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Effect of teaching research concepts and methodologies on the interest for research in medical students.

Efecto de la enseñanza de conceptos y metodologías de investigación en el interés por la investigación en estudiantes de medicina.

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Abstract

Objectives: The number of medical students interested in performing research in their future careers is progressively declining. In the present study, the effect of teaching a subject explaining different concepts and methodologies related to research on the interest to carry out research in the future in second year medical students was assessed. **Methods:** The interest of combining clinical care with research in the future was asked to 193 second year medical students (65 males/128 females), aged 19.3 ± 0.5 years, mostly of Caucasian origin. The survey was carried out before and after taking a mandatory subject entitled "Introduction to Research" where concepts and methodologies regarding scientific research are taught with a theoretical and practical approach. **Results:** One hundred and seventy one out of the 193 students (88.6%) answered the question before taking the subject, while 131 out of the 193 students (67.9%) answered it thereafter. In both occasions the question was answered anonymously. Prior to the subject, 55.6% of the respondents declared that they would like to combine clinical care with research. After taking the subject, there was an increase in the percentage of students with an affirmative response, reaching a 67.9% of them interested in doing research in their future medical careers (P = 0.009). **Conclusions:** Introducing research concepts and methodologies early in the medical curriculum as a subject may have a positive impact on the willingness to do research in the future career of medical students.

Keywords: Medical education, medical students, research, interest for research, survey

Resumen

Objetivos: El número de estudiantes de medicina interesados en realizar investigación en sus futuras carreras está disminuyendo progresivamente. En el presente estudio, se evaluó el efecto de impartir una asignatura que explica diferentes conceptos y metodologías relacionadas con la investigación sobre el interés en llevar a cabo investigación en el futuro en estudiantes de medicina de segundo año. **Métodos:** Se preguntó a 193 estudiantes de medicina de segundo año (65 hombres/128 mujeres), con una edad promedio de 19,3 ± 0,5 años, en su mayoría de origen caucásico, acerca de su interés en combinar la atención clínica con la investigación en el futuro. La

encuesta se realizó antes y después de cursar una asignatura obligatoria titulada "Introducción a la Investigación", en la que se enseñan conceptos y metodologías de investigación científica con un enfoque teórico y práctico. **Resultados:** Ciento setenta y uno de los 193 estudiantes (88,6%) respondieron la pregunta antes de cursar la asignatura, mientras que 131 de los 193 (67,9%) lo hicieron después. En ambas ocasiones, la respuesta fue anónima. Antes de la asignatura, el 55,6% de los encuestados declaró que le gustaría combinar la atención clínica con la investigación. Tras cursarla, se observó un aumento en el porcentaje de estudiantes con respuesta afirmativa, alcanzando el 67,9% de interés en realizar investigación en sus futuras carreras médicas (P = 0,009). **Conclusiones:** Introducir conceptos y metodologías de investigación de manera temprana en el plan de estudios de medicina como asignatura puede tener un impacto positivo en la disposición a realizar investigación en la futura carrera de los estudiantes de medicina.

Palabras clave: Educación médica, estudiantes de medicina, investigación, interés por la investigación, encuesta

1. Introduction

Future progress in medicine depends on current scientific research. However, nowadays there is a lack of interest in research in medical professionals. In this sense, the number of physicians involved in doctoral studies as well as the amount of physician-scientists has decreased worldwide over the last years (1-5). Moreover, the number of medical students "exclusively" or "significantly" interested in research as a career activity at the beginning and end of medical school significantly decreased in the period between 1987-2003 (1, 6).

There are several reasons explaining the lack of interest in research and the decline in the number of physician-scientists including structural defects in the curriculum with disproportionate weight given to clinical practice during undergraduate medical training, the length of learning research methodology and the fact that salaries for physician-scientists are quite lower than those that can be earned in medical practice (6-9). In addition, the involvement of medical students in scientific research is hindered by the lack of allotted time and opportunities, insufficient mentoring and the absence of motivation due to inadequate scientific training in medical school (2, 6, 10-14).

Several measures have been proposed for increasing the physician's interest in research including developing appropriate reward systems for mentors and trainees, to encourage continuing medical education tools to bring practitioners up to date on research-related issues, but also to try to awaken the interest of students with subjects, courses or programs that teach them the different aspects of biomedical research (15-17).

Within the context of medical education in Spain, integrating biomedical research as a core component of the curriculum remains a challenge for many universities (16). While the importance of training physicians with a strong understanding and positive attitude towards research is widely acknowledged, there is a lack of studies that specifically assess the impact of a dedicated biomedical research course on medical students' interest and motivation (18). This study represents a pioneering effort in the Spanish university setting by directly comparing students' interest in research before and after completing a biomedical research course, thereby providing both quantitative and qualitative insights into the formative effect of such training early in their professional development.

The authors posed the hypothesis that increasing knowledge about biomedical research may result in a higher interest for doing research in the future. With that purpose, the effect of teaching a subject entitled "Introduction to Research" to second year medical students explaining different topics and methodologies related to research on the interest to carry out research in their future careers as physicians was evaluated.

2. Methods

2.1. Study design

We performed a single-group pre–post quasi-experimental anonymous question before and after taking the subject entitled "Introduction to Research" at the School of Medicine of the University of Navarra in Pamplona, Spain. We studied a class of 193 students (65 males/128 females), aged 19.3 ± 0.5 years including 179 Spanish students, 6 from other European countries, 3 from Asia, 1 from North America and 4 from Central and South America. The subject took place in the first trimester of the academic year 2020-2021 during the second year of the academic degree. All methods were carried out in accordance with relevant ethical guidelines and regulations. All information remained confidential and anonymous, as there were no personal identifiable data included in the questionnaire. The project was classified as curricular evaluation and the Institutional Review Board of the University of Navarra confirmed exemption given that student participation was anonymous and voluntary.

2.2. Objectives of the subject

"Introduction to Research" is a core subject in the second year of the medical degree with the following general objectives: 1) familiarize students with the fundamentals of research from a historical and dynamic perspective; 2) distinguish between the diverse types of research and their adequate application depending on the final aim; 3) understand the basic methodological & ethical requirements to obtain reliable and reproducible results; 4) understand the methodological issues underlying the currently applied technology for the advancement of science; 5) critically analyze biomedical articles and scientific images and 6) explore the potential applications of biomedical research in the discovery of novel forms of diagnosis and treatment. The nature of the subject allows students to awaken curiosity and interest in research activities, so that they can be consolidated throughout the subsequent undergraduate and postgraduate training.

2.3. Structure of the subject

Throughout the subject there are 8 lectures, where topics such as historical background, types of research, the scientific method, ethics in human and animal research, scientific rigor, evaluation of scientific results with bibliometric indicators (impact factor, h-index, among others) are introduced. During the 14 classes following the lectures, students design a directed research project, in groups of approximately 6-7 students (randomly designated) applying team-based learning methodology. The research project may be about any disease being focused on a relevant aspect of the pathology susceptible of being investigated. Students have to search and revise bibliography, formulate a hypothesis, describe the specific objectives to address it, and delineate the type of clinical trial they would carry out, the experimental groups, the appropriate ethical considerations for either human or animal experiments, and the determinations they would use. Before each class students had to work on the material specifically prepared to address each of the sections they had to develop in their research project. At the beginning of each class students underwent a readiness assessment test on the series of concepts and guidelines they would have to work on that session. During the sessions the students worked within their group on their assignments with 3 teachers per 10-15 groups providing advice, guidance and answering questions. At the end of the trimester each team carried out a 5 minutes oral presentation followed by questions asked by their classmates or the professors. In parallel, the students had 6 practical sessions where they learned how to search and retrieve scientific information in PubMed, Web of Science, OMIM, and Gene, among others. They also learned the basics of different experimental methodologies, together with basic skills for the analysis of data with Excel and for the writing of a research abstract, and how to prepare a scientific poster.

2.4. Survey instrument

The primary outcome was assessed with a single, anonymous item administered before and after the course: 'Would you like to combine clinical practice with research in your future career?' Response options were 'Yes', 'No' and 'Undecided'. The item was developed by the teaching team based on prior literature and reviewed for clarity by three faculty members (face validity). The pre-course item was administered in-class using Socrative and the post-course item via Google Forms. No formal psychometric validation was performed.

2.5. Statistical analysis

Data are presented as percentage and number of responses. Differences between proportions of responses were assessed by the Chi-square test. We performed a sensitivity analysis to estimate the potential impact of non-response on the primary outcome. The calculations were performed using the SPSS version 23 (SPSS, Chicago, IL). A P value lower than 0.05 was considered statistically significant.

3. Results

The first question was performed in the classroom on the first day of the subject "Introduction to Research" using the Socrative internet-based tool. Of the 193 second year medical students (66.3% females) enrolled, 171 (88.6%) answered the question. The same question was performed after the last class via Google Forms and communicated to the students via notification through the Online Learning & Teaching Platform Blackboard. One hundred and thirty one out of the 193 students (67.9%) answered the question the second time. On both occasions the question was answered anonymously.

As observed in Figure 1, 55.6% of the respondents declared before taking the subject "Introduction to Research" that they would like to combine clinical care with research in the future, 21.1% of them answered "no" to the question, while a 23.4% did not know. After taking the subject, in which many aspects related to biomedical research were introduced, there was an increase in the percentage of students with an affirmative response, 67.9%, interested in doing research in their future medical careers (P = 0.009). There was a reduction in the percentage of students showing no interest (8.4%), while the number of doubtful students remained very similar (23.7%).

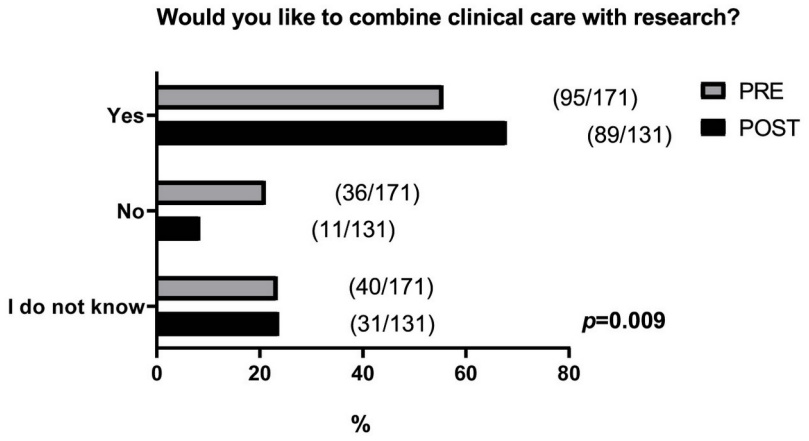

Figure 1. Changes in the proportion of responses of second year medical students before and after taking a subject regarding research concepts and methodology to a question about their interest for performing research in their future careers.

To evaluate the potential effect of non-response bias, we performed sensitivity analyses assuming lower levels of interest among non-respondents (n = 62). If non-respondents had been 10 or 20 percentage points less interested than respondents (57.9% or 47.9%, respectively), the estimated overall post-course proportions of interested students would still remain higher than the pre-course level (65.1% and 62.0%, respectively, *vs*. 55.6% at baseline). Only under an extreme assumption that none of the non-respondents were interested (0%) would the post-course proportion drop below the pre-course value (45.5%). These results indicate that the observed increase in research interest is robust to plausible levels of non-response bias. Due to preserving anonymity of students it was not possible to analyze responses as regards potential gender and/or cultural differences.

4. Discussion

The main objective of the present study was to analyze the impact on second year medical students of taking a subject where relevant concepts regarding medical research are introduced and "practiced" (elaborating a research project) on the interest for doing research in their future careers as physicians. We found a significant increase in the expression of interest for performing research in the future after taking the mentioned subject.

Medical students reportedly have a positive attitude towards science and scientific research (19). However, medical students express lack of interest to do research in their future careers due to several reasons, with a lack of appropriate teaching of research skills during the medical degree being among them (12). In the present study we have shown that teaching a mandatory subject where students learn important aspects related to biomedical research and develop fundamental skills to do research produces a significant increment in the attitude towards performing research in their future careers. Contrarily to the Anglo-Saxon systems where scientific publications help medical students in their future professional placements, the Spanish system does not value research during the medical degree at all. This contextual distinction reinforces the originality of our work, as it evaluates a compulsory course integrated early in the Spanish undergraduate medical curriculum, where research is not institutionally rewarded.

A previous study showed that teaching a mandatory subject where the principles of scientific research in medicine were learnt increases the value given to research (17-19). The reported positive effect was more evident in the third year of medical school, after taking the subject in the second year. In our hands, the positive effect was found within the second year since the subject and the surveys were taken in the first trimester of the given year. In our study, the magnitude of the increment in the interest for scientific research was more notable than in the work of Hren and colleagues (19), but it would be of interest to analyze the impact of the subject in the last year of the degree. Interestingly, the positive attitude towards research is higher in 4th year than in 2nd year medical students (10), being this increase associated to the accumulation of knowledge and maturation of students (20). However, other authors have reported a decrease in the interest in research as the academic years progress (16).

Other studies with similar purpose evidenced that attendance of a course on research methodology had a causative short-term effect on positive attitudes toward science in medical students (17, 18, 20). Our survey is the first to specifically ask about the willingness to do research in the future career as physicians, showing that teaching research concepts and methodology promotes the interest for doing research in the future. Importantly, our primary outcome focused on the specific intention to combine clinical care and research—a construct that had not been explicitly measured in prior studies. This targeted assessment provides a more precise estimate of early professional orientation toward physician–scientist careers. In this sense, according to studies

performed in different countries, medical students engaged in research during the years in medical school are more probably involved in postgraduate research (2, 18).

Physician-scientists play a fundamental role in translating research-driven healthcare practices and new discoveries into clinical care (2). If we want to have physician-scientists in the future, we have to awaken the interest of medical students during the medical degree. In our opinion, the inclusion in the curricula of subjects that teach the fundamentals of biomedical research is a good way to promote it (21). In this sense, 73% of German medical students believed that the medical curriculum should include the teaching of more or much more skills to critically analyze a scientific publication, and 68% considered that it should also include the teaching of more or much more skills regarding scientific writing (12). Our work and other studies (19, 22) suggest that an adequate planning of the medical curricula introducing mandatory as well as elective subjects or programs related to research exerts a positive impact on the students regarding the practice of research in the future physicians. Thus, our results contribute evidence from a Spanish medical school supporting the global trend: early, compulsory exposure to research methodology fosters sustained academic interest and offers actionable insights for curriculum planners.

The present study has several limitations. First, being the subject mandatory, we were unable to compare with students who had not taken the subject, but we believe that the significant increase in interest is more than remarkable. Second, our intervention was evaluated in the short-term as mentioned above, and we will reevaluate the interest for doing research in the future career in the last years of medical school, but it seems that the interest increases per se in higher years. Third, the single-group pre–post design does not allow causal inference and the primary outcome is a single self-reported item measuring intention, not actual subsequent research activity. Fourth, our survey was performed in a single medical school. Although our sample was composed by a 7.3% of foreign students, the consistency with previous studies from other geographical locations (19-20) suggests that our results may be extensive to other academic settings.

Although the response rate declined from 88.6% pre-course to 67.9% post-course, the direction and magnitude of the observed effect appears robust. Sensitivity analyses showed that even under conservative assumptions—presuming that non-respondents were 10–20 percentage points less likely to express research interest—the overall post-course proportion would remain higher than baseline (62–65% *vs*. 55.6%). Only under an unrealistically extreme scenario (0% interest among non-respondents) would the apparent gain disappear. These findings suggest that attrition is unlikely to have materially biased the main outcome. Nevertheless, the possibility of some self-selection cannot be excluded, and it is possible that students who perceived greater benefit from the course were more motivated to complete the follow-up survey. Future studies using controlled designs, larger samples, longer follow-up and validated multi-item scales will be needed to confirm these preliminary findings and to explore whether early exposure to research training translates into long-term engagement in scholarly activity such as participation in projects, abstracts or publications.

5. Conclusions

- Introducing teaching of research concepts and methodologies as subject in the core curriculum of the medical degree may have a positive impact on the willingness to perform research in the future career of medical students.

- The findings of the present study may have relevant implications for the design of curricula in medical schools.

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6. References

1. Ley TJ, Rosenberg LE: The physician-scientist career pipeline in 2005: build it, and they will come. *JAMA*. **2005**, 294(11), 1343-1351. https://doi.org/10.1001/jama.294.11.1343
2. Stockfelt M, Karlsson L, Finizia C: Research interest and activity among medical students in Gothenburg, Sweden, a cross-sectional study. *BMC Med Educ*. **2016**, 16(1), 226. https://doi.org/10.1186/s12909-016-0749-3
3. Huang X, Dovat S, Mailman R, Thiboutot D, Berini D, Parent LJ: Building a system to engage and sustain research careers for physicians. *Acad Med*. **2021**, 96(4), 490-494. https://doi.org/10.1097/ACM.0000000000003886
4. Melk A, Grabitz C, Ernst J, Saenger T, Degraeuwe E, Beck Schimmer B, Vande Walle J, Azukaitis K, Prakken B, Campo E et al: Structured programs to train the next generation of clinician scientists. *Nat Med*. **2025**, 31(1), 24-27. https://doi.org/10.1038/s41591-024-03339-2
5. Kelly DP: Replenishing the physician-scientist pipeline in the post-late bloomer era. *J Clin Invest*. **2024**, 134(1), e172691. https://doi.org/10.1172/JCI172691
6. Sobczuk P, Dziedziak J, Bierezowicz N, Kiziak M, Znajdek Z, Puchalska L, Mirowska-Guzel D, Cudnoch-Jedrzejewska A: Are medical students interested in research? - students' attitudes towards research. *Ann Med*. **2022**, 54(1), 1538-1547. https://doi.org/10.1080/07853890.2022.2076900
7. Salgueira A, Costa P, Goncalves M, Magalhaes E, Costa MJ: Individual characteristics and student's engagement in scientific research: a cross-sectional study. *BMC Med Educ*. **2012**, 12, 95. https://doi.org/10.1186/1472-6920-12-95
8. Brown AM, Chipps TM, Gebretsadik T, Ware LB, Islam JY, Finck LR, Barnett J, Hartert TV: Training the next generation of physician researchers - Vanderbilt Medical Scholars Program. *BMC Med Educ*. **2018**, 18(1), 5. https://doi.org/10.1186/s12909-017-1103-0
9. Epstein N, Eberle J, Meuleners J, Lachmann D, Heuser S, Herzig S, Neuhaus B, Fischer MR: The role of research competence as an influencing factor for the careers of young academics. Findings and implications from studies on doctorates in medicine and life sciences in Germany. *GMS J Med Educ*. **2023**, 40(6), Doc70. https://doi.org/10.3205/zma001652
10. Siemens DR, Punnen S, Wong J, Kanji N: A survey on the attitudes towards research in medical school. *BMC Med Educ*. **2010**, 10, 4. https://doi.org/10.1186/1472-6920-10-4
11. Funston G, Piper RJ, Connell C, Foden P, Young AM, O'Neill P: Medical student perceptions of research and research-orientated careers: An international questionnaire study. *Med Teach*. **2016**, 38(10), 1041-1048. https://doi.org/10.3109/0142159X.2016.1150981
12. Ratte A, Drees S, Schmidt-Ott T: The importance of scientific competencies in German medical curricula - the student perspective. *BMC Med Educ*. **2018**, 18(1), 146. https://doi.org/10.1186/s12909-018-1257-4
13. El Achi D, Al Hakim L, Makki M, Mokaddem M, Khalil PA, Kaafarani BR, Tamim H: Perception, attitude, practice and barriers towards medical research among undergraduate students. *BMC Med Educ*. **2020**, 20(1), 195. https://doi.org/10.1186/s12909-020-02104-6

14. Catalán V, Rodríguez A, Becerril S, Unamuno X, Mentxaka A, Gömez-Ambrosi J, Frühbeck G: The 'new normality' in research? What message are we conveying our medical students? *Eur J Clin Invest*. **2021**, 51(9), e13586. https://doi.org/10.1111/eci.13586
15. Murillo H, Reece EA, Snyderman R, Sung NS: Meeting the challenges facing clinical research: solutions proposed by leaders of medical specialty and clinical research societies. *Acad Med*. **2006**, 81(2), 107-112. https://doi.org/10.1097/00001888-200602000-00002
16. Sanabria-de la Torre R, Quinones-Vico MI, Ubago-Rodriguez A, Buendia-Eisman A, Montero-Vilchez T, Arias-Santiago S: Medical students' interest in research: changing trends during university training. *Front Med (Lausanne)*. **2023**, 10, 1257574. https://doi.org/10.3389/fmed.2023.1257574
17. Jeon SJ, Yoo HH: Changes in medical students' research-related perceptions through student-engaged medical research curriculum experience. *BMC Med Educ*. **2024**, 24(1), 1002. https://doi.org/10.1186/s12909-024-06003-y
18. Shen J, Qi H, Liu G, Li X, Fang Y: The impact of a curriculum-based research training program on medical students' research productivity and future research interests: a longitudinal study. *BMC Med Educ*. **2024**, 24(1), 836. https://doi.org/10.1186/s12909-024-05841-0
19. Hren D, Lukic IK, Marusic A, Vodopivec I, Vujaklija A, Hrabak M, Marusic M: Teaching research methodology in medical schools: students' attitudes towards and knowledge about science. *Med Educ*. **2004**, 38(1), 81-86. https://doi.org/10.1111/j.1365-2923.2004.01735.x
20. Vujaklija A, Hren D, Sambunjak D, Vodopivec I, Ivanis A, Marusic A, Marusic M: 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. https://doi.org/10.2310/JIM.0b013e3181cb42d9
21. Chang Y, Ramnanan CJ: A review of literature on medical students and scholarly research: experiences, attitudes, and outcomes. *Acad Med*. **2015**, 90(8), 1162-1173. https://doi.org/10.1097/ACM.0000000000000702
22. Torres Belma A, López Valladares C: Importance of research skills in the training process of medical students. *Rev Esp Educ Med*. **2024**, 5(4), 632891. https://doi.org/10.6018/edumed.632891