan and Jeffe, 2008; Brass et al, 2010; Santoro, Mosse, and Young, 2007). However, fewer studies have explored the factors that influence medical school graduates to choose a research-focused career. Instead, the emphasis has been on college and graduate students and the factors related to their entry into PhD programs and research careers in the STEM (Science-Technology-Engineering-Math) fields (Jeffe, Andriole, Wathington, and Tai, 2014; Adedokun, Bassenbacher, Parker, Kirkham, and Burgess, 2013: Wand and Degol, 2013; Byars-Winston, 2014).

In addition, regardless of the population studied, most studies focusing on career paths have been conducted in the absence of a theoretical framework. The present study attempts to address both gaps, focusing on factors influencing physicians to pursue research-oriented careers using the Theory of Planned Behavior (TPB). The TPB has served as the framework for several hundred social science studies (Fishbein and Ajzen, 2010; Zemore and Ajzen, 2014; Tyson, Covey, and Rosenthal, 2014 Gallucci, Martin, Beujean, and Usdan, 2015). It posits that behaviors are determined by a combination of three internal and external factors. These are: a) attitude toward a class of behavior (e.g., research); b) the role of others (e.g., mentors, peers, family) as sources of external influence in encouraging research involvement; and c) perceived control over outcomes, very similar to the concept of self-efficacy (Bandura, 1994; Black, et al, 2013), the belief that has one has the requisite skills to succeed in a given domain).

In addition, we have also utilized the concept of stereotype threat. In research focusing on women and minority group members, it has been hypothesized and demonstrated in numerous contexts that individuals demonstrate a tendency to avoid situations and fields of endeavor in which they are in the minority and might be judged as exemplars of their social group (Burgess, Joseph, van Ryne, and Carnes, 2012; Woodcock, Hernandez, Estrada, and Schultz, 2012; Steele, 1997).

To study these issues, in 2012-2014 we conducted a survey of four Harvard Medical School (HMS) graduating classes, 1996-1999, approximately 15 years after they had earned their MD degrees. The goal of this study was to determine the extent to which those in our sample were presently engaged in research and to identify the demographic, attitudinal, experiential, and contextual factors most closely associated with their research involvement.

METHODS

Sample and survey administration

The survey sampling frame consisted of all recipients of the MD degree from HMS in the years 1996 through 1999 (n = 690). Some of these former students received other degrees in addition to the MD (these included several kinds of Masters and Doctoral level degrees in fields such as business, public health, public policy, education, and the basic sciences); however the single inclusion criterion for this study was the receipt of the MD degree from HMS during the selected years. The surveys were administered electronically via SurveyMonkey between October 2012 and January 2014, when all respondents were 14 to 16 years post-graduation (class of 1996, 16.3 years post-graduation; class of 1997, 16.3 years; class of 1998, 15.3 years; class of 1999, 14.6 years). These four graduating cohorts were chosen with the assumption that, since all members of the sample were approximately 15 years since medical school graduation, all had had sufficient time to complete their postgraduate training and commit to a specific career path. The HMS institutional review board reviewed the study protocol and determined that it was exempt.

Of the 690 HMS graduates from 1996-1999, 70 had made specific requests not to be contacted and one had died. For an additional 72, no current e-mail contact information could be ascertained in spite of internet-based searches, telephone calls, and e-mail requests to a variety of sources. The final sample to whom the survey was sent was 547. Each respondent received up to four reminder e-mails over the subsequent six weeks, followed by phone calls to professional offices for those who had not who had not responded. The overall response rate for the survey was 65.4% (358/547), with response rates by cohort ranging from 61% to 74%.

The Survey Instrument

The survey, which took approximately 10-15 minutes to complete, was pre-tested on a small sample of current HMS students to check for areas of ambiguity, and small changes were made in the content [see Appendix A for instrument]. It contained a range of demographic questions, including age, sex, race/ethnicity, age, and debt level at graduation. Respondents were defined as Under-Represented in Medicine (URiM) if they self-identified under any of the listed categories of Black, Mexican-American, American Indian, Alaska Native, Native Hawaiian, or mainland Puerto Rican (Association of American Colleges, 2015a). Attitude toward research was determined using the approach of expectancy-value theorists (Ajzen and Fishbein, 2008; Hewstone and Young, 1988). On 5-point Likert-type scales, respondents answered two sets of related questions. In the first set of nine questions, participants indicated the extent to which they agreed that a research-focused career would be, for example, intellectually stimulating, financially rewarding, and widely respected. The second

set of questions contained the same nine items, but respondents rated the importance of each when they were choosing a career (from extremely important to extremely unimportant). An attitude index was created by multiplying scores for each of the nine attitude items by its corresponding importance rating, then summing the nine resultants.

A summed normative influence index was created in a parallel manner by asking respondents to indicate how much they agreed or disagreed that five sources (parents, spouse/partner, friends and classmates, teachers, and mentors) would like them to pursue a research-focused career, multiplied by their responses to how much each of these sources was important to them when they were making a career choice.

Stereotype threat was assessed by asking respondents their level of agreement with the statement: I often feel that my performance is being judged more closely than others (on a 5-point Likert scale). Other questions focused on whether the respondent had obtained a mentor in medical school; whether the mentor had encouraged the respondent to go into research; and the extent to which the respondent had been involved in and published research while in medical school. [Note: The measure of perceived control was mistakenly asked in the present tense rather than the past, and could not be used as a predictor.]

Finally, the outcome measure used was taken directly from the American Association of Medical Colleges (AAMC) Graduation Questionnaire (GQ) (Association of American medical Colleges, 2015b), modified slightly so that it was in the past tense: In reference to the respondent's current position, it asked: “How exclusively have you been involved in research in this position?” For analytic purposes, the five response options provided to respondents were grouped into three categories to distinguish among different levels of research involvement: 1) ”not involved;” 2) , involved to a lesser extent (i.e., “involved in a limited way” or “somewhat involved”); and 3) committed to a research career (i.e., “significantly” or “exclusively involved”).

Statistical Analyses

All analyses were performed using Stata 13.1 (Stata Corp, College Station, TX). Results are presented as proportions with 95% confidence intervals (95%CIs), means with standard deviations (SDs), and medians with interquartile ranges (IQRs). To evaluate factors potentially associated with research involvement, we performed unadjusted analyses using chi-square, Fisher's exact, ANOVA, and Kruskal- Wallis tests, as appropriate. Multivariable ordinal regression was conducted to evaluate independent predictors of research involvement. Factors were tested for inclusion in the model if they were found to be associated with the outcome in unadjusted analyses ($P<0.20$) or were selected *a priori* based on literature review. We also tested for potential effect modification between having acquired early research experience[31] (i.e., authoring or co-authoring more than two scientific publications while at HMS) and all other covariates. Regression model results are reported as odds ratios (ORs) with 95%CIs. A two-tailed $P\leq0.05$ was considered statistically significant.

RESULTS

As shown in Table 1, the sample had a mean age of 44 years, with a somewhat greater percentage of men than women (57 vs 43%, respectively). Seventeen percent were designated as URiM. Over half (56%) of the sample graduated with a medical school debt of $50,000 or more; and more than half (54%) were employed in an academic medicine setting at the time of our survey. The demographic characteristics of the sample closely resemble the overall characteristics of the former students studied (i.e., our respondent sample was representative of the population). Slightly more than a quarter (28%) of those responding did not have a mentor in medical school; however, among those who did have a mentor, 60% (150/251) reported that their mentor somewhat or strongly encouraged them to go into research. Almost half (46%) report that they authored or co-authored “several” papers in medical school.

In addition, the vast majority (91%) reported being somewhat or very satisfied with the progress of their careers, two-thirds (67%) reported that what they are doing now is generally similar or almost identical to what they anticipated doing when they were in medical school, and only 7% indicate that looking back they would make major changes in the career path they chose (56% would make no changes at all).

In unadjusted analyses, extent of involvement in research was significantly associated with the demographic/personal characteristics sex, race/ethnicity, and graduation debt, such that males, students who were not under-represented, and those with the least debt burden were most likely to be engaged in research careers (Table 1). In recalling their experiences in medical school, those who were currently more engaged in research reported more positive attitudes toward research, stronger normative pressures to pursue a research career, more mentor encouragement, and greater research productivity in medical school. Those who were most exclusively involved in research were currently more satisfied with the progress of their careers and more likely to make no changes in the career decisions they had made.

Results of the multivariable ordinal regression analysis (Table 2) showed that many of the variables for which we detected associations with current research involvement in the unadjusted analyses, (most notably sex, URiM status, indebtedness, attitude, normative pressures, and mentor encouragement), also had a strong independent relationship with the outcome after controlling for the presence of multiple factors. For instance, those who recall the strongest level of social pressures from others to go into research were more than three times as likely to pursue research as a career than those who recalled normative pressures to be weak. The McFadden R-squared for the final model was .18. Using the Brandt test for ordinal regression, the model did not violate the fundamental assumption of proportional odds (P =.50).

The association between stereotype threat, in the form of feeling that one's performance was monitored more closely than others, and extent of research involvement did not reach statistical significance in unadjusted analyses (P=0.26). However, this variable emerged in the multivariable regression model as a significant independent predictor (P=0.04), with those reporting greater stereotype threat more likely to pursue a research career. Conversely,

being listed as an author of a published scientific paper was associated with greater career involvement in research in the simple analyses, however the direct effect of this variable on our outcome variable was not significant in the regression analyses. Instead, we discovered an interaction between publication history in medical school and respondents' sex (P=0.05 for interaction term). Not accounting for HMS research productivity, men (42%, 84/199) were more likely to be involved in research careers than women (27%, 40/148). Among men who had published fewer papers in medical school, 35% went into research vs. 49% among those with more publications in medical school. In comparison, among women who had fewer publications, 21% pursued a research career; whereas the proportion was almost double (41%) for women who had published more than two papers (Figure 1).

DISCUSSION

The results indicate that a variety of factors are independently associated with the pursuit of a research career, some that are facilitative (i.e., show a positive relationship) and others that serve to direct physicians toward other paths (i.e., show a negative relationship). These findings are consistent with the TPB, demonstrating that both internal/psychological forces and external/situational forces made a difference. Of the former, attitude toward research was a strong predictor, both in the unadjusted and regression analyses. Of the latter, normative pressure to pursue a research career, especially the influence of mentors, was a strong positive predictor of how exclusively the physicians studied were involved, while indebtedness was a factor negatively associated with the outcome.

Our finding that being a member of a racial/ethnic minority in medicine is associated with a reduced tendency to pursue a research career, combined with the fact that minority students were likely to graduate with greater debt, is not welcome news to those who desire to diversify the biomedical research workforce. On the other hand, our regression analyses indicated that those who reported that they were closely watched (our operationalization of stereotype threat) reported greater rather than lesser involvement in the very career activity —research—that prior findings suggest that such students might shy away from. Although the data we collected cannot support or refute any given explanation of this finding, we propose that among the sample we studied, who were sufficiently trained and talented to be accepted at a leading medical school, it may be that these individuals responded to the threat, not by "avoidance" as reported in prior research with less selective samples of students, but via "approach," as described originally by Walter Cannon (1932) in describing the fight-or-flight syndrome concerning stress and threat.

Most importantly, however, our finding that many of the factors that support or discourage the pursuit of a research career are *modifiable* has positive implications for the possibility of diversifying the scientific research workforce.. Although we cannot draw cause-effect inferences from this study, it is possible that well designed programs of intervention aimed at reducing student debt may have the potential to direct more medical school graduates, especially minority students, into research careers. Similarly, the findings that respondents' favorable attitudes toward research and encouragement from mentors and significant others are associated with higher levels of research involvement (which apply to the sample as a whole) also suggest practical interventions.

In addition, medical school curricular interventions that support a positive orientation toward research careers and create a positive normative atmosphere toward research also have the potential to increase the numbers of physicians attracted to this career pursuit. In particular, the growing trend among medical schools to require that all students complete a scholarly project(Chang and Ramnanan, 2015; Boninger et al, 2015; Schor, Troen, Kanter, and Levine, 2005) could contribute to changing norms and attitudes as well as encourage the building of skills and self-efficacy that might affect the career paths of young physicians. Furthermore, the interaction we found between gender and scientific publication experience in medical school suggests that increasing the involvement in research leading to publication during medical school may be particularly effective among women.

The findings we report here are limited by the fact that much of our data involve retrospective reporting of experiences and attitudes by physicians who are approximately 15 years removed from their medical school experiences. While the environment that these students experienced may have changed in the 15-year interim, and while retrospective reporting may introduce biases, this approach avoids other problems inherent in prospective studies of medical students' anticipated career plans. In spite of their interests or intentions, at the time of graduation medical students are not able to anticipate the impact that postgraduate experiences may have on their career trajectories, nor can they take into account various unanticipated factors that can alter, derail, or redirect career pathways.

Another potential limitation to our observations is that, derived as they are from HMS, they may apply to students graduating from research-intensive medical schools but may not be generalizable to all medical school graduates, especially students from schools that have less of a research infrastructure and fewer research faculty. However, while the overall culture of HMS may be more research-oriented, there was no formal research instruction or requirement at the time that these students attended HMS that would differentiate their curriculum from those of many other medical schools. Moreover, given a potential concern about generalizability, if factors such as norms, attitudes, and mentor encouragement were important at a medical school where there is already a strong research orientation, it is possible that the same factors might be even more influential at schools in which research involvement is not a strong cultural value. Therefore, while our findings are suggestive, they obviously require replication on a broad national sample to further substantiate the relationships reported here.

In conclusion, our data indicate that 15 years after graduation from medical school, medical students who are URiM, highly indebted, and female are less likely to go into careers that focus "significantly" or "exclusively" on research. Attitudes and normative pressures from friends, family and mentors concerning a research career are influential in the choice of this career path; and, for women, greater research productivity during medical school is associated with a twofold likelihood of pursuing a career path with extensive research involvement. We suggest that these findings complement and add to those deriving from pipeline programs for younger populations (K—12 and college) and whose goals are to increase overall involvement in STEM careers (Williams, Thakore, & McGee, 2015; Schultz et al, 2011; Smith et al, 2009). Accordingly, we believe that there is reason for optimism that

programs that address these factors in medical school may contribute to increasing both the number and diversity of those choosing a career focused on biomedical research.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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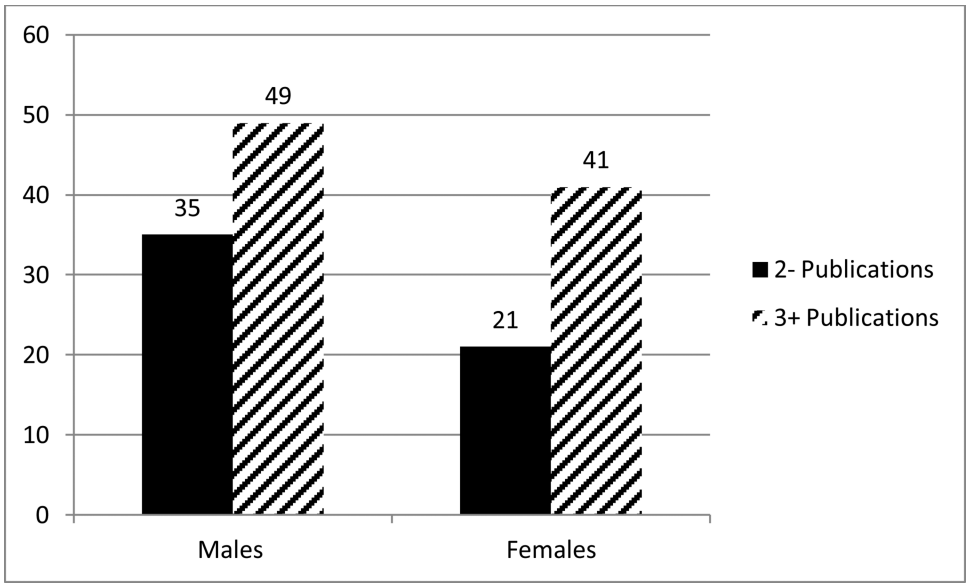

Figure 1.
Percentage of male and female physicians who are significantly or exclusively involved in research according to number of publications in medical school.

Table 1

Characteristics of Harvard Medical School alumni sample, and comparisons of three sub-groups according to the extent of their research involvement (n=358)

Characteristics	overall (n=358)		not involved (n=106)	involved in a limited way; somewhat involved (n=117)	significant involved; exclusively (n=125)	
	n	*column %*	*column %*	*column %*	*column %*	*P*
Current age, years, mean (SD)	338	44 (2.8)	43 (2.4)	44 (3.1)	44 (2.8)	.58
Sex						<.001
Male	200	57	42	61	68	
Female	148	43	58	39	32	
URiM status						.001
non-URiM	285	83	75	80	93	
URiM	58	17	25	20	7	
Amount of medical school debt:						<.001
no debt	91	26	16	30	31	
$1-$49,999	61	18	10	17	24	
≥$50000	195	56	74	53	44	
Type of work that characterizes current position:						<.001
Non-academic medicine	157	46	88	37	19	
Academic medicine	182	54	12	63	81	
Attitude index; −10 to 10, median (IQR)	356	4.1 (3.3-5.1)	3.8 (2.8-4.6)	4.0 (3.2-4.6)	4.6 (3.7-5.9)	<.001
Stereotypthreat; 1 to 5, median (IQR)	354	2.0 (1.5-3.0)	2.0 (1.0-3.0)	2.0 (1.5-3.0)	2.0 (2.0-3.0)	.55
Social norms index						<.001
weak	113	32	50	31	17	
moderate	103	29	24	35	28	
high	107	30	10	27	49	
unknown	35	10	16	7	6	
Mentor encouraged research as career						<.001
no mentor	99	28	38	33	17	
strongly /somewhat disagree/neither agree nor disagree	101	29	44	30	15	
strongly/somewhat agree	150	43	18	37	68	
Listed as an author on published scientific paper in med school?						<.001
never/once or twice	188	54	71	54	41	
yes, several	159	46	29	46	59	
Felt performance was judged more closely than others						.26
strongly /somewhat disagree/neither agree nor disagree	302	85	90	87	82	
strongly/somewhat agree	52	15	10	13	18	
Satisfied with the progress in your career?						.02
very satisfied/somewhat satisfied	316	91	86	89	96	

Characteristics	overall (n=358)		not involved (n=106)	involved in a limited way; somewhat involved (n=117)	significant involved; exclusively (n=125)	
	n	*column %*	*column %*	*column %*	*column %*	*P*
somewhat unsatisfied/very unsatisfied	33	9	14	11	4	
How close is what you are doing now compared to what you anticipated you would be doing at the end of medical school?						.64
Almost identical to what I anticipated doing/ Generally similar to what I anticipated doing	232	67	68	63	69	
Generally dissimilar to what I anticipated doing/Not at all what I anticipated doing	116	33	32	37	31	
Looking back, if you could choose your career path again, would you make change in the decisions you made?						.048
Make no changes at all	194	56	51	55	61	
Alter several of the decisions I made	128	37	36	41	33	
Make major changes in the path I took	26	7	13	3	6	

Table 2

Multivariable ordinal regression analysis of current level of research involvement among Harvard Medical School alumni

Characteristics	OR	95%CI		P
Current age, years				
<45	1.00	reference		
≥45	1.13	0.69	1.86	.62
unknown	0.63	0.15	2.67	.54
Female-Sex	0.33	0.18	0.62	<.001
URiM	0.37	0.19	0.72	.004
Amount of medical school debt at the time of graduation from HMS	0.88	0.81	0.96	.005
Attitude index score	1.38	1.18	1.63	<.001
Social norms index score				
weak	1.00	reference		
moderate	2.74	1.56	4.83	<.001
high	3.26	1.77	6.00	<.001
unknown	1.33	0.57	3.10	.51
Felt performance was judged more closely than others				
strongly /somewhat disagree/neither agree nor disagree	1.00	reference		
strongly/somewhat agree	2.05	1.03	4.06	.04
Mentor encouraged research				
no mentor	0.39	0.22	0.69	.001
strongly /somewhat disagree/neither agree nor disagree	0.34	0.19	0.62	<.001
strongly/somewhat agree	1.00	reference		
During time in medical school, listed as an author on published paper scientific paper?				
never/once or twice	1.00	reference		
yes, several	0.82	0.45	1.51	.53
INTERACTION TERM: Female X Coauthored several publications	2.53	1.00	6.40	.05