

## Visibility and impact of the Cuban dental scientific output, Scopus 1995-2017.

Visibilidad e impacto de la producción científica cubana sobre Estomatología, Scopus 1995-2017.

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**Abstract:** **Aim:** To identify the differences between Cuban scientific research published in highly visible journals and the rest of the national dental scientific output. **Materials and Methods:** A bibliometric analysis was conducted using 1995-2017 data from the Scopus database. The following search strategy was used: country (Cuba), subject area (Dentistry), publication source (Journals), article type (Original Research, Review Article). Bibliometric indicators of output, visibility, leadership, collaboration and impact were examined. **Result:** 521 articles were published in 21 journals, of which 20 are international and 13 are within the first quartile (Q1), led by *Clinical Oral Implants Research*. There was a prevalence of Spanish language publications, without collaboration, and in *Revista Cubana de Estomatología*. The Cuban scientific leadership significantly diminishes in the journals located in the highest visibility quartile (Q1) ( $p=0.0144$ ). The high dependency of citation-based indicators, as well as international collaboration, in relation to the journals' quartile, was confirmed. **Conclusion:** The national scientific output in first quartile journals that has the biggest influence on the scientific international community is dependent on international collaboration to reach high levels of visibility and impact, and the national scientific output is not still able to systematically generate research that impacts in a significant way the scientific international community.

**Keywords:** Dentistry; oral medicine; scholarly communication; periodicals as topic; bibliometrics; Cuba.

**Resumen:** **Objetivo:** Identificar las diferencias existentes entre la investigación que se publica en revistas de máxima visibilidad, y el resto de la producción científica cubana sobre Estomatología. **Materiales y Métodos:** Se realizó un análisis bibliométrico del período 1995-2017 utilizándose Scopus como fuente de datos. Se empleó la siguiente estrategia de búsqueda: país (Cuba), área temática (Dentistry), origen de los artículos (journals), tipos de artículos (originales y revisiones) y años de publicación (1995-2017). Se estudiaron indicadores bibliométricos de producción, visibilidad, liderazgo, colaboración e impacto. **Resultados:** Se publicaron 521 artículos en 21 revistas, de las cuales 20 son internacionales y 13 pertenecen al primer cuartil, encabezadas por *Clinical Oral Implants Research*. Existió predominio de la publicación en español, sin colaboración, en la *Revista Cubana de Estomatología*. En la medida en que las revistas se ubican en los cuartiles de mayor visibilidad disminuye significativamente el liderazgo científico cubano ( $p=0,0144$ ). Se confirmó la alta dependencia de los indicadores basados en análisis

de citas, así como de la colaboración internacional, en relación con el cuartil de las revistas. **Conclusión:** La producción científica nacional en revistas del primer cuartil es la que ejerce mayor influencia sobre la comunidad científica internacional, depende de la colaboración internacional para alcanzar altos niveles de visibilidad e impacto, y aún

no es capaz de generar sistemáticamente investigaciones que impacten de manera significativa sobre la comunidad científica internacional.

**Palabra Clave:** *Odontología; medicina oral; comunicación académica; publicaciones periódicas co-mo asunto; bibliometría; Cuba*

## INTRODUCTION.

The publication of research results plays a significant role in their dissemination in the scientific community and among readers interested in the subject.

Scientific journals are considered the usual means of disseminating scientific knowledge as they reduce the time between the production of results and due to their adequate dissemination.<sup>1</sup> Additionally, journals help to ensure the quality of publications through the peer review system.<sup>2,3</sup>

The journal impact factor (IF) is one of the most widely used parameters when choosing the platform to publish research findings. The prestige of the journal and the scientific community's assessment of it depend greatly on this indicator.<sup>4,5</sup> Impact indicators are bibliometric measures that allow the classification of journals based on their impact on the research community and are calculated taking as a reference the number of citations received by articles published in a given period of time since their publication.<sup>6</sup>

For many years the databases of the Institute for Scientific Information (ISI) were the only sources for bibliometric work. Web of Science [(WoS) ISI, Thomson Reuters, now Clarivate Analytics] was the only international, multidisciplinary tool available to access scientific, technological, and biomedical literature, among other fields. The Journal Citation Report (JCR) uses this database, which includes WoS journals as citers, and is where their IF is published, despite its limitations.<sup>7,8</sup>

In 2004 Scopus emerged as an initiative of Elsevier with the aim of reducing the limitations established by WoS.<sup>9</sup> It is currently considered the largest multidisciplinary database and has put an end to the supremacy of WoS.<sup>10</sup> By including bibliographic references it is also capable of offering alternatives to the IF measurement.<sup>11,12</sup>

In 2007, the SCImago Journal Rank (SJR) appeared as an initiative of the SCImago group, becoming the quality indicator of journals indexed in Scopus. One of the main advantages of this over the JCR is that it is free of charge

to access, in addition to the fact that, for its calculation, citations are weighted according to the citing journal.<sup>13-15</sup>

In the calculation of the IF, only articles and reviews are included in the denominator. It includes the citations to any type of document, in addition to the fact that self-citations are not corrected in the total number of citations. The length of its citation window is limited to 2 years to keep statistics up to date but, in some disciplines, documents begin to be cited after this period. For its part, the SJR tries to overcome many of the criticisms made of the analysis of citations.

One of its fundamental characteristics is that it distinguishes between the prestige and popularity of a journal and is not affected by citations to and from documents that are categorized as non-citable, and although they are cited, they are not counted in the number of articles published by the journals. The peak of citations in some disciplines has a 3-year-window and in others it is almost 5 years. The SJR has a 3-year citation window because this is an optimal period for a given discipline, in which the impact matures more slowly until it reaches its maximum value, and at the same time it does not penalize disciplines in which the impact matures faster.<sup>16</sup>

Some studies have been carried out on the individual characterization of journals in the dental field,<sup>17-19</sup> as well as the general characterization of the publications in this area indexed in the Scientific Electronic Library Online (SciELO) database.<sup>20</sup> At the country level, the publication of articles by Chinese researchers in international journals indexed in WoS,<sup>21</sup> and dentistry scientific research and productivity in Mexico,<sup>22,23</sup> Uruguay,<sup>24</sup> Argentina,<sup>25</sup> Chile,<sup>26</sup> and Cuba<sup>27-29</sup> have been studied. The visibility of scientific production has also been evaluated in dentistry using the IF<sup>30,31</sup> as an analysis measurement.

The IF and the indicators based on citation analysis have received multiple criticisms, which is why several studies have tried to uncover the biases associated with their implementation in determining leading journals.<sup>32-34</sup>

However, the influence of the articles published in these

journals on the scientific community is undeniable.<sup>35-39</sup> Using as a tool the quartiles established by the Scimago Journal & Country Rank<sup>14</sup> elaborated from the Scopus database,<sup>40</sup> this paper aims to evaluate this phenomenon in the Cuban scientific output on dentistry and answer the research question: is the Cuban scientific output on dentistry homogeneous in the country and does it spring from a culture of publishing in this field? As such, the aim of the study was to identify the differences between the research published in highly visible journals, and the rest of the national scientific output on dentistry.

## MATERIALS AND METHODS.

### Design, search strategy and data management

A bibliometric study of the Cuban scientific output was carried out in journals indexed in the Scopus database in the subject area of dentistry. Scopus is the largest database of citations and abstracts of peer-reviewed literature and high-quality sources on the web. It has intelligent tools to follow, analyze and characterize the behavior of the activity in science, especially with respect to consumption, based on the use of citation data from works and authors. It has become a milestone for its potential as a source of information for bibliometric analysis and for its competition against the monopoly of Thomson Reuters Web of Science (WoS), in terms of functionality, services and data.<sup>16,40</sup>

The database was accessed on January 4, 2019, to retrieve the publications, available at: <http://www.scopus.com>. An advanced search was carried out using a filter by country (Cuba), subject area (Dentistry), source of publication (journals), types of articles (original research and review articles), and years of publication (1995-2017). The search strategy used is shown in Table 1.

The records were exported to an ad hoc database, through the bibliographic reference manager EndNote X7. The SCImago Journal & Country Rank platform available at: <http://www.scimagojr.com><sup>14</sup> was accessed to determine the placement of the journals according to the quartile (Q) they fall into. Once the records were normalized, the articles were organized according to the following distribution in the journal quartiles: Q1, Q2, Q3 and Q4.

### Bibliometric indicators

-Number of documents (Ndoc). Total number of documents in which at least one of the authors appears under affiliation to a Cuban institution.

-Level of visibility Q (value). Expected visibility

expressed in %, according to quartile (Q1: 100%; Q2: 75%; Q3: 50%; Q4: 25%), according to the SCImago Journal & Country Rank (SJR) available at: <https://www.scimagojr.com>.<sup>14</sup>

-Cited articles (Ndoc). Total number of published articles that have been cited at least once in Scopus.

-Total number of citations received (Ncit). Total citations received for articles indexed in Scopus.

-Average of citations per document (Cpd). Mean number of citations received by articles indexed in Scopus.

-H index (h index). The h index considers both the number of articles and the number of citations they receive. An author has an index  $h=x$  if she/he has  $x$  articles that have been cited at least  $x$  times.<sup>41</sup> This index is also used to characterize sets (a group of authors, a department, or a country). It has also been used to evaluate the output and citations of articles and journals, as it is the case in this study.<sup>28,29</sup>

-R index (r index). Square root of the total number of citations received by the core of most visible articles in Scopus.<sup>42</sup>

-Scientific leadership (Lead). Total number of articles in which the corresponding author belongs to Cuban institutions. They are called led documents.<sup>43</sup>

### Types of collaboration

-Articles with international collaboration (IC). Articles with at least one author that belongs to a non-Cuban institution.

-International collaboration led by Cubans (IC Lead). Articles with at least one international author that have been led by Cuban authors.

-International and national collaboration (I&NC). Articles signed by more than one Cuban institution and at least one foreign one.

-International and national collaboration led by Cubans (I&NC Lead). Articles signed by more than one Cuban institution and at least one foreign one, which have been led by Cuban authors.

-National collaboration (NC). Articles with authors who belong to more than one Cuban institution, excluding those with international participation.

-Without collaboration (w/o Colab). Articles with authors who belong only to a Cuban institution.

-Articles in Spanish (Ndoc Spa). Articles published in Spanish.

-Articles in English (Ndoc Eng). Articles published in English.

-Articles in Spanish and English (Ndoc Spa-Eng).  
 Articles published in both Spanish and English.

### Statistical analysis

For the analysis of correlations, the Kolmogorov-Smirnov test was used to determine if the bibliometric indicators studied fit a normal distribution. For those that had a normal distribution, the Pearson correlation was performed, and for those that did not, the Spearman or rank correlation was performed.

All the indicators were correlated with each other, with the exception of those related to scientific collaboration (%w/o Colab, % NC, % I&NC and % IC) because most of their values are extreme (0 or 100). A confidence level of 95% was considered. The statistical package MedCalc version 8.0 was used, and values  $p \leq 0.05$  were considered statistically significant.

### Ethical considerations

The study used the data provided by the Scopus database, so prior review by an institutional ethics committee was not considered a requirement.

## RESULTS.

### Publications in journals that belong to the first quartile (Q1).

During the 23-year period evaluated, the Cuban scientific output in the subject area of dentistry in the Scopus database amounted to 521 articles published by 21 journals, of which 20 (95.2%) are international.

No articles published in journals located in Q3 were retrieved in this subject area; 12.3% (n=64) of the articles were published in 13 journals that belong to the first quartile, headed by the *Journal Clinical Oral Implants Research*, which with 47 publications (73.4% of the total articles in the first quartile), is the most widely used international journal by Cuban researchers to disseminate the results of their research. (Table 2)

In nine of the 23 years evaluated, there was no scientific production in this quartile. This production showed a linear growth from 2012, when eight articles were published that received 111 citations. (Table 3)

This growth was at the expense of the publication in *Clinical Oral Implants Research*, since of the 51 articles published during the years 2010-2017, 45 corresponded to this journal. Research in the area of implantology (n=50 articles) predominated among the topics addressed in the articles published in the journals in this quartile.

All articles were published in English and have received citations, reaching a total of 1,176, which represents 64.5% of the total citations received in the period studied. These articles received an average of more than 18 citations, they have an h index of 18 and an r index of 5.9. Even if articles published in *Clinical Oral Implants Research* are excluded from the analysis, the h index would be 11 and would be well above the value of this indicator in the second and fourth quartiles. (Table 4)

The 20 articles included in core h showed, according to the r index, a mean of almost six citations. As such, it can be stated that the "expected impact" from the use of leading journals for the dissemination of research results did not become a "real impact" when taking into account the volume of citations received by them after their publication in such journals.

Thirteen articles have received from 1 to 5 citations, 14 articles from 6 to 10 citations, 21 articles from 11 to 20 citations, and the remaining 16 more than 21 citations. The most cited article in the quartile, which coincides with the most cited in the entire period (218 citations), was related to the levels of interleukins in the crevicular gingival fluid of adult patients with periodontitis. Cuban authors led 29.7% of the articles, and 95.3% were carried out in international collaboration (26.2% with Cuban leadership). (Table 4)

Table 1. Search strategy.

Connector	Field	Search term
	AFFILCOUNTRY	Cuba
AND	SUBJAREA	dent
AND	SRCTYPE	j
AND	PUBYEAR	>1994
AND	LIMIT-TO	DOCTYPE, "ar" OR DOCTYPE, "re"
AND	EXCLUDE	PUBYEAR, 2018
AND	EXCLUDE	PUBYEAR, 2019

**Table 2.** Bibliometric indicators of the Cuban scientific output on Stomatology according to journals. Scopus 1995-2017.

Journals	Q	Ndoc	Ncit	Cited doc (%)	c/d	h index	r index	Lead (%)	IC (%)	CI&N (%)	NC (%)	w/o C (%)
 Clinical Oral Implants Research	Q1	47	587	47 (100)	12.5	14	4.5	16 (34.0)	47 (100)	-	-	-
 Clinical Implant Dentistry and Related Research	Q1	3	16	3 (100)	5.3	3	2.3	-	3 (100)	-	-	-
 Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontics	Q1	3	38	3 (100)	12.7	3	3.5	2 (66.7)	1 (33.3)	-	1 (33.3)	1 (33.33)
 International Journal of Oral and Maxillofacial Surgery	Q1	2	47	2 (100)	23.5	2	4.8	-	2 (100)	-	-	-
 Dental Materials	Q1	1	18	1 (100)	18.0	1	4.2	-	1 (100)	-	-	-
 European Journal of Oral Sciences	Q1	1	50	1 (100)	50.0	1	7.1	-	1 (100)	-	-	-
 International Endodontic Journal	Q1	1	2	1 (100)	2.0	1	1.4	-	1 (100)	-	-	-
 Journal of Dental Research	Q1	1	77	1 (100)	77.0	1	8.8	-	1 (100)	-	-	-
 Journal of Oral Rehabilitation	Q1	1	23	1 (100)	23.0	1	4.8	1 (100)	-	-	-	1 (100)
 Journal of Periodontology	Q1	1	218	1 (100)	218.0	1	14.8	-	1 (100)	-	-	-
 Medicina Oral, Patología Oral y Cirugía Bucal	Q1	1	68	1 (100)	68.0	1	8.2	-	1 (100)	-	-	-
 Oral Diseases	Q1	1	6	1 (100)	6.0	1	2.4	-	1 (100)	-	-	-
 Oral Oncology	Q1	1	26	1 (100)	26.0	1	5.1	-	1 (100)	-	-	-
 Journal of Oral Pathology and Medicine	Q2	1	10	1 (100)	10.0	1	3.2	1 (100)	-	-	1 (100)	-
 Dental Traumatology	Q2	1	24	1 (100)	24.0	1	4.9	1 (100)	-	-	-	1 (100)
 Community Dental Health	Q2	1	1	1 (100)	1.0	1	1.0	1 (100)	1 (100)	-	-	-
 Journal of Periodontal Research	Q2	1	105	1 (100)	105.0	1	10.2	-	1 (100)	-	-	-
 Revista Cubana de Estomatología	Q4	447	493	231 (51.7)	1.1	6	2.6	443 (99.1)	15 (3.4)	2 (0.4)	138 (30.9)	292 (65.3)
 Revista Española de Cirugía Oral y Maxilofacial	Q4	4	4	3 (75.0)	1.0	1	1.4	4 (100)	-	-	3 (75.0)	1 (25.0)
 Journal of Oral Research	Q4	1	8	1 (100)	8.0	1	2.8	1 (100)	-	1 (100)	-	-
 Oral Surgery	Q4	1	1	1 (100)	1.0	1	1	-	1 (100)	-	-	-

Q: Quartile; Ndoc: number of documents. Ncit: number of citations. c/d: mean number of citations per document. IC: International collaboration. N&IC: National and international collaboration. NC: National collaboration. w/o C: without collaboration.

Collaborations were established mainly between researchers affiliated with the School of Stomatology of the Universidad de Ciencias Médicas de la Habana (n=52 articles) and their counterpart in institutions in Italy (n=54 articles), Brazil (n=41), China (n=34), and Switzerland (n=21). The Ariminum Odontológica research center in Italy, the São Paulo State University in Brazil, the University of Hong Kong in China, as well as the University of Bern and the University of Zurich (both in Switzerland) were the

most important international institutions in this quartile.

**Publications in journals that belong to the second quartile (Q2).**

The second quartile grouped four articles, published in the same number of international journals, which accounted for 0.8% of all publications for the entire period. (Table 1) All articles were published in English and have received 140 citations, with an average of 35.0 and an h index of 3. Cuban authors led 75.0% of the articles,

**Table 3.** Annual bibliometric indicators of Cuban scientific output on Stomatology according to quartiles. Scopus, 1995-2017.

Year	Q1				Q2				Q4			
	Ndoc	Ncit	Cited doc (%)	c/d	Ndoc	Ncit	Cited doc (%)	c/d	Ndoc	Ncit	Cited doc (%)	c/d
1995	2	45	2 (100)	22.5	0	-	-	-	0	-	-	-
1996	3	56	3 (100)	18.7	0	-	-	-	14	19	11 (78.6)	1.4
1997	1	7	1 (100)	7.0	0	-	-	-	16	40	14 (87.5)	2.5
1998	0	-	-	-	0	-	-	-	21	30	15 (71.4)	1.5
1999	0	-	-	-	0	-	-	-	15	27	9 (60.0)	1.8
2000	2	268	2 (100)	134.0	0	-	-	-	20	21	9 (45.0)	1.1
2001	0	-	-	-	1	105	1 (100)	105.0	21	29	15 (71.4)	1.4
2002	1	26	1 (100)	26.0	0	-	-	-	25	49	20 (80.0)	2.0
2003	0	-	-	-	0	-	-	-	0	-	-	-
2004	0	-	-	-	0	-	-	-	0	-	-	-
2005	1	77	1 (100)	77.0	0	-	-	-	0	-	-	-
2006	0	-	-	-	1	1	1 (100)	1.0	35	32	15 (42.9)	0.9
2007	0	-	-	-	1	24	1 (100)	24.0	42	32	14 (33.3)	0.8
2008	0	-	-	-	0	-	-	-	25	14	10 (40.0)	0.6
2009	0	-	-	-	1	10	1 (100)	10.0	33	62	26 (78.8)	1.9
2010	1	18	1 (100)	18.0	0	-	-	-	31	38	17 (54.8)	1.2
2011	2	62	2 (100)	31.0	0	-	-	-	25	29	12 (48.0)	1.2
2012	8	111	8 (100)	13.9	0	-	-	-	16	10	7 (43.8)	0.6
2013	8	158	8 (100)	19.8	0	-	-	-	33	31	18 (54.5)	0.9
2014	7	104	7 (100)	14.9	0	-	-	-	12	10	7 (58.3)	0.8
2015	14	144	14 (100)	10.3	0	-	-	-	35	16	8 (22.9)	0.5
2016	10	92	10 (100)	9.2	0	-	-	-	16	14	6 (37.5)	0.8

**Q:** Quartile; **Ndoc:** number of documents. **Ncit:** number of citations. **c/d:** mean number of citations per document. **IC:** International collaboration. **N&IC:** National and international collaboration. **NC:** National collaboration. **w/o C:** without collaboration.

and 50.0% were carried out in international collaboration, (Table 3) fundamentally with institutions from the Netherlands and Spain. The University of Amsterdam and Universidad Complutense de Madrid were the international institutions with the greatest weight in the quartile. As in Q1, the most cited article (105 citations) was related to periodontitis in adult patients.

#### Publications in journals that belong to the fourth quartile (Q4).

The fourth quartile comprised 86.9% of the total, represented by 453 articles that have received 506 citations with an average of 1.12 citations per article and an h index of 7. A total of 447 articles were published in the *Revista Cubana de Estomatología* which accounted for

**Table 4.** Bibliometric indicators of the Cuban scientific output on Stomatology according to quartiles, Scopus, 1995-2017.

Indicators	Q1	Q2	Q4
Ndoc	64	4	453
Q (value)	100%	75%	25%
Cited doc (%)	64 (100)	4 (100)	236 (52.1)
NCit	1176	140	506
Cpd	18.4	35.0	1.12
h index	18	3	7
r index	5.9	6.1	2.6
Ndoc Spa (%)	-	-	447 (98.7)
Ndoc Eng (%)	64 (100)	4 (100)	3 (0.7)
Ndoc Spa-Eng (%)	-	-	3 (0.7)
Lead (%)	19 (29.7)	3 (75.0)	448 (98.9)
IC (%)	61 (95.3)	2 (50.0)	16 (3.5)
IC Lead (%)	16 (26.2)	1 (50.0)	11 (68.8)
N&IC (%)	-	-	3 (0.7)
N&IC Lead (%)	-	-	3 (100)
NC (%)	-	1 (25.0)	141 (31.1)
w/o Colab (%)	3 (4.7)	1 (25.0)	293 (64.7)

**Q1:** 1st quartile. **Q2:** 2nd quartile. **Q4:** 4th quartile. **Ndoc:** number of documents. **Ncit:** number of citations. **Cpd:** Average of citations per document. **Ndoc Spa:** Articles published in Spanish. **Ndoc Eng:** Articles published in English. **Ndoc Spa-Eng:** Articles in Spanish and English. **IC:** International collaboration. **N&IC:** National and international collaboration. **NC:** National collaboration. **w/o Colab:** without collaboration.

**Table 5.** Correlation between the main indicators used to characterize the Cuban scientific output on Stomatology, Scopus 1995-2017.

	Q	% Cited doc	Cpd	h index	r index	% Lead
Q	X	-0.5984 <i>p</i> =0.0042	-0.2952 <i>p</i> =0.1939	-0.0359 <i>p</i> =0.877	-0.4059 <i>p</i> =0.067	0.5258 <i>p</i> =0.0144
% Cited doc		X	0.1976 <i>p</i> =0.3906	-0.2326 <i>p</i> =0.310	0.2354 <i>p</i> =0.304	-0.4078 <i>p</i> =0.0665
Cpd			X	-0.1750 <i>p</i> =0.448	0.9508 <i>p</i> <0.000	-0.3791 <i>p</i> =0.0901
h index				X	-0.0958 <i>p</i> =0.679	0.0691 <i>p</i> =0,7660
r index					X	-0.4052 <i>p</i> =0.0684
% Lead						X

**Q:** Quartile; **Ndoc:** number of documents. **Ncit:** number of citations. **c/d:** mean number of citations per document. **IC:** International collaboration. **N&IC:** National and international collaboration. **NC:** National collaboration. **w/o C:** without collaboration.

**Table 6.** Bibliometric indicators of the Cuban scientific output on Stomatology according to quartiles, Scopus, 1995-2017.

Articles	Citations	Afiliations
Gamonal J, Acevedo A, Bascones A, Jorge O, Silva A. Levels of interleukin-1 $\beta$ , -8, and -10 and RANTES in gingival crevicular fluid and cell populations in adult periodontitis patients and the effect of periodontal treatment. <i>Journal of Periodontology</i> (Q1). 2000;71(10):1535-1545.	218	Facultad de Odontología, Universidad de Chile (Chile-líder); Hospital Universitario de la Princesa (España); Facultad de Odontología, Universidad Complutense de Madrid (España); Centro Nacional de Biopreparados (Cuba); Centro de Investigaciones Biológicas, Consejo Superior de Investigación Científica (España).
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98.7% and 85.8% of the total number of articles in the fourth quartile, as well as the total articles published in the period studied, respectively. (Table 2) Four hundred and forty-seven articles (98.7%) were published in Spanish, three (0.7%) in English, and the same number in Spanish and English in *Revista Española de Cirugía Oral y Maxilofacial* (the second most used international journal by the Cuban dental scientific community).

Output in the quartile presented a constant pace during the period evaluated, with the exception of the years 2003-2005, as well as 2016 and 2017. (Table 3)

Considering all the quartiles, of the 82 papers written in collaboration with international institutions (including international, as well as national and international collaborations), 28 (34.1%) were led by Cuban researchers. However, only 26.2% of the articles with international collaboration published in journals of the first quartile were led by Cuban authors. Therefore, the dependence on international collaboration regarding the search for communication channels of maximum visibility is evidenced and highlighted.

#### Correlation analysis

Table 5 identifies the existing correlation between the different indicators used for the bibliometric characterization of the Cuban scientific output on stomatology/dentistry. It is necessary to highlight the existence of a very strong significant correlation between citations per document and the r index (Cpd - r index;  $p < 0.000$ ), which is evident considering the definition of the r index itself. Likewise, as journals are located in the quartiles with the highest visibility (Q1 and Q2), the percentage of articles cited (Q - % Cited doc  $r = -0.5984$ ;  $p = 0.0042$ ), citations per document (Q-Cpd  $r = -0.2952$ ;  $p = 0.1939$ ), as well as h and r indices increased significantly (Q - h index  $r = 0.0359$ ;  $p = 0.877$  and Q - r index  $r = -0.4059$   $r = 0.4059$ ;  $p = 0.067$ ), but Cuban scientific leadership decreases significantly (Q - % Lead  $r = 0.5228$   $p = 0.0144$ ). It is also remarkable to note that as the number of articles cited increases, the h index decreases (% Cited doc - h index  $r = -0.2326$ ;  $p = 0.310$ ), although the r index increases (% Cited doc - r index  $r = 0.2354$ ;  $p = 0.304$ ).

#### Most cited articles

The ten most cited articles received 599 citations (32.9% of the total for the entire period) and were published in seven journals that belonged to the first quartile, with a predominance of the *Journal Clinical Oral Implants Research* (n=4 articles). There was no Cuban scientific leadership in the top-ten. (Table 6)

## DISCUSSION.

This is the first study that analyzes the Cuban scientific output on dentistry according to the quartiles of the journals indexed by the Scopus database, based on their impact through the SJR.

The present study assumes that the impact of a research, of an author, of an institution or of a journal, is given by the reception given to these studies, authors, institutions or journals by the rest of the academic and scientific community, once they are published. Similarly, it assumes that the number of citations reached by published articles represents the quantitative expression of this reception by the scientific community, which will inevitably identify and use as models those elements derived from these works that may serve as a basis for new research.<sup>39</sup>

Critical analysis is key for the interpretation of bibliometric indicators. For example, the figures for Cuban scientific leadership are meaningless when referring to works with sole authorship of Cubans, but they are of great interest when analyzed in articles with international collaboration. The combined study of the number of citations according to the language of the publication, which at the same time considers the journal quartile and the existence of international collaboration, is much more informative than the global citation figures provided by the search in Scopus.<sup>44,45</sup>

Articles published in journals that belong to the quartiles with the highest visibility (Q1 and Q2) had repercussions in the scientific community and the implications of their results are considered by other authors, since they have been cited on average 19 times. Those studies published in dissemination channels of greater relevance to the scientific community, expressed in the greater frequency of citation of their content, are more likely to become reference models for new research.<sup>39,46</sup>

The combination of factors that determine the quality of a research (its novelty, scientific rigor, contribution to knowledge, correct writing), together with others as a language accessible to more potential readers, increase the visibility of articles when they use these communication channels to make themselves public.<sup>39,47</sup>

In line with findings reported in studies that evaluated the Cuban scientific output on stomatology indexed in the Web of Science<sup>28</sup> and Scopus,<sup>29</sup> there was a high concentration of those who publish in the journals with the highest visibility and impact (Q1) with a core positioned in the School of Stomatology "Raúl González Sánchez" of Havana and in implantology research.

Although this is positive in terms of strengthening a line of research with high impact and international visibility, it would be also good to encourage the publication of research carried out in the other dentistry schools and training units related to other equally important research areas, as well as to stimulate international scientific collaboration. This situation is not particular to Cuba though, and has been previously reported.<sup>26</sup>

The placement of the School of Stomatology "Raúl González Sánchez" in Q1 is not fortuitous and is not generalizable to the whole country. This happens for several reasons, including being the only School of Stomatology that existed in Cuba prior to the triumph of the Revolution, as well as the fact that it is currently the only accredited institution of excellence in all the country dedicated to dentistry/stomatology. The latter makes it the national governing center of stomatological sciences. In addition, it is the school with the largest number of scientific collaboration agreements with foreign institutions, including some from developed countries, which provide technologies that the rest of the stomatology schools do not have access to. This, in turn, makes their researchers able to publish in Q1 journals, where the technological aspects applied to research are crucial.

It is interesting to observe that the quartile with the highest visibility and impact (Q1) is the one in which international collaboration was greater, which could be due to the predominance of research in the area of implantology. This transcends the national borders of the topics discussed, which makes implantology of greater interest to the international scientific community. With respect to research carried out in international collaboration, the use of the English language is thus not a barrier when publishing scientific results.

This ease to publish in English, however, it is not common for the majority of Cuban health workers to be fluent in English, and it is not specific to those who work in stomatology.<sup>44</sup> International collaboration per se does not determine the quality or relevance of a study. However, it is evident that a problem that gets the interest of specialists from multiple institutions or countries in search of a solution, must involve a certain degree of complexity and novelty, and is capable of quickly capturing the attention of the scientific community.

Furthermore, at early stages, it can attract potential readers from the countries of origin of the authors.<sup>39</sup> Narin

*et al.*,<sup>48</sup> reported that research carried out in international collaboration received on average twice the citations of those papers written without collaboration. In this way, they concluded that collaboration, fundamentally internationally, increases the number of citations substantially.

A low percentage of Cuban leadership was found in articles published in international collaboration. These results may have various explanations, including the possibility that they may respond to international research projects generated and led by the foreign entity. Involving foreign or international institutions in lines of research led by Cuban entities allows strengthening of national capacities, especially actions to train human resources and acquire technologies.<sup>44,49,50</sup>

On the other hand, it is necessary to point out that there is a culture of low interest in conducting research for publishing and sometimes authors are unaware that the corresponding author is the leader of the article. If this leadership were known, on many occasions it would pass into the hands of the Cuban author, who contributes the experience, the sample and sometimes the national technology itself.

When the other authors are asked why a particular author is the corresponding author, we can find answers like these: foreigners are the ones who have better command of the English language, those who have better Internet connections, or because the foreign party is the one that pays for publishing in the high impact journal.

All these arguments should not be valid to define the leader, who usually is the Cuban researcher. This study could serve to clarify the leadership aspect of conducting research. This study also reveals other patterns associated with the phenomenon of scientific leadership, since publication in the most visible journals is inversely proportional to Cuban scientific leadership. The journals where the greatest scientific leadership is held by Cuban researchers are those that are in the quartiles with the least visibility.

Particularly interesting aspects in Q4 were the presence of more scientific production without collaboration (above 50%) than articles produced in international collaboration (3.5%), as well as the national leadership in 98.9% of the studies. Undoubtedly, the significant volume of articles produced without collaboration influenced the growth of observed leadership. The above is conditioned by the fact that the largest volume of scientific production was published in

the *Revista Cubana de Estomatología* that belongs to Q4, and is the only Cuban publication in the subject area.

Despite the fact that 17 of the 21 journals involved in the study were located in quartiles 1 and 2, the highest percentage belongs to Q4, in agreement with another study.<sup>26</sup> Publishing little in journals of the first quartile is a common pattern of Cuban science and not specific to the health sciences. The latter reveals the need to increase publications in high-impact journals.<sup>44,46</sup>

Regardless of the fact that most of the articles were published in *Revista Cubana de Estomatología*, which subscribes to the open-access initiative and that it is in a privileged position to disseminate scientific results in the field of health given its indexation in Scopus, the impact on terms of citation was less than expected, since from said indexing all articles are favored by the high visibility that such database provides.

However, being open-access does not necessarily lead to higher citation figures. Strategies must be established to promote publication in more prestigious journals, always seeking a balance between high-quality articles published in Cuban journals and those published in foreign ones, as well as prioritizing publication in multilingual journals.<sup>51</sup>

The analysis of all this volume of Cuban articles, mostly written in Spanish and with little international collaboration, determines that the impact indicators are in agreement with the global characterization of the national scientific output carried out in previous studies.<sup>28,29,39,44,46,52</sup>

The language of publication of the articles constitutes an important element to characterize the scientific production disseminated in the most visible journals.<sup>39,44</sup> The search carried out initially retrieved 70 articles published in Spanish and English, which after a manual critical examination were reduced to only three. The overrepresentation was due to the fact that articles with abstracts in two languages were retrieved from the database, which has been reported in previous studies.<sup>44</sup>

Sixty-eight articles were published in English (64 in Q1 and 4 in Q2), and they represented the total of publications included in both quartiles. The fact that the quartiles with 100% of the articles published in English are, in turn, those that have significantly higher impact indicators in terms of citations, confirms the greater visibility of the works published in this language, considered by many authors as the lingua franca of

contemporary science. This aspect has been evidenced in previous Latin American studies.<sup>53</sup>

Particularly Amaro-Ares *et al.*,<sup>39</sup> Corrales-Reyes *et al.*,<sup>44</sup> as well as Chinchilla *et al.*,<sup>46</sup> identified a much higher number of citations per article in Cuban articles published in English in various thematic areas in Scopus.

The journal *Clinical Oral Implants Research* (official publication of the European Association for Osseointegration) was the foreign publishing destination with the largest number of articles.

This is conditioned by the placement of this journal in the quartile with the highest visibility in Scopus (Q1), its monthly frequency,<sup>28,29</sup> as well as by the execution of collaboration projects with countries such as Spain and Italy, which has had an impact on the number of professors from the School of Stomatology "Raúl González Sánchez" in Havana who have participated as co-authors in articles published in this journal, as well as in the Spanish journal *Medicina Oral, Patología Oral y Cirugía Bucal*.<sup>54,55</sup>

The most cited article was published in the *Journal of Periodontology* (Q1) and received 218 citations. The number of citations received by an article is a measure of its recognition and impact within a specific field of knowledge. Citation analysis can help identify articles, research areas, and authors of influence. Furthermore, understanding the inherent characteristics of highly cited studies may help researchers interested in publishing.<sup>56</sup>

Limitations. The main limitations are related, on the one hand, to the data source used, and, on the other hand, to the thematic dispersion of the journals where the research results of professionals in the area are published.<sup>38</sup>

The first limitation is due to deficiencies identified in the Scopus database regarding the accuracy of the data it provides, which was corroborated when analyzing the language of publication of the articles, and detecting an overrepresentation.<sup>11,12,39,44,57</sup>

The second limitation is given by the fact that Cuban publications on stomatology appear in many multidisciplinary and foreign journals at a national and inter-national scale (indexed or not in Scopus),<sup>58</sup> so the volume of knowledge generated by the Cuban scientific community cannot be fully covered through identification methods based on the source classification scheme of the international citations indexes (Web of Science and Scopus).<sup>59</sup>

## CONCLUSION.

The Cuban scientific output on stomatology that is published in journals that belong to the first quartile in Scopus has the greatest influence on the international scientific community. This output differs from that published in the rest of the quartiles because it is written exclusively in English, and involves a larger number of international research institutions.

This scientific production shows a high dependence on international collaboration to achieve relevant results, or results of broad international visibility.

The greater the leadership in Cuban research, the lower its impact, and the lower the rates of international collaboration. Cuban researchers are not yet capable of systematically producing research that has a significant impact on the international scientific community.

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