

## ORIGINAL ARTICLE

# DEVELOPING INTEREST IN EVIDENCE BASED MEDICINE THROUGH BASIC GENETIC RESEARCH IN UNDERGRADUATE MEDICAL STUDENTS

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## ABSTRACT

**Objectives:** To develop interest in laboratory based genetic research in undergraduate medical students and to identify the effectiveness of hands on laboratory exposure in culminating interest and confidence in students to pursue further skills and evidence based medicine before they begin clinical rotations in the 3rd year of medical college.

**Methods:** A two-month long study was conducted that included lab work and data collection through an online form. Out of 120 MBBS students initially registered, only 100 filled out the form. The experiment was conducted over three hours under faculty supervision. The participating students had no prior experience of the materials/methods, safety precautions, equipment, procedure, expected outcomes and application and relevance to clinical practice.

**Results:** Out of 100 participating students, 81 were second year and 19 from third year. The difference in response to research opportunity between 2nd and 3rd year medical students was highly significant (p value <0.001). Out of 100, 96 students were seeking opportunities to participate in research. However, 73 students had no previous knowledge of bench work. The remaining 27 students had prior laboratory experience at school but were not familiar with DNA extraction or related equipment. The increase in confidence (97%) to handle the equipment was highly significant (p value 0.0008).

**Conclusion:** The introduction to laboratory skills in pre-clinical years was found to be effective as shown by the difference in initiative among 2nd and 3rd year medical students (p value <0.001). Incorporation of laboratory based research module is recommended in preclinical years of the medical undergraduate curriculum.

**KEYWORDS:** Medical Students, Laboratories, Evidence-Based Medicine, Research

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## INTRODUCTION

In an era of rapid technological advancement in every field, it has become a necessity to stay updated in techniques involved in the progress of medical techniques. Health research training, therefore, has become an essential component of medical education. Research serves to inculcate critical thinking and reasoning skills and provides us with

new findings that have the potential to influence health care and therefore, motivate students toward research related activities. Refined research and laboratory skills can help developing countries like Pakistan to achieve self-reliance in health care and development.<sup>1</sup> The importance of providing research lab experiences, however, is not emphasized on an undergraduate level and has therefore, diminished the importance and role of research

and laboratory skills in the mind of medical students<sup>1</sup>. In a research conducted at Aga Khan University (Karachi, Pakistan), it was found that knowledge of research is lower during initial years of medical school.<sup>2</sup> Students undergoing lecture-based learning generally show less active interest towards health research rather than those undergoing problem-based learning and hands on experience.<sup>3</sup> Experience-based teaching methods address many of the limitations of the traditional teaching style. It integrates many diverse tactics to aid learning processes and outcomes. With greater interaction between all stakeholders, there is an emphasis on collaboration and peer learning all brought together in an active learning environment.<sup>14</sup>

In Pakistan, currently, research laboratory work has not been incorporated into the medical school curricula.<sup>12</sup> This cross-sectional study has been designed to assess research interest of undergraduate medical students and to identify the effectiveness of a minimal amount of hands on research lab exposure in developing interest and confidence in undergraduate students to pursue further skills and bring their attention to evidence based medicine before they begin clinical rotations in the 3rd year of medical college.

## METHODS

The students were taken from 2nd and 3rd year MBBS of Ziauddin University, Clifton, Karachi and participation was on a completely voluntary basis. The study was conducted over a period of 2 months which included lab work and data collection which was done through an online form. A group of 100 subjects filled out the online response voluntarily. A total of 120 subjects initially registered to participate, however, participants who did not complete the predetermined number of research lab hours and objectives were considered loss to follow up.

Of the 100 students who participated in the laboratory experiment, none of them had prior experience of the materials or method, pre-exposure knowledge of safety precautions, equipment, the procedure to be conducted and what to expect in terms of outcome.

Each student completed a laboratory experiment spanning over duration of 2 to 3 hours. There were two faculty members providing basic instructions and monitoring their work. The number of hours was based on a basic DNA Extraction Method; Cheelex. The resources used by the institute, in terms of time,

faculty, equipment, printing checklists and supplying gloves to the students did not incur any additional costs to the regular running of the laboratory. The students volunteered their time in between regularly scheduled classes.

Laboratory exposure: The students were exposed to the research lab and were instructed to observe all the safety precautions which included white coats and gloves.

## RESULTS

Among the total number of students who participated in the study, 81 were second year MBBS students while 19 were third year MBBS students, ranging in age from 20-22 years. The difference in response between 2nd and 3rd year medical students was highly significant on chi square (p value <0.001). The test was based on the number of students who volunteered to participate out of the total number of students in each class.

Out of 100, 96 of the subjects were enthusiastic about research before enrolling for this laboratory experience, however, 73 of the students described that they had no previous experience or knowledge of bench work. Of the 27 who had some previous experience, they were not familiar with DNA extraction or most of the equipment.

Regarding instruments handling, 86 rated their comfort 4 or 5 on Likert scale of 1 to 5. Incorrect practices leading to false positive results were correctly identified by 58, whereas 5 could not and 37 were still unsure.

Overall, 96 students were of the opinion that adequate information about the safety regulations of the research laboratory had been given in a comprehensive manner. All 100 students that participated in the experiment reported a significant improvement in self-confidence. Of the subjects, 48 are confident that they can conduct the DNA extraction procedure independently, while 49 (49%) concluded they may require some guidance. However, only 3 (3%) of the students were not confident in conducting the experiment single-handedly. The increase in confidence in handling equipment was highly significant (p value 0.0008).

Out of 10 listed equipment for DNA extraction, 68(68%) students were comfortable with handling 7 of the equipment whereas, 31(31%) with all the equipment.

**Table 1:** The students level of confidence in handling of the equipment

Name of Equipment	Subjects with complete command after completing experiment N(%)	Subjects unsure of use after completing experiment
Eppendorf Tubes	64%	36%
Pipettes	97%	3%
Beakers	80%	20%
Centrifuge	94%	6%
Vortex	90%	10%
Heating Block	59%	41%
Electrophoresis Apparatus	61%	39%
Ultracentrifuge	64%	36%

### DISCUSSION

With recent advances in health care and medicine, research undoubtedly is the pinnacle of modern medicine. Motivating students to pursue research can help provide capable future physicians with improved novel approaches for current practices, allowing developing countries to progress towards self-reliance.<sup>2</sup> This study revealed that this project generated great interest in students who were earlier not aware of the importance and considered it unrelated to their profession. Overall, 97 of the total 100 participants after volunteering in the laboratory exhibited interest and initiative in future research. This proves the importance of providing timely opportunities in laboratory skills.

Quite a few studies have proven a lack of interest as a general trend among medical students resulting in a consequent lack of commitment to publishing an article.<sup>1,3</sup> This decline in interest can be attributable to a number of factors, including a paucity of institutional incentive, time restraints due to an exhaustive curriculum, a lack of practical application of research methodology, failure to understand the important role that research plays in our community and the availability of mentors to overlook such projects.<sup>5</sup> A study conducted at King Edward University involving 4th year medical students showed that curriculum overload, internet inexperience, an uncooperative community, difficulty in finding a mentor, difficulty in selecting a topic and lack of previous exposure were the main issues among students.<sup>4</sup>

Out of the 97 of 100 medical students who were enthusiastic about research, only 27 had previous exposure. This shows a significant lack of initiative despite enthusiasm among undergraduate medical students, leading to lack of experience, understanding and a consequent lack of confidence to initiate relevant projects in their fields of practice later in life. This has led to an observed decline in physician-scientists with proven causes ranging from a lack in incentives to inadequate prior exposure during undergraduate years.<sup>19,20</sup>

Among 3<sup>rd</sup> year medical students, only 19% volunteered to participate. It is interesting to note a significantly contrasting response to research opportunities between students currently undergoing classroom-based training in basic sciences and those who have commenced clinical training. The schedule and pressure involved in clinical clerkships and rotations drastically decreases the motivation and time available to undergraduate students to avail in research, laboratory and otherwise. A KAP study conducted at AKU points out that students' knowledge and attitude towards health research significantly improved with increasing years of medical education.<sup>1</sup> However, our study observed that despite their increased knowledge, out of a class of 129, only 19 students participated in a research laboratory opportunity during their free time.

Once participants were enrolled, they were familiarized with the laboratory environment and briefed before commencing the experiment. The orientation included a tutorial on how to handle micropipettes, centrifuge and ultracentrifuges. The students were provided a checklist of DNA extraction and guided through each step by the instructors present and introduced to eppendorf tubes, micropipettes, centrifuge, ultracentrifuge, vortex, heating block and electrophoresis apparatus. They performed each step independently and were continuously monitored by the Research Laboratory instructors. Apart from assessing the interest in research in undergraduate students at Ziauddin Medical college, another objective was to evaluate the importance of a hands-on experience in working at the research lab. We noted that, 68(68%) students stated that they were comfortable with handling 7 of the listed equipment whereas, 31(31%) with all of them.

As noted by the Centres for Disease Control and Prevention (CDC) in 2008, "an integral component of care is laboratory medicine which extends across research, clinical and public health settings"<sup>9</sup>. Engaging medical students in authentic scientific practice is a key role in developing their interest in research.<sup>10</sup> It is important to make sure students

carry out procedures that resemble practices conducted by scientists as it portrays a more appealing picture of science as compared to data-base experience which they are usually limited to.<sup>11</sup> According to the PMDC curricula for medical universities, only a limited number of procedures are required in the five years of education.<sup>12,30</sup> An initiative conducted on classroom undergraduate research experiences (CUREs) in Indianapolis, Indiana. Each course engaged students in independent research projects requiring significant student input into the questions, experimental designs, data analysis, and result's data presentation. By the end, 75% students were running their own research projects and 97% of students showed an increase in their interest in pursuing further careers related to research.<sup>5</sup> Studies have also shown that with the introduction of clinical skill laboratories (CSLs) as part of the medical curriculum has yielded beneficial results. It has also been shown that students execute procedures that they have gotten the opportunity to practice with confidence leading to improvement in exam results.<sup>8</sup> In this study, all participants (100%) expressed an interest in pursuing further research, laboratory skills and conducting independent studies. It has been observed by other researchers that students who are actively involved in medical research are more likely to undertake research in their postgraduate years.<sup>23, 26</sup>

Often students are faced with the difficulty of understanding complex concepts and how they are related to one another. Lab experiences may work to eliminate these barriers and allow students to understand processes better.<sup>15</sup> In this study, we experienced that 97% of the students that were engaged, gained the confidence to conduct the procedure in a laboratory environment with minimal or no guidance. We noted that devoting appropriate time to the briefing had outstanding results in sparking interest in these undergraduate students. Although they had attended presentation based lessons on DNA extraction before, they had been unable to recall most of what they had been taught. Whereas, the opportunity to practically conduct the process in the laboratory left a lasting impression on them and they reported a willingness to take the initiative and participate in future research projects and laboratory activities.<sup>15</sup>

In this study, conducted from the perspective of a developing country, we aimed to prove that a minimum time duration spent on an easily doable technique in a basic laboratory setup can be quite effective in sparking interest and building confidence of medical students in bench work. The inculcation of a laboratory module in the medical curriculum would not be difficult for colleges and universities that already have a research laboratory existing on campus. The safety regulations, acceptable behaviours, confidence in conducting procedures

and focus on new research topics and experiments are all outcomes that can be easily achieved by incorporating mandatory laboratory introduction and experience sessions during undergraduate medical training, preferably in the earlier years before the onset of clinical rotations. While undergraduate students are enthusiastic about research, not many are able to discern what research is all about. Their narrow perception of research and laboratory skills can therefore be improved upon with proper mentoring, structure and opportunity and a push in the direction of evidence based medicine.<sup>24</sup>

## CONCLUSION

The results of this study have been able to substantiate the fact that undergraduate medical students require motivation to get involved in research projects, as 97 out of 100 students were enthusiastic about research; only 27 had any previous exposure. Students show a lack of initiative to opportunities in their clinical years so they should be given laboratory exposure in the earlier years of their medical education. Through this study we have aimed to prove that a minimum amount of time spent on an easily doable technique, in a basic laboratory setup can be quite successful in building undergraduate students' confidence and attentiveness to research and evidence based medicine

## REFERENCES

1. Khan H, Khawaja MR, Waheed A, Rauf MA, Fatmi Z. Knowledge and attitudes about health research amongst a group of Pakistani medical students. *BMC medical education*. 2006 Nov 2;6(1):54.
2. Scaria V. Whisking research into medical curriculum. *Calicut Medical Journal*. 2004;2(1):e1.
3. Jimmy R, Palatty PL, D'Silva P, Baliga MS, Singh A. Are medical students inclined to do research?". *Journal of clinical and diagnostic research: JCDR*. 2013 Dec;7(12):2892.
4. Sheikh AS, Sheikh SA, Kaleem A, Waqas A. Factors contributing to lack of interest in research among medical students. *Advances in medical education and practice*. 2013;4:237.
5. Kowalski JR, Hoops GC, Johnson RJ. Implementation of a Collaborative Series of Classroom-Based Undergraduate Research Experiences Spanning Chemical Biology, Biochemistry, and Neurobiology. *CBE-Life Sciences Education*. 2016 Dec 21;15(4):ar55.
6. de Oliveira NA, Luz MR, Saraiva RM, Alves LA. Student views of research training programmes in medical schools. *Medical education*. 2011 Jul 1;45(7):748-55.
7. Bernhard J: Insightful learning in the laboratory:

- Some experiences from ten years of designing and using conceptual labs. *Eur J Eng Educ.* 2010, 35 (3): 271-287. 10.1080/03043791003739759.
8. Upadhyay N. Clinical training in medical students during preclinical years in the skill lab. *Advances in medical education and practice.* 2017;8:189.
  9. Mostafa SR, Khashab SK, Fouaad AS, Abdel Baky MA, Waly AM. Engaging undergraduate medical students in health research: students' perceptions and attitudes, and evaluation of a training workshop on research methodology. *J Egypt Public Health Assoc.* 2006;81(1-2):99-118.
  10. Zier K, Stagnaro-Green A. A multifaceted program to encourage medical students' research. *Acad Med.* 2001;76(7):743-747.
  11. Weller JM. Simulation in undergraduate medical education: bridging the gap between theory and practice. *Medical education.* 2004 Jan 1;38(1):32-8.
  12. 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.
  13. Mokry J, Mokra D. Opinions of medical students on the pre-graduate scientific activities – how to improve the situation? *Biomed Pap Med FacUnivPalacky Olomouc Czech Repub.* 2007;151(1):147-149.
  14. Ruben BD. Simulations, games, and experience-based learning: The quest for a new paradigm for teaching and learning. *Simulation & Gaming.* 1999 Dec;30(4):498-505.
  15. National Research Council. *America's lab report: Investigations in high school science.* National Academies Press; 2006 Jan 20.
  16. Kowlowitz V, Curtis P, Solane PD. The procedural skills for medical students: expectations and experiences. *Academic Medicine.* 1990;65:656-658.
  17. Nelson MS, Traub S. Clinical skills training in US medical students. *Academic Medicine.* 1993;68(12):926-928.
  18. Solomon SS, Tom SC, Pichert J, Wasserman D, Powers AC. Impact of medical student research in the development of physician-scientists. *J Investig Med.* 2002;51(3):149-156.
  19. Lloyd T, Phillips BR, Aber RC. Factors that influence doctors' participation in clinical research. *Med Educ.* 2004;38(8):848-851. doi: 10.1111/j.1365-2929.2004.01895.x.
  20. Neilson EG. The role of medical school admissions committees in the decline of physician-scientists. *J Clin Invest.* 2003;111:765-767.
  21. Siemens DR, Punnen S, Wong J, Kanji N. A survey on the attitudes towards research in medical school. *BMC medical education.* 2010 Jan 22;10(1):4.
  22. Lopatto D. Undergraduate research experiences support science career decisions and active learning. *CBE-Life Sciences Education.* 2007 Dec 21;6(4):297-306.
  23. Segal S, Lloyd T, Houts PS, Stillman PL, Jungas RL, Greer 3rd RB. The association between students' research involvement in medical school and their postgraduate medical activities. *Academic Medicine.* 1990 Aug 1;65(8):530-3.
  24. Devi V, Abraham RR, Adiga A, Ramnarayan K, Kamath A. Fostering research skills in undergraduate medical students through Mentored Student Projects: Example from an Indian medical school. *Kathmandu University Medical Journal.* 2012 Jun 3;8(3):294-8.
  25. Burgoyne LN, O'Flynn S, Boylan GB. Undergraduate medical research: the student perspective. *Medical education online.* 2010 Jan 1;15(1):5212.
  26. Murdoch-Eaton D, Drewery S, Elton S, Emmerson C, Marshall M, Smith JA, Stark P, Whittle S. What do medical students understand by research and research skills? Identifying research opportunities within undergraduate projects. *Medical Teacher.* 2010 Jan 1;32(3):e152-60.
  27. Bangera G, Brownell SE. Course-based undergraduate research experiences can make scientific research more inclusive. *CBE-Life Sciences Education.* 2014 Dec 21;13(4):602-6.
  28. Hofstein A, Lunetta VN. The role of the laboratory in science teaching: Neglected aspects of research. *Review of educational research.* 1982 Jun;52(2):201-17.
  29. Wickramasinghe DP, Perera CS, Senarathna S, Samarasekera DN. Patterns and trends of medical student research. *BMC medical education.* 2013 Dec 28;13(1):175.
  30. Pakistan Medical & Dental Council. [Online] Available at: <http://www.pmdc.org.pk/LinkClick.aspx?fileticket=EKfBIOSDTKE%3D>