ORIGINAL ARTICLE

South American scientific research on the use of botulinum toxin in plastic surgery: a bibliometric analysis of articles indexed in Scopus

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ABSTRACT

Objective: To analyze the scientific evolution of the use of botulinum toxin in plastic surgery in Latin America.
Materials and methods: A cross-sectional bibliometric study was conducted using Scopus as the data source. Visual and bibliometric analyses were performed, and metrics were generated to evaluate the evolution, general characteristics and impact of the Latin American evidence on the use of botulinum toxin in plastic surgery. The bibliometrix R-package was utilized for this analysis.
Results: The study included 34 papers published between 2002 and 2023, out of which 52.9 % (*n* = 18) were original articles, while 44.1 % (*n* = 15) were review articles. International collaboration was identified in 32.3 % of the cases. The four most prolific authors were from Colombia and Brazil, each having published only two papers. Brazil (*n* = 20) was the most prolific country, followed by Chile (*n* = 5), Argentina (*n* = 4) and Colombia (*n* = 4). Regarding research trends, quality of life, dermal fillers, hyaluronic acid and wrinkles were the subtopics most related to the use of botulinum toxin in plastic surgery in Latin America. There were basically five associated research lines related to symptoms and aesthetic procedures, cosmetic complications and quality of life. The level of development of the topics was largely driven by the aesthetic interventions. A multiple correspondence analysis based on authors' keywords revealed that patient follow-up, cohort studies, risk assessment, outcome evaluation, rejuvenation and adults were elements that primarily complemented the base subtopics.
Conclusions: Slow growth with low production and impact has been identified in Latin American research on the use of botulinum toxin in plastic surgery over the last 20 years. This research has focused on clinical studies related to clinical outcome assessment, quality of life and aesthetic techniques. Brazil leads research in the region and maintains a strong network of intercontinental collaboration.

Keywords: Botulinum Toxins; Surgery, Plastic; Research; Publications; Latin America (Source: MeSH NLM).

INTRODUCTION

Over time, advancements in research and technology within plastic surgery have expanded the application of techniques originally confined to aesthetic procedures [1]. The novel pharmacological mechanisms of certain drugs and the cellular properties of specific tissues have made it possible to derive additional benefits from traditional techniques [2,3]. One notable example is botulinum toxin, commonly known as Botox. Typically, Botox was used exclusively to treat wrinkles and lines on the face and other areas of the body. However, its application in other medical interventions, such as direct injection into muscle tissue during reconstructive and plastic surgeries, has demonstrated certain benefits, including reduced recovery time and improved outcomes [4].

As research and innovation in neurotoxins continue to evolve, they may offer solutions to longstanding challenges in medicine [5-8]. However, no comprehensive study has yet examined the diversity, trends or research patterns concerning botulinum toxin. This gap is particularly evident in regions like Latin America, where the scientific progress of this topic remains unexplored. In order to

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provide a novel and updated view of the historical gaps and trends in research on the use of botulinum toxin, this study aimed to analyze the scientific development and trends in botulinum toxin research within the context of plastic surgery in Latin America.

MATERIALS AND METHODS

Study design and population

This bibliometric study utilized the Scopus database as its primary source. The selection of this database and citation index was based on prior discussions highlighting its advantages [9,10]. Notably, Scopus houses the world's largest collection of peer-reviewed literature.

Variables and measurements

A search strategy using Medical Subject Headings (MeSH) terms was designed and structured to identify publications related to the use of botulinum toxin in plastic surgery. Following a pilot test, the final search query was as follows: TITLE-ABS-KEY ("Botulinum Toxin") OR TITLE-ABS-KEY ("Botulinum Neurotoxins") OR TITLE-ABS-KEY ("Clostridium Botulinum Toxins") OR TITLE-ABS-KEY ("Botulinum Neurotoxin") OR TITLE-ABS-KEY ("Botulin") AND TITLE-ABS-KEY-AUTH ("Plastic Surgery Procedure") OR TITLE-ABS-KEY-AUTH ("Plastic Surgical Procedure") OR TITLE-ABS-KEY-AUTH ("Esthetic Surgical Procedure") OR TITLE-ABS-KEY-AUTH ("Esthetic Reconstructive Surgical Procedures") OR TITLE-ABS-KEY-AUTH ("Reconstructive Surgical Procedure") OR TITLE-ABS-KEY-AUTH ("Cosmetic Surgical Procedure") OR TITLE-ABS-KEY-AUTH ("Cosmetic Reconstructive Surgery") OR TITLE-ABS-KEY-AUTH ("Cosmetic Reconstructive Surgical Procedures") OR TITLE-ABS-KEY-AUTH ("Plastic Surgery") AND AFFILCOUNTRY (Antigua AND Barbuda) OR AFFILCOUNTRY (Argentina) OR AFFILCOUNTRY (Bahamas) OR AFFILCOUNTRY (Barbados) OR AFFILCOUNTRY (Belize) OR AFFILCOUNTRY (Bolivia) OR AFFILCOUNTRY (Brazil) OR AFFILCOUNTRY (Chile) OR AFFILCOUNTRY (Colombia) OR AFFILCOUNTRY (Costa AND Rica) OR AFFILCOUNTRY (Cuba) OR AFFILCOUNTRY (Dominicana) OR AFFILCOUNTRY (Ecuador) OR AFFILCOUNTRY (El AND Salvador) OR AFFILCOUNTRY (Grenada) OR AFFILCOUNTRY (Guatemala) OR AFFILCOUNTRY (Guyana) OR AFFILCOUNTRY (Haiti) OR AFFILCOUNTRY (Honduras) OR AFFILCOUNTRY (Jamaica) OR AFFILCOUNTRY (Mexico) OR AFFILCOUNTRY (Nicaragua) OR AFFILCOUNTRY (Panama) OR AFFILCOUNTRY (Paraguay) OR AFFILCOUNTRY (Peru) OR AFFILCOUNTRY (Dominican AND Republic) OR AFFILCOUNTRY (Saint AND Lucia) OR AFFILCOUNTRY (Suriname) OR AFFILCOUNTRY (Trinidad AND Tobago) OR AFFILCOUNTRY (Uruguay) OR AFFILCOUNTRY (Venezuela).

The inclusion criteria consisted of peer-reviewed papers published in scientific journals with an explicit focus on the use of botulinum toxin in plastic surgery. Excluded materials comprised conference abstracts, errata, books, book chapters, among others, which did not follow the standard peer-review process. The search was conducted on January 30, 2024, with results filtered using the tags "humans" and "journals." Due to the historical nature of the analysis, no specific publication time frame was considered.

Data on citation domains, bibliographic information, abstracts and keywords were exported in CSV format for manual review and standardization using Microsoft Excel 2016. Four authors independently reviewed the data for this study, removing unrelated papers based on their titles, abstracts and keywords. To ensure consistency, this review process was repeated collaboratively to resolve any discrepancies. The papers were categorized as follows: original articles (studies employing observational or experimental designs, including primary data or data reassessment), review articles (narrative reviews, systematic reviews with or without meta-analysis, umbrella reviews and exploratory reviews), case reports (single-case reports or case series) and correspondences (letters to the editor, commentaries, editorials and other brief formats sharing similar structure and intent).

A descriptive analysis and characterization of the scientific production was conducted. Metrics such as the h-index, g-index and m-index were used to measure the impact of authors, institutions and countries. Bibliometric studies have referenced definitions and specifications for the use of these metrics [11]. Frequencies and percentages were calculated using Microsoft Excel 2016.

Statistical analysis

A bibliometric and visual analysis was performed to assess the evolution, general characteristics and impact of Latin American research on botulinum toxin in plastic surgery. This analysis utilized the bibliometrix R-package (version 4.3.1) to calculate quantitative scientometric indicators and generate data visualizations [12]. Synonyms, errors, plurals and variations were standardized through a thesaurus to ensure consistency across keywords, authors and institutions.

Ethical considerations

This study did not require the approval of an ethics committee, as it did not involve human subjects, biological models or the use of medical records.

RESULTS

The study included 34 papers published between 2002 and 2023 based on the inclusion and exclusion criteria. Of these, 52.9 % (*n* = 18) were original articles, while 44.1 % (*n* = 15)

were review articles. International collaboration was identified in 32.3 % of the cases, with an average article age of approximately 10 years and an annual production growth rate of 3.3 % (Table 1). A total of 103 authors were involved, out of whom 95.1 % had published only one article, in accordance with Lotka's Law. Since 2002, scientific production has shown fluctuating growth, with 2013 being the most prolific year, producing five articles. A similar pattern was observed in citation trends, although a noticeable decline has been observed since 2008 (Figures 1A and 1B).

Table 1. Initial characteristics of Latin American research on the use of botulinum toxin in plastic surgery (*N* = 34)

	n	%
Type of article		
Original article	18	52.90
Review article	15	44.11
Correspondence*	1	2.99
Study design		
Case series	1	2.99
Narrative review	15	44.11
Longitudinal	4	11.96
Experimental	1	2.99
Clinical trial	1	2.99
Cross-sectional	10	28.98
Case report	1	2.99
Letter to the editor	1	2.99
Authors		
Authorships	103	–
Authors with single-author articles (*N* = 103)	4	3.88
Collaboration		
Articles with a single author	4	–
Co-authorships per article (average)	3.20	–
International co-authorship	–	32.30
Keywords	127	–
Journals	23	–
Average article age (years)	9.94	–
Average citations per article	17.70	–
Annual growth	–	3.36

*Includes letters to the editor, editorials, commentaries, etc.

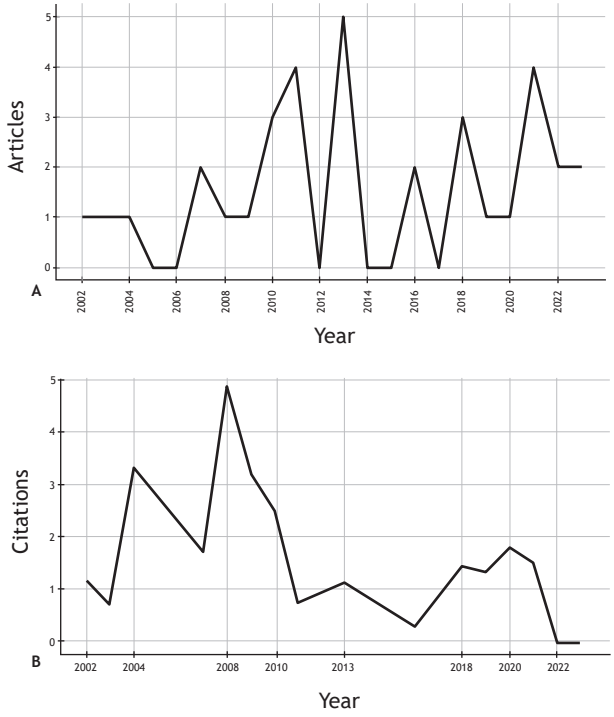

Figure 1. Evolution of Latin American research on the use of botulinum toxin in plastic surgery. A. Annual scientific production from 2002 to 2023. B. Average number of citations received per article per year.

The analysis of the scientific development of this topic revealed that the four most prolific authors were from Colombia (Roxana Cobo) and Brazil (Marcus Castro Ferreira, Alessandra Salles and George Kroumpouzos), each having published only two papers. Authors from other countries have contributed only one paper. These authors exhibited low impact metrics, primarily due to the limited number of publications. At the institutional level, the Universidade de São Paulo (Brazil) was the most prolific in the region, with a total of six papers, followed by the Universidad de Chile (Chile) with three. Brazil (*n* = 20) was the most prolific country, followed by Chile (*n* = 5), Argentina (*n* = 4) and Colombia (*n* = 4) (Table 2).

Table 2. Metrics of affiliations and most prolific Latin American countries in research on the use of botulinum toxin in plastic surgery

Affiliation	Papers published over time				Total articles	h-index	Country
	2002-2006	2007-2011	2012-2016	2017-2023			
Universidade de São Paulo	2	2	0	2	6	5	Brazil
Universidad de Chile	0	3	0	0	3	3	Chile
Country	**Papers published over time**				**Total articles***	**h-index**	
	2002-2006	**2007-2011**	**2012-2016**	**2017-2023**			
Brazil	3	4	4	9	20	9	
Chile	0	1	2	2	5	3	
Argentina	0	2	2	0	4	3	
Colombia	0	2	2	0	4	3	

*Article production was counted individually, meaning that a paper could have been counted multiple times depending on the level of international collaboration.

In terms of journal characterization, *Aesthetic Plastic Surgery* has published the highest number of articles (*n* = 5) and accounts for the majority of the citations (152). However, due to the relatively low production volume, the overall impact has remained modest, with the *Journal of Cosmetic Dermatology* holding the top position (h-index = 4) (Figure 2A – 2F).

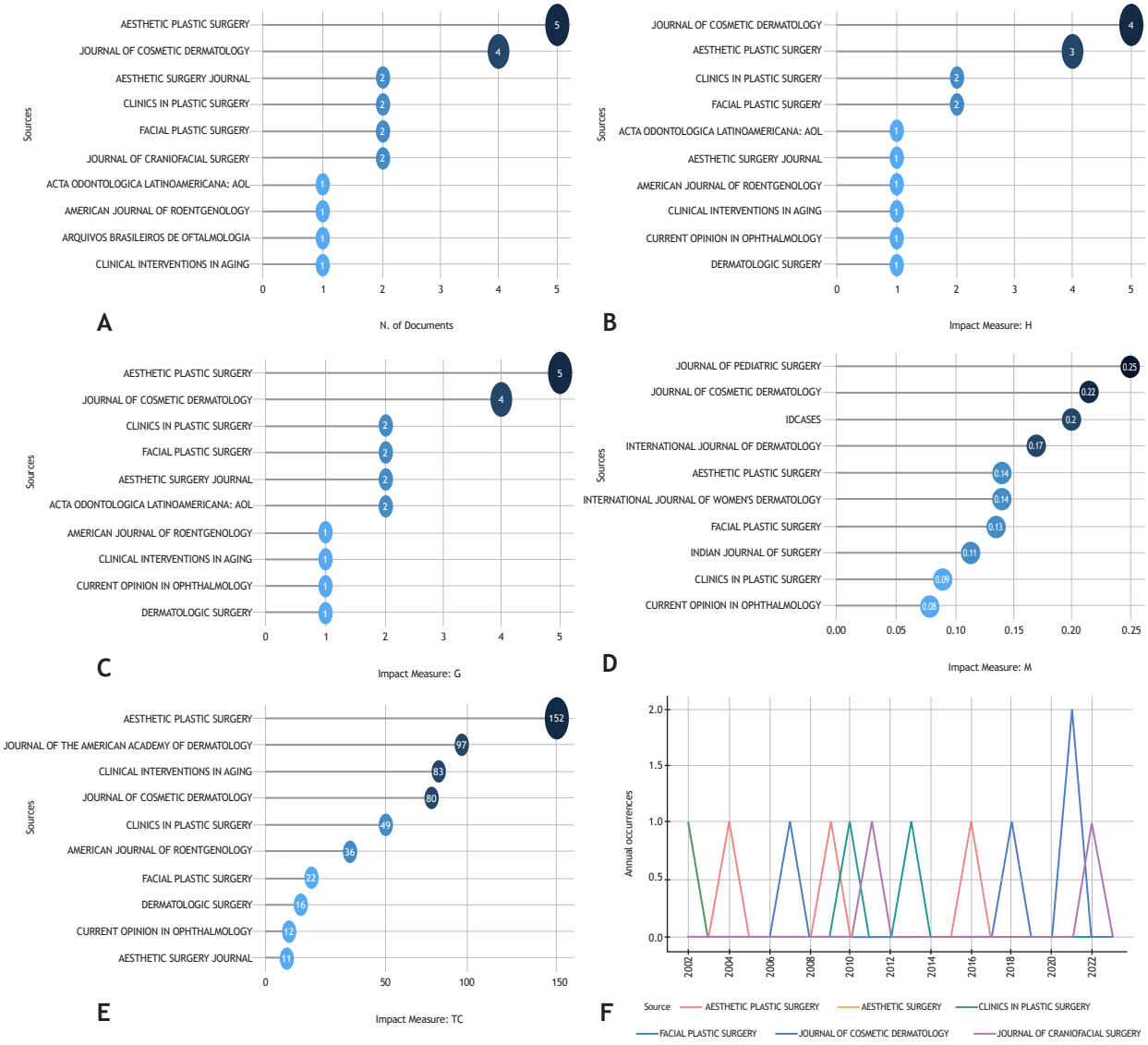

Figure 2. Frequency and impact of journals derived from Latin American publications on the use of botulinum toxin in plastic surgery. A. Journals with the highest number of publications. B. Journals with the highest h-index. C. Journals with the highest g-index. D. Journals with the highest m-index. E. Journals with the highest number of citations. F. Annual production of the most prolific journals over time.

Regarding research trends, quality of life, dermal fillers, hyaluronic acid and wrinkles were the subtopics most related to the use of botulinum toxin in plastic surgery in Latin America (Figure 3A). There were basically five associated research lines related to symptoms and aesthetic procedures, cosmetic complications and quality of life (Figures 3B and 3C). The level of development of the topics were largely driven by the aesthetic interventions (Figure 3D). A multiple correspondence analysis based on authors' keywords revealed that patient follow-up, cohort studies, risk assessment, outcome evaluation, rejuvenation and adults were elements that primarily complemented these subtopics (Figure 3E).

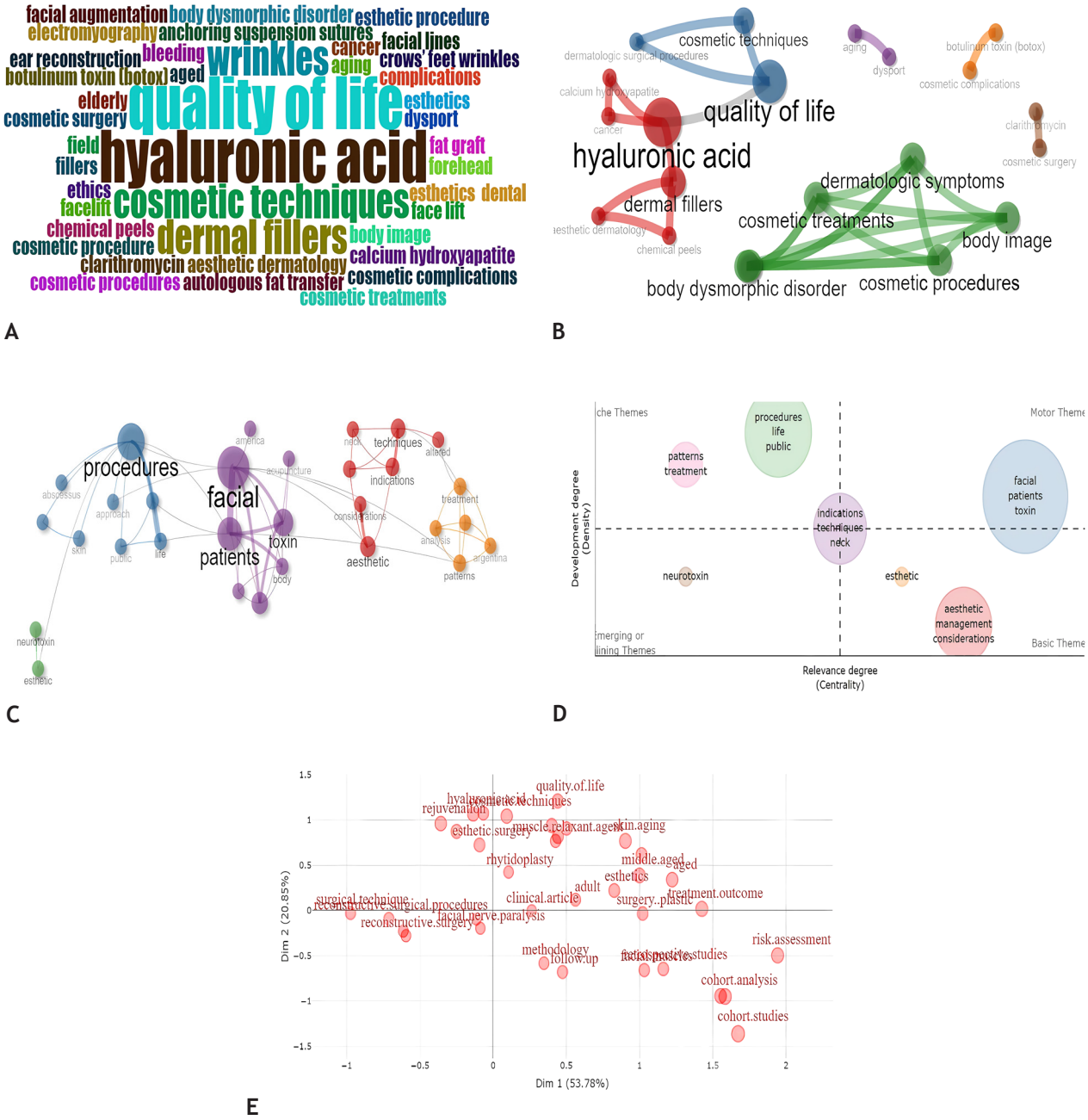

Figure 3. Trends, co-occurrence and level of development of topics on the use of botulinum toxin in plastic surgery. A. Word cloud of the most frequently used keywords. B. Co-occurrence of keywords. C. Co-occurrence of titles. D. Thematic map showing the level of development of the topics under study. E. Multiple correspondence analysis based on keywords.

A regional research collaboration network led by Brazil was identified, with notable involvement from the United States, as well as countries in Europe and Asia. Additionally, Colombia, Argentina and Chile stood out for their strong collaborations with other nations within the region (Figure 4).

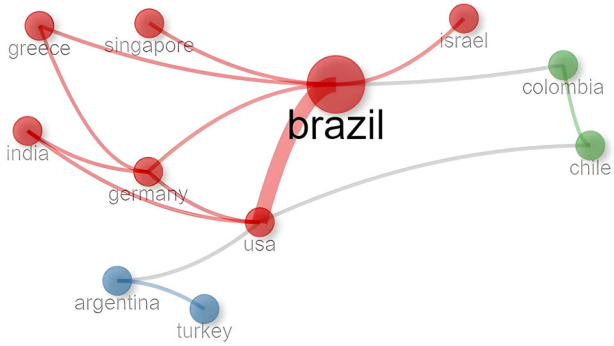

Figure 4. Collaboration network between countries related to Latin American research on the use of botulinum toxin in plastic surgery.

The papers from the region with the highest number of citations include: 1) "The minimal approach: an innovation in facial cosmetic procedures" (published in *Aesthetic Plastic Surgery*, 2004, with 70 citations, DOI: 10.1007/s00266-004-0037-1); 2) "Elderly skin and its rejuvenation: products and procedures for aging skin" (published in *Journal of Cosmetic Dermatology*, 2007, with 59 citations, DOI: 10.1111/j.1473-2165.2007.00289.x); and 3) "Botulinum toxin injection in long-standing facial paralysis patients: improvement of facial symmetry observed up to 6 months" (published in *Aesthetic Plastic Surgery*, 2009, with 51 citations, DOI: 10.1007/s00266-009-9337-9).

To assess the global relevance of Latin American research on the use of botulinum toxin in plastic surgery, filters by country were removed, resulting in a total of 678 papers. The most prolific countries in global research were the United States (*n* = 302), the United Kingdom (*n* = 47) and Germany (*n* = 40). Latin American scientific production accounts for only 5.01 % of the global production.

DISCUSSION

This study provided, for the first time, an overview of Latin American research on the use of botulinum toxin in plastic surgery, a tool that has gained increasing relevance in surgical and aesthetic practices, not only in plastic surgery but also in other specialties that complement their results with this tool. With advancements in biomedical and surgical sciences, innovative techniques have been developed for the application of botulinum toxin, not only for skin treatments but also in other organs, promoting regeneration and enhancing organic plasticity [13-18].

The findings of this study reveal that, over the past 20 years, the growth of Latin American research on the use of botulinum toxin in plastic surgery has been slow, characterized by a low frequency of publications and citations. However, more than 30 % of these publications involve international collaboration. To understand the possible causes of this slow growth, it is crucial to conduct a meta-research analysis that evaluates determinants such as research quality and biases [19-23], lack of funding or strong collaborations, deficits in infrastructure, limited access to high-quality databases, and variables related to the timing and training of researchers in plastic surgery. It is important to note that, despite recent advancements in the discovery and testing of biomarkers for outcomes and prognoses in plastic surgery and related specialties, a predominant pattern of clinical research was observed [18].

In comparison with other surgical specialties [9], the impact and frequency of publication in plastic surgery are notably low. This predominance of clinical evidence also highlights the absence of robust research lines and researchers focused on basic, translational and applied sciences in Latin American plastic surgery. Brazil leads research in the region, as is the case in other medical specialties [24]. However, it is noteworthy that no studies have evaluated the usefulness of techniques or tools in plastic surgery from a perspective other than clinical research.

A novel finding in this study is the identification of emerging research lines and trends. Plastic surgery has traditionally been associated with cosmetic surgery, despite its much broader scope. The frequent appearance of terms such as "quality of life" and "hyaluronic acid" in these publications can be attributed to their strong connection to aesthetic interventions. These results should be used to reassess the research needs in plastic surgery within the region and to design a research agenda aligned with the health needs and priorities of the specialty [25, 26]. Furthermore, they can help identify gaps in existing evidence and facilitate the design of more complex studies that address higher-level research problems [27-29]. For instance, the low frequency of experimental studies suggests that efforts could be made to strengthen this area of research.

Strengthening national, regional and international interinstitutional collaboration could address the inherent limitations of the region, as described earlier [30, 31]. Unlike Brazil, few other Latin American countries engage in significant collaborative efforts, which may explain why Latin American production represents only 5 % of global research on botulinum toxin in plastic surgery. Therefore, while Latin American research has grown gradually, it has not kept pace with the global trend.

One limitation of this study is that only a single database, Scopus, was used. While Scopus indexes a larger number of Latin American publications compared to PubMed and Web of Science, there is an inherent bias in the metadata recorded in the database. However, the process of standardization and manual review minimizes the margin of error.

In conclusion, slow growth with low production and impact has been identified in Latin American research on the use of botulinum toxin in plastic surgery over the last 20 years. This research has focused on clinical studies related to clinical outcome assessment, quality of life and aesthetic techniques. Brazil leads research in the region and maintains a strong network of intercontinental collaboration.

Author contributions: ODFZ, TCMD, LACM, VBB and SABB contributed equally to the original idea, study design, literature review and analysis, draft writing, manuscript writing, and approval of the final version. JSSD, LSCC, JMRM, MAAM and YAPJ were involved in the manuscript conception and design, data analysis and interpretation, manuscript writing and critical revision, and approval of the final version.

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BIBLIOGRAPHIC REFERENCES

1. American Society of Plastic Surgeons. Botulinum toxin [Internet]. American Society of Plastic Surgeons: Illinois. Available from: https://www.plasticsurgery.org/cosmetic-procedures/botulinum-toxin#:~:text=Injections%20of%20botulinum%20toxin%20block,unwanted%20facial%20wrinkles%20or%20appearance
2. Freeman MD, Margulies IG, Sanati-Mehrizy P, Burish N, Taub PJ. Nonaesthetic applications for botulinum toxin in plastic surgery. Plast Reconstr Surg. 2020;146(1):157-70.
3. Noland ME, Lalonde DH, Yee GJ, Rohrich RJ. Current uses of botulinum neurotoxins in plastic surgery. Plast Reconstr Surg. 2016;138(3):519e-530e.
4. Yu Y, Sun J, Shen Z, Lin X, Xu J. Auxiliary usage of botulinum toxin A in plastic surgery in China. J Cosmet Dermatol [Internet]. 2020; 19(5):1021-1028.
5. Noland ME, Morris SF. Botulinum toxin treatment in Plastic Surgery. En: Jabbari B. Botulinum Toxin Treatment in Surgery, Dentistry, and Veterinary Medicine. Connecticut: Springer Publishing Group; 2020. 247-267.
6. Monheit G. Neurotoxins: Current concepts in cosmetic use on the face and Neck--Upper face (Glabella, Forehead, and Crow's Feet). Plast Reconstr Surg [Internet]. 2015;136(5):72-75.
7. Erickson BP, Lee WW, Cohen J, Grunebaum LD. The role of neurotoxins in the periorbital and midfacial areas. Facial Plast Surg Clin North Am [Internet]. 2015;23(2):243-55.
8. Safeek RH, Aslami Z, Azad CL. The role of plastic surgery in addressing the global burden of disease: plastic surgery and the sustainable development goals. Plast Reconstr Surg Glob Open [Internet]. 2023;11(5):90.
9. Lozada-Martinez ID, Visconti-Lopez FJ, Marrugo-Ortiz AC, Ealo-Cardona CI, Camacho-Pérez D, Picón-Jaimes YA. Research and publication trends in pediatric surgery in Latin America: a bibliometric and visual analysis from 2012 to 2021. J Pediatr Surg [Internet]. 2023;58(10):2012-2019.
10. Yubo S, Ramayah T, Hongmei L, Yifan Z, Wenhui W. Analysing the current status, hotspots, and future trends of technology management: Using the WoS and scopus database. Heliyon [Internet]. 2023;9(9):e19922.
11. Rousseau R, Egghe L, Guns R. Becoming Metric-Wise: a bibliometric guide for researchers. United Kingdom: Chandos Publishing; 2018.
12. Aria M, Cuccurullo C. Bibliometrix: an R-Tool for comprehensive science mapping analysis. J Informetr [Internet]. 2017;11:(4)959-75.
13. Klochkova OA, Kurenkov AL. Priorities and goals of botulinum toxin a treatment in cerebral palsy. Zh Nevrol Psikhiatr Im S S Korsakova [Internet]. 2019;119(2):118-124
14. Pellett S, Yaksh TL, Ramachandran R. Current status and future directions of botulinum neurotoxins for targeting pain processing. Toxins (Basel) [Internet]. 2015;7(11):4519-63.
15. Pirio Richardson S, Altenmüller E, Alter K, Alterman RL, Chen R, Frucht S, et al. Research priorities in limb and task-specific dystonias. Front Neurol [Internet]. 2017;8:170.
16. Wong C. The effect of botulinum toxin-A on chronic muscle-related pain in cerebral palsy. Front Neurol [Internet]. 2022;13:936625.
17. Ip AH, Phadke CP, Boulias C, Ismail F, Mills PB. Practice patterns of physicians using adjunct therapies with botulinum toxin injection for spasticity: a Canadian multicenter cross-sectional survey. PM R [Internet]. 2021;13(4):372-78.
18. Yao D, O'Flynn LC, Simonyan K. DystoniaBoTXNet: novel neural network biomarker of botulinum toxin efficacy in isolated dystonia. Ann Neurol [Internet]. 2023;93(3):460-71.
19. Lozada-Martinez ID, Ealo-Cardona CI, Marrugo-Ortiz AC, Picón-Jaimes YA, Cabrera-Vargas LF, Narvaez-Rojas AR. Meta-research studies in surgery: a field that should be encouraged to assess and improve the quality of surgical evidence. Int J Surg [Internet]. 2023;109(6):1823-4.
20. Lozada-Martinez ID, Lozada-Martinez LM, Fiorillo-Moreno O. Leiden manifesto and evidence-based research: are the appropriate standards being used for the correct evaluation of pluralism, gaps and relevance in medical research? J R Coll Physicians Edinb [Internet]. 2024;54(1):4-6.
21. Loannidis JPA. Meta-research: the art of getting it wrong. Res Synth Methods [Internet]. 2010;1(3-4):169-84.
22. Loannidis JPA, Fanelli D, Dunne DD, Goodman SN. Meta-research: evaluation and improvement of research methods and practices. PLoS Biol [Internet]. 2015;13(10):e1002264.
23. Loannidis JPA. Meta-research: why research on research matters. PLoS Biol [Internet]. 2018;16(3):e2005468.
24. Lozada-Martinez ID, Lozada-Martinez LM, Cabarcas-Martinez A, Ruiz-Gutierrez FK, Aristizabal Vanegas JG, Amorocho Lozada KJ, et al. Historical evolution of cancer genomics research in Latin America: a comprehensive visual and bibliometric analysis until 2023. Front Genet [Internet]. 2024;15:1327243.

25. Lee A, Higginbotham G, Davies P, Young A. Research priority setting in plastic and reconstructive surgery: a systematic review. J Plast Reconstr Aesthet Surg [Internet]. 2023;76:148-59.
26. Eaves FF 3rd, Rohrich RJ, Sykes JM. Taking evidence-based plastic surgery to the next level: report of the second summit on evidence-based plastic surgery. JAMA Facial Plast Surg [Internet]. 2013;15(4):314-20.
27. Zurita-Cruz JN, Márquez-González H, Miranda-Novales G, Villasís-Keever MÁ. Estudios experimentales: diseños de investigación para la evaluación de intervenciones en la clínica. Rev Alerg Mex [Internet]. 2018;65(2):178-86.
28. Knight KL. Study/experimental/research design: much more than statistics. J Athl Train [Internet]. 2010;45(1):98-100.
29. Lee WJ. Research, plastic surgery, and archives of plastic surgery. Arch Plast Surg [Internet]. 2017;44(5):359-60.
30. Cheng F, Ma Y, Uzzi B, Loscalzo J. Importance of scientific collaboration in contemporary drug discovery and development: a detailed network analysis. BMC Biol [Internet]. 2020;18(1):138.
31. Chiang G, Umbuzeiro G, Lo Nostro F. Latin America: Knowledge diversity for a sustainable future. Integr Environ Assess Manag [Internet]. 2023;19(3):613-14.

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