Associated factors with reaching a scientific publication during medical training: evidence from 40 medical schools surveyed in Latin America.

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Abstract

Background Scientific publication during medical training is key to promote an enduring cutting-edge knowledge. The promotion of science among medical students in Latin America is a multi-sphere issue hampered by the unawareness of governments to invest in national research, as well as a lack of support from local universities. This study aims to determine the factors associated to reach a scientific publication during medical training among Latin American medical students of local scientific societies.

Methods This is a secondary-data-analysis of a study conducted in 2016 to evaluate the use of information and communications technologies (TICs) among medical students of 40 local scientific societies of medical students affiliated to the Latin American Federation of Medical Students Scientific Societies (FELSOCEM, in Spanish). Local teams in each local scientific society surveyed self-reported scientific publications and explored its association with socioeconomic, academic, and research training conditions. We included medical students enrolled in the 2016-I term and excluded medical interns. We implemented nested models to identify covariates associated with self-reported scientific publication until reaching a parsimonious mixed-effect multilevel model clustered by medical scientific society.

Results We surveyed 11,587 medical students. The prevalence of scientific publications increased in 36% among medical students affiliated to a Scientific Society of Medical Students [parsimonious prevalence ratio (PRp)=1.36, 95%CI=1.16–1.59], 51% among medical students with advanced English proficiency [PRp=1.51, 95%CI=1.21 – 1.87], 85% among medical students who attended a scientific writing skills course [PRp=1.85, 95%CI=1.59–2.15], 81% among medical students who use Sci-hub [PRp=1.81, 95%CI=1.50–2.20], and 108% among medical students who have access to a pirated academic account [PRp=2.08, 95%CI=1.83–2.36].

Conclusions Reaching a scientific publication among medical students is associated with being affiliated to a Scientific Society of Medical Students, English proficiency, training in scientific writing, use of Sci-Hub, and pirated academic accounts.

Background

Scientific publication during medical training is key to promote the constant medical training and to encourage students to create cutting-edge knowledge; in this way, students will build-up research skills, a critical thinking, and conduct evidence-based practice and patient-centered care with an endured vision to follow a scientific career (1–3). Latin American universities are progressively recognizing the critical importance of foster science in the early onset of undergraduate, and are implementing research-oriented courses such as research design methods, biostatistics, epidemiology, and a final research-centered thesis (4). However, there are still gaps in Latin America when comparing to research university systems from developed countries in terms of the number of publications, the quality of articles published, the outreach of the studies, and funding opportunities (5). Studies in Colombia and Brazil show that medical students consider scientific research as an important issue of their training and the low scientific production is influenced by the lack of inspirational and committed mentors as role models for the beginning of a scientific career (6,7). Between 1997 and 2010, the global Peruvian scientific production

reported an increase of 8.4% student participation in manuscripts published on journals indexed in Scielo-Peru, of whom 42% reported being affiliated to a scientific society of medical students (4,8).

In Peru, the progress of research in medical undergraduate has been strongly promoted by the Peruvian Scientific Society of Medical Students (SOCIMEP, by its acronym in Spanish), an organization that has been improving the research training of medical students for 27 years (9). SOCIMEP stands scientific and academic committees in their central and 38 local scientific societies throughout local medical schools of Peru, and held international, national, and local scientific conferences (9). The SOCIMEP also foster societies to actively participate and integrate them into a nation-wide research network, and provide connections with experienced research mentors. Being affiliated to the SOCIMEP's local scientific society is associated with increased scientific production (PR: 2.41; 95% CI: 1.55–3.74) (10). However, only 10% of the projects conducted in local scientific societies are published in indexed journals due to deficient methods implemented in the studies, lack of knowledge about editorial process, the reduced number of local mentors and the lack of financial support from public agencies and institutions (11). The funding opportunities for medical students are poor in local medical schools of Peru and mostly in Latin America, overall, the investment of governments is unfairly disproportional to attend local public health priorities with well-implemented laboratories, and full-time research-centered faculties (12). In Peru, less than 30% of universities have research funding programs for students to implement their thesis research operations, or research student program awards (13).

The promotion of science among medical students in Latin America is a multi-sphere issue hampered by the unawareness of governments on the investment in nation research and innovation well-structured systems, as well as a lack of local universities support, their lack of investment in research facilities, and a lack of international-research experienced mentors (3). In this scenario, our study aims to determine the factors associated with scientific publication during medical training, in order to identify the needs of Latin American local scientific societies for the implementation of their continuing education programs in research.

Methods

Study design

This is a secondary-data-analysis of a study conducted in 2016 to evaluate the use of information and communications technologies (TICs) in medical students along Latin America (13,14). This cross-sectional study evaluated 40 scientific societies of medical students from Latin America. Our current research is a sub study which primarily evaluated the self-report of scientific publications and used the following variables to explore its associated factors: gender, age, university, current year of career, affiliated to a scientific medical student society, English proficiency, studied previous career, courses in scientific databases including Pubmed, Scopus and Scielo, courses in scientific writing skills, courses in scientific browsing, courses in Zotero, use of Sci-Hub, access and provider of pirated academic accounts.

Population and sampling

The primary study surveyed 11,587 students from 40 medical schools including two from Ecuador, two from Panama, four from Paraguay, three from Bolivia, 18 from Peru, two from Mexico, two from Venezuela, one from Honduras, three from Colombia, one from Chile, and two from Argentina. This study included medical students enrolled in the term 2016-I and excluded who were doing the internship.

We made a stratified sampling using the academic year in the medical school as a stratum. The estimated sample size for each investigation site was 289 medical students, we also added 10% to anticipate withdraws. Thus, 318 medical students were estimated to survey in each university. We consider a sample size calculation with an 80% of power, and 5% of significance for an infinite sample size. Regarding participants selection, the interviewers-team enter to the course with greatest credits in each academic year and picked the students who were sit in an odd numbered location per row. In three universities, the sample size was not enough large to reach the minimum required, then we conducted a census-type sampling.

Operational procedures

In 2015, the ICTs project was awarded on the category of multi-center projects by the XXX International Congress of the Latin American Federation of Medical Students Scientific Societies (FELSOCM, by its acronym in Spanish). This award let connect the researchers within the FELSOCM's international collaboration network and carry out the study. We could enroll teams from 40 out of 69 Scientific Medical Students Society (SOCMs, by its acronym in Spanish) along Latin American. Each scientific society had at least one team with three medical students who were trained on scientific integrity (15), standardized methods for survey participants, data entry procedures, and quality control of datasets.

In each medical school, every interviewers-team surveyed at the beginning or the end of the lectures, prioritizing the students have long time enough for their convenience. The surveys were self-reported and last approximately 15 minutes per participant.

Data analysis

We evaluated the association between self-reported manuscript publication and its covariates using Chi²-tests for categorical variables and Mann-Whitney U test for numerical variables. Poisson family regressions were performed using a log link function and mixed effects multilevel models. We estimated nested models following a manual forward selection method to identify covariates associated with self-reported manuscript publication until reaching a parsimonious multivariable model. These covariates were selected using likelihood ratio tests. Crude and adjusted prevalence ratios (PR) were estimated with 95% confidence intervals (CI 95%). All hypotheses were contrasted using 5% significance. The analysis was performed using Stata 15.1 ED ®, and the analysis code is openly available in git-hub (16).

Ethical considerations

The primary study was reviewed and approved by San Bartolome Hospital's Institutional Review Board (CIE15325-15). The surveys were self-reported and anonymous. Also, the data was coded to save privacy

of the participants.

Results

We interviewed 11,587 medical students of whom the mean age was 21 ± 2.9 years and the 53% were females. The 22.2% ($n = 2,575$) of medical students were in the first year of career. The 12.5% ($n = 1,449$) were affiliated to a Scientific Medical Student Society. Besides, the 14.1% ($n = 1,618$) reported advanced English skills.

The 65.1% ($n = 3,989$) attend a scientific writing course, and 7.9% ($n = 893$) published at least one scientific article during his medical training. The 22.6% ($n = 2,514$) had a pirated academic account, and from a total of 6,632 medical students, the 19.2% ($n = 1,273$) used Sci-Hub at a certain point of their careers (Table 1)

There were differences on the prevalence of scientific publications among first-year and last-year medical students (13% vs 4.3%), being affiliated to a Scientific Medical Student Society (12.43% vs 7.24%), the advanced and elementary proficiency of English (11.2% vs 6.4%), took a scientific writing course (14.6% vs 4.3%), use Sci-Hub (19.3% vs 4.7%) and having pirated academic accounts (15.3% vs 5.5%) (Table 2).

The nested models progressively selected the following covariates: courses in scientific writing, pirated academic accounts, universities, courses in Zotero, courses in scientific databases, year of study, previous career, English proficiency, and affiliation to a Scientific Medical Student Society. The prevalence of scientific publications were 36% ($PRp = 1.36$, 95%CI = 1.16–1.59, $p < 0.001$) higher if a medical student was affiliated to a Scientific Medical Student Society, 51% ($PRp = 1.51$, 95%CI = 1.21–1.87, $p < 0.001$) higher among the medical students with advanced English proficiency, 85% ($PRp = 1.85$, 95%CI = 1.59–2.15, $p < 0.001$) higher in medical students who took a scientific writing course, 81% ($PRp = 1.81$, 95%CI = 1.50–2.20, $p < 0.001$) higher in medical students used Sci-hub, and 108% ($PRp = 2.08$, 95%CI = 1.83–2.36, $p < 0.001$) higher among medical students who have a pirated academic account (Table 3).

Discussion

Pirated academic accounts and use of Sci-hub

The use of Sci-Hub was reported in 19.2% ($n = 1273$) of the students surveyed, of whom 19.3% ($n = 243$) published a manuscript during their medical training. The awareness and use of Sci-Hub may be due to the high need to access top-level scientific evidence behind a paying wall. However, medical students have reported difficulties to access Sci-Hub because it is considered an illegal service in many regions, then the web domain is often blocked (18)(19–21).

The use of Sci-Hub was associated with higher prevalence of scientific publications among medical students ($PR: 1.81$; $CI_{95\%}: 1.50-2.20$). Students feel the great need to obtain access to payed articles, leading to seek free access throughout Sci-Hub (19,21). However, even those students who do not face a

paying wall, found convenient to reduce the time and simplicity of browses using Sci-Hub (23). In addition, many researchers and students identify Sci-Hub as a faster option not limited to their institution's catalog (21). This is likely homogeneous between high and low income countries worldwide (24). More than 56,000 article downloads via Sci-Hub came from different east coast cities of the United States, especially from cities where large universities have subscriptions to different editorial groups (23).

The use of pirated academic accounts was associated with higher prevalence of scientific publications (PR: 2.08; CI95%: 1.83-2.36). The institutional licenses let access to journals, books, or specialized databases such as Scopus or Web of Science. These paid services are funded by government institutions in low- or middle-income countries (LMIC), however, these are not widely distributed or have not been implemented in LMIC (24). Alternatives such as HINARI allow access to paid articles in low- and middle-income countries, and is available to the academic and research community only from certified institutions who achieved certain milestones defined by local science systems (25). All this complex context, lead users to exchange, loan or acquire access accounts or proxy links to journal catalogs of institutions by non-legal terms (23).

Courses in scientific writing

The 34.9% of students who reach a scientific publication attended a course in scientific writing skills. Attending a scientific writing skills course increased the prevalence of scientific publications in 85% (PRp=1.85, CI95%=1.59 - 2.15, p<0.001). This likely because of the great need of medical students to improve their skills to effectively communicate scientific findings, make a relevant academic reflection, and enhance the chances of acceptance into a scientific journal (26). Novel medical students in research training are eager to be trained in scientific writing skills and seek an experienced mentor to train them (28). In addition, medical students actively seek for courses of scientific writing and communication, for instance, the Brazilian DivulgaMicro initiative was a course funded by the Fundação de amparo a pesquisa do estado de São Paulo (FAPESP, by its acronym in Portuguese) to train early career researchers to translate complex scientific messages to understandable pieces of information to community members (29). After 30 days of launched, the website registered 1,026 users from different regions worldwide including Latin American, United Kingdom, Pakistan, Germany and Canada. This was one of the most visited free and open scientific communication workshops, that trained over 600 novel medical student researchers (29).

English proficiency

An advanced English proficiency was reported in 14.1% of the students, of whom 11.2% published a scientific manuscript during medical training. In addition, the prevalence of scientific publications increased in 51% among students with advanced English proficiency (PRp=1.51, 95%CI=1.21 - 1.87, p<0.001). Students are encouraged to understand a scientific evidence written in English (29). The TOEFL score is correlated with publishing in a medical journal (correlation coefficient: 0.63) (30). Scientific journals preferably accept articles from English natives versus non-English natives (acceptance rate 7% vs 3.6%, accordingly) (31). Likewise, Americans are 49% more likely to reach an article peer-review or

acceptance in an American journal comparing to non-English natives (31). Medical students from second to sixth year who attended an English scientific writing skills training reported 53% of them perceived that they were not English proficient enough to publish a manuscript in English written journals (32).

The association between scientific publications and advanced English proficiency could be likely because of students' desire to pursue an academic training abroad offered by institutions requiring academic excellence and a great potential. In 2016, the Peruvian Program of Educational Grants and Credits (PRONABEC, by its acronym in Spanish) jointly funded the Fulbright, FONDECYT (Fondo Nacional de Desarrollo Científico y Tecnológico), and Chevening scholarships in Peru which benefited 14, 6, and 15 Peruvian graduate applicants, accordingly (33). In this way, the scholars could be trained in outstanding foreign universities and capitalize a generation of researchers with masters and doctoral degrees who upon returning to their home countries seek to improve the science and technology system (34–36). During 2004-2012, the Fogarty International Clinical Research Fellows Program funded promising initiatives of highly competitive English-dominant students from LMIC whose scientific discoveries can address long-term global health needs (37,38). This approach has become Fogarty's hallmark: bringing great science to solve local problem of global outreach and building local research capacities (38). During 2014-2015, Fogarty has contributed substantially to the training of more than 6,100 global health leaders, 140 of whom have earned doctorates in epidemiology and 96 in public health (39).

The Fogarty International Center builds a bridge between the NIH (National Institutes of Health) and the global health research community, 85-90% of trained fellows return to LMICs and obtain research positions into academia, government agencies, and institutes (38). However, young Latin American scholars and postdoctoral researchers trained abroad find it difficult because of an unfavorable science system (25). For instance, the investment of the Peruvian administration to progress in science and research is still insufficient, it is only 0.12% of the gross domestic product compared to 0.36% in Chile, 1.3% in Brazil and 2.8% in the United States (41)(40).

Affiliated to a scientific medical student society

Our findings showed that being affiliated to a medical student scientific society increased the prevalence of scientific publication in 36% (PRp:1.36, CI95%=1.16-1.59, $p<0.01$). Student scientific societies, such as the Peruvian Medical Student Scientific Society (SOCIMEP, by its acronym in Spanish) tries to fill the gaps of research training and provide students the mentors, courses, and scientific opportunities to pursue a research career (9,41). Over 30 years of operations with local-level scientific societies across Peru, SOCIMEP promotes research events at a regional, national, and local level multidisciplinary university research and service camps (CUMIS, by its acronym in Spanish), the annual scientific conferences, and foundation courses in epidemiology, research design, and biostatistics (42). The enduring outreach of the SOCIMEP achieved overall societies underlie 242 published articles, of which 11% ($n=67$) were published in Q1 journals, under the mentorship of highly experienced national researchers (43).

However, we must understand our findings under the following statements. First, the information bias, several parameters of the questionnaire were self-reported which may cause an undifferentiated

classification of the outcome, and may increase the residual confusion of confounding parameters. However, we tried to control this situation motivating the students to answer the questionnaire truthfully and did not rush their answers; in this sense, our outcome is consistent with reality. Second, selection bias, all 40 medical schools were affiliated with FELSOCM, so our findings are useful for these schools and similar studies should be extended to understand local and regional scientific realities from different countries.

Conclusion

Factors associated with reaching a publication among medical students during their medical in Latin America are being affiliated to a local Scientific Society of Medical Students, having an advanced English proficiency, attended a course of scientific writing skills, the use of Sci-Hub, and having pirated accounts. The promotion of science among medical students in Latin America is a multi-sphere issue which needs to be addressed as part of multilevel strategies coming from high government authorities, to finally empower universities and build-up a committed science system in each nation.

Abbreviations

- TICs: Information and communications technologies
- FELSOCM: Latin American Federation of Medical Students Scientific Societies
- SOCIMEP: Peruvian Scientific Society of Medical Students
- SOCEMs Scientific Medical Students Society
- LMIC: Low- or middle-income countries
- FAPESP: Fundação de amparo a pesquisa do estado de São Paulo
- PRONABEC: Peruvian Program of Educational Grants and Credits
- FONDECYT: National Fund for Scientific, Technological Development and Technological Innovation
- CUMIS: Multidisciplinary university research and service camps

Declarations

Ethics approval and consent to participate

The primary study was reviewed and approved by San Bartolome Hospital's Institutional Review Board (CIEI15325-15). Verbal consent was approved by the IRB considering the vulnerating of human subject rights of our study was of low-risk, according to the Peruvian National Institute of Health regulations for Institutional Review Boards (44). Interviewers verbally consent the participants, also the surveys were self-reported and anonymous. Also, the data was coded to save privacy of the participants.

Consent for publication

Not applicable.

Availability of data and materials

The anonymize dataset of the study is available at [10.6084/m9.figshare.11888187](https://doi.org/10.6084/m9.figshare.11888187), also the code of analysis is openly available in git-hub (17).

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

MV, CC and CM conceived and designed the study and analyzed the data; AR, MA, JC, JF, FR retrieved the data and drafted the manuscript. All authors read and approved the final manuscript.

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Tables

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