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ASSESSING CLINICAL AND RESEARCH TRAINING NEEDS OF MEDICAL STUDENTS ACROSS 26 COUNTRIES

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ABSTRACT: This study surveyed medical students' attitudes toward clinical and research education as well as the factors that discouraged participation in research in 26 different nations. An online survey with 94 questions was distributed via social media and worldwide academic networks from November 1, 2020, to December 31, 2020. The survey was available in several languages. Demographics, training history, study exposure, and perceived difficulties were among the data sets examined using descriptive statistics and geographical comparison models. Latina women made up the majority of the 318 responders. Many more emigrated from other regions, including North America. The majority of students agreed that medical school research was crucial, but many also felt their institutions were lacking in resources that would allow them to conduct adequate research, such as mentors or formal training. Concerns about this intensified as the COVID-19 pandemic progressed. There was very little discussion of financial and technological issues. Research positions were more appealing to students from Latin America and other international regions than to those from North America. The data demonstrate that there is still a severe lack of research training and financing on a global scale. This exemplifies the importance of both national and local strategies to improve the study habits of future doctors.

Keywords: *Medical students; Medical education; Research training; Survey; International study; Barriers to research; Clinical training; Global health*

1. INTRODUCTION

We are currently looking at what medical students around the world already know, the resources available to them, and the barriers to their education. Early involvement in medical research can be very advantageous for medical students. There are many benefits to starting medical research early on. Engaging medical trainees are more likely to make well-informed career decisions, produce more scientific output over the medium and long term, improve their research skills, and become more enthusiastic about their studies. Regular participation by medical students improves attending physicians' academic output. In some parts of the world, involving medical students could be essential to the future of research.

Intercalated degrees, graduation theses (like those in Germany), and other research-oriented graduation requirements have been suggested or put into place to increase medical students' involvement in research because of the importance of research. To determine the importance of teaching medical students about global research, more study is being done. These suggestions and prerequisites are often well-liked by students because they support their long-term academic goals and are relevant to their field of study. Medical students are just as excited about their education in high- and low-income countries.

There hasn't been much research done to determine global trends in research knowledge, opportunity, and involvement, despite calls for changes in medical education and research that could help medical students. Between 1985 and 2018, the United States and the United Kingdom accounted for over half of the studies that examined the research interests and activities of medical students. Most of the research that has identified barriers has been carried out outside of the United States. Among the difficulties were a lack of formal training, a lack of expertise, a lack of funds, and unfamiliarity with the courses offered at their own university. The majority of research looks at challenges inside a particular school. They occasionally look at hurdles that are specific to certain organizations, but they rarely take international barriers into account.

The purpose of this study was to fill in the gaps in our knowledge of medical students' research experiences, opportunities, and difficulties while also demonstrating how geographic differences affect their propensity to conduct research around the world.

2. METHODS

Participants

Any medical student enrolled at an institution, regardless of country, was thought to be eligible for inclusion. The document was also contributed to by the University of Minnesota, Addis Ababa University (Ethiopia), the University of Rwanda, the Universidad de Ciencias Españicas de Costa Rica, and the University of Science and Technology in Zimbabwe.

Before the survey was distributed, it underwent an ethical evaluation by the University of Minnesota Institutional evaluation Board. Since the study (STUDY00010789) did not involve human beings, no further clearances were needed.

Survey Design

After its examination, medical students from many countries, such as the United States, Ethiopia, Zimbabwe, and Costa Rica, worked together to develop the survey.

Vey gathered personal information about patients, such as age, sex, country, medical school, degree, training year, clinical rotations completed, planned specialty, and any other graduate degrees they held. The participants answered questions about six main topics:

1. Clinical experience
2. Research perceptions
3. Research experience
4. Research resource availability
5. Research skills
6. Barriers to research during medical school

The questions included multiple-choice questions, binary questions, rating scales (1–5), and questions that needed quick answers. Nine of the 94 questions asked have to do with demographics. An online survey made possible by Google Forms (Google, Mountain View, USA) was used in one study.

Survey Dissemination

From November 1, 2020, to December 31, 2020, the survey was distributed to medical students via institutional Facebook pages and Twitter/X. It was also shared with email groups in the global surgery network, such as those for Incision and the Global Student Poll Alliance (GSSA). No one was called one-on-one.

Data Analysis

All partially completed responses were examined for possible inclusion after duplicates were eliminated. To examine the survey data by region—North America (NA), Latin America (LA), and Other Regions—we used descriptive statistics.

For binary variables, we used Fisher's exact tests or chi-square tests. Analysis of variance (ANOVA) was utilized for continuous variables. To investigate the connection between location and the propensity to conduct research, our study used logistic regression models. After adjusting for age, gender, and training volume, we displayed odds ratios (OR) and 95% confidence intervals (CI). R (version 3.6.1) and SAS (version 9.4) were used for the statistical analysis.

3. RESULTS

Survey Respondent Characteristics

Participants in the study were third-year medical students from 44 medical schools across 26 countries. The respondents' average age was 23, and 60.3% of them identified as female. At 53.1%, Latin America had the biggest percentage of people, followed by North America at 28.6% and other regions at 18.2%. On average, students spent two months studying and four months working in a clinical setting. Nine percent said they have another college degree.

Research Interests and Experience

Most respondents (58.8% of aspiring doctors and 87.1% of medical students) said they would like to do research. The vast majority of students (87.7%) said that studying was an essential part of medical school. However, more than half of the participants (52.4%) had not done any research, and a sizable percentage (58.1%) were not required to do research in order to graduate. Almost half of them reported that their institutions did not offer them financial aid for their education.

There were clear regional differences. Students from Latin America and other regions showed more interest in learning than their North American counterparts during the training time.

Table 1: Characteristics and demographics of national survey participants

	All participants (N=318)	Latin America (N=169)	North America (N=91)	Other (N=58)	p-value[D]
Age					<0.001
Median (Range)	23.0 (17.0, 49.0)	22.0 (17.0, 49.0)	25.0 (18.0, 34.0)	23.0 (19.0, 32.0)	
Mean (SD)	23.6 (3.4)	22.7 (3.6)	25.5 (2.2)	23.4 (2.8)	
Gender, n (%)					0.033
Female	190 (60.3)	99 (59.3)	64 (70.3)	27 (47.4)	
Male	122 (38.7)	67 (40.1)	26 (28.6)	29 (50.9)	
Non-Binary	3 (1.0)	1 (0.6)	1 (1.1)	1 (1.8)	
Region, n (%)[A]		-	-	-	-
Latin America	169 (53.1)				
North America	91 (28.6)				
Sub-Saharan Africa and Other	58 (18.2)				
Medical institution, n (%)		-	-	-	-
Addis Ababa University	8 (2.5)				
National University of Sciences & Technology	9 (2.9)				
University of California Davis	7 (2.2)				
University of Medical Sciences Costa Rica	146 (46.3)				
University of Minnesota	75 (23.8)				
University of El Salvador	15 (4.8)				
University of Rwanda	10 (3.2)				
Other[B]	45 (14.3)				
Medical School Degree, n (%)					-
MBBS	42 (13.2)	19 (11.2)	0 (0.0)	23 (39.7)	
MbChB/Other*	44 (13.8)	33 (19.5)	0 (0.0)	11 (19.0)	
MD	232 (73.0)	117 (69.2)	91 (100.0)	24 (41.4)	
Percentage of years training[C]					0.070
Median (Range)	66.7 (16.7, 125.0)	66.7 (16.7, 116.7)	50.0 (25.0, 125.0)	66.7 (16.7, 100.0)	
Mean (SD)	60.4 (26.5)	59.2 (27.0)	58.0 (27.1)	67.5 (23.5)	
Years of clinical experience required for your medical degree, n (%)					<0.001
<1 year	6 (1.9)	3 (1.8)	2 (2.2)	1 (1.7)	
1-2 years	18 (5.7)	13 (7.9)	2 (2.2)	3 (5.2)	
2-3 years	106 (33.8)	17 (10.3)	73 (80.2)	16 (27.6)	
3-4 years	89 (28.3)	67 (40.6)	0 (0.0)	22 (37.9)	
≥4 years	95 (30.3)	65 (39.4)	14 (15.4)	16 (27.6)	
Years of clinical experience completed, n (%)					<0.001
<1 year	158 (50.6)	65 (39.4)	71 (78.0)	22 (39.3)	
1-2 years	60 (19.2)	32 (19.4)	13 (14.3)	15 (26.8)	
2-3 years	48 (15.4)	30 (18.2)	7 (7.7)	11 (19.6)	
3-4 years	28 (9.0)	22 (13.3)	0 (0.0)	6 (10.7)	
≥4 years	18 (5.8)	16 (9.7)	0 (0.0)	2 (3.6)	

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	All participants (N=318)	Latin America (N=169)	North America (N=91)	Other (N=58)	p-value[D]
Years of research training required for your medical degree, n (%)					<0.001
<1 year	212 (70.0)	87 (55.1)	86 (94.5)	39 (72.2)	
1-2 years	43 (14.2)	30 (19.0)	4 (4.4)	9 (16.7)	
2-3 years	21 (6.9)	18 (11.4)	1 (1.1)	2 (3.7)	
≥3 years	27 (8.9)	23 (14.6)	0 (0.0)	4 (7.4)	
Years of research training completed, n (%)					<0.001
<1 year	237 (78.5)	103 (66.0)	85 (94.4)	49 (87.5)	
1-2 years	41 (13.6)	32 (20.5)	4 (4.4)	5 (8.9)	
2-3 years	12 (4.0)	10 (6.4)	1 (1.1)	1 (1.8)	
≥3 years	12 (4.0)	11 (7.1)	0 (0.0)	1 (1.8)	

Table 2: Survey respondents were asked to provide their thoughts about medical students' participation in the research.

Topic	All participants (N=318)	Latin America (N=169)	North America (N=91)	Other (N=58)	OR (95% CI) of Latin America vs North America	OR (95% CI) of Other vs North America	p-value[A]
Interested in conducting research as a medical student, n (%)	277 (87.1)	140 (82.8)	83 (91.2)	54 (93.1%	0.54 (0.21, 1.44)	1.82 (0.45, 7.29)	0.095
Interested in conducting research later in medical training, n (%)	225 (70.8)	120 (71.0)	53 (58.2)	52 (89.7)	2.68 (1.35, 5.31)	7.96 (2.85, 22.28)	<0.001
Interested in conducting research as a part of your career as a physician, n (%)	187 (58.8)	103 (60.9)	36 (39.6)	48 (82.8)	3.80 (1.96, 7.36)	9.87 (4.02, 24.22)	<0.001
Most students in your medical institution participate in research, n (%)	106 (33.9)	35 (20.7)	61 (70.1)	10 (17.5)	0.10 (0.05, 0.20)	0.10 (0.04, 0.24)	<0.001
Research is an important component of training, n (%)	277 (87.7)	156 (92.3)	67 (75.3)	54 (93.1)	4.26 (1.82, 9.96)	4.93 (1.49, 16.32)	0.001
Important for physicians to participate in research, n (%)	288 (90.9)	160 (94.7)	71 (78.9)	57 (98.3)	-	-	<0.001
Motivating factors of research: Interest in being a physician scientist, n (%)	62 (20.0)	39 (23.8)	3 (3.4)	20 (35.1)	-	-	<0.001
Motivating factors of research: Competitiveness for matching to specialty training after medical school, n (%)	194 (62.6)	95 (57.9)	69 (77.5)	30 (52.6)	0.44 (0.23, 0.83)	0.37 (0.17, 0.79)	0.027

They differed from their North American counterparts by 9.87; 95% CI: 4.02–24.22 (36, 39.6%, $p < 0.001$). NA students were more likely to participate in the study (61, 70.1%) than LA students (35, 20.7%; aOR: 0.10; 95% CI: 0.05–0.20) and other students (10, 17.5%; aOR: 0.10; 95% CI: 0.04, 0.24; $p < 0.001$). Medical students in LA (39, 23.8%) and Other (20, 35.1%) were more motivated by the desire to become physician-scientists than those in NA (3, 3.4%, $p < 0.001$). Compared to LA students (95, or 57.9%; aOR: 0.44; 95% CI: 0.23–0.83) and other students (30, or 52.6%; aOR: 0.37–0.89; $p = 0.027$), a higher percentage of

NA students (69, or 77.5%) stated that they wanted to be competitive for specialty training after medical school.

Barriers to Research

The respondents listed the following as research challenges: restricted options for research projects (211, 69.4%), lack of mentors (172, 56.6%), lack of formal training (166, 54.6%), and COVID-19-related problems (150, 49.3%). Financial resources (124, 40.8%) for publication or presentation, availability to suitable equipment (computer or internet connection) (16, 5.3%), and fluency in both written and spoken English (21, 6.9%) were related with less limitations.

There were notable regional differences in the research concerns identified (Table 3). Research is hampered by a number of factors, such as inadequate research mentors ($p = 0.005$), inadequate research projects ($p = 0.028$), limited physical resources ($p = 0.029$), a lack of research resources ($p < 0.001$), limited access to medical research articles ($p < 0.001$), and inadequate funding for publication and presentation expenses ($p < 0.001$). Compared to LA and NA, navigating these challenges in the Other area was more difficult. Additionally, their institution had a lower overall emphasis on a "research-focused" culture than Los Angeles and other places ($p < 0.001$). There were no regional differences in the length of the study or the number of willing volunteers once the problems were fixed.

4. DISCUSSION

Research usually piques the interest of medical students. Early involvement in medical research can have a big impact on a medical student's future medical career. Additionally, it can help students understand their coursework and make well-informed career decisions. It is thought that medical students help solve important problems in international medical research.

We still don't fully understand the opportunity, knowledge, and involvement of medical students in research around the world. In the last thirty years, the United States and the United Kingdom have accounted for more than half of all research. When undertaking research, medical students face a number of major obstacles, such as institutional restrictions, a lack of expertise, inadequate formal training, and financial limitations. By analyzing the benefits and drawbacks of medical students conducting global and international research, this study sought to supplement earlier findings.

Table 3: Responses to the survey revealed obstacles that prevent medical students from learning.

Topic	All participants (N=318)	Latin America (N=169)	North America (N=91)	Other (N=58)	OR (95% CI) of Latin America vs North America	OR (95% CI) of Other vs North America	p-value[A]
Lack of research mentors, n (%)	172 (56.6)	91 (55.8)	42 (48.8)	39 (70.9)	1.82 (0.97, 3.42)	4.06 (1.76, 9.34)	0.005
Lack of available research project opportunities, n (%)	211 (69.4)	112 (68.7)	53 (61.6)	46 (83.6)	1.68 (0.86, 3.25)	3.62 (1.40, 9.32)	0.028
Lack of physical resources (computer or internet access), n (%)	16 (5.3)	7 (4.3)	2 (2.3)	7 (12.7)	-	-	0.029
Lack of research resources (database or statistical software), n (%)	55 (18.1)	24 (14.7)	8 (9.3)	23 (41.8)	1.44 (0.57, 3.64)	5.61 (2.11, 14.92)	<0.001
Lack of financial resources for publication/presentation, n (%)	124 (40.8)	77 (47.2)	13 (15.1)	34 (61.8)	5.62 (2.72, 11.60)	10.52 (4.42, 25.04)	<0.001
Lack of access to medical research articles, n (%)	36 (11.8)	15 (9.2)	3 (3.5)	18 (32.7)	2.60 (0.69, 9.81)	13.66 (3.55, 52.58)	<0.001
Lack of ability to attend conferences, n (%)	87 (28.6)	57 (35.0)	8 (9.3)	22 (40.0)	5.55 (2.39, 12.89)	7.79 (2.99, 20.33)	<0.001
Lack of 'culture research' at your institution, n (%)	115 (37.8)	71 (43.6)	12 (14.0)	32 (58.2)	6.44 (2.99, 13.88)	12.88 (5.19, 31.97)	<0.001
COVID19 Pandemic, n (%)	150 (49.3)	79 (48.5)	53 (61.6)	18 (32.7)	0.68 (0.38, 1.25)	0.43 (0.20, 0.93)	0.097
Lack of time for research, n (%)	4 (1.3)	2 (1.2)	2 (2.3)	0 (0.0)	-	-	0.646
Willing to participate in research if barriers were removed, n (%)	294 (94.5)	158 (94.6)	83 (92.2)	53 (98.1)	-	-	0.342

Compared to students from Los Angeles and other areas, Native American students have more academic experience, but they are less likely to become researchers in the long run. There were statistically significant differences in areas' levels of interest and willingness for research. Medical students' educational goals differed greatly depending on their intended careers. Students from Sub-Saharan Africa were much more likely to want to do research in the future. Students in North America were much more likely to have peers who were studying medicine. Compared to their NA peers, students from Other and LA demonstrated a stronger desire to pursue professions as physician-scientists.

This can be explained in a number of different ways. Children in North America who receive early education may be better able to express their career goals. Compared to academics in Los Angeles and other areas, people in North America could have more possibilities for lifestyle and career advancement. In the US, there are some situations where teachers are paid less than independent contractors. Study skills can lead to better work opportunities in some fields than others. Employment in public health or with an NGO may pay more than exclusive clinical practice in some countries or areas.

Participants reported a lack of training and education in research. Many medical schools across the world have made participating in studies and writing a graduation thesis requirements in order to increase medical students' engagement in research. Positive opinions about these institutions have been voiced by international trainees. However, not everyone is required to participate in this phase. The Young British Journal of Surgery (BJS) and the American College of Surgeons (ACS) provide brief, free workshops on research technique and help creating a study protocol. These courses can be helpful to those who want to specialize in physician-scientist work.

Compared to their North American peers, students from other countries have fewer options for mentorship and research. This is especially true for countries in Latin America and other

regions. While going to school and attending classes can be helpful, they might not give you the knowledge and abilities you need to study on your own. Students must participate in hands-on activities similar to learning clinical skills in order to improve their study abilities. When used in this context, it usually means that you can study under the guidance and support of a mentor. Medical students can find possible projects and make connections with others who might be willing to work together by using a database of research project prospects. For joint initiatives with faculty and residents, the GSSA created a network and resource database that is available to all medical students. This strategy might deal with important problems and more general difficulties. In several areas, the lack of mentorship opportunities for medical students doing research was noted as a problem. Additional initiatives and resources at the institution that match each medical student with a mentor could make the process easier.

Research tools, including material and financial resources, continue to be a problem. Students need funds in addition to the materials needed for their research project in order to publish and present their findings at conferences. While students in LA and Other needed help with their papers and speeches, students in NA did not. It would be advantageous to have a program that helps international medical students with study reports, attendance costs, and research travel. Although virtual seminars can help students all over the world, they might lessen the value of face-to-face networking at these kinds of events.

There were no differences found in an evaluation of COVID-19's effects on students in the area. Given the limitations imposed by COVID-19, an enhanced curriculum or program may encourage more medical students worldwide to continue their education. This may be demonstrated by an online curriculum or a locally operated program based on a standardized global curriculum. Initiatives that support research in a variety of training settings and programs that link medical school courses to residency training and early-career teaching roles may be advantageous.

The small sample size and scattered locations of survey participants may not accurately reflect the diverse community of international medical students, despite the study's global reach. Compared to medical students from Europe, Southeast Asia, the Middle East, and East Asia, those from North America, Latin America, and Sub-Saharan Africa were more likely to reply. These places might not be sufficiently represented in this study. The fact that the survey was done in both Spanish and English may have introduced bias in favor of those whose first language is English. People who speak Spanish or English as their first language would therefore have been more inclined to participate. Because of institutional diversity, the poll results could not be representative of all institutions in the nation. This is because students may come from multiple colleges. The pedagogical strategies used by medical schools to teach particular subjects may have skewed the respondents' opinions. Another problem could be self-selection bias, as survey respondents may be more interested in research as medical students than non-respondents. Because the poll was distributed via email lists and social media platforms, biases may result from differing levels of social media engagement and email accessibility. The participants in the survey are not identified in this study, and we have not held any additional review sessions with them to go over the results and information gathered.

Future research and initiatives should focus on investigating regional discrepancies at the institutional level in order to create a projected pilot program that facilitates research for

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medical students. The goal is to carry out a needs assessment study at partner universities around the world, particularly in North America, Sub-Saharan Africa, and Latin America. The problem of selection bias among poll respondents will be lessened as a result. In the future, surveys tailored to a particular nation may evaluate the needs of medical students in particular areas. Future studies will focus on creating surveys that participants can fill out in their mother tongues and holding additional review sessions with them. In order to build a more extensive web database of scientific surveys with individual contact information, researchers will think about sharing survey respondents' contact information in the future.

5. CONCLUSION AND IMPLICATIONS FOR TRANSLATION

Despite their considerable interest in research, medical students around the world claim a lack of formal training and opportunities to participate in research activities. They claim that their ability to study has been hampered by the COVID-19 pandemic. According to this survey, research education is crucial for all students worldwide.

Compliance with Ethical Standards

Conflicts of Interest: No conflicting interests are disclosed by the writers.

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Ethics Approval: Before the poll was distributed, it was ethically reviewed by the University of Minnesota's Institutional Evaluation Board. Since there were no human subjects in the study, no further investigation was necessary.

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