

Research during medical school: is it particularly difficult in developing countries compared to developed countries?

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Objectives: Medical student involvement in research has been declining over the years. We reviewed the factors that hinder participation in research with a focus on developing countries.

Methods: Literature search was performed using PubMed, MEDLINE and Cochrane Library. Peer-reviewed articles published between 1995 and 2017 were screened for relevance to identify key factors affecting medical student involvement in research with a particular focus on developing world. Analytical review is presented here in this article in relation to commonly reported aspects related to research during medical school.

Results: This search revealed varied contributing factors that hinder students' growth and interest in research. It commonly highlighted few aspects in relation to research during medical school, and they were "variability in research uptake among students and issues related to them, their knowledge and attitude toward research and organizational input and its influence on students".

Conclusion: While early introduction to research by inculcating a mindset aimed at research has been proposed, it has not been seen in practice during either the medical school or beyond to an extent that was expected. It appears that developing countries, while they share some of the reasons with developed countries, have their own set of difficulties, which are influenced by culture, beliefs and priorities.

Keywords: developing country, developed country, medical student, undergraduate, research

Introduction

Engaging students in active learning lies at the heart of effective education, and student engagement has been the subject of increasing scholarly research. Student engagement is generally accepted as a function to the time and energy devoted to educationally purposeful activities in and out of the classroom. In medical schools, individual student engagement in learning and research has come under increasing attention. Medical students' engagement in research has been reported in the literature and has been associated with the acquisition of transferrable skills in the areas of communication, teamwork, time management and critical thinking, gaining experience and motivation for a research career, improving critical thinking abilities and fostering positive attitudes toward science and scientific methodology.¹⁻⁵

Students' views differ and more so when one looks at students from different backgrounds, more specifically those from developing countries compared to developed countries.⁶ Unfortunately, the future of academic medicine has come into question as recent reports point to declining numbers of clinician–scientists in both developed and developing countries.⁷⁻¹⁰ We here review and describe some of the reasons behind the difference in interest amongst medical students from developing and developed coun-

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tries and their research output. We also discuss the factors that motivate students to get involved in research, with additional focus on undergraduate students from developing countries.

Methods and results

We conducted a search for articles from PubMed, MEDLINE and Cochrane Library using the following keywords: “undergraduate research” and “medical students” and combining them with “developing country” and “developed country” separately looking for various factors that were discussed to be the hindrances for participation of medical students in research in developing countries. This revealed 75 and 41 articles, respectively. The search encompassed all the articles from 1995 till 2017.

In these articles, we focused on the most common topics discussed in relation to varied involvement of medical students in developed and developing countries. We included only those articles that focused on factors that hindered or encouraged research in medical school in developing countries and those articles that compared the difference in medical school research between developed and developing countries. These aspects and topics have formed the headings for discussion in the following. This refined search revealed 40 articles that we analyzed for contents. The various aspects commonly reported in the literature and so chosen to be discussed here are important for undergraduate medical research, variability in research uptake among students and issues related to them, their knowledge and attitude toward research and organizational input and its influence on students.

Importance of undergraduate medical research

There is a rapidly mounting propensity toward incorporating structured scientific research training into undergraduate medical education.¹¹ Publishing manuscripts during the early years of medical education is correlated with more engagement in future research experiences.¹² It is even seen as one of the main measures of progress of a country in the world scientific community.⁴ In spite of this, some students produce, to a greater degree, technically correct and scientifically sound pieces of literature that can be potentially transformed into valuable publications, while some fail to do so. This very fact raises two important questions: 1) what is the reason behind this production–outcome mismatch and 2) who should be held responsible?¹³ Student research publications should not be viewed as “inferior” scientific evidence as they can provide distinguished intellectual perspectives

with a significant contribution to the ever-expanding body of science. Otherwise, it only encourages medical students to move away from perceiving curricular research activities as mere occasions to simply accomplish tasks and satisfy the grade-related requirements of a particular course or an assignment. This is where motivation plays a pivotal role, specifically when the student’s motivation is intrinsic. Course instructors play central roles in the process too. Continuous feedback and step-by-step guidance from course instructors on how students’ research classwork can be translated into layouts suitable for publication in professional scientific journals are equally important.¹⁴

Issues behind variability in research uptake among undergraduate medical students

There are numerous issues that have been raised as causal factors responsible for varied uptake of research at the undergraduate medical school level. All these are largely due to these three factors: attitude to, knowledge of and barriers to research.^{1,15,16} These factors are much more exaggerated in developing countries.^{17–19} Streamlined training also may affect the number of trainees engaging in full-time higher degrees (such as Master of Philosophy [MPhil] or Doctor of Philosophy [PhD]) in spite of the fact that those who do engage are more likely to do well academically and clinically. Students are concerned about the career choices affecting their research program and vice versa, prolongation of training program, timing of family for women, job opportunities as a clinician-scientist and timing regarding full-time research amidst undergraduate training (more preferring to do after).^{20,21} A published systematic review on attitudes of medical studies to medical leadership reported that one of the most important barriers to implementing research activities within medical schools is a lack of time given competing educational demands; the main cause cited by students in developing countries as their priority is in completing clinical studies.^{7,22}

Attitude

It has been found that when students hold positive attitudes toward an academic subject, it is easier for them to study that subject and feel the subject useful to their studies and future career; they tended to possess higher “self-efficacy” in studying the relevant subject. The outcome of the research in the form of a publication provided reassurance and recognition of their work.²³ Self-efficacy is a person’s belief in his or her ability to succeed in a particular manner and how they go about it in order to reach their goals. This is widely variable, and

the outcomes are reflection of one's own efficacy. A period of time spent in research may be beneficial for a number of reasons. It may aid in the development of critical appraisal and problem-solving skills as well as lending an increased understanding of the process involved in developing surgical research and make them more academically productive.²⁴ Additionally those who take active interest tend to have a higher number of first author publications and are more likely to take up academic positions later in their career.²⁵ The literature reports positive attitudes toward research among the majority of Irish, Pakistani, Croatian and New Zealand medical students throughout their career.^{1,8,19,26} However, it is variable and more so in developing countries with lower levels of positive attitude in developing countries.⁶ This study from Iran showed that 90% of students had significantly lower levels of positive attitude toward research.⁶

Knowledge

Adequate knowledge of the study subject and awareness of research principles are essential prerequisites for any study. Inadequate knowledge is one of the most common reasons behind suboptimal study design or interpretation.^{27–29} It is a common notion that most of the students who pursue serious or full time research would have some prior experience or at least a thorough knowledge of the process. Studies of medical students show that in spite of inadequate knowledge of the scientific inquiry process, they were nonetheless interested in pursuing research in the future.^{19,30} On the other hand, if students had prior knowledge, they are more likely to pursue academic career, especially in developed countries compared to developing countries.^{7,14} An interview-based study revealed that 64% compared to 48% of students who had prior research experience were willing to pursue in this field.¹⁴ This study also identified that when three domains of self-determination theory were applied, well-supported compulsory research activities that incorporate group learning and elements of choice may promote motivation to do research and, potentially, careers in research, even in a research-naïve student body.

Organizational input and its influence

Infrastructure and curriculum change could bring about change in the attitude and approach of students toward research. This could help them to realize the importance of career progression and remove some of the barriers for research uptake. Reformed curriculum may lead to increased student involvement in research.³¹ Pruskil et al noted that appropriate change in curriculum invited more final-year

students to take part in research. This change has been seen irrespective of cultural or demographic background.^{4,28,30} Some of the universities and training boards have exemplified this change by offering points toward selection to competitive specialties post Bachelor of Medicine and Bachelor of Surgery (MBBS) in an attempt to encourage participation in medical school research.³² It is imperative that clinicians and researchers with experience with regular commitment to guide the students lead these changes. In Royal Devon and Exeter Hospital, UK, student scholars learn from taking part in tutorials pertaining to relevant skills such as academic writing.³³ In all, 90% of students showed active interest after a similar experience from Stanford University and 75% published minimum of one paper as a result of such intervention from mentors.³⁴ Both these demonstrate the concept of experiential learning that has been brilliantly put forth by Aristotle in his own words: “for the things we have to learn before we can do them, we learn by doing them”.³⁵

In developed countries, universities have taken prominent steps to encourage and develop an environment where research mindset can flourish. Heidelberg University in Germany provides students in a pre-final year a dedicated period before completing the course for research.³⁶ Medical students in Split University, Croatia, are given a month to complete a simple project early in the course.³⁶ This would involve data collection, statistical analysis, presentation and publication. In both these universities, appropriate pre-training and support are provided to make the experience useful and enjoyable, thereby creating a positive mindset toward future academic career in the students upon graduation.

Universities and licensing agencies, including governmental organizations, may sometimes play a pivotal role in shaping a student's academic career. In the USA and Canada, MD/PhD programs have been long established.³⁷ This comprises typically 2 years of preclinical training, a period of laboratory-based research and 2 further years of clinical training. At the end, the students are conferred both MD and PhD. A number of questions have been asked criticizing this model.³⁸ Are we mixing research and clinical training just because we can or are we doing justice to any component individually at all? Normally, a PhD student would spend at least 3 years in research, resulting in publication of numbers of scientific articles and or a thesis. So, in comparison to the conventional PhD, an MD/PhD degree might seem a quick and easy solution to improving one's academic portfolio. An MD student otherwise would spend 5–8 years depending on the country of training, completely training in preclinical and clinical areas, committing to learn core medicine before embarking on the full-time research. As much as this program

is attractive, only 2% of the medical students in the USA are pursuing this route (subject to availability and choice). On the other hand, 15% of students who choose such intercalated degrees pursue competitive specialties such as surgery.³⁹

The General Medical Council from the UK, on the other hand, has recommended that learning outcomes for all medical graduates should include research skills to enable them to study in-depth areas that are of particular interest to them and to obtain insight into scientific and research methods.⁴⁰ This curriculum seems to be a gentle middle ground between a fully-fledged research-based program and a conventional medical curriculum where only core medical topics are taught. In the UK and Ireland, Cambridge University has led the way in creating a similar MB BChir/PhD program.⁴¹ On a recent questionnaire-based survey of medical students in Ireland, medical students responded favorably to such intercalated degrees with research component.⁴² The cohort who preferred research in this study was mainly made up of those who had prior research experience, aimed at pursuing competitive specialties, were males and had previous university degrees.

While the changes in attitude are positive at the undergraduate level, there seems to be a disparity in relation to its continuity once the students finish school. This disparity is ever so apparent in studies from developing countries.^{4,43,44} In a questionnaire-based study from Brazil, while 82% of the students showed initial promise to engage in scholarly activities, only 5% followed it through postgraduation.⁴⁵ Similarly, a large proportion of medical students from India do not actively take part in research after completing medical school due to some common, repetitive reasons in the developing world.⁷ A cross-sectional review stated that even the findings of positive attitude lacked the power to assess a possible causal relationship between the engagement in research and attitudinal changes as students passed through senior and to postgraduate years.⁴⁶ This indicates that just an interest in research or even playing part in research during undergraduate years does not necessarily imply a choice of future academic career. Three big reasons for this poor attitude in developing countries seem to be lack of career opportunities in academics, lack of resources in relation to funding as well as electronic resources such as Internet and lack of time in relation to clinical services, which is viewed as more important or demands from the curriculum.^{7,8,30,47}

A modern perspective from Indian undergraduate training points toward some of the factors discussed.⁷ Although a long-standing culture of research has existed in postgraduate period of Indian medical training, it has not seen its influence on undergraduate medical education or inspired a significant

proportion of graduates to take up academic career. This is in spite of series of efforts from enthusiastic academics at conferences and meeting with governmental organizations and universities.⁴⁸ In a survey-based study of a long-standing undergraduate medical research program from Sudan, although 91% of the students perceived research as important to medicine, only 18% saw it to be beneficial for their career in their home country.⁴⁷ All the three big reasons mentioned earlier were the prime reasons here for lack of interest in pursuing an academic career. A similar study from Saudi Arabia indicated that 91% of the students thought that it was a good idea to have some research background, but only 43% believed it to be useful for residency and even less beyond.²⁹ This issue has not even spared India, the largest democratic nation in the world where opportunities and intelligence are perceived to be in abundance. A study from the south Indian state of Pondicherry suggested that lack of recognition in postgraduation for their work done in graduate medical school was a major cause in spite of numerous universities in southern India having a undergraduate research monitoring committee.⁴⁴

There is a general negative notion among the students and their parents attending medical school in developing countries, more so in heavily indebted poor countries. The community and parents expect the qualified medical doctors to become high-earning clinicians and live an affluent life and care for their family, which takes time away from research and further deters students from pursuing an academic life.⁴⁷ Financial resources could potentially be better spent on other priorities, with pressing issues, some solely due to a large population. Adequate resource includes not only finance, which of course is a prime barrier, but also supportive intellectual human resource in the form of competent research supervisors. Alghamdi et al²⁹ found that 85% of the students cited lack of professional supervision as a barrier to successful research project. University supervisors are overburdened with clinical work and are underpaid, resulting in a declining number of university researchers and scientists in the past 2 decades.^{17,49} Furthermore, they lack research experience sufficient enough to supervise full-time research students in medical school if any are interested. An additional human resource, potentially, would be from the experienced peers in medical school. The concept of peer-assisted learning could be of benefit at medical school for smaller projects, which could stimulate interest in less experienced cohort. Unfortunately, the practice of peer-assisted learning is rarely seen as a part of the curriculum in developing countries. Non-governmental organizations play a vital role in providing

financial resource for research projects. Any withdrawal from such involvement has a significant effect not only on the ongoing projects but also on the future projects that may make potential research students rethink about their research options, as was recently found in a study from Canada.⁵⁰

Medical students from developing countries often find that the demands from the curriculum are overwhelming. Frequent clinical examinations force students to prioritize the major demands of the curriculum ahead of research activities.⁴⁷ Lack of options for intercalated degrees would further accentuate this problem. Regular research conferences aimed at medical students are in place to encourage research from undergraduate students.⁴⁸ This has been taken advantage of by not only Indian students but also many sub continental medical students who are invited to these conferences.

Conclusion

There is a global decrease in students taking up research in undergraduate medical schools, for a variety of reasons. There are some common reasons that need to be addressed and could be very challenging in developing countries with large population where the priorities could be different for students, government and communities. Although the mindset exists about the long-term benefits of research, it needs to be channeled into effective actions with change in attitudes. It needs involvement of multiple third parties and organizations to bring about a change not just at the level of medical school but far beyond that as the motto for the first Forum for Medical Students Research in India said: “Far Beyond Vision”.

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Disclosure

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References

- Burgoyne LN, O’Flynn S, Boylan GB. Undergraduate medical research: the student perspective. *Med Educ Online*. 2010;15.
- Reinders JJ, Kropmans TJB, Cohen-Schotanus J. Extracurricular research experience of medical students and their scientific output after graduation. *Med Educ*. 2005;39(2):237–237.
- Hren D, Lukic IK, Marusic A, et al. Teaching research methodology in medical schools: students’ attitudes towards and knowledge about science. *Med Educ*. 2004;38(1):81–86.
- Vujaklija A, Hren D, Sambunjak D, et al. Can teaching research methodology influence students’ attitude toward science? Cohort study and nonrandomized trial in a single medical school. *J Investig Med*. 2010;58(2):282–286.
- Buckley S, Coleman J, Davison I, et al. The educational effects of portfolios on undergraduate student learning: a Best Evidence Medical Education (BEME) systematic review. BEME Guide No. 11. *Med Teach*. 2009;31(4):282–298.
- Memarpour M, Fard AP, Ghasemi R. Evaluation of attitude to, knowledge of and barriers toward research among medical science students. *Asia Pac Fam Med*. 2015;14(1):1.
- Garg R, Goyal S, Singh K. Lack of research amongst undergraduate medical students in India: it’s time to act and act now. *Indian Pediatr*. 2017;54(5):357–360.
- Amin T, Kaliyadan F, Abdulatheem EA, et al. Knowledge, attitudes and barriers related to participation of medical students in research in three Arab Universities. *Educ Med J*. 2012;4(1):47–55.
- Baumal R, Benbassat J, Van JA. Reflections on the current and future roles of clinician-scientists. *Isr Med Assoc J*. 2014;16(8):475–478.
- Kosik RO, Tran DT, Fan AP, et al. Physician Scientist Training in the United States: a survey of the current literature. *Eval Health Prof*. 2016;39(1):3–20.
- Abu-Zaid A, Bamogaddam I, AlBader L, AlFakhri L, Nurhussen A. A call to encourage curricular research publications by medical students. *Int J Med Educ*. 2016;7:406–406.
- Lopatto D. Undergraduate research experiences support science career decisions and active learning. *CBE Life Sci Educ*. 2007;6(4):297–306.
- Abu-Zaid A, Alkattan K. Integration of scientific research training into undergraduate medical education: a reminder call. *Med Educ Online*. 2013;18:22832.
- Rosenkranz SK, Wang SY, Hu WD. Motivating medical students to do research: a mixed methods study using Self-Determination Theory. *BMC Med Educ*. 2015;15:95.
- Khan H, Taqui AM, Khawaja MR, Fatmi Z. Problem-based versus conventional curricula: influence on knowledge and attitudes of medical students towards health research. *PLoS One*. 2007;2(7):e632.
- Rosemann T, Szecsenyi J. General practitioners’ attitudes towards research in primary care: qualitative results of a cross sectional study. *BMC Fam Pract*. 2004;5(1):31.
- Khan H, Khawaja MR, Waheed A, Rauf MA, Fatmi Z. Knowledge and attitudes about health research amongst a group of Pakistani medical students. *BMC Med Educ*. 2006;6:54.
- Sabzwari S, Kausar S, Khuwaja AK. Experiences, attitudes and barriers towards research amongst junior faculty of Pakistani medical universities. *BMC Med Educ*. 2009;9:68.
- Vodopivec I, Vujaklija A, Hrabak M, Lukic IK, Marusic A, Marusic M. Knowledge about and attitude towards science of first year medical students. *Croat Med J*. 2002;43(1):58–62.
- Cochran A, Melby S, Neumayer LA. An Internet-based survey of factors influencing medical student selection of a general surgery career. *Am J Surg*. 2005;189(6):742–746.
- Glynn RW, Kerin MJ. Factors influencing medical students and junior doctors in choosing a career in surgery. *Surgeon*. 2010;8(4):187–191.
- Abbas MR, Quince TA, Wood DF, Benson JA. Attitudes of medical students to medical leadership and management: a systematic review to inform curriculum development. *BMC Med Educ*. 2011;11:93.

23. Zier K, Stagnaro-Green A. A multifaceted program to encourage medical students' research. *Acad Med*. 2001;76(7):743–747.
24. Derham C, Vohra RS, Homer-Vanniasinkam S. Academia and MMC: uncomfortable bed-fellows? *Surgeon*. 2009;7(1):4–5.
25. Smith JJ, Patel RK, Chen X, Tarpley MJ, Terhune KP. Does intentional support of degree programs in general surgery residency affect research productivity or pursuit of academic surgery? *J Surg Educ*. 2014;71(4):486–491.
26. Park SJ, McGhee CN, Sherwin T. Medical students' attitudes towards research and a career in research: an Auckland, New Zealand study. *NZ Med J*. 2010;123(1323):34–42.
27. Chakraborti CBD, Gleeson E, Gunderson W. Identifying barriers to successful research during medical school. *Med Educ Dev*. 2012;2(2):5–8.
28. Wang SC, Guo YJ. *Counseling Students' Attitudes Toward Research Methods Class*. 2011. Available from: https://www.counseling.org/Resources/Library/VISTAS/2011-V-Online/Article_30.pdf. Accessed July 21, 2017.
29. AlGhamdi KM, Moussa NA, AlEsa DS, AlOthimeen N, Al-Saud AS. Perceptions, attitudes and practices toward research among senior medical students. *Saudi Pharm J*. 2014;22(2):113–117.
30. Khan H, Khan S, Iqbal A. Knowledge, attitudes and practices around health research: the perspective of physicians-in-training in Pakistan. *BMC Med Educ*. 2009;9:46.
31. Pruskil S, Burgwinkel P, Georg W, Keil T, Kiessling C. Medical students' attitudes towards science and involvement in research activities: a comparative study with students from a reformed and a traditional curriculum. *Med Teach*. 2009;31(6):e254–e259.
32. Patel SB, Bennett T, Bradley A, Homer R, Sinha A. Getting undergraduate medical students involved in research. *Educ Health (Abingdon)*. 2016;29(1):56.
33. Exeter Spinal Surgery Unit [homepage on the Internet]. *Exeter Research Scheme*. 2015. Available from: <https://www.exeterspineunit.co.uk/undergrad>. Accessed July 21, 2017.
34. Jacobs CD, Cross PC. The value of medical student research: the experience at Stanford University School of Medicine. *Med Educ*. 1995;29(5):342–346.
35. Aristotle RW, Ackrill J, Urmson J. *The Nicomachean Ethics, Book II*. Oxford: Oxford University Press; 1998.
36. Simunovic F. Is there a place for medical students in research laboratories? A student's perspective. *Med Teach*. 2008;30(9–10):875–876.
37. Andriole DA, Whelan AJ, Jeffe DB. Characteristics and career intentions of the emerging MD/PhD workforce. *JAMA*. 2008;300(10):1165–1173.
38. Ahn J, Watt CD, Man LX, Greeley SA, Shea JA. Educating future leaders of medical research: analysis of student opinions and goals from the MD-PhD SAGE (Students' Attitudes, Goals, and Education) survey. *Acad Med*. 2007;82(7):633–645.
39. Andriole DA, Klingensmith ME, Jeffe DB. Who are our future surgeons? Characteristics of medical school graduates planning surgical careers: analysis of the 1997 to 2004 Association of American Medical Colleges' Graduation Questionnaire National Database. *J Am Coll Surg*. 2006;203(2):177–185.
40. General Medical Council. *Tomorrow's Doctor*. Manchester: General Medical Council; 2009. Available from: www.gmc-uk.org/Tomorrow_s_Doctors_1214.pdf_48905759.pdf. Accessed July 21, 2017.
41. Cox TM, Brimicombe J, Wood DF, Peters DK. The Cambridge Bachelor of Medicine (MB)/Doctor of Philosophy (PhD): graduate outcomes of the first MB/PhD programme in the UK. *Clin Med*. 2012;12(6):530–534.
42. Bolger JC, MacNamara F, Hill AD. An analysis of medical students' attitude to surgical careers and pursuing intercalated research degrees. *Ir J Med Sci*. 2016;185(1):177–182.
43. Houlden RL, Raja JB, Collier CP, Clark AF, Waugh JM. Medical students' perceptions of an undergraduate research elective. *Med Teach*. 2004;26(7):659–661.
44. Chatterjee K, Sen C. Undergraduate research in India hoping for a new dawn. *J Postgrad Med*. 2016;62(1):49–50.
45. Moraes DW, Jotz M, Menegazzo WR, et al. Interest in research among medical students: challenges for the undergraduate education. *Rev Assoc Med Bras*. 2016;62(7):652–658.
46. Naing C, Wai VN, Durham J, et al. A systematic review and meta-analysis of medical students' perspectives on the engagement in research. *Medicine*. 2015;94(28):e1089.
47. Osman T. Medical students' perceptions towards research at a Sudanese University. *BMC Med Educ*. 2016;16(1):253.
48. Deo MG. Undergraduate medical students' research in India. *J Postgrad Med*. 2008;54(3):176–179.
49. Al-Nashmy F, Al-Shalawy AH. Knowledge, attitudes and perceived barriers towards scientific research among undergraduate health sciences students in the central province of Saudi Arabia. *Educ Med J*. 2015;7(1):16–21.
50. Manoranjan B, Dey AK, Wang X, et al. Role of non-government organizations in engaging medical students in research. *J Investig Med*. 2017;65(3):709–716.

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