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# Scientific Publications in Dentistry in Lithuania, Latvia, and Estonia Between 1996 and 2018: A Bibliometric Analysis

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Study Design A  
Data Collection B  
Statistical Analysis C  
Data Interpretation D  
Manuscript Preparation E  
Literature Search F  
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This study aimed to determine the number and quality of scientific publications in dentistry from the Baltic countries of Lithuania, Latvia, and Estonia between 1996 and 2018 using bibliometric analysis.

Web of Science and Scopus were searched to identify scientific publications in dentistry between 1996 and 2018 by authors from centers in Lithuania, Latvia, and Estonia. The annual number of scientific publications, citation rate, and h-index for each publication, and trends in international co-authorship were investigated by country and institution.

There were 651 scientific publications in dentistry between 1996 and 2018, by authors from Lithuania (280 publications), Latvia (210 publications), and Estonia (161 publications). Publications from Estonia were ranked highest in qualitative terms (citation rate and h-index), followed by Lithuania, and Latvia. Of 28 authors with at least ten publications, 54% were Lithuanian (15 authors), 25% were Estonian (7 authors), and 21% were Latvian (6 authors). Estonian authors collaborated mainly with Finland (27 publications), Latvian authors with the USA (16 publications), and Lithuanian authors with Canada (26 publications). Most publications came from the academic institutions of the Lithuanian University of Health Sciences (136 publications), the University of Tartu (109 publications), Vilnius University (101 publications), and Riga Stradins University (28 publications). During the past 22 years, authors from Lithuania had the most publications in the field of dentistry, and authors from Estonia had the most cited publications. Authors mainly published in native journals and collaborated with authors in Scandinavia and North America.

**MeSH Keywords:** **Baltic States • Bibliometrics • Dentistry • Estonia • Latvia • Lithuania**

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## Background

Twenty-seven years ago, the Baltic countries of Lithuania, Latvia, and Estonia restored their independence from the Soviet Union. During this time, five main academic centers began to train dental specialists and undertook and published scientific research in the Baltic countries and included the Lithuanian University of Health Sciences and Vilnius University in Lithuania, the University of Latvia and Riga Stradins University in Latvia), and the University of Tartu in Estonia. A sufficient period has now passed to evaluate the quantity and quality of scientific publications in dentistry in the three Baltic countries.

In 1987, Broadus defined bibliometrics as, 'the measurement of patterns in written communication' [1]. Bibliometrics now involves not only the evaluation of patterns of publications and citations, but also the assessment of variables that include the number of publications and citation from each author, research group, or institution [2]. Bibliometric methods have previously been used in the health sciences, including medicine and dentistry [3]. Scientific publications are indicators of important areas of research and show research trends and output by individual authors, research groups, academic centers, and countries [4]. Bibliometric studies can assess scientific performance and are used to provide objective information for planning research and development programs, allocation of research funding, and for optimizing resources and materials to support the scientific community.

Scientific impact indicators are used to evaluate the quality of the publications in biomedical journals according to the number of times the publications are cited and the quality of the publications. Basic research impact indicators include citation analysis of the impact or quality of an article assessed by the number of times the publication is cited. The h-index measures both the productivity and the impact of citations of the publications of an author [5,6]. However, although the h-index has some limitations, it can be complemented by other indices, including the g-index that quantifies productivity in science based on the number of publications [7], and the hg-index [8], that combines both measures [9].

The second type is impact indicator reflects the journal that the author publishes in. Worldwide, the most used index of journal quality is the journal impact factor (IF) [10]. The IF has been the most important factor in assessing the quality of journals for several decades. However, alternative indicators of journal quality are used, including the SCImago Journal Rank (SJR) indicator [11], and the Source Normalized Impact per Paper (SNIP) [12]. It is important that the appropriate use of impact measures be used and that their limitations are recognized, as these indices have a direct impact on the author and academic performance measures and in the allocation of research funding [13].

Web of Science and Scopus are important sources for citation data, and the interdisciplinary coverage of these databases represents a significant strength for the study and comparison of different scientific fields, including dentistry [14]. Currently, multidisciplinary and international bibliometric analysis and the coverage from these individual databases can vary between countries, which may introduce some bias when performing comparative analysis [15]. Therefore, the combined use of Scopus and Web of Science was chosen to identify publications in the field of dentistry in this bibliometric study.

To our knowledge, no previous bibliometric studies have evaluated the research output in dental sciences in terms of publications from the Baltic countries. Therefore, this study aimed to determine the number and quality of scientific publications in dentistry from the Baltic countries of Lithuania, Latvia, and Estonia between 1996 and 2018 using bibliometric analysis.

## Material and Methods

### Information sources

Two databases were selected to analyze the publications, the Web of Science (Clarivate Analytics) and Scopus (Elsevier). The study investigated publications from 1996, the first year when Scopus data could be accessed, and included all publications until 2018.

### Types of publications

There were no restrictions regarding the types of publications, but Ph.D. and other theses or dissertations were excluded. No restrictions regarding the language of the publications were applied.

### Search strategy

An advanced search strategy was used. The keywords used to search the two databases were: lithuania, or lietuvos republika, or lietuva, or, republic of lithuania, or lt, and dent, or all Medical Subject Heading (MeSH) terms associated with dentistry. Latvia, or latvija, or republic of latvia, or lv, and dent, or all MeSH terms associated with dentistry. Estonia or eesti, or republic of Estonia, or ee, and dent, or all MeSH terms associated with dentistry.

The choice of keywords was intended to be broad, to collect as much relevant data as possible without relying on electronic means alone to refine the search results.

**Table 1.** General scientific productivity measurements of each Baltic country, Lithuania, Latvia, and Estonia between 1996 and 2018.

	Lithuanian	Latvia	Estonia
Total document WoS	50.276	27.044	39.439
Total documents Scopus	47.671	24.640	38.023
Documents Dentistry WoS	479	250	343
Documents Dentistry Scopus	373	160	270
% Total production/dentistry production WoS	0.86	0.92	0.95
%Total production/dentistry production Scopus	0.71	0.64	0.78
Selection Dentistry Documents	280	210	161
<i>h</i> -Index	27	20	30
<i>g</i> -index	47	45	55
<i>hg</i> -index	35	30	40
Sum of times cites	3,454	2,379	3,597
Citing articles	2,922	2,321	3,369
Average citations per item	12	11.33	22.34
Without self citations*	3,274	2,358	3,528
Without self citations**	2,823	2,299	3,358

\* This field displays the total number of citations (cited references) to all of the items found in the results set minus any citation from article in the set; \*\* This field displays the total number of citing articles minus any article that appears in the set of search results on the citation report.

### Selection of studies

The identified publications were independently reviewed by two reviewers to verify their eligibility for inclusion in the bibliometric evaluation. Publications associated with dental research only were included. Reviewers resolved any differences in journal selection by discussion and consensus, with the inclusion of a third-party opinion when consensus could not be reached. The country of origin of the publications was identified using multiple count analysis and each publication was assigned to a country identified from the details of the authors.

### Sequential search strategy

The bibliometric analysis was conducted in several stages. First, the annual scientific output over the period for each Baltic country was established. Then, the most productive authors and institutions were identified. To identify the most productive authors, the different forms of the author names and their ORCID identifiers were used, where applicable. Collaborating countries and institutions were also identified. The bibliometric indicators included the total number of publications, authors, institutions, the number of citations, the citing publications, the average citations per publication, with and without self-citation, were identified using the *h*-index, *g*-index, and *hg*-index.

### Synthesis of the results

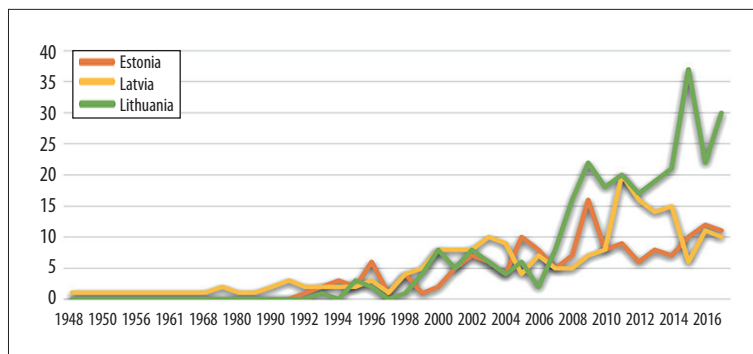
Relevant data of the bibliometric variables were collected and organized into tables, according to the Baltic country of authorship. The tables included results according to the most productive countries, institutions, journals, authors, and bibliometric indices.

## Results

### Quantitative and qualitative bibliometric data for publications in dentistry

The results of this study showed that that over the period between 1996–2018, a total of 651 scientific publications in dentistry were identified for the three Baltic countries of Lithuania, Latvia, and Estonia (Table 1). Lithuania was ranked highest in quantitative terms (280 publications), followed by Latvia (210 publications), and Estonia (161 publications). Estonia was ranked highest in qualitative terms (number of citations, *h*-index, *g*-index, and *hg*-index), followed by Lithuania, and Latvia.

The annual number of scientific publications for each country is presented in Figure 1. There was an increase in the number of publications from 1990. During the period between 1996–2006, all three Baltic countries showed a similar publication rate.



**Figure 1.** Annual scientific output published by the Baltic countries, Lithuania, Latvia, and Estonia between 1996 and 2018.

However, in 2007 the number of publications in dentistry from Lithuania started to increase, and in the last five years have remained at almost twice the number compared with those from Latvia and Estonia.

### **Bibliometric data on authors of publications in dentistry**

The most productive authors from each country, who had published at least ten publications between years 1996–2018, were investigated in detail and bibliometric indices were counted. There were 28 authors (Table 2), of which 54% were Lithuanian (15 authors), 21% were Latvian (six authors) and 25% were Estonian (seven authors). The most productive author (Lukevics E) had a total of 463 publications, followed by an author (Metspalu A) with 345 publications, and an author (Zharkovsky A) with 131 publications. A qualitative analysis of the h-index ranked the authors, and showed one author (Metspalu A) in first place with an h-index of 60, followed by an author (Lukevics E) with an h-index of 26, and an author (Zharkovsky A) with an h-index of 22. The University of Tartu had the highest number of publications (seven publications). The Latvian Institute of Organic Synthesis, Vilnius University, and Lithuanian University of Health Sciences had publications from six authors in the list, whereas Vilnius Implantology Center had publications from two authors, and the University of British Columbia had a publication from one author.

### **Bibliometric data of publications in dentistry by country**

Each Baltic country was analyzed individually to assess most productive authors, institutions, and collaborative countries in terms of the numbers of publications and their citations (Tables 3–5). Estonian authors had 96 collaborative publications with other countries, Latvian authors had 57 international collaborative publications, and Lithuanian authors had 53 international collaborative publications. Estonian authors most frequently collaborated with authors in Finland (27 publications), Sweden (23 publications), and the USA (19 publications). Latvian authors most frequently collaborated with authors in the USA (16 publications), England (14 publications), Germany (12 publications). Lithuanian authors most frequently

collaborated with authors in Canada (26 publications), Finland (21 publications), and the USA (20 publications). Authors in all three Baltic countries tended to collaborate with each other. Collaboration between Latvian and Estonian authors included ten publications. Collaboration between Latvian and Lithuanian authors included nine publications. Collaboration between Lithuanian and Estonian authors included four publications.

### **Bibliometric data of publications in dentistry by institution**

The most productive institutions in all three Baltic countries were universities that trained dental specialists. The University of Tartu in Estonia had 109 publications (68% of all Estonian publications). Riga Stradins University in Latvia had 28 publications (13% of all Latvian publications) and the University of Latvia had 23 publications (11% of all Latvian publications). The Lithuanian University of Health Sciences had 136 publications (49% of all Lithuanian publications), and Vilnius University had 101 publications (36% of all Lithuanian publications).

Technical universities in each country had significant numbers of publications. Tallinn University of Technology had 12 publications, ranking 3<sup>rd</sup> for the number of publications in Estonia. Riga Technical University had 11 publications, ranking 5<sup>th</sup> for the number of publications in Latvia). Kaunas University of Technology had 17 publications, ranking 4<sup>th</sup> for the number of publications in Lithuania. Private institutions were ranked lowest on scientific output and bibliometric indices, except for the Vilnius Implantology Center that had 16 publications and was ranked 6<sup>th</sup> for the number of publications in Lithuania.

### **Bibliometric data of publications in dentistry by journal**

Authors from the three Baltic countries submitted publications to different types of journals. Estonian authors published scientific research in journals that included *European Neuropsychopharmacology* (eight publications), *Molecular Brain Research* (five publications), and the *European Journal of Neuroscience*. Latvian authors published scientific research in journals that included the *British Journal of Dermatology* (five publications), the *Journal of the American Academy of*

**Table 2.** Qualitative and quantitative evaluation of the publications of the authors with at least ten or more publications in dentistry in the Baltic countries Lithuania, Latvia, and Estonia between 1996 and 2018.

Author	Affiliation	Total publications	h-index	g-index	hg-index	Country
Edmunds Lukevics	Latvian Institute of Organic Synthesis	463	26	39	31	Latvia
Andres Metspalu	University of Tartu	345	60	147	93	Estonia
Alexander Zharkovsky	University of Tartu	131	22	38	28	Estonia
Edgars Abele	Latvian Institute of Organic Synthesis	103	16	19	17	Latvia
Juris Popelis	Latvian Institute of Organic Synthesis	102	14	20	16	Latvia
Pavel Arsenyan	Latvian Institute of Organic Synthesis	98	14	21	17	Latvia
Kira Rubina	Latvian Institute of Organic Synthesis	84	13	24	17	Latvia
Jolanta Aleksejuniene	University of British Columbia	81	13	22	16	Lithuania
Gintaras Juodzbals	Lithuanian University of Health Science	67	14	22	17	Lithuania
Edvitar Leibur	University of Tartu	51	12	22	16	Estonia
Vita Maciulskiene	Lithuanian University of Health Sciences	48	15	30	21	Lithuania
Irena Balciuniene	Vilnius University	48	9	24	14	Lithuania
Ricardas Kubilius	Lithuanian University of Health Sciences	43	11	16	13	Lithuania
Vytaute Peculiene	Vilnius University	42	9	24	14	Lithuania
Alina Puriene	Vilnius University	41	7	15	10	Lithuania
Mare Saag	University of Tartu	36	13	19	15	Estonia
Kulli Jaako Movits	University of Tartu	36	9	18	12	Estonia
Antanas Sidlauskas	Lithuanian University of Health Sciences	35	9	16	12	Lithuania
Ilze Akota	Latvian Institute of Organic Synthesis	32	6	11	8	Latvia
Tomas Linkevicius	Vilnius Implantology Center	30	14	26	19	Lithuania
Alvydas Gleiznys	Lithuanian University of Health Sciences	29	4	7	5	Lithuania
Vilma Brukiene	Vilnius University	25	6	9	7	Lithuania
Diana Mieliauskaite	Vilnius University	24	5	8	6	Lithuania
Laura Linkeviciene	Vilnius University	22	7	16	10	Lithuania
Tamara Zharkovskaya	University of Tartu	22	9	17	12	Estonia
Julija Narbutaite	Lithuanian University of Health Sciences	20	7	13	9	Lithuania
Algirdas Puisys	Vilnius Implantology Center	20	12	23	16	Lithuania
Triin Jagomagi	University of Tartu	17	8	15	10	Estonia

**Table 3.** Scientific publications in dentistry from Estonia according to international collaborations by country, institution, and journal between 1996 and 2018.

Countries	Records	Institutions	Records	Journals	Records
Estonia	148	University of Tartu	109	European Neuropsychopharmacology	8
Finland	27	University of Helsinki	13	Journal of Dental Research	7
Sweden	23	Karolinska Institute	12	Acta Odontologica Scandinavica	6
USA	19	Tallinn University of Technology	12	Brain Research Molecular Brain Research	5
Germany	17	University of Turku	12	Caries Research	5
England	11	Tartu University Hospital	9	Bulgarian Chemical Communications	4
Norway	11	Estonian Biocenter	8	Microbial Ecology in Health and Disease	4
Latvia	10	National Institute of Chemical Physics Biophysics	7	Applied Radiation and Isotopes	3
France	9	University of California	6	European Journal of Neuroscience	3
Netherlands	9	University of Oslo	6	Oral Surgery Oral Medicine Oral Pathology Oral Radiology	3

**Table 4.** Scientific publications in dentistry from Latvia according to international collaborations by country, institution, and journal between 1996 and 2018.

Countries	Records	Institutions	Records	Journals	Records
Latvia	145	Riga Stradins University	28	Proceedings of The Latvian Academy of Sciences Section B Natural Exact and Applied Sciences	16
USA	16	Latvian Institute of Organic Synthesis	23	British Journal of Dermatology	5
England	14	University of Latvia	23	Journal of The American Academy of Dermatology	5
Germany	12	Latvian Biomedical Research Study Centre	11	Papers on Anthropology University of Tartu	5
Estonia	10	Riga Technical University	11	Research for Rural Development	5
Switzerland	9	Russian Academy of Medical Science	8	Acta Dermato Venereologica	4
Lithuania	9	Children's Clinical University Hospital Riga	6	Khimiya Geterotsiklicheskikh Soedinonii	4
Russia	8	Latvian Academy of Sciences	6	Metal Based Drugs	4
Finland	7	University of Tartu	5	Official Gazette of The United States Patent and Trademark Office Patents	4
Sweden	7	Latvia University of Agriculture	4	Allergy	3

**Table 5.** Scientific publications in dentistry from Lithuania according to international collaborations by country, institution, and journal between 1996 and 2018.

Countries	Records	Institutions	Records	Journals	Records
Lithuania	258	Lithuanian University of Health Sciences	136	Medicine Lithuania	31
Canada	26	Vilnius University	101	Clinical Oral Implants Research	13
Finland	21	University of British Columbia	21	Medical Science Monitor	12
USA	20	Kaunas University of Technology	17	Journal of Dental Research	10
Germany	17	Aarhus University	16	Caries Research	8
Denmark	16	Vilnius Implantology Center	16	Elektronika ir Elektrotechnika	7
Norway	15	University of Oslo	14	Mechanika	7
England	10	State Research Institute Centre for Innovative Medicine	11	Implant Dentistry	6
Italy	9	University of Michigan	11	Dental Materials Journal	5
Latvia	9	University of Oulu	11	European Journal of Dental Education	5

*Dermatology* (five publications), *Acta Dermato-Venereologica* (four publications). Lithuanian authors published in journals of implant dentistry, including *Clinical Oral Implants Research* (13 publications), and *Implant Dentistry* (six publications). Authors tended to publish their scientific data in local journals in Lithuania and Latvia, including 31 publications in *Medicina*, the first choice of journal in Lithuania, and 16 publications in the *Proceedings of the Latvian Academy of Sciences*, the first choice of journal in Latvia.

## Discussion

To our knowledge, this is the first study to quantify and analyze all electronically available scientific publications from authors in the field of dentistry in the Baltic countries of Lithuania, Latvia, and Estonia. In 2012, Petrauskiene reported the findings from a survey on the need for bibliometric analysis of publications from Vilnius University in Lithuania in which 80% of the respondents agreed that such analysis was required [16]. In 2003, Allik performed a general bibliometric analysis of scientific publications in the Baltic countries after the first decade of independence [17]. This author concluded that Estonian and Lithuanian scientists had more than doubled the number of journal publications as indexed by the Web of Science (formerly, the ISI Web of Knowledge), while the number of publications from Latvia had increased by 10%. In 2008, analysis of all publications between 1997–2007 indicated that Lithuania showed

improvement in the quality of scientific publications, Estonia increased the impact of its publications, and the impact and quality of publications in Latvia remained the same [18]. These results are also reflected by a similar relationship in the field of dental publications that have shown an increased number of publications in dentistry from Lithuania and improved the quality of publications in dentistry from Estonia.

The annual increase the number of publications in dentistry from 1990 can be explained by the restoration of independence to the Baltic states and the establishment of academic centers that have provided training and research based on models from Western Europe countries and international research collaborations [19]. Currently, there are scientific collaborations between the Baltic and Scandinavian countries and of the Baltic countries, Russia continues to collaborate only with Latvia [20].

Data for this bibliometric study were obtained from two databases, the Web of Science and Scopus, for 1996–2018, as Scopus did not include citations before 1996 [21]. However, data from the past 22 was adequate for bibliometric analysis. Alternatively, the Google Scholar database could have been used, but this database has fewer bibliometric tools, generates multiple versions of the same publication, and can include non-research publications [22].

In this study, publications were retrieved that were not only in the dentistry category but also in the remaining biomedical

categories that included keywords associated with dentistry. Current guidelines recommend multidisciplinary dental management not only for clinical cases but also for research studies [23]. Therefore, further analysis of scientific output in dentistry is required following the current broad search strategy, which was designed to compile an extensive database [4]. Therefore, dermatological and neuroscientific journals appeared in the list of publications, and of the three countries, publications by dental researchers in Lithuania were mainly published in dental journals.

This study had several limitations. Despite a large number of journals in the Scopus and Web of Science databases, there is bias in both databases between countries and language, with most publications being in the English language, which may introduce bias when performing comparative analysis. Also, the two databases were established in different years, with the Web of Science database established in 1950, and Scopus in 1996, and the databases had different journal indexing, which might have affected the results [24]. Also, the identification of the authors of the publications was affected by the variations in the names used for the authors, some of which were written using national letters, and the full first name or only the first letter was provided by the journals, resulting in difficulty in analyzing the data electronically [25]. To eliminate these errors, the searches for the authors were performed using the different forms of names included in the database or using the ORCID identifier [26].

There were also limitations in the analysis of the institutions where the studies were conducted. Most medical schools have university hospitals, and most authors were working as academics and clinicians [27]. Therefore, the same authors had different affiliations [28]. For example, the Hospital of the Lithuanian University of Health Sciences Kaunas Clinics was linked with the Lithuanian University of Health Sciences, the Tartu University Hospital was linked with the University of Tartu, and Pauls Stradins Clinical University Hospital and the Children's Clinical University Hospital Riga were linked with Riga Stradins University. Therefore, it is recommended that authors of scientific publications include multiple institutional affiliations in the author information [29].

## Conclusions

This study aimed to determine the number and quality of scientific publications in dentistry from the Baltic countries of Lithuania, Latvia, and Estonia between 1996 and 2018 using bibliometric analysis. During the past 22 years, authors from Lithuania had the most publications in the field of dentistry, and authors from Estonia had the most cited publications. The use of the h-index, g-index, and hg-index identified the Lithuanian University of Health Sciences as being the academic center with the most cited publications in dentistry during the study period. Authors mainly published in native journals and collaborated with authors in Scandinavia and North America.

## Conflict of interest

None.

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