



Cross-sectional Study

## Surgical research in Colombia part 2: Scientific production of Colombian academic surgeons



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## ABSTRACT

**Introduction:** The production of quality surgical evidence and the development of academic surgery have emerged as priorities for the solution of current barriers to achieving the objectives of global surgery. The academic training and scientific production of academic surgeons is essential for the production of new knowledge. In Latin America, specifically in Colombia, there are no studies that have analyzed this production.

**Methods:** A retrospective cross-sectional bibliometric study was carried out, in which the Colombian Ministry of Science database was consulted with the validated results up to July 2021. In the search section for research profiles, the key word “Surgery” was used, and all associated CvLAC (profiles where the information of Colombian researchers can be found) and their registered products were reviewed.

**Results:** A total of 1701 researchers in surgery were registered in the database of the Colombian Ministry of Science, of which only 380 corresponded to academic surgeons with correct registration. Only 6 (1.6%) were found to have a Ph.D., 45 (11.8%) a fellow, and 20 (5.3%) a master’s degree. 79.5% (n = 302) of Colombian academic surgeons are men. Only 10.2% (n = 39) are formally categorized as researchers. 45.3% (n = 172) have not published scientific articles. The total number of published articles was 2386, and most of them were published in Q4 journals (n = 1121; 47%) or not indexed by SJR/Publindex (n = 517; 21.6%). Only 3 surgeons have more than 100 articles. 9.5% have published at least 1 book, and 40% have participated in at least 1 project.

**Conclusions:** According to data registered with the Colombian Ministry of Science, a large part of the scientific production of Colombian academic surgeons is concentrated in scientific articles, most of which are found in Q4 or non-categorized journals. Approximately half of the academic surgeons have not published at least one scientific article. However, one fifth of those who have, have published at least 8 articles. Less than 20% of surgeons have additional postgraduate studies, and only 1 in 4 academic surgeons is a woman.

## 1. Introduction

Research is an indicator of progress in the knowledge of a discipline.

In medical sciences, it is beneficial in the context of the development of skills for adequate decision making based on high quality evidence in clinical practice, in order to ensure timely attention to the needs of

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patients and to avoid errors in medical practice to a greater extent [1,2]. As a result, key objectives for global surgery for the year 2030 have been proposed, including achieving greater access to essential and emergency surgical services, a global reduction in the burden of disease [3,4], increasing the promotion of academic surgery [5], promoting the design of models and strategies that improve outcomes in healthcare practice [6], among others. Therefore, the production of quality surgical evidence and the development of academic surgery have emerged as priorities for the solution of the current barriers that hinder the achievement of the aforementioned objectives [7].

Nowadays, technical skills are not enough for the full development of a profession, in this case, a medical-surgical profession. For this reason, the residence should encourage non-technical competencies that involve the participation of surgeons in interest and research groups, tools that promote the personal and professional growth of its members, together with better opportunities for other postgraduate studies and for the establishment of collaboration networks at national and international level [8]. In this way, academic surgeons (also called in this context as researcher surgeons) will be able to contribute to the dissemination of high quality scientific knowledge. However, it has been described that the research development capacity of low- and middle-income countries, such as those in Latin America, remains inefficient and fragmented [9]. This is attributed to various limitations faced by researchers, such as the low budget available to governments to invest in research, which is very low compared to developed countries.

According to 2010 statistics, Colombia had only 193 researchers per million people, while the United States, a high-income country, had 3867 researchers per million people [10]. Similarly, in order to publish in a high-impact journal, a high publication fee is sometimes required, which is why many researchers in Latin America prefer to publish their articles in journals that do not charge a publication fee [9]. In addition, it is important to mention that low- and middle-income countries have a higher burden of diseases that possibly require surgical care; therefore, investing in high-quality research in these countries that will lead to an improvement in surgical services becomes a highly necessary objective [7,11,12].

At present, the productivity of academic surgeons in Colombia, a Latin American country, is not specifically known. Previously, Lozada-Martinez et al. [9] characterized the scientific production of surgical research groups in Colombia, finding that there are significant gaps in the scientific productivity of Colombian surgery [9]. However, in order to know in depth and to propose precise and practical solutions, it is necessary to determine what is the training and scientific productivity of academic surgeons in this country. In this order of ideas, the aim of this study was to characterize for the first time the scientific productivity of Colombian academic surgeons.

## 2. Methods

The study has been reported in line with the STROCSS criteria [13]. A retrospective cross-sectional bibliometric study was carried out, in which the Colombian Ministry of Science database was consulted with the validated results up to July 2021 [14].

In the search section for researcher profiles, the key word "Surgery" was used, and all associated CvLAC (profiles where the information of Colombian researchers can be found) were reviewed. Profiles of researcher who have declared start and end dates, both undergraduate medical and postgraduate in general surgery, were included. Data from all profiles referring to other areas of medicine and branches other than general surgery and subspecialties, such as urology, orthopedics or plastic surgery, were excluded.

The following data were collected: academic background (academic degrees), gender, research categorization granted by the Colombian Ministry of Science (from highest to lowest level: emeritus, senior, associate, junior researcher) [15], number of scientific publications, publication quartile (based on Scimago Journal Rank [SJR] or Publindex

[Colombian system for the evaluation and classification of scientific journals]), book chapters and books published, membership in a research group, peer review activity, undergraduate or graduate theses directed, participation in scientific events, project development and existence of underreporting.

Data were collected in Microsoft Excel and subsequently exported to IBM SPSS v25 software (Chicago, Illinois, USA), where nominal and ordinal variables were analyzed and expressed as percentages and frequencies, while discrete and continuous variables were expressed as mean and standard deviation or median and interquartile range (IQR), if they did not have a normal distribution. Ethical approval was not necessary for this study as it did not involve human or animal subjects, and the Colombian Ministry of Sciences database is open access.

## 3. Results

A total of 1701 surgical researchers were registered in the Colombian Ministry of Science database, of which only 380 corresponded to academic surgeons with the correct registration. Only 6 (1.6%) were found to have a Ph.D., 1 (0.3%) a postdoc, 45 (11.8%) a fellow, and 20 (5.3%) a master's degree. 185 (48.7%) surgeons belonged to recognized Colombian research groups, and only 28 (7.4%) were peer reviewers recognized by the Colombian Ministry of Science. 79.5% (n = 302) of the Colombian academic surgeons are men, 20% (n = 76) are women and 0.5% (n = 2) did not specify their sex.

Only 10.2% (n = 39) are formally categorized as researchers by the Colombian Ministry of Science, and these are mainly Junior Researchers (the lowest category) (n = 27), while 1.8% (n = 7) were senior researchers and 1.3% (n = 5) were associates researcher. 45.3% (n = 172) have not published scientific articles. However, among the surgeons who have published, there is a predominance of those who have published at least 8 articles (n = 88; 23.2%). The total number of published articles was 2386, and most of them were published in Q4 journals (n = 1121; 47%) or journals not indexed by SJR/Publindex (n = 517; 21.6%). 411 (17.2%), 116 (4.8%) and 222 (9.3%) articles have been published in Q1, Q2, and Q3 journals, respectively. Only 3 surgeons have published more than 100 scientific articles (Table 1). 9.5% have published at least 1 book, and 40% have participated in at least 1 project. 98.2% (n = 373) have never participated in the development of a clinical practice guideline (see Table 2).

56.9% (n = 216) and 70.6% (n = 268) of academic surgeons have no record of having participated in national and international scientific events, respectively (Table 2). Only 129 (33.9%) surgeons had tutored undergraduate thesis; 21.8% (n = 83) of the surgeons had tutored a medical specialty or master's degree thesis, and only two surgeons (0.5%) had tutored a Ph.D. thesis (Fig. 1). A total of 185 profiles were identified as having under-registered data, with a total of 1731 under-registrations, almost all of which were due to the lack of DOI registration of articles (n = 1686; 97.4%).

## 4. Discussion

Surgical research emerged with the aim of improving health care globally, including among its objectives the identification of more effective ways to organize, manage, finance and deliver better health care, thereby reducing medical errors and improving patient safety [16]. As a result, academic surgery has involved research as a fundamental pillar nowadays. Thus, the creation of various research groups focused on research in different medical specialties has arisen, as is the case of groups focused on the surgical area that provide better guidance when making decisions regarding the highest quality therapeutics for certain surgical diseases [17]. The scientific production of these groups, and therefore of these research surgeons, is an indicator of the quality of surgical programs in a country or region and can therefore represent the progress of surgery [9].

Previous analyses have found that 127,560 scientific articles were

**Table 1**  
Top 25 Colombian academic surgeons with the greatest productivity.

Number	Name	Highest academic degree	Articles	Book chapters	Projects executed	H Index <sup>a</sup>
1	Álvaro Enrique Sanabria-Quiroga	Ph.D.	151	17	47	28
2	Carlos Hernando Morales-Uribe	Medical specialization	108	50	11	23
3	Rodrigo Castaño-Llano	Medical specialization	101	40	3	4
4	Sergio Ivan Hoyos-Duque	Medical specialization	93	12	2	8
5	Luis Felipe Cabrera-Vargas	Medical specialization	81	1	42	3
6	Carlos Alberto Ordoñez-Delgado	Fellow	80	4	10	31
7	Luis Carlos Domínguez-Torres	Fellow	78	4	29	10
8	Gustavo Adolfo Quintero-Hernández	Master	65	7	9	6
9	Fabian Emura	Ph.D.	63	26	18	19
10	Neil Valentín Vega-Peña	Master	58	2	4	7
11	Andrés Ignacio Chala-Galindo	Medical specialization	54	2	1	0
12	Adonis Tupac Ramírez-Cuellar	Fellow	51	2	0	4
13	Mónica Bejarano-Castro	Master	43	2	0	2
14	Robin German Prieto-Ortiz	Fellow	30	2	0	1
15	Jaime Camacho-Mackenzie	Fellow	38	2	1	3
16	Enrique Cadena-Piñeros	Medical specialization	38	8	0	1
17	Alberto Federico García-Marín	Medical specialization	38	8	24	15
18	Eduardo Londoño-Schimmer	Medical specialization	38	6	0	3
19	Luis Armando Caicedo-Rusca	Fellow	36	0	9	1
20	Saul Rugeles-Quintero	Fellow	34	4	3	8
21	Oscar Alexander Guevara-Cruz	Medical specialization	34	12	6	2
22	Guillermo Eduardo Aldana-Dimas	Medical specialization	28	2	15	2
23	Lilian Torregrosa-Almonacid	Master	28	4	0	5
24	Fernando Giron-Luque	Medical specialization	27	3	14	2
25	Francisco Herrera-Saenz	Medical specialization	26	0	8	1

<sup>a</sup> Metrics based on Scopus until 2022.

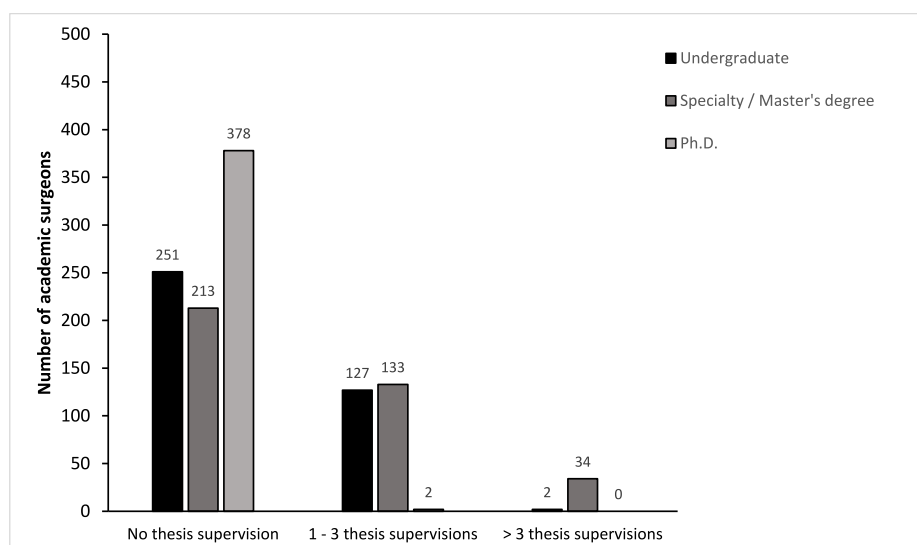
**Table 2**  
Participation of Colombian academic surgeons in national and international events.

Participation in scientific events	National events	International events
	N (%)	
Yes	164 (43.1)	112 (29.4)
No	216 (56.9)	268 (70.6)

published in Latin America in the area of health between 2006 and 2015, of which Brazil, Cuba and Colombia contributed 58.55%, 10.52% and 8.3% of the total number of publications, respectively, with smaller percentages in countries such as Chile, Argentina, Venezuela, Peru and Uruguay, which in past decades were the main promoters of scientific dissemination [18]. In addition, it is worth noting that during this period, the average growth rate was 9.3%, with an average annual

production of 1059 publications [18]. However, the contribution to surgical research was not discriminated. More specifically, in Colombia, there has been a progressive increase in the number of publications about research in the area of general surgery since 2013 [19]. However, a low number of publications and citations in high impact journals is observed, which coincides with the findings of the present study in which most of the articles were published in Q4 or not indexed journals by SJR/Pubindex. But, it is important to point out that the real and exact volume of surgical scientific production in the country is unknown, due to the high percentage of underreporting.

One of the important findings to highlight is the percentage of surgeons who have completed master's degrees (5.3%), Ph.D. (1.6%) and postdoctoral studies (0.3%), which are specific degrees for research and production of new knowledge. This trend may be influenced by the costs and difficulties in accessing postgraduate studies of this category in low- and middle-income countries, which prevents simultaneous work and



**Fig. 1.** Number of academic surgeons who have been thesis supervisors, according to the academic degree of the thesis.

study, due to the time dedicated to a high level research thesis. In addition, the surgeon's traditional clinical focus can lead to a lack of attention to promoting research knowledge, to involvement in research groups and projects. This correlates with the percentage of surgeons who belong to groups formally recognized by the Colombian Ministry of Science (48.7%); considering that under the objectives of global surgery and the pillars of academic surgery, all surgeons should participate and contribute to the development of evidence-based solutions to help reduce the burden of surgical diseases and improve access to surgical services.

As reported by recent evidence, there is an obvious gender gap, which is also the result of traditional beliefs about the difficulty that women can have in general surgery residency (which is considered very hard), which has been associated in recent years with burnout, depression, anxiety, stress, harassment, among others (a problem that is indifferent to gender) [20–22]. Fortunately, with the empowerment of young surgeons in academic surgery, an awareness of professionalism in surgery has been created, which improves the resident education process, decreases the gender gap in residency entry, and promotes the physical and emotional harmony and integrity of the resident for better outcomes [20,21]. Several authors have argued that this trend will be on the rise over the years, thanks to new policies and concepts related to equity and diversity in surgery. Although the gap is still large at present, it is likely to become smaller and smaller over time [20–22].

The large percentage of surgeons who are formally categorized as researchers, but in the lowest category, can be explained by some aspects: 1. The underreporting substantially biases the real picture of the scientific production and human talent of Colombian surgery, which should be higher than that found in the Colombian surgical field; 2. Some surgeons who state that they carry out research activities are not necessarily linked to the university sector. Therefore, they do not supervise postgraduate theses and do not reach higher categories; 3. Their scientific articles are published in journals not indexed in SJR/Pub-index. Therefore, they do not meet the established criteria of scientific quality [15]. However, it is necessary to mention that in order to reach the highest categories as a researcher, a minimum number of scientific products is required. However, it was found that about 20% of the academic surgeons have at least 8 published articles (type of product most frequently found, among others that can also add up); therefore, it can be presumed that the absence of products would explain this result. It also influences the fact that more than 60% of the articles are published in Q4 or non-indexed journals, that less than 10% have written a book chapter and that only 40% have participated in a project. The low productivity, which is also homologated and indexed as low quality productivity because it is published in journals belonging to low quartiles, represents two problems: the evidence produced has limitations that do not allow it to be published in high impact journals, or the lack of knowledge about scientific publication and relevance of scientific knowledge dissemination, allows studies with high value to be published in low impact journals.

It is very strange to observe little participation in events, both national and international, since the diversity of surgery allows a surgeon to participate in numerous subspecialty events per year. If this is indeed the case, then lack of time, lack of funding, lack of production of evidence for participation as speakers, may be some of the reasons that can be extrapolated from previously published studies, which have found that these factors are associated with low participation in meetings [23, 24]. On the contrary, underreporting may again have an impact on these results. The massive under-registration found is the main cause of the underestimation of the productivity of Colombian academic surgery. Around 1800 scientific products are not recognized or categorized, as they are not adequately registered and supported. Lack of time, unfamiliarity with virtual platforms, lack of interest in proper reporting of science-related data and meta-data could be some of the reasons for this scenario.

One of the solutions to correct this error is the inclusion of medical

students in the research process, who, since they have more time available, can contribute to the adequate and timely recording of data. Likewise, academic surgeons need to be trained on the value of databases in science, their correct recording and the need to constantly evaluate results, in order to verify consistency between what is produced and what is achieved.

Likewise, a development plan for Colombian surgery should be established, aimed at correcting the errors found. Training in research methodology, clinical epidemiology, scientific publication, statistics, among other areas, which are part of the surgeon's non-surgical skills, should be reinforced. Another proposal would be to rethink the way in which research working groups are formed, since recent evidence found that including a methodologist in a working group improves the quality of the evidence produced [25], and therefore, the probability of publishing in a journal of greater impact. Considering the current difficulties of surgery in low- and middle-income countries, such as Colombia, it is necessary that academic surgery advances rapidly, in order to progressively reach the objectives of global surgery and the needs established by the health institutions of each nation [3,5]. Training in research is imperative in the surgeon [26]. More surgeons with Masters and PhD degrees are needed. More surgeons are needed who are more critical of the evidence produced, who can quickly identify gaps and new opportunities to solve problem questions. There is a need to encourage mentoring, and the participation of students who pursue the dream of becoming surgeons [2,8]. There is a need to improve the quality of theses produced by the residents, giving them a prudent time to carry out research, reducing a little the time of assistance load. Currently, not only technical skills are needed in the operating room.

For the first time, this study discriminates the productivity and academic training of Colombian academic surgeons. These results will be useful to identify more barriers and to propose more precise solutions with real impact. Although a large underreporting was evidenced, these results reflect the state of current academic surgery in Colombia, since these are the data that are analyzed to share the scientific production in the country.

As limitations, we found the previously mentioned underreporting, which can only be modified and identified by each researcher in his or her respective profile. In addition, due to the nature of the Colombian Ministry of Science platform, it is not possible to track scientific production over time in greater depth, since these data are not available to the public. There was also no discrimination on the type of evidence and typology of articles that each academic surgeon possesses, which can bias the value of the evidence produced. Future studies could aim to find correlations and associations between variables of academic training, line of research, subspecialty, project participation, affiliation, among others; with higher productivity and higher quality productivity.

## 5. Conclusions

According to data registered with the Colombian Ministry of Science, a large part of the scientific production of Colombian academic surgeons is concentrated in scientific articles, most of which are found in Q4 or non-categorized journals. Approximately half of the academic surgeons have not published at least one scientific article. However, one fifth of those who have, have published at least 8 articles. Less than 20% of surgeons have additional postgraduate studies. Only 1 in 4 academic surgeons is a woman. 1 in 10 surgeons is formally categorized as a researcher by the Colombian Ministry of Science, the vast majority being in the lowest category, and less than 20% of research surgeons have additional postgraduate studies.

## Ethical approval

It is not necessary.



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None.

## Author contribution

Ivan David Lozada-Martinez: Study conception and design; Acquisition of data; Analysis and interpretation of data; Drafting of manuscript; Critical revision; approved the final version.

Nicolas Navarro-Pulido: Analysis and interpretation of data; Drafting of manuscript; Critical revision; approved the final version.

Yelson Alejandro Picón-Jaimes: Analysis and interpretation of data; Drafting of manuscript; Critical revision; approved the final version.

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Alexis Narvaez-Rojas: Drafting of manuscript; approved the final version.

**Colombian Future Surgeons Collaborative Group:** Acquisition of data; Analysis and interpretation of data; Critical revision; approved the final version.

## Research registration Unique Identifying number (UIN)

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2. Unique Identifying number or registration ID: NCT05354908
3. Hyperlink to your specific registration (must be publicly accessible and will be checked): <https://clinicaltrials.gov/ct2/show/NCT05354908>

## Guarantor

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## Appendix A. Supplementary data

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