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Title

Attractions and barriers to Australian physician-researcher careers

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Abstract

Background: There is a global concern that physician-researchers are "a dying breed." Recent studies of clinical career choices of Australian medical students and doctors have signalled the rising age of medical graduates, generational shifts in work-life attitudes, and increased proportion of female graduates. There are scant data regarding Australian physician-researchers.

Aims: To develop and utilise a questionnaire determining respondent characteristics and 'push and pull' factors for medical graduates to incorporate research into their careers.

Methods: We developed and administered an 88-item online survey, including quantitative and qualitative questions, to medical students, faculty and alumni of Sydney Medical School, The University of Sydney, asking about their medical career, research experience and interest and reasons for doing or not doing medical research. Responses to all 74 quantitative questions are reported herein.

Results: Data from 427 respondents (44% female; mean±SD age 38±13 years; 56% completed or undertaking a PhD) were analysed. Attractions of research included a desire to improve human health, intellectual stimulation and career diversity. Barriers related to low funding rates, job insecurity and low salaries. Although few were prepared to undertake or recommend full-time research, 71% would recommend part-time research. Respondents perceived a smaller than actual gap between clinical and research salaries, and if comparable

(75-100% of a clinician's) salaries were available, 89% would like to spend 21-60% work-time undertaking research.

Conclusion: Many Australian medical students and doctors are interested in research, especially part-time. Perceived obstacles include job insecurity, low funding rates and salary. Respondents underestimated clinical and research salary differences.

Introduction

Australian medical innovations, including revealing the link between Helicobacter pylori and peptic ulcers, the cochlear implant and the human papilloma virus vaccine have improved lives globally.[1-3] Due to their training and patient interactions, physician-researchers are well-placed to develop, conduct, evaluate and translate research to improve human health. Yet, in recent decades, concerns have been expressed that physician-researchers are "a dying breed" or "an endangered species."[4-12] Some potential attractions and barriers for medical students and doctors to be active (or inactive) in medical research are shown in Table 1.

Physician-researchers are medical graduates who undertake medical research in a basic science laboratory or in patient-based research, or a combination thereof. In addition to their medical degree, and often specialty ('Fellowship') training, physician-researchers usually complete two to four years full-time (or equivalent part-time) research towards a higher research degree, such as an MD, DMedSci or PhD, then several years of postdoctoral training. During and after their postdoctoral years, physician-researchers typically work clinically and in research – often varying the fractions throughout their careers. Valued non-

physician scientists currently dominate the medical research field in Australia and physician representation in the life-sciences is shrinking.[7,13] Our published data regarding Australian physician-researchers demonstrate declining physician-researcher led funding success on National Health and Medical Research Council (NHMRC) Project Grants since 1990 to H21% of all such awards commencing in 2014.[14,15] There is little information relating to attitudes towards medical research careers among Australian medical students and graduates.

This study describes quantitative elements of an online survey of Sydney Medical School (SMS) medical students and medical practitioners, aiming to explore push and pull factors influencing whether they undertake medical research. We also compared responses from those who have enrolled in or completed a PhD with those who have not.

Materials and Methods

Participants

Ethics approval was provided by The University of Sydney Human Research Ethics Committee. Participants were recruited from SMS, The University of Sydney, via email. Participants were medical students, medical graduates or alumni on the SMS email list, an existing regular communication device from the Dean of Medicine (formerly, B.G.R.). Approximately 4200 individuals comprising 1200 medical students and 3000 others, including an unspecified number of medical practitioners, scientists, teaching and administrative staff were emailed. However, the number of recipients who were not medically qualified or studying medicine, and thus ineligible to participate in the study, could not be determined as these data were not available for the faculty mailing list. Participants

were self-identified medical students or medical graduates who voluntarily responded to the online questionnaire, which was anonymous and without reimbursement. Eligible survey respondents were divided into PhD and No PhD groups, with the former including medical graduates who had either completed or were currently enroled in a PhD or higher doctorate degree.

Questionnaire development

An 88-item questionnaire was developed using Google Forms, a web-based survey application (J.M.Z.M.). Questions were developed based on a literature review and feedback from physician-researchers (including A.J.J., A.C.K., A.S.J. and B.G.R.), medical practitioners, physician/PhD students and medical students. The survey could be completed in <15 minutes.

Quantitative questions were mostly formulated as propositions with a seven-point response scale ranging from 1 (*'strongly disagree'*) to 7 (*'strongly agree'*). For reporting purposes, responses have been aggregated into Disagree (score 1-3, strongly to mildly), Neutral/Undecided (score 4), and Agree (score 5-7, mildly to strongly). Qualitative questions (not reported herein) consisted of free-text boxes asking respondents to list factors that encouraged and discouraged their pursuit of medical research, feedback and comments, and will be the subject of a future thematic research analysis.

Procedure

A web-link to the online questionnaire was included in an email from the SMS Dean (B.G.R.) sent in July 2014, with three reminders spaced one week apart. There was no further

contact with email recipients. Survey data were exported into Microsoft Excel and manually verified.

The following quantitative sections comprising 74 items were analysed: demographics (41 items), reasons for undertaking medical research (1 item), experience with and perceptions of a research career (8 items), perspectives on research job security (12 items), perceived opportunities for medical research (4 items), willingness to do future research and salary expectations (8 items).

Statistical analysis

Data were analysed using IBM SPSS Statistics 22.0. Differences in continuous variables between two groups were compared using t-test or Mann-Whitney U test. Proportions between groups were compared using Ç2 test. Two-sided statistical significance was drawn at $p<0.05$.

Results

Respondent characteristics

There were 427 eligible respondents (five additional respondents were excluded as they reported they were neither medical students nor medical practitioners). Medical students (n=161) and qualified doctors (n=266) comprised 38% and 62% of the final sample, respectively. Thirty-two responding doctors were junior (intern to registrar levels), 203 had completed Specialist or General Practice training, nine were clinical fellows, 10 were research fellows, and 12 were not currently practicing in either medicine or medical research.

The 266 doctor respondents reported working (mean ± SD) 46 ± 19 hours per week with 248 doctors (93%) reporting current research activity. Of the research active doctors 35% reported spending 1-20% of their work-week on research; 20% reported spending 21-40% of their work-week on research, and 24% reported spending over 60% of their work-week on research. Hence, the majority (55%) of research active doctors are spending most of their time on clinical activities.

Over half (56%) of the respondents were undertaking or had completed a PhD. Respondent demographics, including by PhD status: 'No PhD' (n=190) or 'PhD' (n=237) are summarised in Table 2. Within the 'No PhD' group, 44% indicated that they intended to undertake a PhD in the future. Relative to the 'No PhD' group, of whom 69% were current medical students, the PhD group worked more hours per week (44±21 vs. 22±24; $p<0.0001$) and supported more (adult and child) dependents (1.5 vs. 0.4; $p<0.0001$). Significantly more of the PhD group had attained Fellowship of a specialist college than the 'No PhD' group (76% vs. 25%; $p<0.0001$), and also attained other post-baccalaureate qualifications such as Masters, postgraduate diplomas or certificates (60% vs. 42%; $p=0.003$).

Overall, 227 (53%) of the respondents had completed an undergraduate-entry medical programme. Within this group, 24% stated that their undergraduate medical degree included research experience.

Research involvement

Overall, 85% of all respondents declared having medical research experience, with those in the PhD group reporting more experience as measured by current research involvement (224/237 or 95%) and career research output (Table 2). In the 'No PhD' group,

31% (58/190) did not have any research experience. Among those in the 'No PhD' group currently involved in research, 53% (100/190) spent up to 20% of their work week doing research and only 4% (7/190) spent 80% or more of their work week doing research. In the PhD group, these figures were 35% and 17% respectively ($p<0.0001$).

Respondents involved in research, without a PhD (n=100) generally became involved earlier in their careers than those with a PhD (n=224): started before medical school (No PhD vs. PhD: 23% vs. 13%; $p=0.02$), by the end of medical school (44% vs. 32%; $p=0.04$), by the end of registrar training (12% vs. 23%; $p=0.02$), by the end of Fellowship (4% vs. 11%; $p=0.04$) and after completing Fellowship (7% vs. 7%; $p=0.95$).

Reasons for undertaking medical research

Among those who had prior research exposure and answered the questions about their motivations to undertake a PhD and/or medical research (n=358; comprising PhD group, n = 230 and 'No PhD' group, n=128) the most frequent reason given was 'to contribute to improvements in medical knowledge and advancing therapies' (78%, Figure 1). This was in turn followed by 'to broaden the scope of my medical career' (66%), 'interest in a medical research career' (61%), 'availability of interesting projects' (55%), 'influenced by an academic role model (49%), 'thought it might be helpful for my medical studies or clinical practice' (40%), 'to enter a competitive specialty or training programme' (32%), 'persuaded by an enthusiastic mentor (25%), 'medical research is prestigious' (18%) and 'recommended by others' (11%). The least common reason given for undertaking a PhD and/or medical research was 'to earn money' (3%).

A significantly greater proportion of respondents in the No PhD group compared with the PhD group reported that they did research because they wanted 'to enter a competitive specialty/training' (48% vs. 24%; $p<0.0001$) or because they 'thought it might be helpful for my medical studies or clinical practice' (54% vs. 33%; $p<0.0001$). More respondents in the PhD group, compared with 'No PhD' group, indicated that they did research because they were 'interested in a medical research career' (68% vs. 49%; $p=0.0004$) or were 'influenced by an academic role model' (54% vs. 41%; $p=0.02$).

Attitudes towards medical research

The relative perceptions of a medical research career by all respondents and subdivided by PhD status are shown in Table 3. In general, 88% of the cohort regarded research as a relevant part of medical training, 86% agreed that a doctor's practice is enhanced by undertaking research and 87% agreed that medical research appeals to their pursuit of scholarly interests. Most respondents (57%) agreed that medical research appealed to their preference for autonomy and less than one-third (29%) agreed that medical research appeals to their interests in a managerial role . Although over 80% of respondents agreed that medical research appeals to their desire to serve the community , only 49% agreed that medical research is a lifestyle friendly career , and fewer among those with, than without, a PhD (45% vs. 54%; $p=0.06$). A majority (67%) indicated that they have experienced barriers to getting involved in research.

Barriers to medical research

Perspectives of job security in a medical research career are outlined in Table 4. Most respondents (69%) agreed that medical researcher is prestigious and 51% agreed that it is

compatible with family responsibilities. Respondents would generally recommend medical students and doctors undertake medical research on a part-time (71%), but not a full-time basis (16%).

Overall, 40% of respondents did not think that doctors who undertake medical research have a good work-life balance. The majority of respondents (86%) did not perceive medical research as a financially rewarding career and 91% were not motivated by the financial incentives of a medical research career.

A significantly higher proportion of the PhD than 'No PhD' group disagreed with the statement that 'doctors who undertake medical research have a balanced lifestyle' (47% vs. 32%, p=0.001). More people in the PhD than No PhD group perceived that medical research is not a financially rewarding career (90% vs. 80%, p =0.002).

Research experience by PhD status

Over 72% of respondents perceived that they have many opportunities for medical research, 71% agreed that they have adequate training in research methodology to undertake medical research, and 70% agreed that that they were able to find a research mentor or supervisor easily (Table 5). Just over half (52%) of respondents agreed that they had adequate time to undertake medical research.

Regarding expectations for a future medical research career, 81% of respondents planned to pursue medical research part-time (i.e. <70% full-time equivalent), but only 11% on a full-time basis (Table 6). Compared to the 'No PhD' group, the PhD group was significantly more interested in doing full-time research (2% vs. 18%; $p<0.0001$).

Overall, 75% of respondents were interested in a long-term medical research career

and 86% planned to be involved in research throughout their career. Most respondents (86%) believed that publications are important for progressing in training or their chosen clinical specialty, and a large proportion (79%) indicated that their ideal/chosen clinical specialty gives opportunities for medical research. The No PhD group was significantly less likely than the PhD group to report a desire to become involved in research during their medical career (77% vs. 93%; p <0.0001).

Salary expectations of a medical research career

Beliefs regarding salary for clinicians undertaking medical research versus clinical duties are shown in Figure 2. In general, respondents indicated awareness that full-time medical researchers earned less than full-time clinicians in private or public hospital practice. As seen in Figure 2A, 68% of the PhD group posited that a full-time medical researcher earned <50% salary compared to a full-time clinician in private practice. By contrast, the 'No PhD' group was divided – with 49% of the group estimating the percentage salary was <50% and the rest indicating that it was between 50% and 150%. Figure 2B shows that a greater overall proportion of the PhD than the No PhD group believed that a full-time medical researcher earned d75% salary of a full-time clinician in public hospital practice (93% vs. 81%; p=0.0003).

The willingness to do research by comparative salary of a full-time medical researcher and full-time clinician is shown in Figure 3. As seen in Figure 3A, 43% 'No PhD' and 50% of the PhD group are willing to do full-time research for d75% of a full-time clinician salary (p=0.19). If the salary as a researcher was equal to that of a clinician, the percentage of people willing to do full-time research (e0.7 FTE) rises to 87% and 96% of the

'No PhD' and PhD groups, respectively. Figure 3B shows that if researcher and clinician salaries were equal then only 9% "No PhD" vs. 31% PhD would like to spend more than 60% of their time doing research, with the PhD group preferring to spend significantly more time doing research than the 'No PhD' group ($p<0.0001$).

Discussion

We report quantitative data from an online survey administered to medical students and practitioners affiliated with The University of Sydney, Sydney Medical School assessing the push and pull factors for incorporating research in a medical career. Broadly, our results show that perceived attractions of medical research include the opportunity to contribute to improved human health, perceived scholarly appeal, lifestyle and family friendliness of medical research, while perceived barriers include job insecurity, low grant funding rates and lower comparative salary than for a clinical career.

In this era of evidence-based medicine, most medical students and doctors are exposed to research methodology during training. The majority of our sample comprised medical professionals with or undertaking a PhD (55%). Among those who did not have PhDs, 72% currently or had previously been involved in research and 44% intended to undertake a PhD in future. These percentages are likely higher than for doctors in the national population, but we speculate are typical for doctors and medical students currently associated with a medical school. Our data show that research interest is strong, and most people perceived that they had many opportunities, adequate time, and adequate training in research methodology to undertake medical research. Notably, those in the 'No PhD' group showed

greater optimism compared to the PhD group in relation to their perceived ability and opportunity for undertaking a research career.

In a 2016 survey of 19 Australian medical schools by the Medical Deans of Australia and New Zealand, 62% of exiting students expressed interest in medical research (up from 54% in 2011).[15] Our findings agree with trends reported in other national and overseas studies, demonstrating that greater research exposure prior to and during medical school encourages interest in a physician researcher career.[16,17,32] As reflected in our survey, many Australian medical students and graduates have research experience and express interest in research, suggesting there is a prime opportunity for promoting medical research careers. Given the declining funding rates and researcher vs. clinician salary gaps across career-stage,[14,28,29] it is important that potential physician-researchers, like the patients they treat, be fully informed, in this case, as to the rewards and challenges of medical research.

Prior to 1996, Australian medical degrees were six-year undergraduate entry programmes. Today, 12/19 Australian medical schools offer a four-year graduate entry programmme.[18,19] Representing a change in the medical education landscape, students from SMS, which has been graduate-entry since 1997, who completed the survey comprised 38% of the sample and 19% of the PhD group. Our respondent demographics also captured this shift towards post-baccalaureate medical degrees, as seen by fewer respondents from undergraduate compared to graduate entry programmes (53% vs. 63%). Consequently, the average age of respondents was H39 years old. Indeed, there has been a considerable ageing of commencing medical students within Australia, with a rising proportion of e25 year olds from 6.9% to 18.4% observed between 1989 and 2012.[20,21] New graduates are now older and

at later life stages, which will potentially impact clinical and research workforce patterns and influence research training and continuation choices.

Generational differences are emerging in the rankings of perceived lifestyle friendliness and prestige of medical specialties between Australian medical students and practitioners.[13] Australian medical graduates now decide their specialty earlier in their careers compared to pre-1996 graduates.[22] Both the higher expense of university education and older age of doctors entering the workforce may account for the relative attractiveness of financially more lucrative specialties.[23] Moreover, high competition for clinical training positions means that a PhD may have value as an entry aid or alternate career. Australian surveys show a high level of interest in medical research during and shortly after medical school.[24-26,32] It is unclear what impact the move from undergraduate to graduate medical education will have on medical research career decisions.

Perceived job uncertainty and lower salaries of medical research compared to clinical careers pose a barrier for many to do research. The majority of respondents thought that medical researchers earned d50% salary of a clinician in private practice and many thought that medical researchers earned d50% salary of a clinician in public hospital practice (Fig. 2B). Based on our recent review of physician-researcher pay scales from the Australian NHMRC, university, and public hospital appointments from entry to senior level career stages, the salary of a medical researcher is 22-33% that of a public hospital clinician.[14] Even greater differentials are likely between clinicians in medical research compared to those in private practice. Our results show that only 16% PhD and 10% No PhD groups would be

willing to do research at d50% salary of a clinician (Fig 3A). One wonders what these percentages would be at the real salary differential.

These attitudes are perhaps reflected in 2015 national statistics showing that only 1.3% of the 102,805 registered medical practitioners in Australia were engaged in full- or near full-time research.[27] Set against this is also the reality of declining grant funding, where the number of NHMRC Project Grant applications has more than doubled and funding success rates have fallen from 35% in 1990 to 16% in 2017, with physician-researchers leading only about 1 in 5 Project Grants commencing in 2014, and with only about 1 in 5 of these physician researchers being female.[14,28,29] Such trends in declining salary and funding rates may continue to negatively impact research careers in the long run. The new $20 billion Medical Research Future Fund (MRFF) and imminent restructuring of the NHMRC grant funding programs may help to address this decline.[30, 31]

Strengths and limitations

We believe this research is novel in Australia and adds to a small body of knowledge from overseas related to drivers and barriers for medical research. The research is timely due to the restructuring of our major research funding body, the NHMRC, [31] emergence of the MRFF, [30] the emphasis on evidence from medical research in contemporary medical education, and declining rates of medical practitioner-led NHMRC Project Grants.[14] In our study, both genders and medical practitioners with and without research experience were well-represented, and covered a wide age range across career stages.

Study limitations include selection biases, with only SMS alumni (medical students, graduates, staff and other alumni) being eligible, with recruitment by email and online

anonymous survey completion only, together with the modest sample size. The absence of a clear denominator as to the numbers of medical alumni on the mailing list (as medical practitioner status information is not held on the database) prevents us from assessing the survey response rate among eligible email recipients, as well as whether the proportions of medical students vs. graduates who responded were different. Furthermore, while the anonimity may have garnered responses that more genuinely reflected participant feelings, it also prevented the opportunity for any direct communication with email recipients to encourage survey completion. There was also an uneven career stage distribution of respondents, with relatively smaller representation of early career doctors. Additionally, some survey questions may have been subject to interpretation bias, although participants were given the option of not responding if any ambiguity was perceived.

Future directions

We are analysing the related qualitative survey question results and additional comments, which, in general, support the quantitative responses. A similar, but larger-scale, Australia-wide survey of medical students and clinicians, comparisons with other countries, and comparisons with the experience of non-medically qualified medical researchers would be of great interest. Ultimately, instigating action to accurately inform potential physician-researchers regarding the attractions and barriers to medical research careers is desirable, and to implement strategies to reverse current concerning trends if Australia is to remain a leader in medical research into the foreseeable future.

Conclusions

Our quantitative survey results confirm, we believe for the first time, that for Australian physician-researchers the attractions and barriers to medical research align well with those postulated by previous opinion pieces. We have also identified that a high proportion of medical students and clinicians are keen to include medical research in their career, or encourage junior colleagues to do so, predominantly for altruistic reasons, though usually on a part-time basis, and only if there is a much smaller salary gap than currently exists between clinical and research salaries. In particular, job security, funding rates and salary issues need to be addressed if current and future Australian physician-researchers are to continue our proud history of globally important innovations in healthcare.

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Author Roles

(1) Research Project: A. Conception; B. Organisation; C. Execution; (2) Statistical Analysis: A. Design; B. Execution; C. Review and Critique; (3) Manuscript Preparation: A. Conceptualisation; B. Writing of the first draft; C. Review and Critique.

J.M.Z.M.: 1A, 1B, 1C, 2A, 2B, 2C, 3A, 3B, 3C

A.S.J.: 2A, 2B, 2C, 3C

B.G.R.: 1A, 1B, 2C, 3C

C.L.T.: 2C, 3C

A.J.J.: 1A, 1B, 1C, 2A, 2C, 3A, 3B, 3C

A.C.K.: 1A, 1B, 1C, 2A, 2C, 3A, 3C

Conflicts of Interest

None identified

Table and Figure Legends

Table 1. Potential attractions and barriers for medical practitioners doing research

Table 2. Characteristics of survey respondents, including the 'No PhD' and PhD subgroups

Table 3. Perceptions of a medical research career

Table 4. Perspectives of job security in a medical research career

Table 5. Perceived opportunities for undertaking a research career

Table 6. Expectations for pursuing a future medical research career

Figure 1. Reasons for undertaking a PhD and/or medical research in general [n = 358, multiple reasons could be recorded]. The black and white bars represent response measures for PhD (n=230) and 'No PhD' (n=128) groups, respectively.

Figure 2. Current beliefs regarding salary of medical researchers compared to clinicians.
The black and white bars represent response measures for PhD and 'No PhD' groups, respectively. (A) Perceived percentage salary of a full-time medical researcher compared to a full-time clinician in private practice. (B) Perceived percentage salary of a full-time medical researcher compared to a full-time clinician in a public hospital practice.

Figure 3. Willingness to do research by comparative salary. The black and white bars represent response measures for the PhD and 'No PhD' groups, respectively. (A) "Percentage of a clinician salary for which the respondent would be willing to pursue full-time medical research. (B) Percentage time in a work-week that the repondent would be prepared to spend doing research if clinician and researcher were equal. .

Table 1.

Potential attractions	**Potential barriers**
Evidence-based medicine era where many are exposed to and interested in research	Need for years of formal research training
Opportunity to better understand health and disease	Costs of university degrees and fees owed from previous education
Opportunity to improve health outcomes	Low research funding rates
Intellectual stimulation	Job insecurity relative to a clinical career
Career diversity	Salary gap between research and clinical careers (with lower salaries for researchers)
Flexibility in work times	Work-life attitudes and demands and lifestyle preferences
Opportunities for overseas study / work	Age and other life demands: Medical graduates are older and at later life stages
Team work and collaborative opportunities	Large amount of time required on grant writing and various regulatory (e.g. ethics) applications and administrative activities.
Desire for a university or teaching hospital appointment	
Increase chance of entry into competitive training programmes	

Table 2.

	All (n = 427)	No PhD (n = 190)	PhD (n = 237)	No PhD vs. PhD, *P*-value
Demographic details				
Age, years	39 ± 13	32 ± 11	44 ± 11	**<0.0001**
Australian citizens (%)	386 (91%)	170 (90%)	216 (91%)	0.47
Gender, female/male, (%female)	189/238 (44%)	92/98 (48%)	97/140 (41%)	0.12
Respondents with full time employed spouse (%full-time)	159 (37%)	53 (28%)	106 (45%)	**0.001**
Respondents with dependents, (N / %)	190 / 45%	38 / 20%	152 / 65%	**<0.0001**
Paid work per week, hours	34.5 ± 24.6	22.4 ± 23.7	44.1 ± 20.7	**<0.0001**
Training stage, student/doctor, (%student)	161/266 (38%)	131/59 (69%)	30/207 (13%)	**<0.0001**
Years since medical degree	13 ± 14	5 ± 12	19 ± 13	**<0.0001**
Post-PhD, years	-	-	7 ± 10	-
Tertiary level qualifications				
Medical degree, undergrad / graduate entry (%undergrad)	227/200 (53%)	49/141 (26%)	178/59 (75%)	**<0.0001**
Masters degree (%)	171 (40%)	64 (34%)	107 (45%)	**0.02**
Postgraduate diploma (%)	108 (23%)	31 (16%)	77 (32%)	**0.0001**
Specialty fellowship (%)	227 (53%)	47 (25%)	180 (76%)	**<0.0001**
Medical research experience				
No prior experience (%)	65 (15%)	58 (31%)	7 (3%)	**<0.0001**
Currently active (%)	324 (76%)	100 (53%)	224 (95%)	**<0.0001**
Career research output				

No publications	126 (30%)	108 (57%)	18 (8%)	**<0.0001**
d10 publications (%)	82 (19%)	46 (24%)	36 (15%)	**<0.0001**
11 – 30 publications (%)	49 (11%)	14 (7%)	35 (15%)	0.31
31 – 60 publications (%)	68 (16%)	12 (6%)	56 (24%)	0.26
>60 publications (%)	102 (24%)	10 (5%)	92 (39%)	**0.0003**

Survey respondents were subdivided into two groups ('No PhD' and PhD) depending on whether they reported being enrolled in or having completed a higher doctorate degree. Publications refer to a combination of original research, review articles, and editorials..

Table 3.

	N	Disagree, mildly to strongly (%)	Neutral/ undecided (%)	Agree, mildly to strongly (%)	*P*-value
Research is not a relevant part of medical training					0.21
All	425	375 (88%)	19 (4%)	31 (7%)	
No PhD	188	158 (84%)	13 (7%)	17 (9%)	
PhD	237	217 (92%)	6 (3%)	14 (6%)	
A doctor's practice is enhanced by undertaking medical research					**0.005**
All	425	24 (6%)	37 (9%)	364 (86%)	
No PhD	188	14 (7%)	23 (12%)	151 (80%)	
PhD	237	10 (4%)	14 (6%)	213 (90%)	
Medical research is a lifestyle friendly career					0.06
All	425	141 (33%)	75 (18%)	209 (49%)	
No PhD	188	46 (25%)	40 (21%)	102 (54%)	
PhD	237	95 (40%)	35 (15%)	107 (45%)	
Medical research appeals to my pursuit of scholarly interests					**<0.0001**
All	423	32 (8%)	23 (5%)	368 (87%)	
No PhD	187	28 (15%)	15 (8%)	144 (77%)	
PhD	236	4 (2%)	8 (3%)	224 (95%)	
Medical research appeals to my interests in a managerial role					**<0.0001**
All	425	198 (47%)	103 (24%)	124 (29%)	
No PhD	188	102 (54%)	50 (27%)	36 (19%)	
PhD	237	96 (41%)	53 (22%)	88 (37%)	
Medical research appeals to my preference for autonomy in the workplace					**<0.0001**
All	423	87 (21%)	94 (22%)	242 (57%)	
No PhD	187	50 (27%)	50 (27%)	87 (47%)	
PhD	236	37 (16%)	44 (19%)	155 (66%)	
Medical research appeals to my desire to serve the community					**0.008**
All	423	40 (9%)	42 (10%)	341 (81%)	
No PhD	187	28 (15%)	19 (10%)	140 (75%)	
PhD	236	12 (5%)	23 (10%)	201 (85%)	
I have experienced barriers to getting involved in medical research					**0.02**

All	420	92 (22%)	47 (11%)	281 (67%)
No PhD	184	40 (22%)	32 (17%)	112 (61%)
PhD	236	52 (22%)	15 (6%)	169 (72%)

P-values shown represent comparisons between agree and disagree/neutral responses in No PhD vs. PhD groups.

Table 4.

	N	Disagree, mildly to strongly (%)	Neutral/ undecided (%)	Agree, mildly to strongly (%)	*P*-value
Being a medical researcher is a prestigious profession					0.91
All	425	71 (17%)	60 (14%)	294 (69%)	
No PhD	188	31 (16%)	27 (14%)	130 (69%)	
PhD	237	40 (17%)	33 (14%)	164 (69%)	
Medical research is a financially rewarding career					**0.002**
All	425	364 (86%)	43 (10%)	18 (4%)	
No PhD	188	150 (80%)	31 (16%)	7 (4%)	
PhD	237	214 (90%)	12 (5%)	11 (5%)	
I am motivated by financial incentives of a medical research career					0.66
All	424	385 (91%)	23 (5%)	16 (4%)	
No PhD	188	172 (91%)	9 (5%)	7 (4%)	
PhD	236	213 (90%)	14 (6%)	9 (4%)	
Doctors who undertake medical research have a good work-life balance					**0.0002**
All	422	169 (40%)	111 (26%)	14 (33%)	
No PhD	187	59 (32%)	61 (33%)	67 (36%)	
PhD	235	110 (47%)	50 (21%)	75 (32%)	
Medical research is compatible with family responsibilities					**0.02**
All	423	122 (29%)	84 (20%)	21 (51%)	
No PhD	187	43 (23%)	42 (23%)	102 (55%)	
PhD	236	79 (34%)	42 (18%)	115 (49%)	
I would recommend medical students or doctors undertake medical research on a part-time basis					0.92
All	407	38 (9%)	82 (20%)	287 (71%)	
No PhD	179	17 (10%)	44 (25%)	118 (66%)	
PhD	228	21 (9%)	38 (17%)	169 (74%)	

I would recommend medical students or doctors undertake medical research on a full-time basis				0.31
All	351	185 (53%)	110 (31%)	56 (16%)
No PhD	158	88 (56%)	57 (36%)	13 (8%)
PhD	193	97 (50%)	53 (27%)	43 (22%)

P-values shown represent comparisons between disagree and agree/neutral responses in 'No PhD' vs. PhD groups.

Table 5.

	N	Disagree, mildly to strongly (%)	Neutral/ undecided (%)	Agree, mildly to strongly (%)	*P*-value
I have many opportunities to undertake medical research					**0.0005**
All	423	86 (20%)	31 (7%)	306 (72%)	
No PhD	188	49 (26%)	19 (10%)	120 (64%)	
PhD	235	37 (16%)	12 (5%)	186 (79%)	
I have (or could make) adequate time to undertake medical research					0.28
All	422	182 (43%)	21 (5%)	219 (52%)	
No PhD	186	87 (47%)	8 (4%)	91 (49%)	
PhD	236	95 (40%)	13 (6%)	128 (54%)	
I have adequate training in research methodology to undertake medical research					**<0.0001**
All	424	98 (23%)	24 (6%)	302 (71%)	
No PhD	188	69 (37%)	14 (7%)	105 (56%)	
PhD	236	29 (12%)	10 (4%)	197 (83%)	
I am (or was) able to find a research mentor or supervisor easily					**0.0002**
All	388	77 (20%)	38 (10%)	273 (70%)	
No PhD	157	38 (24%)	25 (16%)	94 (60%)	
PhD	231	39 (17%)	13 (6%)	179 (77%)	

P-values shown represent comparisons between agree and disagree/neutral responses in 'No PhD' vs. PhD groups.

Table 6.

	N	Disagree, mildly to strongly (%)	Neutral/ undecided (%)	Agree, mildly to strongly (%)	*P*-value
I plan to pursue medical research on a part-time basis [<70% of FTE]					0.06
All	408	48 (12%)	29 (7%)	331 (81%)	
No PhD	184	21 (11%)	21 (11%)	142 (77%)	
PhD	224	27 (12%)	8 (4%)	189 (84%)	
I plan to pursue medical research on a full-time basis [e 70% of FTE]					**<0.0001**
All	339	277 (82%)	25 (7%)	37 (11%)	
No PhD	154	141 (92%)	10 (6%)	3 (2%)	
PhD	185	136 (74%)	15 (8%)	34 (18%)	
I am interested in a long-term, full- or part-time, medical research career					**<0.0001**
All	423	70 (17%)	38 (9%)	315 (74%)	
No PhD	186	53 (28%)	27 (15%)	106 (57%)	
PhD	237	17 (7%)	11 (5%)	209 (88%)	
I obtained a higher doctoral degree to pursue a medical research career					**<0.0001**
All	266	57 (21%)	37 (14%)	172 (65%)	
No PhD	58	33 (57%)	22 (38%)	3 (5%)	
PhD	208	24 (12%)	15 (7%)	169 (81%)	
I believe that publications are important for progressing in training or chosen clinical specialty					**0.005**
All	420	39 (9%)	18 (4%)	363 (86%)	
No PhD	185	23 (12%)	12 (6%)	150 (81%)	
PhD	235	16 (7%)	6 (3%)	213 (91%)	
I plan to be involved in full- or part-time research throughout my medical career					**<0.0001**
All	421	31 (7%)	28 (7%)	362 (86%)	
No PhD	184	25 (14%)	18 (10%)	141 (77%)	
PhD	237	6 (3%)	10 (4%)	221 (93%)	
My ideal/chosen clinical specialty gives opportunities for medical research					**0.002**
All	395	37 (9%)	44 (11%)	314 (79%)	
No PhD	165	16 (10%)	30 (18%)	119 (72%)	
PhD	230	21 (9%)	14 (6%)	195 (85%)	

P-values shown represent comparisons between agree and disagree/neutral responses in No PhD vs. PhD groups.
Abbreviation: FTE – full-time equivalent

Figure 1.

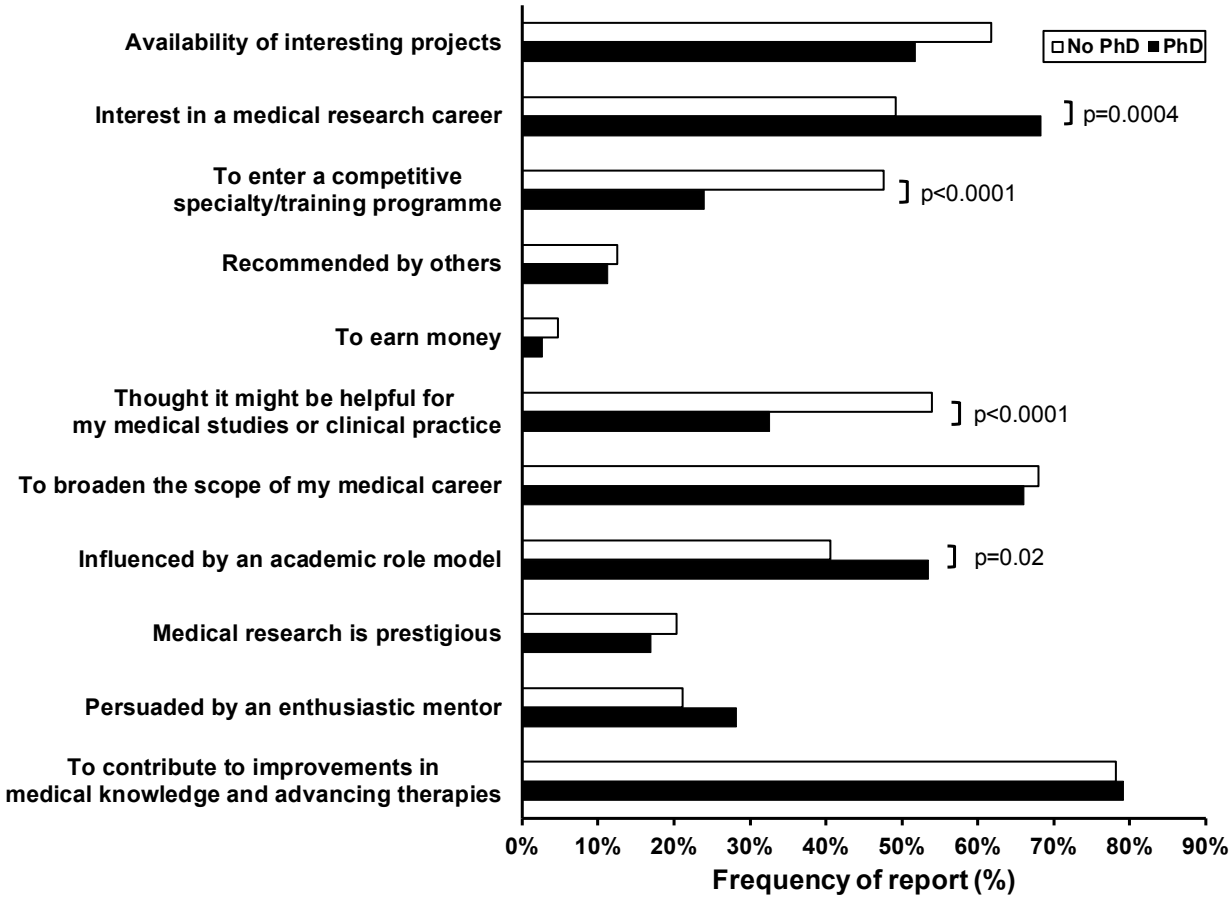
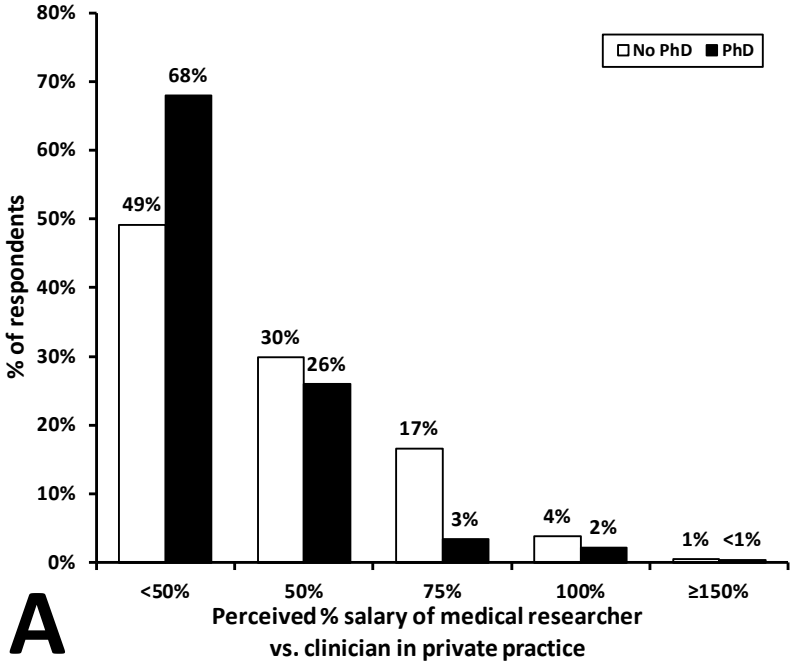


Figure 2.



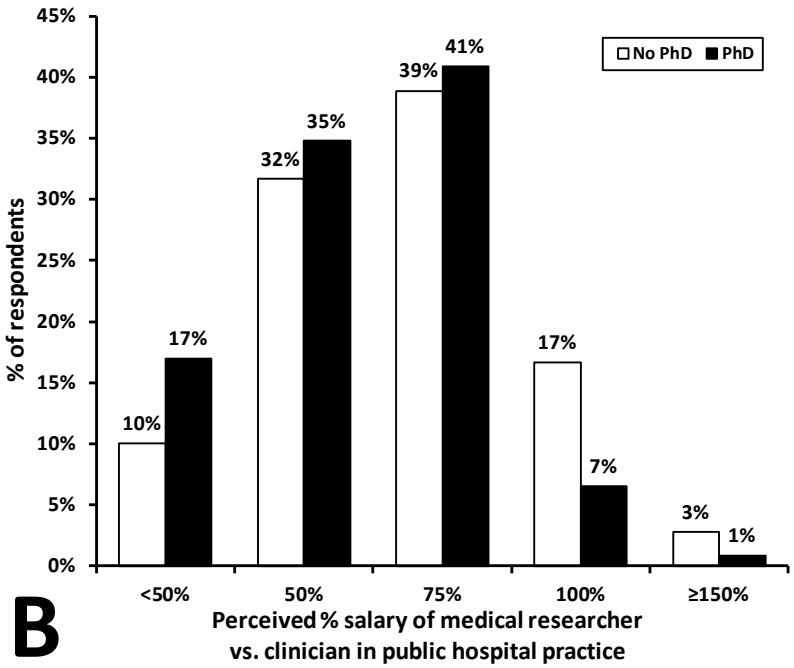
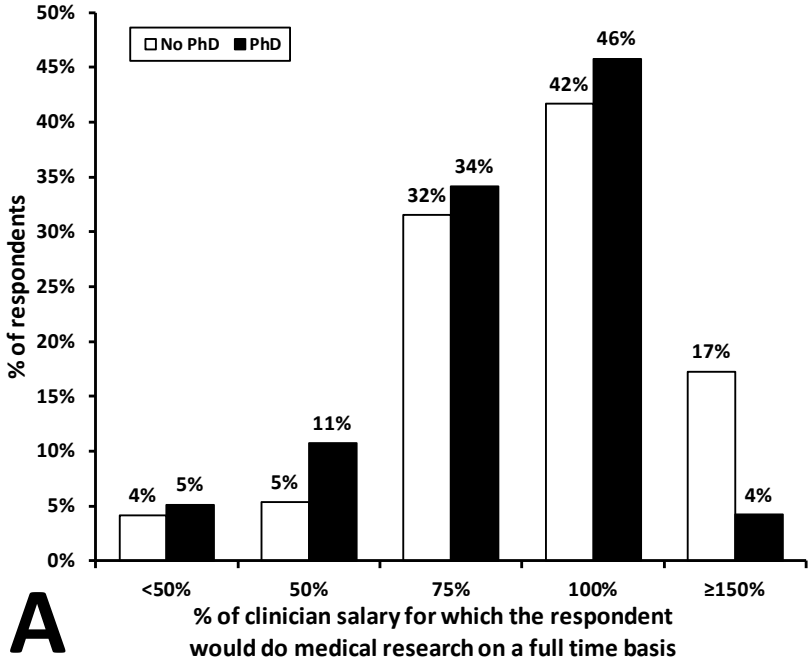
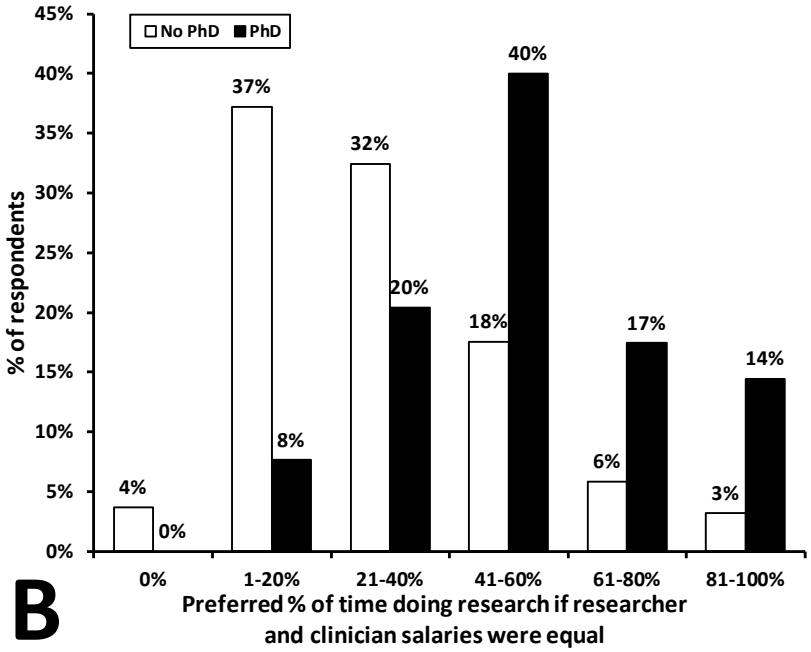
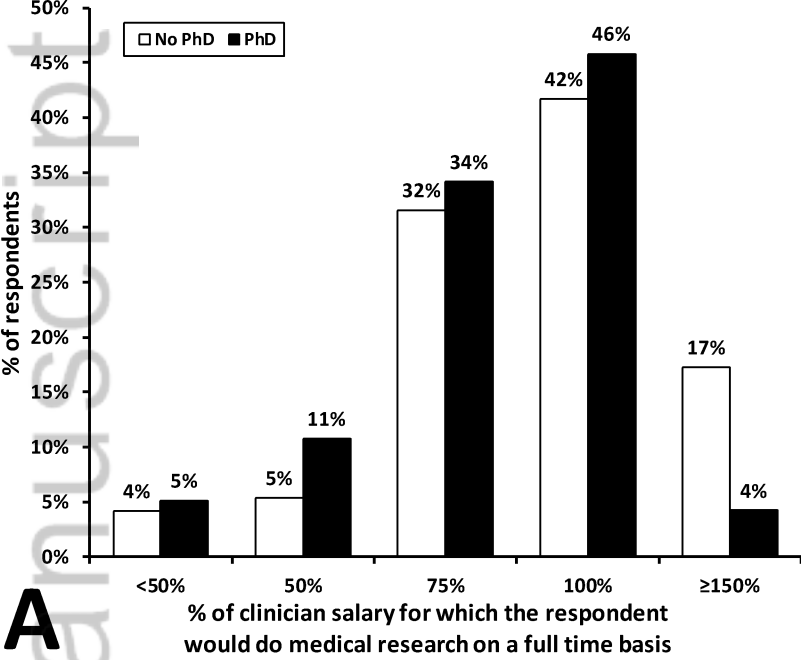


Figure 3.







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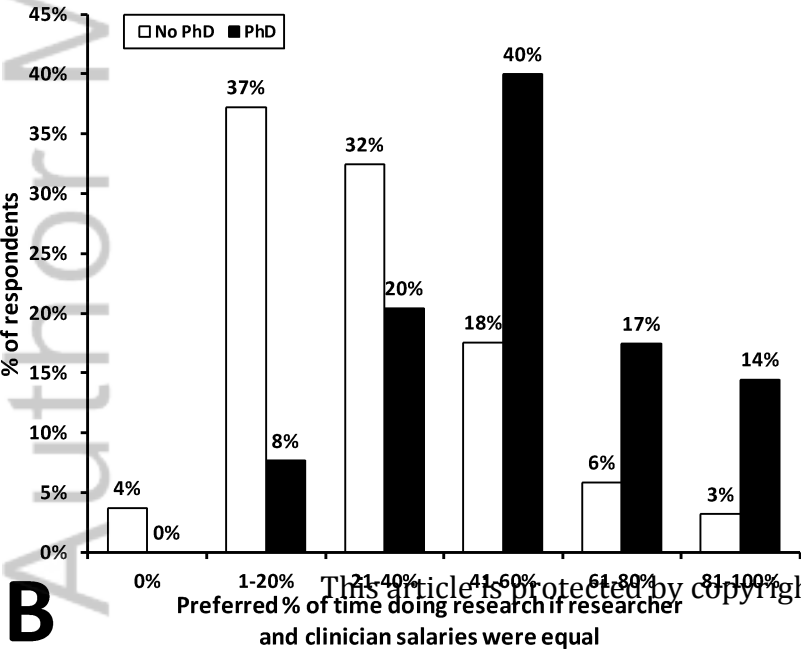

B

Figure 1.

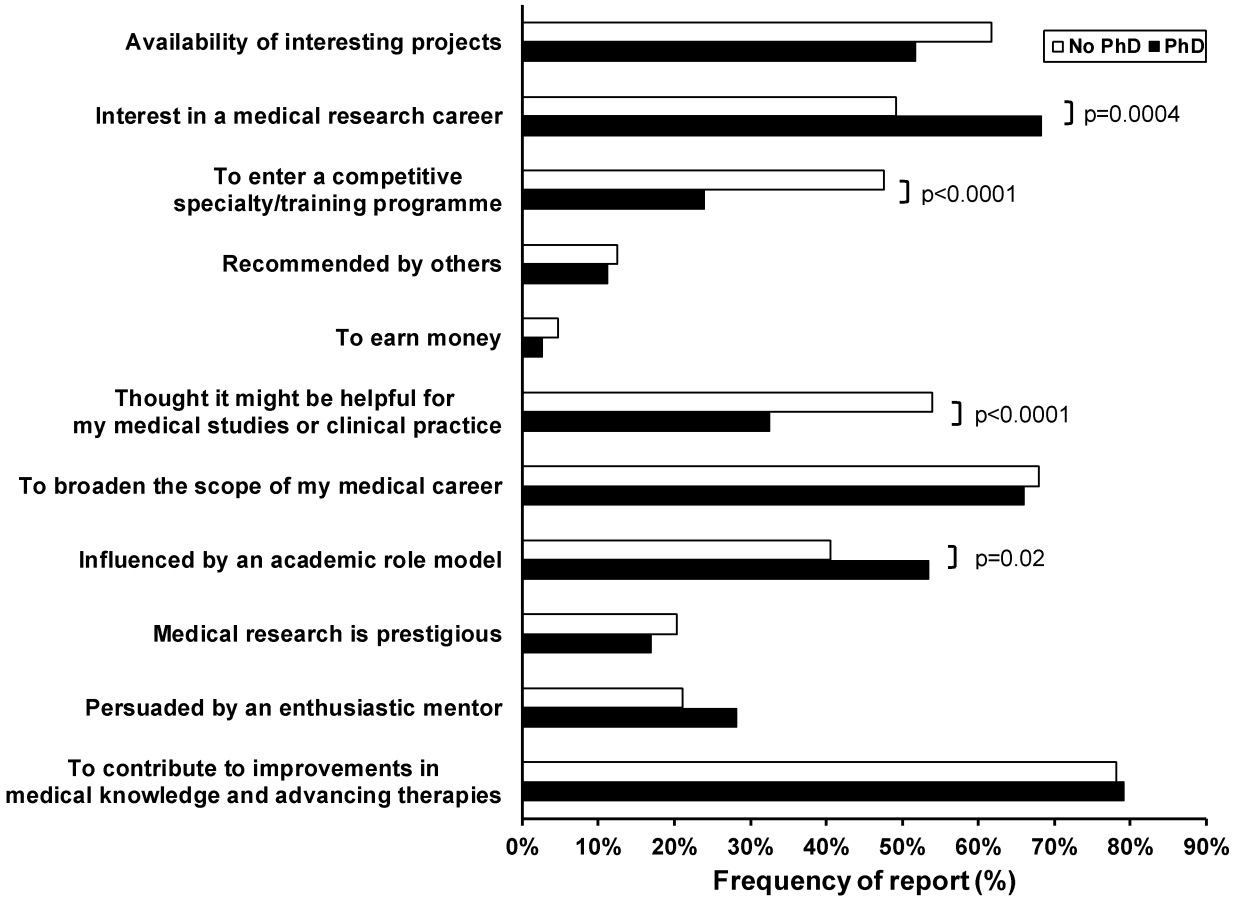

Figure 2.

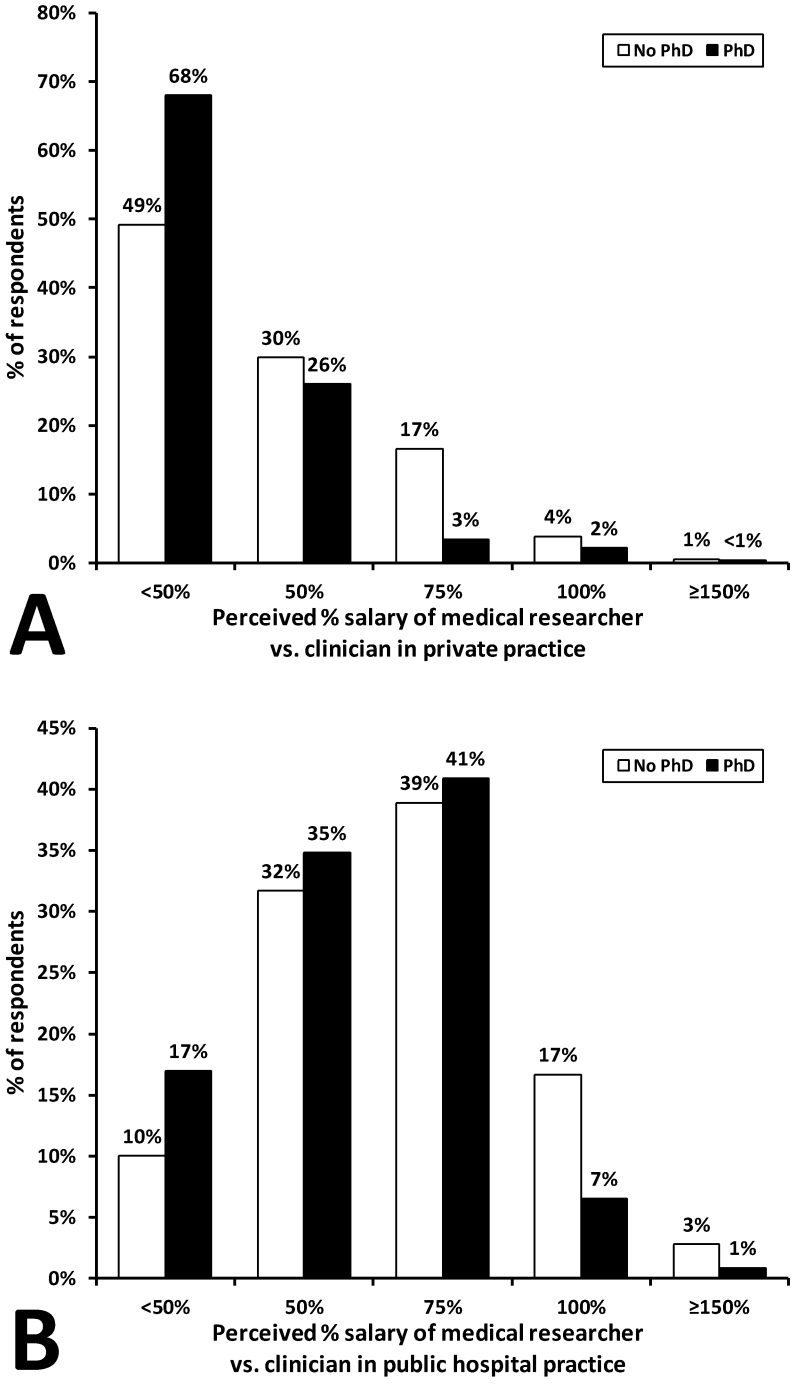

Table 1. Potential attractions and barriers for medical practitioners doing research

Potential attractions	**Potential barriers**
Evidence-based medicine era where many are exposed to and interested in research	Need for years of formal research training
Opportunity to better understand health and disease	Costs of university degrees and fees owed from previous education
Opportunity to improve health outcomes	Low research funding rates
Intellectual stimulation	Job insecurity relative to a clinical career
Career diversity	Salary gap between research and clinical careers (with lower salaries for researchers)
Flexibility in work times	Work-life attitudes and demands and lifestyle preferences
Opportunities for overseas study / work	Age and other life demands: Medical graduates are older and at later life stages
Team work and collaborative opportunities	Large amount of time required on grant writing and various regulatory (e.g. ethics) applications and administrative activities.
Desire for a university or teaching hospital appointment	
Increase chance of entry into competitive training programmes	

Table 2. Characteristics of survey respondents, including the No PhD and PhD subgroups

	All (n = 427)	No PhD (n = 190)	PhD (n = 237)	No PhD vs. PhD, *P*-value
Demographic details				
Age, years	39 ± 13	32 ± 11	44 ± 11	**<0.0001**
Australian citizens (%)	386 (91%)	170 (90%)	216 (91%)	0.47
Gender, female/male, (%female)	189/238 (44%)	92/98 (48%)	97/140 (41%)	0.12
Respondents with full time employed spouse (%full-time)	159 (37%)	53 (28%)	106 (45%)	**0.001**
Respondents with dependents, (N / %)	190 / 45%	38 / 20%	152 / 65%	**<0.0001**
Paid work per week, hours	34.5 ± 24.6	22.4 ± 23.7	44.1 ± 20.7	**<0.0001**
Training stage, student/doctor, (%student)	161/266 (38%)	131/59 (69%)	30/207 (13%)	**<0.0001**
Years since medical degree	13 ± 14	5 ± 12	19 ± 13	**<0.0001**
Post-PhD, years	-	-	7 ± 10	-
Tertiary level qualifications				
Medical degree, undergrad / graduate entry (%undergrad)	227/200 (53%)	49/141 (26%)	178/59 (75%)	**<0.0001**
Masters degree (%)	171 (40%)	64 (34%)	107 (45%)	**0.02**
Postgraduate diploma (%)	108 (23%)	31 (16%)	77 (32%)	**0.0001**
Specialty fellowship (%)	227 (53%)	47 (25%)	180 (76%)	**<0.0001**
Medical research experience				
No prior experience (%)	65 (15%)	58 (31%)	7 (3%)	**<0.0001**
Currently active (%)	324 (76%)	100 (53%)	224 (95%)	**<0.0001**
Career research output				
No publications	126 (30%)	108 (57%)	18 (8%)	**<0.0001**
d10 publications (%)	82 (19%)	46 (24%)	36 (15%)	**<0.0001**
11 – 30 publications (%)	49 (11%)	14 (7%)	35 (15%)	0.31
31 – 60 publications (%)	68 (16%)	12 (6%)	56 (24%)	0.26
>60 publications (%)	102 (24%)	10 (5%)	92 (39%)	**0.0003**

Survey respondents were subdivided into two groups (No PhD and PhD) depending on whether they reported being enrolled in or having completed a higher doctorate degree. Publications refer to a combination of original research, review articles, and editorials..

Table 3. Perceptions of a medical research career

Item		N	Disagree, mildly to strongly (%)	Neutral/ undecided (%)	Agree, mildly to strongly (%)	*P*-value
A_1	Research is not a relevant part of medical training					0.21
	All	425	375 (88%)	19 (4%)	31 (7%)	
	No PhD	188	158 (84%)	13 (7%)	17 (9%)	
	PhD	237	217 (92%)	6 (3%)	14 (6%)	
A_2	A doctor's practice is enhanced by undertaking medical research					**0.005**
	All	425	24 (6%)	37 (9%)	364 (86%)	
	No PhD	188	14 (7%)	23 (12%)	151 (80%)	
	PhD	237	10 (4%)	14 (6%)	213 (90%)	
A_3	Medical research is a lifestyle friendly career					0.06
	All	425	141 (33%)	75 (18%)	209 (49%)	
	No PhD	188	46 (25%)	40 (21%)	102 (54%)	
	PhD	237	95 (40%)	35 (15%)	107 (45%)	
A_4	Medical research appeals to my pursuit of scholarly interests					**<0.0001**
	All	423	32 (8%)	23 (5%)	368 (87%)	
	No PhD	187	28 (15%)	15 (8%)	144 (77%)	
	PhD	236	4 (2%)	8 (3%)	224 (95%)	
A_5	Medical research appeals to my interests in a managerial role					**<0.0001**
	All	425	198 (47%)	103 (24%)	124 (29%)	
	No PhD	188	102 (54%)	50 (27%)	36 (19%)	
	PhD	237	96 (41%)	53 (22%)	88 (37%)	
A_6	Medical research appeals to my preference for autonomy in the workplace					**<0.0001**
	All	423	87 (21%)	94 (22%)	242 (57%)	
	No PhD	187	50 (27%)	50 (27%)	87 (47%)	
	PhD	236	37 (16%)	44 (19%)	155 (66%)	
A_7	Medical research appeals to my desire to serve the community					**0.008**
	All	423	40 (9%)	42 (10%)	341 (81%)	
	No PhD	187	28 (15%)	19 (10%)	140 (75%)	
	PhD	236	12 (5%)	23 (10%)	201 (85%)	
A_8	I have experienced barriers to getting involved in medical research					**0.0**2
	All	420	92 (22%)	47 (11%)	281 (67%)	
	No PhD	184	40 (22%)	32 (17%)	112 (61%)	
	PhD	236	52 (22%)	15 (6%)	169 (72%)	

P-values shown represent comparisons between agree and disagree/neutral responses in No PhD vs. PhD groups.

Table 4. Perspectives of job security in a medical research career

Item		N	Disagree, mildly to strongly (%)	Neutral/ undecided (%)	Agree, mildly to strongly (%)	*P*-value
B_1	Being a medical researcher is a prestigious profession					0.91
	All	425	71 (17%)	60 (14%)	294 (69%)	
	No PhD	188	31 (16%)	27 (14%)	130 (69%)	
	PhD	237	40 (17%)	33 (14%)	164 (69%)	
B_2	Medical research is a financially rewarding career					**0.002**
	All	425	364 (86%)	43 (10%)	18 (4%)	
	No PhD	188	150 (80%)	31 (16%)	7 (4%)	
	PhD	237	214 (90%)	12 (5%)	11 (5%)	
B_3	I am motivated by financial incentives of a medical research career					0.66
	All	424	385 (91%)	23 (5%)	16 (4%)	
	No PhD	188	172 (91%)	9 (5%)	7 (4%)	
	PhD	236	213 (90%)	14 (6%)	9 (4%)	
B_4	Doctors who undertake medical research have a good work-life balance					**0.0002**
	All	422	169 (40%)	111 (26%)	14 (33%)	
	No PhD	187	59 (32%)	61 (33%)	67 (36%)	
	PhD	235	110 (47%)	50 (21%)	75 (32%)	
B_5	Medical research is compatible with family responsibilities					**0.02**
	All	423	122 (29%)	84 (20%)	21 (51%)	
	No PhD	187	43 (23%)	42 (23%)	102 (55%)	
	PhD	236	79 (34%)	42 (18%)	115 (49%)	
B_6	I would recommend medical students or doctors undertake medical research on a part-time basis					0.92
	All	407	38 (9%)	82 (20%)	287 (71%)	
	No PhD	179	17 (10%)	44 (25%)	118 (66%)	
	PhD	228	21 (9%)	38 (17%)	169 (74%)	
B_7	I would recommend medical students or doctors undertake medical research on a full-time basis					0.31
	All	351	185 (53%)	110 (31%)	56 (16%)	
	No PhD	158	88 (56%)	57 (36%)	13 (8%)	
	PhD	193	97 (50%)	53 (27%)	43 (22%)	

P-values shown represent comparisons between disagree and agree/neutral responses in No PhD vs. PhD groups.

Table 5. Perceived opportunities for undertaking a research career

Item		N	Disagree, mildly to strongly (%)	Neutral/ undecided (%)	Agree, mildly to strongly (%)	*P*-value
C_1	I have many opportunities to undertake medical research					**0.0005**
	All	423	86 (20%)	31 (7%)	306 (72%)	
	No PhD	188	49 (26%)	19 (10%)	120 (64%)	
	PhD	235	37 (16%)	12 (5%)	186 (79%)	
C_2	I have (or could make) adequate time to undertake medical research					0.28
	All	422	182 (43%)	21 (5%)	219 (52%)	
	No PhD	186	87 (47%)	8 (4%)	91 (49%)	
	PhD	236	95 (40%)	13 (6%)	128 (54%)	
C_3	I have adequate training in research methodology to undertake medical research					**<0.0001**
	All	424	98 (23%)	24 (6%)	302 (71%)	
	No PhD	188	69 (37%)	14 (7%)	105 (56%)	
	PhD	236	29 (12%)	10 (4%)	197 (83%)	
C_4	I am (or was) able to find a research mentor or supervisor easily					**0.0002**
	All	388	77 (20%)	38 (10%)	273 (70%)	
	No PhD	157	38 (24%)	25 (16%)	94 (60%)	
	PhD	231	39 (17%)	13 (6%)	179 (77%)	

P-values shown represent comparisons between agree and disagree/neutral responses in No PhD vs. PhD groups.

Table 6. Expectations for pursuing a future medical research career

Item		N	Disagree, mildly to strongly (%)	Neutral/ undecided (%)	Agree, mildly to strongly (%)	*P*-value
D_1	I plan to pursue medical research on a part-time basis [<70% of FTE]					0.06
	All	408	48 (12%)	29 (7%)	331 (81%)	
	No PhD	184	21 (11%)	21 (11%)	142 (77%)	
	PhD	224	27 (12%)	8 (4%)	189 (84%)	
D_2	I plan to pursue medical research on a full-time basis [≥70% of FTE]					**<0.0001**
	All	339	277 (82%)	25 (7%)	37 (11%)	
	No PhD	154	141 (92%)	10 (6%)	3 (2%)	
	PhD	185	136 (74%)	15 (8%)	34 (18%)	
D_3	I am interested in a long-term, full- or part-time, medical research career					**<0.0001**
	All	423	70 (17%)	38 (9%)	315 (74%)	
	No PhD	186	53 (28%)	27 (15%)	106 (57%)	
	PhD	237	17 (7%)	11 (5%)	209 (88%)	
D_4	I obtained a higher doctoral degree to pursue a medical research career					**<0.0001**
	All	266	57 (21%)	37 (14%)	172 (65%)	
	No PhD	58	33 (57%)	22 (38%)	3 (5%)	
	PhD	208	24 (12%)	15 (7%)	169 (81%)	
D_5	I believe that publications are important for progressing in training or chosen clinical specialty					**0.005**
	All	420	39 (9%)	18 (4%)	363 (86%)	
	No PhD	185	23 (12%)	12 (6%)	150 (81%)	
	PhD	235	16 (7%)	6 (3%)	213 (91%)	
D_6	I plan to be involved in full- or part-time research throughout my medical career					**<0.0001**
	All	421	31 (7%)	28 (7%)	362 (86%)	
	No PhD	184	25 (14%)	18 (10%)	141 (77%)	
	PhD	237	6 (3%)	10 (4%)	221 (93%)	
D_7	My ideal/chosen clinical specialty gives opportunities for medical research					**0.002**
	All	395	37 (9%)	44 (11%)	314 (79%)	
	No PhD	165	16 (10%)	30 (18%)	119 (72%)	
	PhD	230	21 (9%)	14 (6%)	195 (85%)	

P-values shown represent comparisons between agree and disagree/neutral responses in No PhD vs. PhD groups.
Abbreviation: FTE – full-time equivalent