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## Evaluation of scientific output in Dentistry in Spanish Universities

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### Abstract

**Background:** The aim of this study was to assess the scientific output of Spanish universities that offer a bachelor's degree in dentistry through the use of various bibliometric indicators.

**Material and Methods:** A total of 21 universities offered a bachelor's degree in dentistry in academic year 2016-2017. The search for papers published by authors associated with these institutions was carried out using the selection of journals listed in the Journal Citation Reports (JCR) and the Web of Knowledge database for the period 1986-2017. On the basis of these data, we determined the output, the h-, g- and hg-indexes, the most productive authors, international collaborations, and the most relevant journals.

**Results:** Public universities obtained better results than private universities. The University of Valencia was ranked first, followed by the Complutense University of Madrid and the University of Granada. The most productive author was José Vicente Bagán, but the author with the highest h-index was Mariano Sanz and Manuel Toledado. The universities with the greatest output and highest citation rates had more international collaborations. The most developed fields in Spanish universities were Oral surgery, Oral medicine and Dental materials. The universities had different models of production. At universities such as Barcelona or Valencia, the production was focused on very few departments and authors. At the other extreme, the University of Granada had various sources of research and authors, which meant that its output and citation rate could increase more.

**Conclusions:** University faculties must provide suitable academic and research training, and therefore must be assessed using objective criteria and bibliometric tools. Although the number of university schools and faculties that teach dentistry has increased, and particularly the number of private universities, there is no correlation between their quality and output and the number of places offered on their courses.

**Key words:** Dentistry, h-index, impact factor, universities, Spain.

## Introduction

In recent decades, the area of Dentistry has developed considerably in terms of scientific output and citation rate, which now equal those in other areas of Medicine. A number of bibliometric studies have evaluated dentistry in an international context (1), whilst others have focused on specific countries. Brazil is one of the countries that have been most widely studied (2-4). Various bibliometric indicators have been applied to specific dentistry journals (5), or to subjects such as periodontics (6,7) or orthodontics (8).

In Spain, there has been a change in scientific output and citation rate, as shown in various bibliometric studies, some of which are general (9), whilst others are focused on the fields of biomedicine (10-13), primary care (14), autism (15), cardiology (16), or dentistry (17).

Dentistry in Spain is a young discipline that was separated from Medicine and established as an independent degree in 1986. Since then, the number of Schools offering a degree in Dentistry has risen, which has led to higher numbers of dentistry graduates, particularly those with qualifications from private universities.

At the same time, various indicators for assessing science have been designed in the field of bibliometrics. These include the well-known journal Impact Factor (18) and the h-index (19), which has become one of the most popular indicators since it emerged in 2005. The h-index has some limitations, but is complemented by other indexes, such as the g-index (20), which is based on assessing papers with high citations rates, and the hg-index (21).

The aim of this study was to assess the scientific output of Spanish universities that offer a degree in dentistry, and analyse the most productive authors. We carried out a quantitative (based on the number of papers published) and qualitative evaluation (through the application of the h-, g- and hg-indexes) of universities. We identified the most productive authors, and those with the highest h-index. We also analysed these authors' collaborations and the journals in which they published.

## Material and Methods

A total of 21 (12 public and 9 private) Spanish universities offered a bachelor's degree in dentistry in academic year 2016-2017, according to the Ministry of Education, Culture and Sport's website.

We devised a search strategy to find papers published by authors from these universities. We looked in journals listed in JCR 2015, and took into account changes in the name of the journals and journal supplements. Changes in the name of journals and in the ISSN, along with special journal supplements (7), were identified using the information provided in the Ulrich and Pubmed databases. Each university was analysed individually according to its name and abbreviation.

The study period was from 1986, the year in which Dentistry was first approved as an independent degree to Medicine in Spain, until 2017. The Web of Knowledge and other databases were consulted in 2017 January 3rd. To identify all of the most productive authors, different forms of names were used as well as the ORCID identifier, when applicable.

The data were processed by the database itself, and the h-, g- and hg-indexes were obtained by downloading the information and processing it using Microsoft Excel version Windows 2010.

## Results

The universities of Valencia, Complutense and Granada were ranked highest in quantitative (number of documents) and qualitative (h-index) terms. Private universities were ranked lowest on scientific output and bibliometric indexes, except the International University of Catalunya, which was in tenth place in the table, above the Rey Juan Carlos and Zaragoza public universities (Table 1). Although the University of Granada was ranked third, it had the highest number of publications in the first quartile of the JCR (Fig. 1). The relative importance of dentistry in the various universities was low, and generally did not reach 1% of the total output. Notably, Dentistry accounted for 17.72% of the total output at the International University of Catalunya (Table 1).

We only selected authors who had published at least 60 documents in 1986-2017, which resulted in a total of 32 authors (Table 2). The most productive author was José Vicente Bagán (University of Valencia) with a total of 280/278 WoS and Scopus documents respectively, followed by Cosme Gay Escoda (University of Barcelona) with 267/264 WoS and Scopus documents respectively, and Manuel Toledano (University of Granada) with 270/246 WoS and Scopus documents. However, a qualitative analysis of the h-index placed Manuel Toledano in first position with an h-index of 41 in WoS and Scopus, and Mariano Sanz (h-index of 38 WoS and 43 Scopus), Raquel Osorio (University of Granada) in third position with 38/36 WoS and Scopus. Only eight women were on the list (25% of the total).

The University of Granada had the highest number of researchers (nine; Table 3) and carried out research in various fields (oral surgery, dental materials, endodontics, oral medicine and preventive dentistry). Other universities had a maximum of four authors on the list and their research was focused on specific departments.

The universities of Valencia, Granada and Barcelona, as well as the Complutense University of Madrid, had the highest output and index values, and the highest number of international collaborations (Tables 4-7).

## Discussion

Scientific output in Spain has increased in all disciplines

**Table 1.** Scientific output of Spanish universities.

Position	University	Documents	Documents in Dentistry	% documents	H-index	G-index	Hg-index
1	Univ. València (Estudi General)	119.779	1.049	0, 87%	50	69	58
2	Univ. Complutense of Madrid	88.087	777	0, 88%	52	71	60
3	Univ. Granada	67.092	763	1, 13%	49	65	56
4	Univ. Barcelona	235.407	610	0, 25%	36	55	44
5	Univ. Santiago de Compostela	31.279	384	1, 22%	30	43	35
6	Univ. Murcia	29.250	323	1, 10%	24	33	28
7	Univ. Sevilla	27.815	305	1, 09%	25	40	31
9	Univ. Basque Country Euskal Herriko Unibertsitatea	36.645	220	0, 60%	22	29	25
8	Univ. Oviedo	25.297	178	0, 70%	24	38	30
10	Internacional univ. of Catalunya	993	176	17, 72%	18	25	21
11	Univ. Rey Juan Carlos	7.677	111	1, 44%	17	24	20
12	Univ. Salamanca	22.899	101	0, 44%	14	20	16
13	Univ. Zaragoza	31.091	50	0, 16%	13	25	18
14	Univ. Europea of Madrid	1.680	37	2.20%	13	19	15
15	Univ. Católica of San Antonio	1.145	21	0	2	3	3
16	Univ. Cardenal Herrera-CEU	224	13	5, 80%	4	6	4
17	Univ. San Pablo-CEU	131	6	4, 58%	2	4	2
18	Univ. Alfonso X El Sabio	294	4	1, 36%	3	4	2
19	Univ. Europea of Valencia	109	4	3, 66%	1	1	1
20	Univ. Católica of Valencia San Vicente Mártir	4.604	2	0, 04%	0	0	0
21	Univ. Europea Miguel of Cervantes	107	0	0	0	0	0

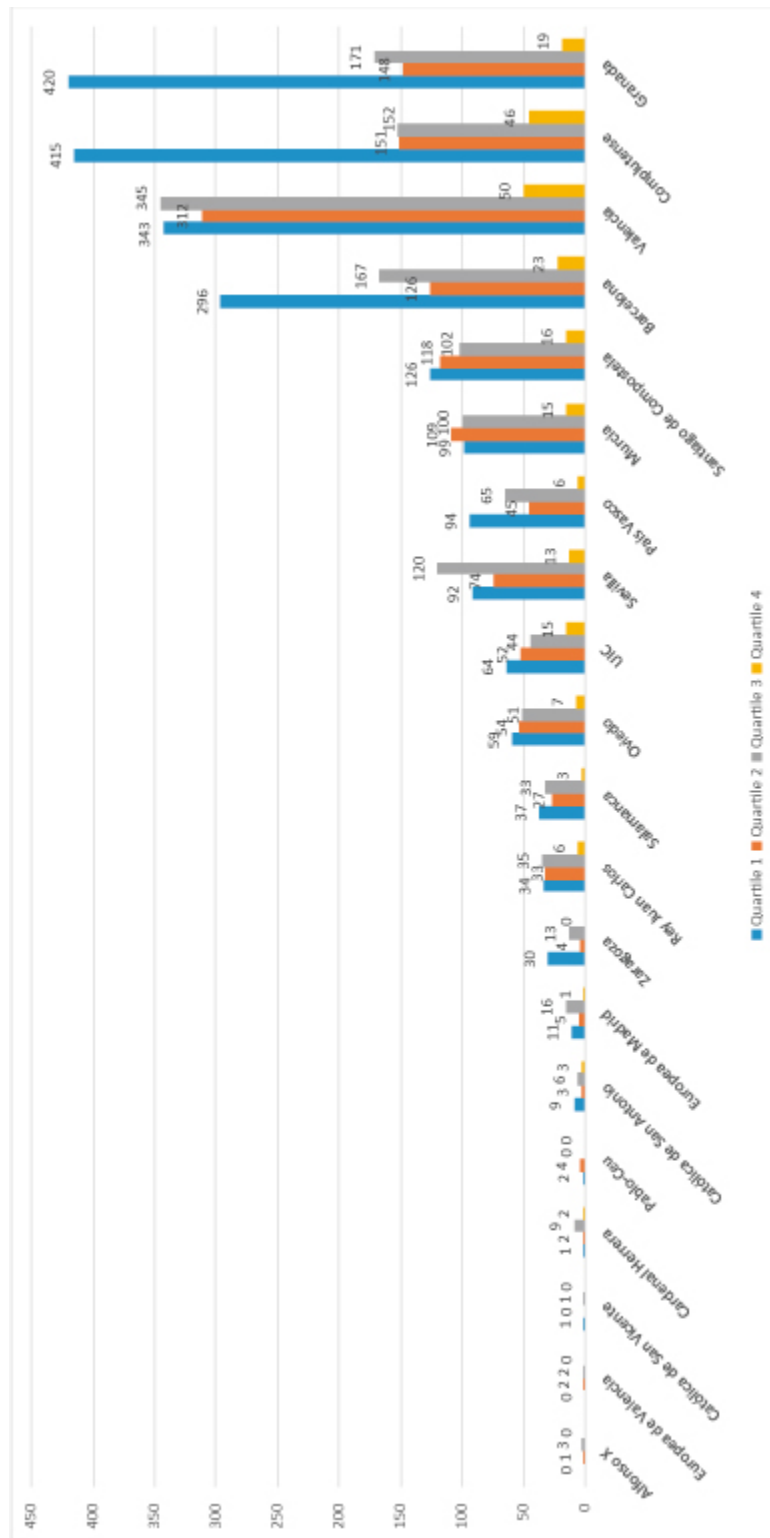


Fig. 1. Representation of universities by number of publications and quartile.

**Table 2.** Scientific output of Spanish authors on dentistry.

Authors	University	Documents WoS	Documents Scopus	H-index WoS	H-index Scopus
Bagán, José Vicente	University of Valencia General Univ Hosp	280	278	31	35
Toledano, Manuel	University of Granada	270	246	41	41
Gay-Escoda, Cosme	University of Barcelona Centro Teknon Idibell inst Bellvitge inst.biomed. Ididell	267	264	20	27
Peñarrocha-Diago, Miguel	University of Valencia Clin Odontol Fac Med Odont	253	235	23	24
Osorio, Raquel	University of Granada	233	223	38	36
Bascones Martínez, Antonio	University Complutense	216	213	22	25
Sanz, Mariano	University Complutense	211	230	39	43
López-Jonet, Pía	University of Murcia Hosp Morales Meseguer	180	174	17	20
Diz Dios, Pedro	University of Santiago de Compostela	168	174	20	25
Calvo-Guirado, José Luis	University of Murcia	164	168	17	18
García-García, Abel	University of Santiago de Compostela	154	136	24	25
Bravo, Manuel	University of Granada	132	104	18	20
Galindo-Moreno, Pablo	University of Granada Univ. Michigan	129	124	22	22
Aguirre Urizar, José Manuel	Universidad of Basque Country	128	115	17	14
Camacho Alonso, Fabián	Universidad of Murcia Univ. of Valencia Hosp Morales Meseguer	127	112	17	20
Bullón Fernández, Pedro	University of Sevilla	122	122	22	23
Seoane Lestón, Juan Manuel	University of Santiago de Compostela	121	125	14	19
Peñarrocha-Diago, María	University of Valencia. Clin Odontol	120	104	15	14
Berini Aytés, Leonardo	University of Barcelona Centro Teknon Idibell inst Bellvitge inst.biomed. Ididell	118	121	17	25
González-Moles, Miguel Ángel	University of Granada	109	106	23	25
Gutiérrez- Pérez, José Luis	University of Sevilla Hosp Univ. Virgen Rocío	108	121	12	15
Torres-Lagares, Daniel	University of Sevilla Sch Dent Seville Virgen Rocío Univ. Hosp	103	111	11	14
Osorio, Estrella	University of Granada Med Coll Georgia	101	93	26	25
Herrera, David	University Complutense	101	101	27	27
Peñarrocha-Oltra, David	University of Valencia Clin Odontol Univ Pisa	100	110	9	11
Segura-Egea, Juan José	University of Sevilla Univ. Barcelona Virgen Rocío. Univ. Hosp	94	115	15	22
Gómez-Moreno, Gerardo	University of Granada Univ. Murcia	94	93	16	16
Tomás, Inmaculada	University of Santiago de Compostela	90	121	18	20
Monticelli, Francesca	University of Zaragoza Univ. Granada Univ. Siena	85	78	33	33
Baca, Pilar	University of Granada	82	70	18	16
Valmaseda-Castellón, Eduard	University of Barcelona Centro Teknon Idibell inst Bellvitge inst.biomed. Ididell	69	73	15	17
Ferrer-Luque, Carmen María	University of Granada	60	62	15	14

**Table 3.** Distribution of selected authors by universities.

University	Authors	Documents WoS	Documents Scopus	H index WoS	H-index Scopus
Univ. Valencia	Bagán, José Vicente	280	278	31	35
	Peñarrocha-Diágo, Miguel	253	235	23	24
	Peñarrocha-Diágo, María	120	104	15	14
	Peñarrocha Oltra, David	100	110	9	11
Univ. Complutense	Bascones Martínez, Antonio	216	213	22	25
	Sanz, Mariano	211	230	39	43
	Herrera, David	101	101	27	27
Univ. Granada	Toledano, Manuel	270	246	41	41
	Osorio, Raquel	233	223	38	36
	Bravo, Manuel	132	104	18	20
	Galindo-Moreno, Pablo	129	124	22	22
	González Moles, Miguel Ángel	109	106	23	25
	Osorio, Estrella	101	93	26	25
	Gómez-Moreno, Gerardo	94	93	16	16
	Baca, Pilar	82	70	18	16
Univ. Barcelona	Ferrer Luque, Carmen María	60	62	15	14
	Gay Escoda, Cosme	267	264	20	27
	Berini Aytés, Leonardo	118	121	17	25
Univ. Santiago de Compostela	Valmaseda Castellón, Eduard	69	73	15	17
	Díz Dios, Pedro	168	174	20	25
	García García, Abel	154	136	24	25
	Seoane Lestón, Juan Manuel	121	125	14	19
Univ. Murcia	Tomas, Inmaculada	90	121	18	20
	López Jornet, María	180	174	17	20
	Calvo Guirado, José Luis	164	168	17	18
Univ. Sevilla	Camacho Alonso, Fabián	127	112	17	20
	Bullón Fernández, Pedro	122	122	22	23
	Gutiérrez-Pérez, José Luis	108	121	12	15
	Torres-Lagares, Daniel	103	111	11	14
Univ. País Vasco	Segura-Egea, Juan José	94	115	15	22
	Aguirre Urizar, José Manuel	128	115	17	14
Univ. Zaragoza	Monticelli, Francesca	85	78	33	33

**Table 4.** Assessment of the University of Valencia, according to international collaborations by country, institution and journal.

Countries	Records	Institutions	Records	Journal	Records
Spain	713	Univ. Valparaiso	75	Med. Oral pat. Oral y cirugía bucal	246
Brazil	148	Univ. London	48	European journal of cancer	141
USA	90	Univ. del Valle	44	J. dental research	67
Chile	84	Univ. Valparaiso	43	J. oral and max. surgery	63
England	72	Univ. College London	40	Oral diseases	46
Italy	56	Hosp. univ. Vall d'Hebron	38	Oral sur. Oral med. Oral pat. Oral radiology and end.	37
Colombia	48	Univ. gen hosp.	35	Int. journal of oral max. implants	35
France	35	Univ. federal de minas gerais	33	J. of periodontology	25
Sweden	28	Univ. Barcelona	28	Dental traumatology	20
Netherlands	24	Univ. do Vale do Paraiba	28	American j. ort. and dentofacial orthopedics	18

**Table 5.** Assessment of the Complutense University of Madrid, according to international collaborations by countries, institution and journal.

Countries	Records	Institutions	Records	Journal	Records
Spain	743	Univ. Granada	43	J. dental research	122
USA	58	Univ. Rey Juan Carlos	32	Med Oral pat. oral y cirugía bucal	91
Italy	56	Univ. Zurich	27	J. clinical periodontology	91
Switzerland	47	Univ. Sevilla	26	Clinical oral implants research	47
England	42	Univ. Zurich	25	J. of periodontology	32
Germany	31	Univ. Santiago de Compostela	24	Journal of dentistry	30
Sweden	25	CSIC	24	European journal of cancer	30
Chile	24	Univ. London	23	Int. journal of prosthodontics	24
Canada	21	Univ. De Chile	21	Int. journal of oral max. implants	17
Wales	20	Univ. Chile	21	J. oral and max. surgery	15

**Table 6.** Assessment of the University of Granada, according to international collaborations by country, institution and journal.

Countries	Records	Institutions	Records	Journal	Records
Spain	735	Univ. Michigan	72	J. dental research	126
USA	223	Univ. Murcia	45	Med. Oral pat. Oral y cirugía bucal	75
Italy	73	Univ. Complutense Madrid	43	Clinical oral implants research	53
Brazil	73	Univ. System Georgia	42	Journal of dentistry	43
England	39	Univ. Augusta	42	Dental materials	37
Peoples R China	31	Univ. De Sao Paulo	41	J. endodontics	31
Argentina	19	Univ. Siena	36	J. of periodontology	26
Portugal	18	Univ. Murcia	33	American journal of dentistry	23
Serbia	14	Univ. Siena	32	Operative dentistry	22
Japan	11	Univ. London	31	Implant Dentistry	21

**Table 7.** Assessment of the University of Barcelona, according to international collaborations by country, institution and journal.

Countries	Records	Institutions	Records	Journal	Records
Spain	609	Hosp- Clinic De Barcelona	137	European Journal of Cancer	200
England	53	Teknon Med Ctr	55	Med. Oral pat. Oral cirugía bucal	116
Usa	50	Ctr Med Teknon	48	J. Dental Research	38
Italy	47	Idibaps	33	J. Oral And Maxillofacial Surgery	21
Germany	41	Autonomous Univ. Barcelona	27	J. of Clinical Periodontology	16
France	35	Hosp. Unive. Vall D Hebron	20	Int. J. of Oral And Maxill Surgery	16
Switzer-land	28	Univ. Sevilla	19	Oral Sur. Oral Med. Oral Pat. Oral radiology and end	14
Nether-lands	24	Univ. Valencia	16	Oral Oncology	13
Brazil	22	Univ. London	15	J. Endodontics	13
Greece	21	Inst Invest Idibell	15	Int. Journal of Oral Maxill. Implants	13

(9). A study on biomedicine in Spain classifies organisations into five sectors (13): the university sector (comprised of universities, university institutions and scientific technical services), the health sector (comprised of hospitals and primary care centres), public research organisations (PRO) (comprised mainly of the Spanish National Research Council [CSIC] and the Carlos III Health Institute [ISCIII]), the business sector (comprised of pharmaceutical companies), and government departments and organisations (in which associations also have an influence). Most dentistry activity is private. Very little dentistry activity takes place in centres or hospitals, where it is generally associated with the oral and maxillofacial surgery department. It is difficult to identify centres and institutions that are associated with universities in this field, as affiliations are not standardised. Therefore, in this study we only evaluated universities recognised by the Ministry of Education, Culture and Sports for academic year 2016-2017. This was considered to be the most objective criterion for assessing the Spanish education system. However, the disadvantage is that some of the main hospitals and health centres were not included, such as the Hospital de la Fe associated with the University of Valencia, or the Teknon or Bellvitge hospitals in the case of the University of Barcelona.

The institutions with the highest scientific output and h-, g- and hg-indexes were public universities. These results are similar to those of studies carried out on other disciplines in Spain. They are related to the education model in Spain, in which the public sector plays a more important role than the private sector (9), unlike models in other countries such as the USA.

In general, there was little variation in the quantitative (number of documents) and qualitative (h-index) rankings, unlike data gathered on the international situation

(7). The universities at the top of the ranking were those with the greatest degree of international cooperation.

Output in dentistry has increased in recent years. However, unlike other fields, the greatest development has been in journals focused on different areas, rather than in journals specific to this field. This could explain why authors such as Manuel Toledano, Raquel Osorio and Francesca Monticelli, who are specialised in dental materials (22), have the best indexes. These fields are more frequently cited than areas such as dentistry. This result is related to the premises that are required and imposed by the National Agency for Quality Assessment and Accreditation of Spain (ANECA) for researchers and teaching staff.

The journal *Medicina Oral, Patología Oral y Cirugía Bucal*, which was established in 2000, is the only Spanish journal listed in the JCR and, therefore, it is the journal in which most authors from Spanish universities publish their papers, particularly those from Valencia, Barcelona or Seville. As it is a Spanish journal, the number of citations it receives is limited, which is disadvantageous for the journal itself and for Spanish universities. There is a clear relationship between geographic situation and potential citations. A total of 91 journals were listed in the JCR in 2015, whilst the SJR classification included a total of 170 journals. As in other disciplines, the number of Spanish authors who publish in international journals is increasing (13).

This kind of study has several limitations. The main limitation is related to time, as the results vary depending on which study period is selected and the date on which the search is carried out. Databases also influence the results as they were established in different years (Web of Knowledge emerged in 1950, Scopus in 1996 and Google Scholar in 2004), and have different journals indexed. Web of Knowledge favours Anglo-



Saxon journals more than the Scopus database. In the JCR, the only Spanish journal that is indexed is *Medicina Oral, Patología Oral y Cirugía Bucal*, whilst Scopus lists three together *Medicina Oral, Patología Oral y Cirugía Bucal* other Spanish journals for the area of dentistry: the *Journal of Clinical and Experimental Dentistry* (2011), *Revista Portuguesa de Estomatología, Medicina Dentaria e Cirurgia Maxilofacial* (2008), *Revista Española de Cirugía Oral y Maxilofacial* (2007), and *Avances en Odontostomatología* (2004).

Another limitation is related to the identification of authors (22). It is particularly difficult to analyse Spanish and Asian authors, as stated in other studies. More than one author may have exactly the same name, or one author may have various forms of his/her name or affiliations. This makes it difficult to analyse the database. To eliminate these errors, the search for authors was carried out using the different forms of names included in the database or using the ORCID identifier, when applicable.

## Conclusions

Public universities have the best indexes of output and quality, and the University of Valencia and University Complutense of Madrid obtain the best results. The areas of dentistry that are most developed in the universities are: oral surgery, periodontics, dental materials and oral medicine. The most productive authors are José Vicente Bagán, Cosme Gay Escoda and Manuel Toledano, although those with the highest h-indexes are Manuel Toledano, Mariano Sanz, and Raquel Osorio. The universities' research models vary. The universities of Barcelona and Valencia, as well as the Complutense University of Madrid, focus their scientific output on very few areas. In contrast, the University of Granada's production model covers many areas. Universities with more international collaboration had greater visibility and output.

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## Disclaimers

The authors do not have any financial interests, either directly or indirectly, in the products or information listed in the paper.

## One sentence summary

This study applied bibliometric indexes to evaluate scientific quality in Dentistry, evaluating Spanish universities.

## Conflicts of interest

The authors have declared that no conflict of interest exist.