




Latin American Research on Bariatric Surgery: a Bibliometric Study

Carlos J. Toro-Huamanchumo^{1,2}  · Cristian Morán-Mariños³ · Jorge L. Salazar-Alarcon^{2,4} · Shamir Barros-Sevillano⁵ · Medalit E. Huamanchumo-Suyon⁶ · Gustavo Salinas-Sedo²

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Abstract

We performed a bibliometric analysis of Latin American documents published between 1984 to 2019 in Scopus-indexed journals. A total of 1856 documents were analyzed. The annual scientific production was 64 documents per year, with an annual increase rate of 15.9%. The countries with the highest scientific production on BS were Brazil (64.7%) and Chile (14.5%). Most of the publications were original (76.6%) and review articles (11.9%). The journal with the highest publication record was “Obesity Surgery” (25.8%). The extra-regional collaboration was mainly with the USA. In conclusion, Latin American scientific production on BS has shown a significant increase in recent years. However, more participation is needed, fostering intra-regional collaboration and involving universities and health institutions in BS research.

Keywords Bariatric surgery · Obesity · Bibliometrics · Latin America

Introduction

In recent years, Bariatric Surgery (BS) has expanded worldwide [1]. This has been reflected in the increase of members in surgical societies [2] and the number of scientific publications in this area [3]. Latin America (LA) has been a leader in the innovation of surgical techniques in BS [4], with Brazil being the country with the highest contribution in the area [3].

Bibliometric analysis is an effective method for measuring scientific contributions in a variety of fields [5]. BS is not the exception and evaluating the collaboration networks, characteristics of quantity (current trends and scope), and quality (rates of citations and level of evidence) of scientific production [6, 7] allows to identify gaps in knowledge. Furthermore, it can direct research towards important unaddressed questions, promoting effective government investment policies [8].

It is important to note that the bibliometric studies of BS conducted to date [3, 9, 10] have some limitations. First, they only included Web of Science (WoS) in their search strategy, excluding, for example, Scopus, which provides 100% Medline coverage, Embase, Compendex, and World textile index [11]. LA is the third region with the most journals in the WoS Emerging Sources Citation Index (ESCI) collection [12]. However, ESCI does not reflect the same quality as the main collections due to the inclusion methods of the journals [13]. Second, previous studies only included the terms “obesity surgery” and “bariatric surgery” as thesauri [3, 10], omitting synonyms and other strategies for a more sensitive search [14]. Third, having used the “obesity” thesaurus [9] could lead to the inclusion of articles not directly related to BS. Fourth, the studies only retrieved articles in English [3, 10].

Data on the evolution of BS from Latin American countries are very limited and unclear. Conducting a bibliometric analysis focused on this region will help identify in detail the

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✉ Carlos J. Toro-Huamanchumo
toro2993@hotmail.com

- ¹ Instituto de Investigación, Universidad Católica Los Ángeles de Chimbote, Chimbote, Peru
- ² Clínica Avendaño, Lima, Peru
- ³ Unidad de Investigación en Bibliometría, Universidad San Ignacio de Loyola, Lima, Peru
- ⁴ School of Medicine, Universidad Nacional Mayor de San Marcos, Lima, Peru
- ⁵ Facultad de Ciencias de la Salud, Escuela de Medicina, Universidad César Vallejo, Trujillo, Peru
- ⁶ Hospital Nacional Almanzor Aguinaga Asenjo, EsSalud, Chiclayo, Peru

current situation of each country, as well as gaps in knowledge to direct efforts towards important unaddressed issues and prioritize financial investments. This study aimed to present an overview of Latin American scientific production on bariatric surgery with a focus over the period 1984–2019.

Methods

Study Design and Data Source

We performed a bibliometric analysis of documents published between 1984 to 2019 in Scopus-indexed journals. Given that, in 1984, the term “bariatric” was first adopted within the field of surgery [15], and the first annual meeting of the American Society of Bariatric Surgery (ASBS) was held, we considered this date to start our search.

Search Strategy

We identified indexed publications in the Scopus database. A Latin American document on bariatric surgery was defined as having at least one author affiliated with a Latin American country. The search strategy included Medical Subject Headings (MeSH) terms for “Bariatric Surgery” and related terms found in previous literature. The publications were limited to original research articles, review articles, letters, notes, conference documents, brief surveys, editorials, and errata. The full search strategy is available in Supplementary File 1. Supplementary File 2 shows the flow-chart of the bibliometric search. The search period was restricted from 1984 to 2019, there were no language restrictions, and terms such as “animal*” and “rat*” were excluded.

Analysis

Two authors (CJTH and CMM) collected all data and downloaded it in a comma-separated values format. We imported the data into Microsoft Excel 2019 and bibliometric indicators were presented for the following: (1) amount of annual research, compared with the SciELO database (via Web Of Science), (2) scientific production by country and institution, (3) type of publication, and (4) journal metrics, available from SCImago-Scopus (Quartile, “Scimago Journal Ranking (SJR),” and CiteScore). These indicators allow us to know a general classification of the journals (quartiles, Q1–Q4), to consider the citations based on their importance (SJR) and to offer a more complete and transparent vision of their impact (CiteScore) [16].

We presented the results in tables and graphs of frequency and percentages. We used Pearson’s correlation to better understand the trends of SciELO’s publications and the Student’s *t* test to ascertain differences in the number of

publications between ranges of years and between intraregional and extra-regional collaboration. A *p* value of less than 0.05 was considered significant.

We created the collaboration network visualization maps using VOSviewer version 1.6.6 (Leiden University, Leiden, The Netherlands). Maps created based on network data included countries and keywords based on co-authorship and co-occurrence networks extracted from Scopus. Briefly, graphical interpretation is based on the circle’s size, the thickness of the connecting lines, and the distance between the elements (countries or keywords). A larger circle size will depend on the item’s weight, which can be given by the occurrence (number of publications). At the same time, the color indicates clusters of closely related terms. The thickness of the link between two elements represents the strength of the relationship and the distance is indicative of the relatedness of the terms [17]. Additionally, thesaurus-based methods were used to create more representative graphs [17, 18].

Results

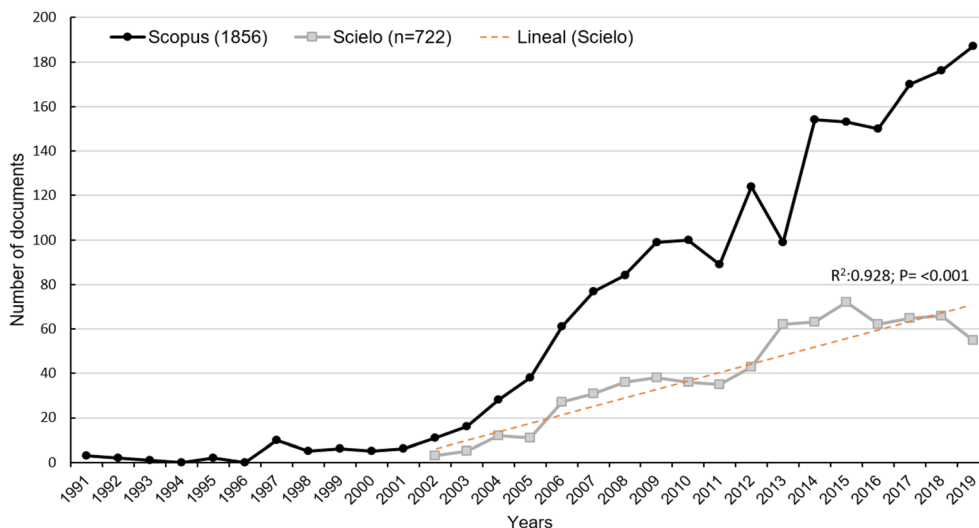
Our initial search retrieved 40,549 publications, of which 1856 were finally analyzed (Supplementary File 2). The annual scientific production was 64 documents per year, with an annual increase rate of 15.9%. Although the search start date was 1984, the first document recorded for LA was in 1991. A comparison with the SciELO database (via Web Of Science) showed a similar trend, with a strong correlation for an increase in scientific production in this database ($R^2 = 0.928$; $p < 0.001$) (Fig. 1). The countries with the highest scientific production on BS were Brazil with 1201 (64.7%) documents and Chile ($n = 268$; 14.5%). The rest of the Latin American countries had less than 32 documents (Fig. 2).

In the last decade (2010–2019), there was a significant increase of up to 5.8 times in scientific production ($p < 0.001$) compared to 1991–2009. Most of the publications were original articles (76.6%) and review articles (11.9%) (Table 1).

The top 10 journals with the highest publication record had a minimum of 23 documents between 1984 and 2019; six journals were from Latin America. According to the number of documents, the leading journals were “Obesity Surgery” with 480 (25.8%) and “Surgery For Obesity And Related Diseases” with 98 (5.2%) (Table 2).

The top ten institutions were mainly from Brazil and Chile, and they represented 47% of the total documents and 65.3% of the citations. Among the universities, the “Universidade de Sao Paulo” was the most productive with 308 documents. However, the universities of Chile had the highest number of citations per document. The “Hospital Clínico de la Universidad de Chile” was the health facility with the highest

Fig. 1 Trends of the annual documents of bariatric surgery research in Latin America, from 1991 to 2019



number of documents, and the “Gastro Obeso Center” had the highest number of citations per document (Table 3).

Figure 3 shows the collaboration networks where 42 countries were registered with a minimum of two publications in Scopus. Thirteen Latin American countries collaborated with 29 extra-regional countries. Brazil ($n = 35$), Argentina ($n = 20$), and Chile ($n = 19$) were the ones that obtained the highest number of collaborative networks with at least 19 countries. Peru, Ecuador, and Puerto Rico only shared a publication with one extra-regional country. Intra-regional collaboration had a lower trend compared to the extra-regional (mean diff. = 4.31). The extra-regional collaboration was mainly with the USA (210 documents, 11.32%), Spain ($n = 65$, 3.5%), Italy ($n = 40$, 2.16%), France ($n = 27$, 1.46%), and the UK ($n = 24$, 1.29%).

Eighty-two out of 6772 keywords were used in 1852 documents and had a minimum of 30 occurrences. They were then organized by thesaurus-based methods and presented in groups as determined by the number of occurrences. The

cluster 1 (Epidemiology) was the most common ($n = 6091$; 41.4%), highlighting the terms “female” and “adults.” In cluster 2, “surgical techniques,” “gastric bypass,” “roux and anastomosis,” and “gastrectomy” were the main terms. All the clusters are presented in Fig. 4.

Discussion

Latin American scientific production on BS has shown a significant increase in recent years. However, growth is lower than that reported worldwide, mainly by North America and Europe [10, 19]. This may be due to the differences in the prevalence of obesity and other factors, such as country population, gross domestic product per capita, human development index, number of internet users or internet access, English proficiency index, and research, health and development expenditure [3, 10, 20]. Factors in which Latin America has historically been relegated [21–23].

Fig. 2 Documents of bariatric surgery research, by periods and per country. *Other: countries with less than 32 publications

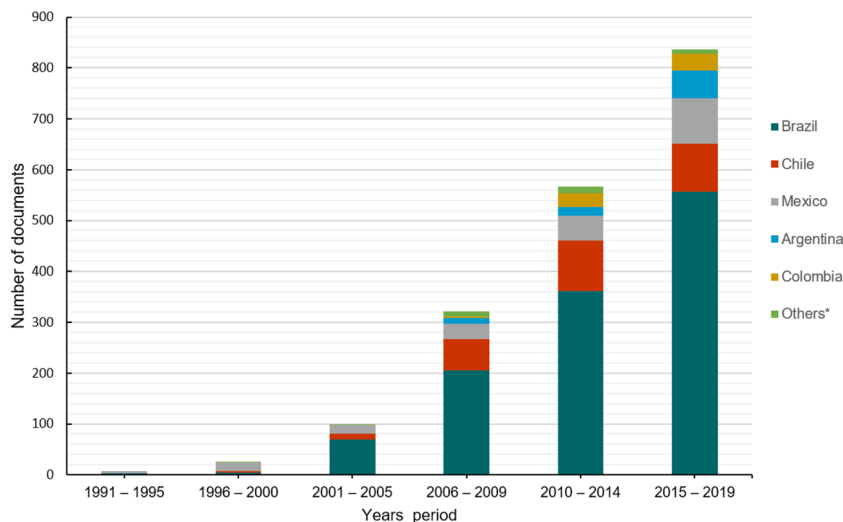


Table 1 Publication years and types of journal articles

Year	Documents	Original research	Review articles	Letter	Others*	<i>p</i>
1991–1995	8	8	0	0	0	< 0.001 ^a
1996–2000	26	14	3	8	1	Mean diff. (122.7)
2001–2005	99	74	10	9	6	
2006–2009	321	256	36	18	11	
2010–2014	566	463	59	26	18	
2015–2019	836	608	112	56	60	
Total	1856	1423 (76.6%)	220 (11.9%)	117 (6%)	96 (5.5%)	

Others*: conference paper, note, editorial, short survey, erratum

^a Significant *p* value, assessing differences between (1991–2009) and (2010–2019)

Brazil and Chile cover almost 80% of Latin American scientific production on BS, and the first one is responsible for more than half of this output. This might not be surprising, since Brazil has characterized itself as a leader in biomedical [24] and public health research [25] in LA. In addition, Ozsoy et al. (2018) reported that Brazil is the second country in the world with the highest number of publications on Roux-en-Y gastric bypass topics and the ninth on sleeve gastrectomy topics [26]. Similarly, Chile is the second country that contributes the most in LA, occupying the seventh position in publications on sleeve gastrectomy worldwide [26].

The first Latin American scientific publication found in our study was in 1991. However, it was not until the second half of the 1990s that there was evidence of an increase in the number of

publications (a threefold increase compared to the previous 5-year period). Three facts stand out as follows: (a) implementation of laparoscopy in bariatric procedures [27], (b) demonstration of the metabolic effects of BS [28], and (c) creation of a journal specialized in BS (Obesity Surgery, 1991) [15].

Publishing in high-impact journals increases visibility and likelihood of being cited. This could explain why most of the Latin American scientific production has been published in journals such as “Obesity Surgery” and “Surgery for Obesity and Related Diseases.” Additionally, it is important to mention that four of the top 10 journals reported in our study were Brazilian, and two were Chilean. This may be the result of the strong investment of both countries in the dissemination of scientific knowledge through the visibility of their national journals

Table 2 Top 10 journals with published documents on bariatric surgery in Latin America, 1984–2019

Journals*	Number of documents (%)	Number of citations	Citations/ documents	Quartile scores ^a	CiteScore 2018 ^Y	SJR 2018 ^Y	% International collaboration (2018) ^a
English only							
Obesity Surgery	480 (25.8)	11,015	22.95	Q1	3	1.439	18.70%
Surgery For Obesity And Related Diseases	98 (5.2)	1680	17.14	Q1	2.51	1.47	17.66%
Surgical Endoscopy	23 (1.2)	644	28	Q1	3.18	1.45	16.50%
English and/or Portuguese							
Arquivos brasileiros de cirurgia digestiva	68 (3.6)	297	4.37	Q3	0.86	0.42	23.29%
Revista Do Colegio Brasileiro De Cirurgioes	46 (2.4)	167	3.63	Q3	0.57	0.22	10.26%
Arquivos De Gastroenterologia	32 (1.7)	201	6.28	Q3	0.90	0.37	4.29%
English and/or Spanish							
Nutricion Hospitalaria	46 (2.4)	266	5.78	Q3	0.87	0.34	9.93%
Revista Chilena De Cirugia	40 (2.1)	51	1.28	Q4	0.09	0.11	0%
Revista Médica De Chile	23 (1.2)	140	6.09	Q3	0.49	0.22	14.89%
English, Portuguese, and/or Spanish							
Revista Da Associacao Medica Brasileira	26 (1.4)	99	3.81	Q3	0.80	0.22	6.22%

^a Source: SCImago Journal and Country Rank (2018), ^Y Source: SCOPUS (2018), *Journals were classified according to their language of publication

Table 3 Top Latin American institutions publishing in bariatric surgery research, 1984–2019

Rank	Institution name	Country	Reports (<i>n</i>)	Citations (1984–2019)	Citations/ documents
Universities					
1	Universidade de Sao Paulo	Brazil	308	4547	14.7
2	Universidade Federal de Sao Paulo	Brazil	92	1179	12.8
3	Universidade Estadual de Campinas	Brazil	90	2061	22.9
4	Universidad de Chile	Chile	87	2351	27
5	Pontificia Universidad Católica de Chile	Chile	72	2086	28.9
Health facilities					
1	Hospital Clínico de la Universidad de Chile	Chile	84	1901	22.6
2	Instituto Nacional de la Nutrición Salvador Zubirán	México	47	934	19.8
3	Hospital de Clínicas de Porto Alegre	Brazil	32	472	14.7
4	Gastro Obeso Center	Brazil	31	1124	36.2
5	Hospital Israelita Albert Einstein	Brazil	30	596	19.8

[29–32]. It is also important to mention that a good international collaboration network will have better results in the citation of articles [33]. This agrees with our results since most of the articles with international collaboration were published in the three journals with the best citation index. Nevertheless, it is striking that extra-regional collaboration is superior to intra-regional. This could be due to several factors: (a) limited national funding for research [34], (b) limited research in BS by countries in the region [19], and (c) search for greater visibility [35].

The USA, Spain, and Italy had the most significant scientific collaboration with Latin American countries. This may have several reasons: (1) the three countries are

considered world leaders in the study of obesity and BS [36, 37], (b) they are part of the top five countries with more publications on BS [3], (c) they are countries with the highest rates of bariatric procedures per year [38], and (d) due to their policy of scientific collaboration with developing countries [39]. On the other hand, and within LA, the top five most productive universities in BS were from Brazil and Chile. This could partially explain why these countries have the highest rates of bariatric procedures performed and the highest scientific production in LA [19, 26].

The analysis of the most used terms as keywords gives us a clearer idea about the topics addressed in BS

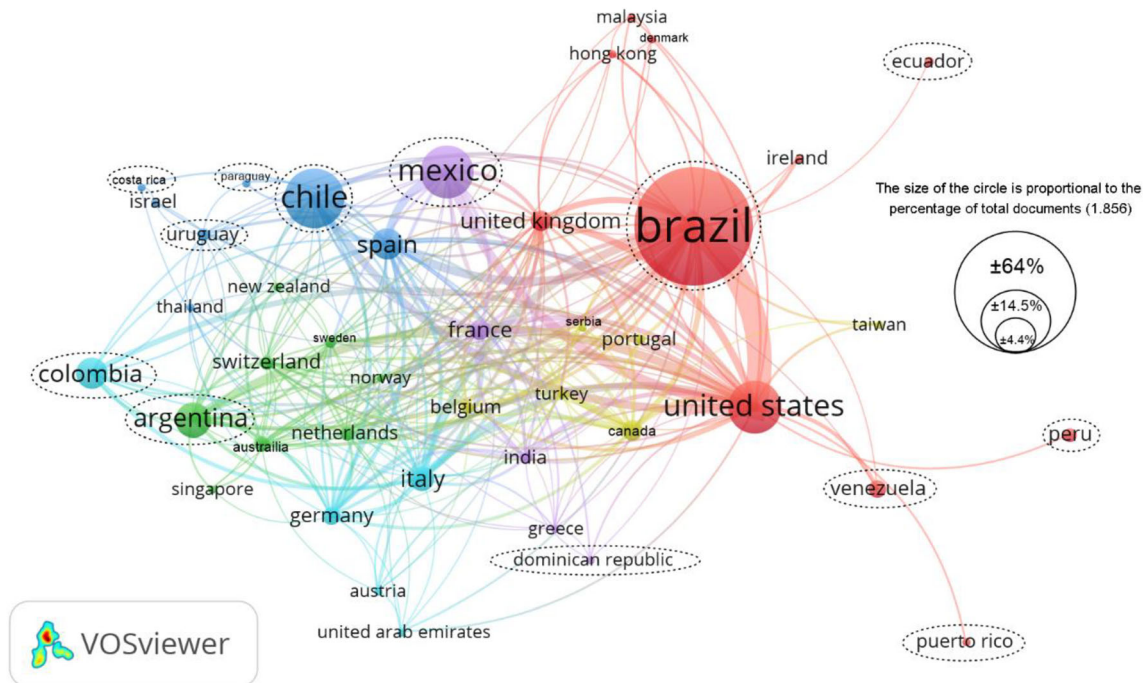


Fig. 3 Extra-regional collaboration network on bariatric surgery research in Latin America

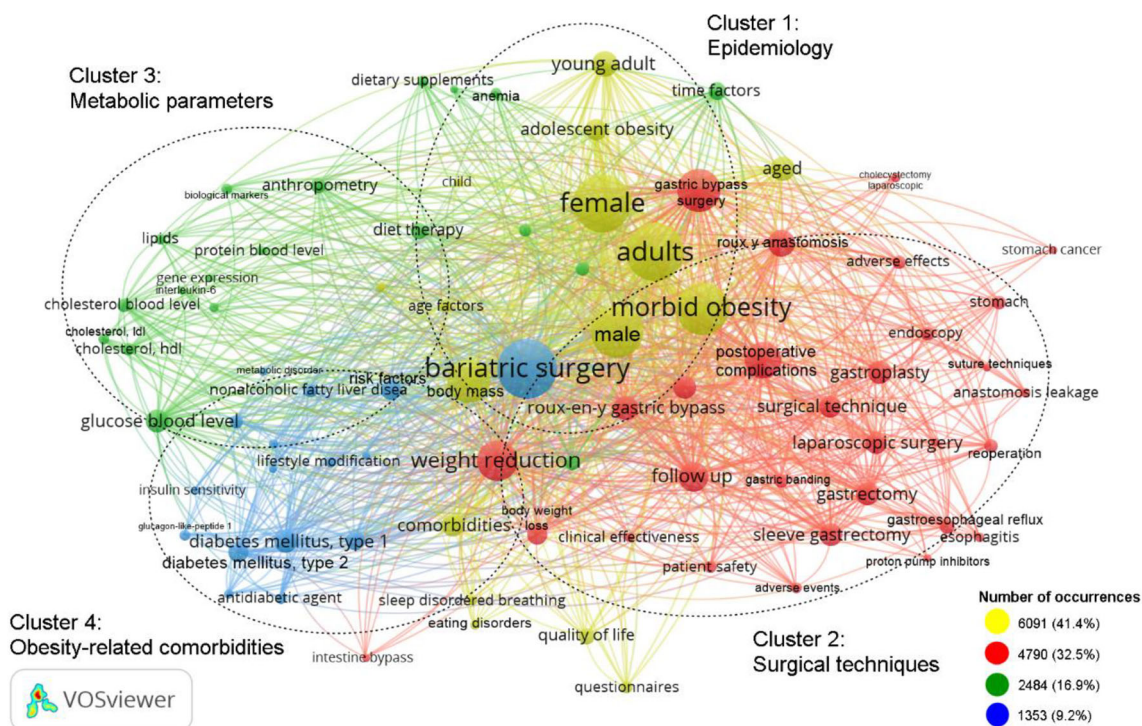


Fig. 4 Network of occurrences of the bariatric surgery keyword map*. *The size of the circles is scaled according to the number of total occurrences of each term

publications. In our study, epidemiological terms were the most common, which is closely related to statistical reports of bariatric procedures in LA [19, 38]. In the second group (surgical techniques), the term “gastric bypass” was the most used, probably for two reasons: the contribution of Brazil (located in the top five countries that publishes the most on this topic) [26], and that this is the most performed procedure in LA [19, 38].

The present study had some limitations. First, only the Scopus database was used for data extraction. Therefore, articles published in some national and regional journals may not have been included. However, it should be noted that Scopus was chosen because it was the most appropriate database for the present study. It is also the world’s largest peer-reviewed database [11] and has a wider coverage of non-English-language journals [40]. Second, the citations reported in our study do not necessarily reflect the quality of the studies, since no quality assessment was performed. However, they allow a quantitative evaluation of the scientific impact in a particular area of knowledge (bariatric surgery). Third, although the VoSViewer software provides a visual analysis of networks, it does not allow us to calculate a statistical relationship. Fourth, the country’s determination was based on Scopus’ indexing of the authors’ affiliations; these might reflect the institutional affiliation rather than the researcher’s true geographical location.

Conclusion

The present study found that scientific production on bariatric surgery in Latin America has been increasing, mainly due to Brazil, and Chile’s contribution. Most of the articles have been published in non-Latin American peer-reviewed journals, and the USA is the extra-regional country that collaborates the most. More participation is needed from all the countries in the region, fostering intra-regional collaboration and involving universities and health institutions in bariatric surgery research.

Authors’ Contributions CJTH and CMM provided the idea and analysis of data. All the authors discussed the results, critically commented on the manuscript at all stages, and prepared and approved its final version.

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Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Ethical Approval This article does not contain any studies with human participants or animals performed by any of the authors.

Informed Consent Informed consent does not apply.

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