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Scientometrics: a tool for the insertion of Brazilian Dermatology in the world scientific production

Cienciometria: uma ferramenta para inserção da Dermatologia brasileira na produção científica mundial

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ABSTRACT

Introduction: The Brazilian scientific production in Dermatology in the international scenario was verified by scientometrics (Sociology segment on quantitative aspects of science).

Objective: The insertion of Brazil in the international scientific production scenario can and should be conducted from a more strategic perspective, and it is necessary to observe the production of documents indexed in Scopus in the Dermatology area and related topics in a more detailed way.

Methods: Through exploratory, inductive, quantitative, and qualitative research on the Scopus platform – a digital platform comprising more than 25 thousand scientific articles and analytical tools to extract results and trends in the field of research, it was possible to obtain quantitative data on Brazilian scientific production in General Dermatology and six prominent dermatoses.

Results: It was possible to analyze and point out the most prominent dermatoses currently in the literature and the related authors, compare Brazilian data with those from other countries that stand out in the scientific literature in Dermatology, and elaborate and justify effective strategies for the international insertion of Brazilian Dermatology scientific production.

Keywords: Impact production; Dermatology; Database; Science

RESUMO

Introdução: *foi verificada a produção científica brasileira em Dermatologia no cenário internacional pela Cienciometria (segmento da Sociologia sobre aspectos quantitativos da ciência).*

Objetivo: *é plausível afirmar que a inserção do Brasil na produção científica internacional pode e deve ser realizada a partir de uma perspectiva mais estratégica, sendo necessário observar a produção de documentos indexados em Scopus na área de Dermatologia e temas relacionados de forma mais minuciosa.*

Métodos: *por meio de pesquisa exploratória, quanti-quali indutiva na plataforma Scopus - plataforma digital que reúne mais de 25 mil artigos científicos e disponibiliza ferramentas analíticas para extrair resultados e tendências no campo da pesquisa -, foi possível obter dados quantitativos sobre a produção científica brasileira em Dermatologia geral e em seis dermatoses proeminentes.*

Resultados: *foi possível extrair análise a fim de apontar as dermatoses mais importantes atualmente na literatura e os autores relacionados, comparar os dados brasileiros com os de outros países que se destacam na literatura científica em Dermatologia e elaborar e justificar as estratégias efetivas de inserção internacional da produção científica da Dermatologia brasileira.*

Palavras-chave: *Produção do impacto; Dermatologia; Base de dados; Ciência*

Original Article

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INTRODUCTION

Research question

A search using the keyword "Dermatology" in the Scopus database,[1] between 2014 and 2017, shows Brazil as the 15th producer, with 426 publications. This production represents 10% of the total of the United States, which ranks first with 4,191 published documents. The most cited article by Brazilian authors, entitled "Computational methods for the image segmentation of pigmented skin lesions: a review", has 95 citations but does not include any dermatologists, although the topic involves the Dermatology field. In the most cited article in the sample, only one Brazilian author collaborated with 25 foreigners.[2]

Even though Brazilian production can be categorized as small (approximately 10% of the publications of the largest producer), it is possible to observe that there is room for a more effective collaboration of Brazilian authors in Dermatology and related topics. In the two cases mentioned, Brazil participates in the most cited documents and collaborates with notable countries. Furthermore, in 2018, Brazil had 831 residency vacancies in Dermatology and 8,317 specialist physicians associated with the Brazilian Society of Dermatology,[3] increasing the demand for this project results.

Therefore, the insertion of Brazil into the international scientific production can and should be conducted from a more strategic perspective and it is necessary to observe the production of documents indexed in Scopus in the Dermatology area and related topics in a more comprehensive way. Also, we need to observe in detail which countries produce more documents, their citations, the Field-Weighted Citation Impact (FWCI), and the prominence of the most important themes. From these quantitative data, it will be possible to design an insertion plan better contextualized for this area. The final objective is a more significant internationalization of Brazil in the Dermatology field, with more mobility and exchange of experiences, in the widest possible way, with other countries that have outstanding production, quantitatively and qualitatively, aiming at generating effective impacts.

It is essential to emphasize that this survey must be conducted critically, that is, its effectiveness, including social, economic, and scientific impact, must be solid. According to the 2012 document "Indicators – basic guidelines applied to public management", from the Ministry of Planning, Budget and Management,[4] effectiveness is one of the performance evaluation indicators in public management and is defined as:

Effectiveness: measures the positive or negative effects on the reality that underwent the intervention, that is, it indicates whether there were socioeconomic, environmental, or institutional changes resulting from the outcomes obtained by the policy, plan, or program. It is what matters for social transformation.

Thus, the themes must be contextualized to the Brazilian reality and also among the most prominent countries in the international literature due to their significance in Dermatology clinical practice. It is plausible to foresee the publication of documents stating that it is not coherent for Brazil to produce science on certain global topics, as these topics do not concern the Brazilian reality. A scientometric diagnosis is a set of indications that require a detailed qualitative analysis and this exercise expands the frontiers of scientific research. So whatever the outcome, the effort is worth it.

Question

What is the impact of Brazilian Dermatology scientific production on the international scene regarding the most prominent dermatoses? Which dermatoses, types of collaboration, and collaborators could help increase this production and generate more social, economic, and scientific impact?

Primary objective

To build more effective strategies for the insertion and scientific interaction of Brazil into prominent countries and the scientific production of relevant topics in the Dermatology field.

Secondary objectives

- Search for quantitative data on Brazilian scientific production, in General Dermatology, and six prominent dermatoses.
- Search Scopus and Web of Science databases and collect data about the outstanding production in the Dermatology field.
- Point out the most prominent dermatoses in the literature nowadays and related authors.
- Compare Brazilian data with those from other countries that stand out in the scientific literature in Dermatology.
- Develop and justify effective strategies for the international insertion of scientific production in Brazilian Dermatology.

METHODS

The research conducted is quantitative, qualitative, and exploratory.

Quantitative research focuses on objectivity, using mathematical language to describe the causes of a phenomenon, the relationships between variables, etc.[5]

This approach is necessary to know in detail, from Scientometrics, the countries that produce more documents, their citations, the FWCI, and the prominence of the most important themes.

Qualitative research, on the other hand, is not concerned with numerical representation but with the deepening of the understanding of a social group, an organization, etc.[6]

Thus, the qualitative approach is necessary to justify a deeper insertion route in a criticism, considering the Brazilian reality.

Qualitative and quantitative methods are different and potentially complementary ways to collect data, whose usefulness depends on the suitability for a particular research task.[6]

Therefore, the use of both methods is significant since this research proposes to conduct a data collection of a more numerical bias and critically analyze them to identify more effective international insertion alternatives for the Brazilian Dermatology scientific production. Thus, it is coherent to affirm that this project is quantitative-qualitative, based on the words of Minayo and Sanches:[6]

The relationship between quantitative and qualitative, between objectivity and subjectivity, cannot be reduced to a continuum, it cannot be thought of as a contradictory opposition. On the contrary, it is desirable that social relations can be analyzed in their most "ecological" and "concrete" aspects and deepened in their most essential meanings. Thus, the quantitative study can generate questions to be qualitatively deepened and vice versa.

Using Flick's words freely,[7] this approach aims to provide more credibility and legitimacy to the results to be made available at the end of the project.

The research project still presents an inductive perspective since, from the data observation, hypotheses are formulated to expand knowledge about routes for the effective internationalization of Dermatology scientific production.[7]

According to Gil,[7] exploratory research aims to provide greater familiarity with the problem, intending to make it more explicit or build hypotheses. One of the ways to conduct this study is through bibliographic surveys, such as in our research. It assesses the impact of the Brazilian Dermatology scientific production on the international scene concerning the most prominent dermatoses through data collection in the Scopus and Web of Science databases and, based on this information, seeks themes and partners to make a more effective international insertion for Brazilian Dermatology. The choice of Scopus is justified because it is the largest database in the world, used as a parameter to develop articles in the Scientometrics area.

We searched the databases based on the selected dermatoses, using the "article title, abstract, and keywords" tab, limited to the period 2012-2018.[1] We observed the most cited articles and extracted the analysis of the results to obtain the main authors, universities, and countries. Once we collected the data of interest (prominent dermatoses and others relevant to the objectives) from this procedure, we performed the sample analysis, and constructed the hypotheses of effective international insertion for the Brazilian Dermatology scientific production.

Context

We found 81,300 publications in the search conducted on 04/17/2021 in the Scopus database with the keyword "Dermatology", from 1897 to 12/31/2020, using the article title, abstract, and keywords tabs.1 The most cited article in the sample had 3,030 citations. The United States was the country that published the most, with 23,642 documents. Brazil was the 11th country, with 1,642 publications. The most cited Brazilian article was produced in international collaboration and had 757 citations. The largest international partner was the USA, with 174 articles.

A new search, in the same database, with the same keywords between quotation marks and the title tab, between 1898 and 12/31/2020, retrieved 18,772 publications. The most cited article remained the same, with 3,030 citations. The United States remained the country that published the most, with 4,289 publications. Brazil occupied the 11th position, with 290 publications. The most cited article had 164 citations. The largest international partner, the USA, cooperated on 35 articles.

The leading Brazilian journal in Dermatology – "Anais Brasileiros de Dermatologia" – is in quartile 3 of the Scimago Journal and Country Rank, and, in 2019, only 7.69% of its publications had international collaboration. The total number of citations of documents published by the journal between 2016 and 2019 was 900, while the total number of the British Journal of Dermatology, a quartile 1 journal, was 5,937.1

Therefore, it is inferred that the Brazilian scientific production in Dermatology can be categorized as small, little internationalized, and cited compared to notable countries. By applying Scientometrics, it is possible to map and analyze the current state of Brazilian scientific production in Dermatology, and to build effective strategies for the insertion and scientific interaction of Brazil with distinguished countries in relevant themes of Dermatology.

Scientometric data

We selected eight dermatoses from the article "Nosological profile of dermatological consultations in Brazil" to compare the scientific production of prominent dermatoses in Brazil, which has the production of the United States, Germany, China, and India, using institutional authorship, that is, from the Brazilian Society of Dermatology.[8] The document aimed to verify the frequency of the principal diagnoses in the practice of dermatologists. A sample of dermatologists surveyed for a week the diagnoses referring to dermatological outpatient care were, and 49 services offering medical residency. The results presented were based on more than 57 thousand dermatological consultations. Table 1 shows the main causes of registered consultations.

Based on the 13 chief causes of medical consultations in the article, searches were performed with the keywords in Scopus: "acne", "superficial mycoses", "pigmentation disorder", "skin aging", "contact dermatitis", "seborrheic dermatitis", "verruca", "melanocytic nevus", "eczema", "psoriasis", "atopic dermatitis", "seborrheic keratosis", and "nonmelanoma skin cancer", spelled like this and with quotation marks, using the "title, abstract, and keywords" tab and a time limit between 2012-2018.

To expand the topic to be explored, the dermatosis "actinic keratosis" was replaced by "skin aging" and "photoaging" ("photo-aging") while "basal cell carcinoma" was replaced by "nonmelanoma skin cancer" ("non-melanoma skin cancer").

Among these dermatoses, we chose the seven that resulted in more documents to compare the productions of the

Table 1: Nosological profile of dermatological consultations in Brazil - with the main causes of consultations registered in Dermatology

Posto	CID-10	(Letter + 2 digits)	N.	%	% accumulated
1	L70	Acne	8.049	14	14
2	B35	B37 - Superficial mycoses	5.003	8.7	22.8
3	L81	Pigmentation disorders	4.822	8.4	31.2
4	L57	Actinic keratosis	2.953	5.1	36.3
5	L23 and L25	Contact dermatitis	2.241	3.9	40.2
6	L21	Seborrheic dermatitis	2.005	3.5	43.7
7	B07	Viral warts	1.958	3.4	47.1
8	D22	Melanocytic nevi	1.881	3.3	50.4
9	L30	Dermatitis: eczema / dyshidrosis / pityriasis alba	1.520	2.7	53.1
10	L40	Psoriasis	1.422	2.5	55.5
11	L20	Atopic dermatitis	1.391	2.4	58
12	L28	Seborrheic keratosis	1.305	2.3	60.3
13	C80	Unespecified malignant neoplasm - basal cell carcinoma	1.248	2.2	62.4
14	L65	Non-scarring alopecias/ telogen effluvium	1.221	2.1	64.6
15	L85	Epidermal thickening/Xerosis cutis	974	1.7	66.3
16	L72	Follicular cysts of the skin and subcutaneous tissue	891	1.6	67.8
17	L64	Androgenetic alopecia	863	1.5	69.3
18	B86	Scabies	799	1.4	70.7
19	L80	Vitiligo	780	1.4	72.1
20	A30	Leprosy	708	1.2	73.3
21	L28	Lichen simplex chronicus and prurigo nodularis	678	1.2	74.5
22	Q82	Congenital skin malformation / acrochordon	636	1.1	75.6
23	L50	Urticaria	633	1.1	76.6
24	L73	Other follicular disorders/ folliculitis	624	1.1	77.8
25	L90	Atrophic striae/scars and skin fibrosis	564	1	78.8
All diagnoses			**57343**	**100**	**100**

United States, Germany, China, India, and Brazil. When the "title, abstract, and keywords" tab was activated, with a time limit between 2012-2018, the number of documents per search was as follows:

"acne"	11.647
"superficial mycoses"	137
"pigmentation disorder"	999
"skin aging"	3.984
"contact dermatitis"	5.909
"seborrheic dermatitis"	1.180
"verruca"	1.872
"melanocytic nevus"	1.451
"eczema"	9.853
"psoriasis"	21.155
"atopic dermatitis"	12.825
"seborrheic keratosis"	1.019
"non melanoma skin cancer"	2.902
"photoaging"	1.709

Due to the greater number of documents in Scopus, the eight dermatoses chosen for a pre-study were: acne, contact dermatitis, eczema, psoriasis, atopic dermatitis, basal cell carcinoma, photoaging, and skin aging. The pre-study included the following data: number of documents published between 2012 and 2018, primary sources of documents, main authors, number of documents by affiliation, most important funders, number of documents by country, area of study, and document types.

The graphics below show the total number of documents between 2012 and 2018 and the number of documents per country for the eight dermatoses.

Acne - Graphics 1.1 and 1.2
Skin aging - Graphics 2.1 and 2.2
Contact dermatitis - Graphics 3.1 and 3.2
Eczema - Graphics 4.1 and 4.2
Non melanoma skin cancer - Graphics 5.1 and 5.1
Psoriasis - Graphics 6.1 and 6.2
Atopic dermatitis - Graphics 7.1 and 7.2
Photoaging - Graphics 8.1 and 8.2

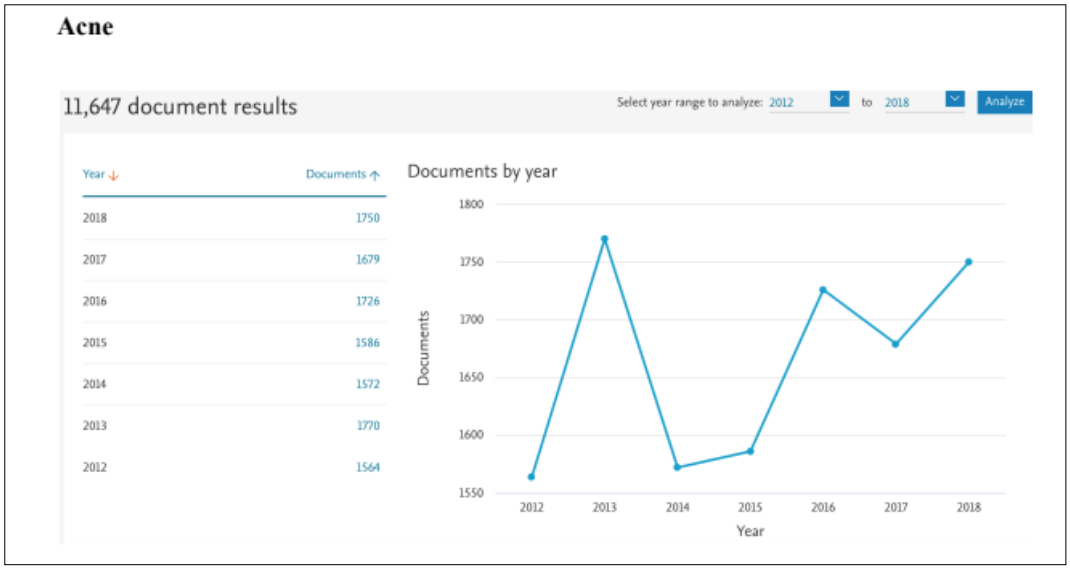
Analysis

Once the pre-analysis data of these dermatoses are exposed, the dermatoses chosen for a deeper analysis will be presented and justified.

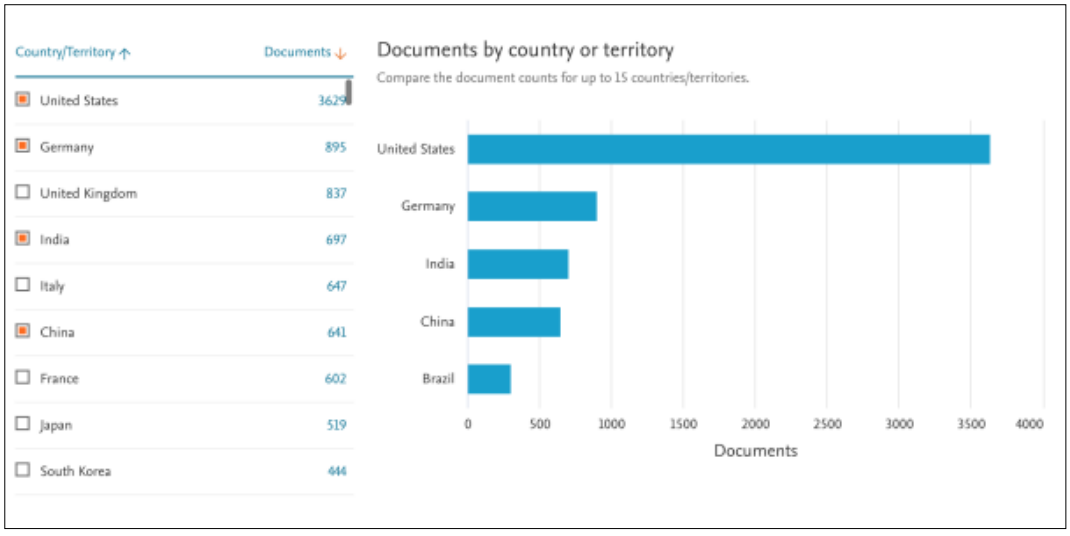
It is necessary to define effectiveness and efficiency within the context of this research to achieve the objective of elaborating and justifying effective strategies for the international insertion of the scientific production of Brazilian Dermatology.

Effectiveness refers to the greater internationalization of Brazil in the Dermatology field, with more mobility and exchange of experiences, in the widest possible way, with foreign countries that have outstanding production quantitatively and qualitatively. This strategy aims to generate effective impacts, that is, solutions to the problems found in the most cited Brazilian articles. Efficiency is defined by the speed in generating effective impacts and reducing costs.[5]

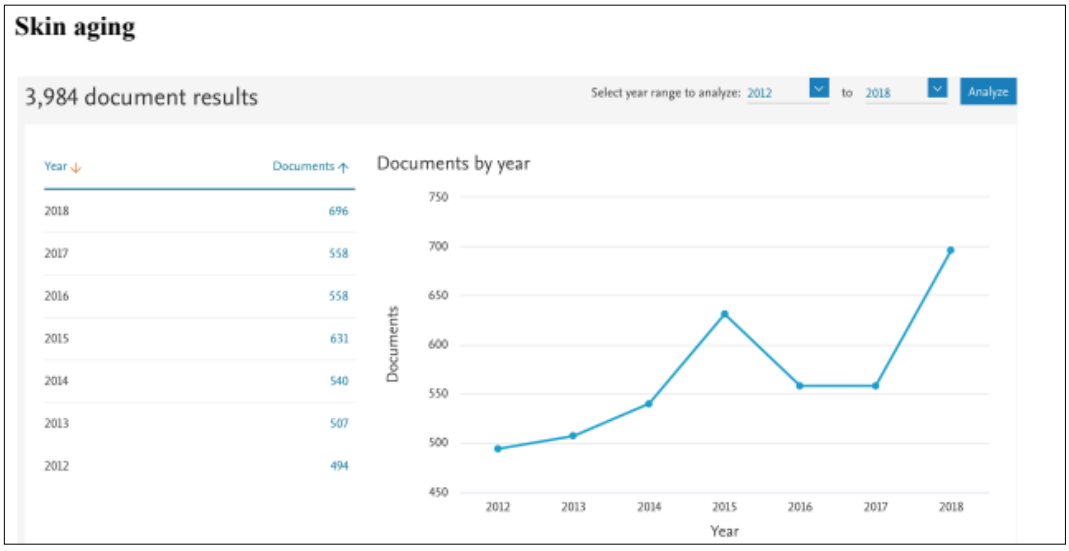
Given the concepts described above and the objective of the research, we chose the dermatoses "photoaging" and "skin aging" for analysis. Skin aging is the set of skin changes caused by intrinsic and extrinsic factors. Photoaging is the set of early skin changes caused by environmental factors, particularly chronic and uncontrolled exposure to the sun. We chose these dermatoses because they are prevalent and present the possibility



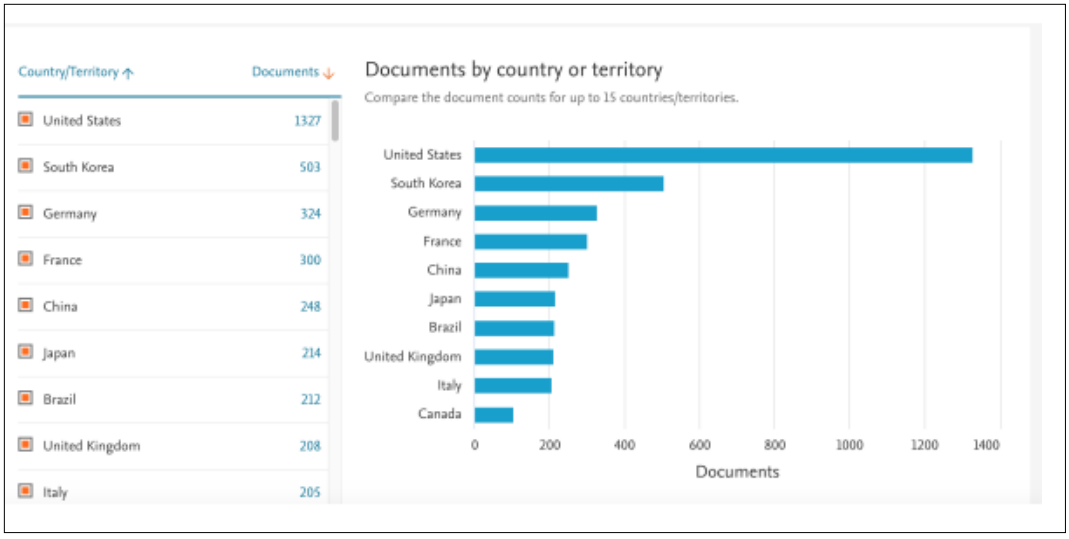
Graphic 1.1: Total number of documents between 2012 and 2018 – Acne



Graphic 1.2: Total number of documents between 2012 and 2018 – Acne



Graphic 2.1: Total number of documents between 2012 and 2018 – Skin aging

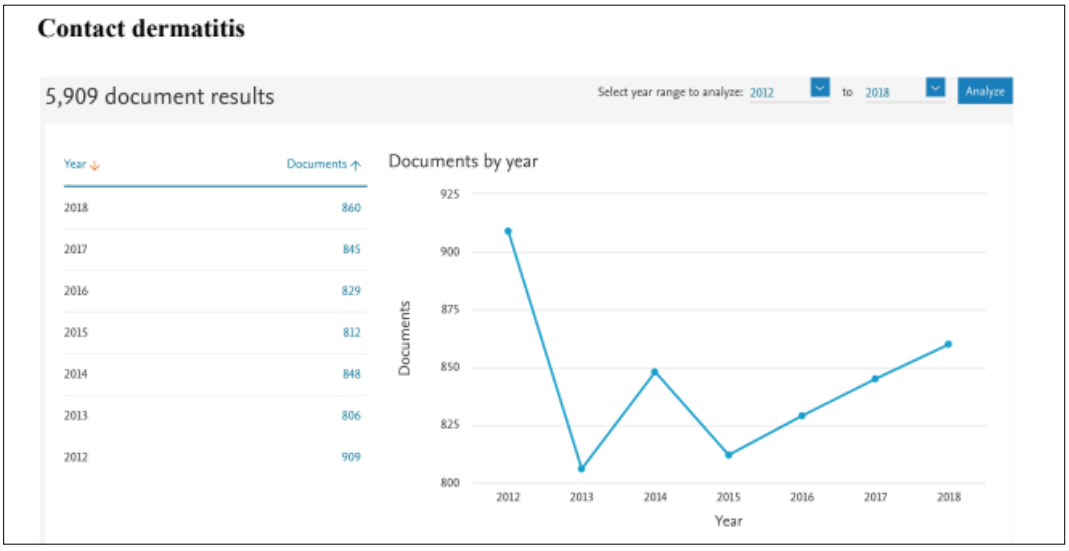


Graphic 2.2: Total number of documents between 2012 and 2018 – Skin aging

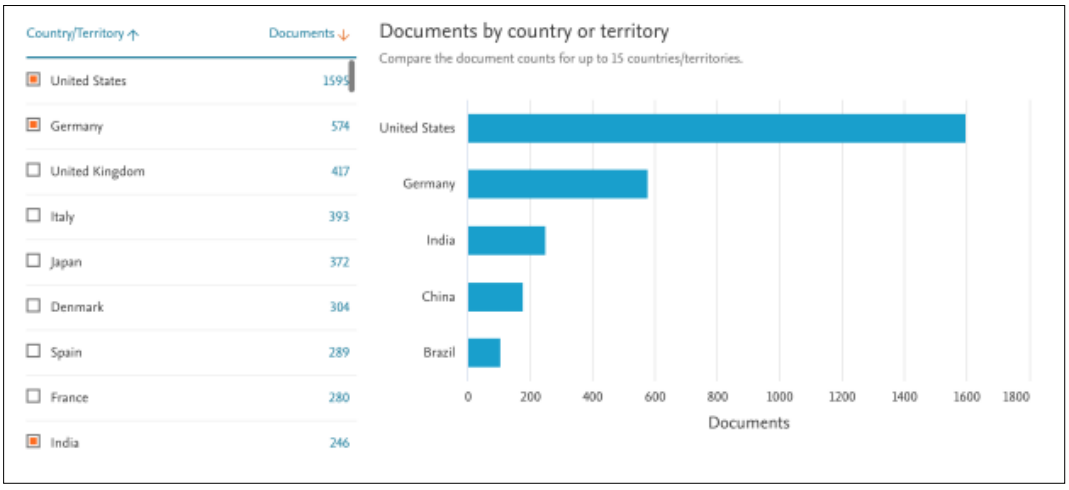
of reducing public health costs through prevention and early treatment. Also, they may reduce the incidence of nonmelanoma skin cancers (basal and squamous cell carcinomas), highly prevalent in sunny countries and with a culture of intense exposure to the sun. Solar radiation, particularly ultraviolet, is the primary environmental factor in premature skin aging, with epidermal and dermal damage and cellular mutations.

Nonmelanoma skin cancer is the type of malignant neoplasm most frequently diagnosed in both sexes.[9] According to the National Cancer Institute (INCA), in Brazil, the number of new cases of nonmelanoma skin cancer expected for each year of the 2020-2022 triennium will be 83,770 in men and 93,160 in women, corresponding to an estimated risk of 80.12 new cases per 100,000 men and 86.65 new cases per 100,000 women. Also, in Brazil, there were 1,301 deaths from nonmelanoma skin cancer in men in 2017, corresponding to a risk of 0.92/100 thousand; and 949 deaths in women, with a risk of 0.92/100 thousand.[9]

Skin cancer, including the most serious one (melanoma), is directly related to chronic, uncontrolled, and unprotected exposure to solar radiation.[10] Of course, there are other risk factors, such as skin and eye color, and genetic predisposition, among others. Solar radiation also causes premature skin aging. It represents a complex biological process influenced by a combination of endogenous or intrinsic factors, such as genetics, and exogenous or extrinsic factors, such as exposure to solar radiation, pollution, diet, stress, smoking, drugs, systemic diseases, hormones, etc. These factors lead to progressive changes in skin structure and physiology, especially in areas exposed to the sun, where extrinsic factors account for 85% of the "aged skin" phenotype. Over time, solar lentigines, leukoderma punctata, thickening in some areas, atrophy in others, wrinkles, and pre-malignant lesions



Graphic 3.1: Total number of documents between 2012 and 2018 – Contact dermatitis



Graphic 3.2: Total number of documents between 2012 and 2018 – Contact dermatitis

called actinic or solar keratoses (AKs) appear. These, isolated or multiple, represent one of the signs of advanced photodamage and are considered risk markers for developing malignant lesions, especially basal and squamous cell carcinomas.10 Thus, prevention and early treatment of skin aging might reduce the incidence of AKs and nonmelanoma skin cancer.

According to the article "Estimated cost of treating nonmelanoma skin cancer in the State of São Paulo – Brazil", the average annual cost of treating nonmelanoma skin cancer in the State of São Paulo between 2000 and 2007, per patient, was R$ 1,172 ± R$ 424 in SUS, and total treatment expenses were R$ 37,773,449.92.[11]

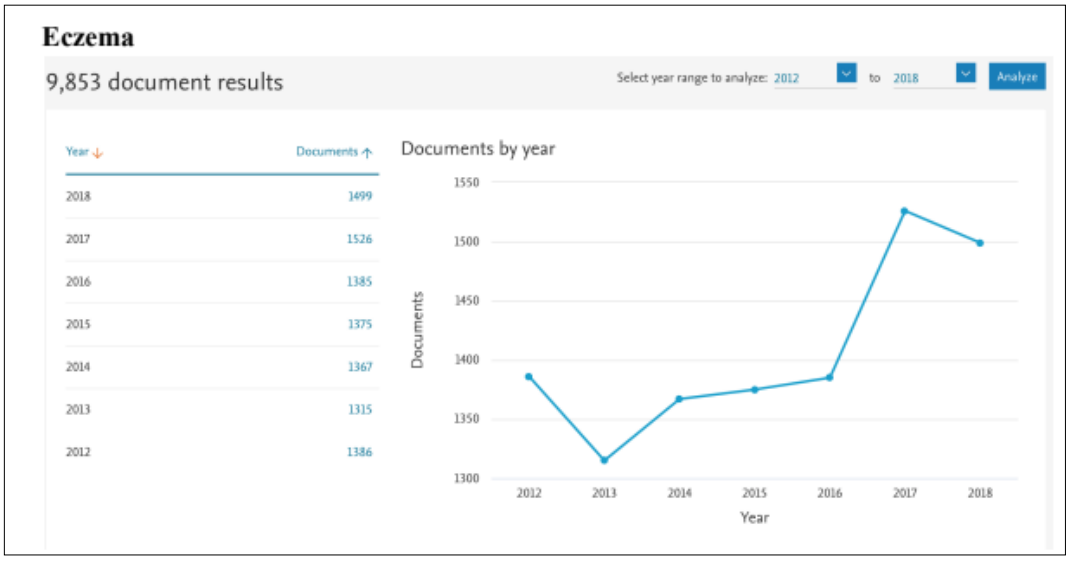
Therefore, nonmelanoma skin cancer is a condition that represents a high cost for public health in Brazil. The prevention and treatment of skin aging and the early diagnosis and treatment of nonmelanoma skin cancer can result in reduced health costs, also avoiding invasive surgeries and procedures for patients.

Between 2012 and 2018, the term "photoaging", in the search for "article title, abstract, keywords", resulted in 1,709 documents in Scopus, with the United States being the largest producer (464) and Brazil the fifth (101).[1]

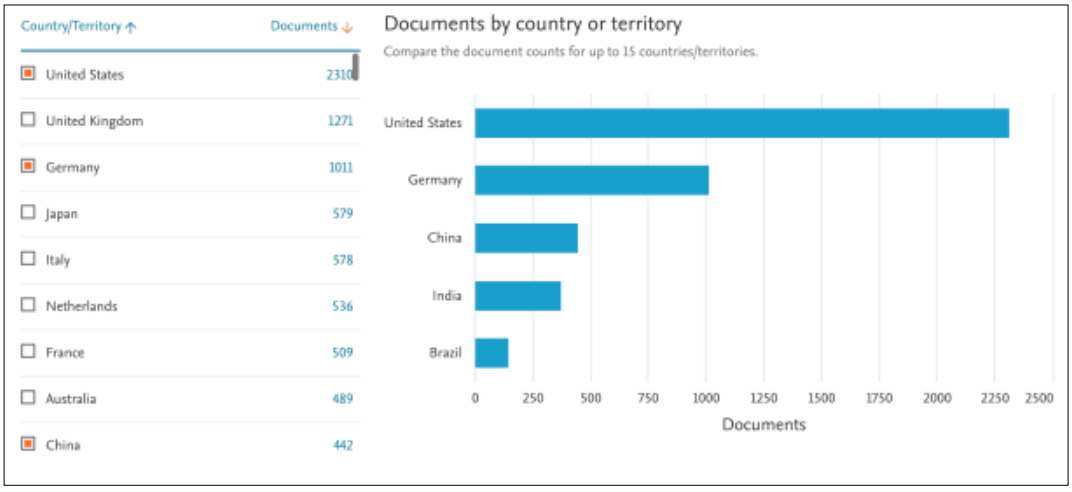
Between 2012 and 2018, the term "skin aging", in the search for "article title, abstract, keywords", resulted in 3,984 documents in Scopus, with the United States being the largest producer (1,327) and Brazil the seventh (212).[1]

Assessing the main problems found in the semantics of the Brazilian articles most cited in Scopus about skin aging and photoaging, it will be possible to find potential international collaborators that help generate effective impacts.

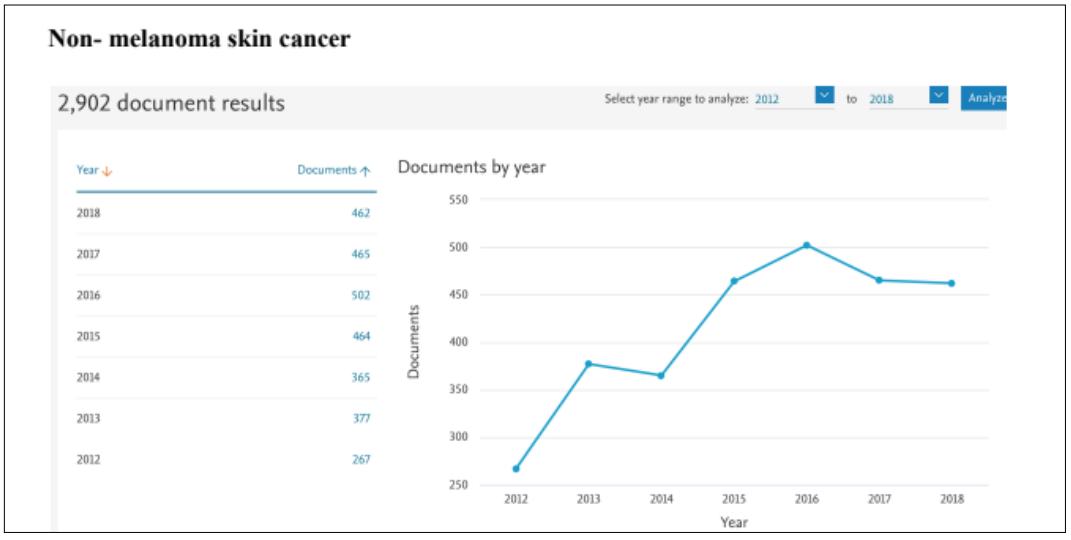
The search in Scopus1 with the term "skin aging", limited to Brazil, analyzed the 10 most cited documents between 2012 and 2020.



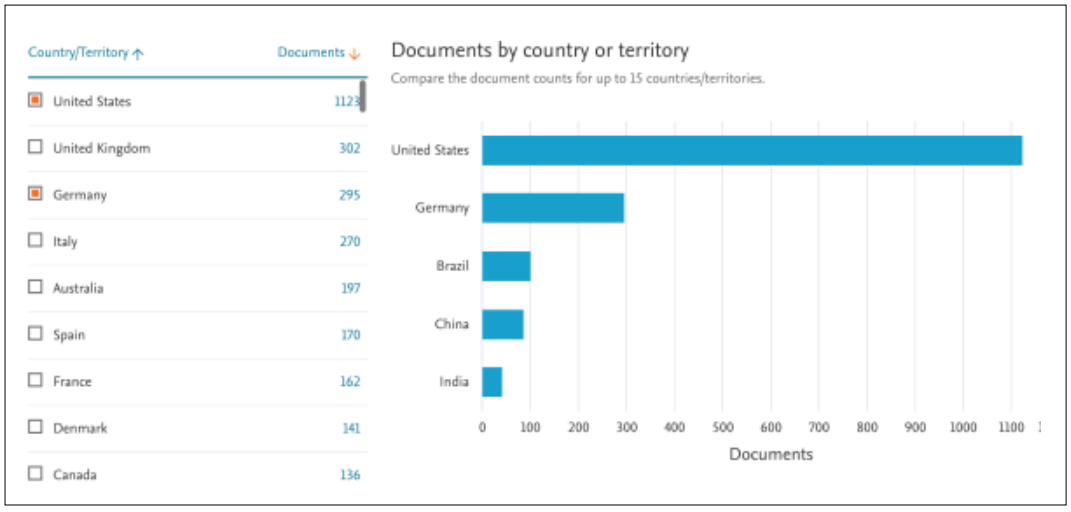
GRAPHIC 4.1: Total number of documents between 2012 and 2018 – Eczema



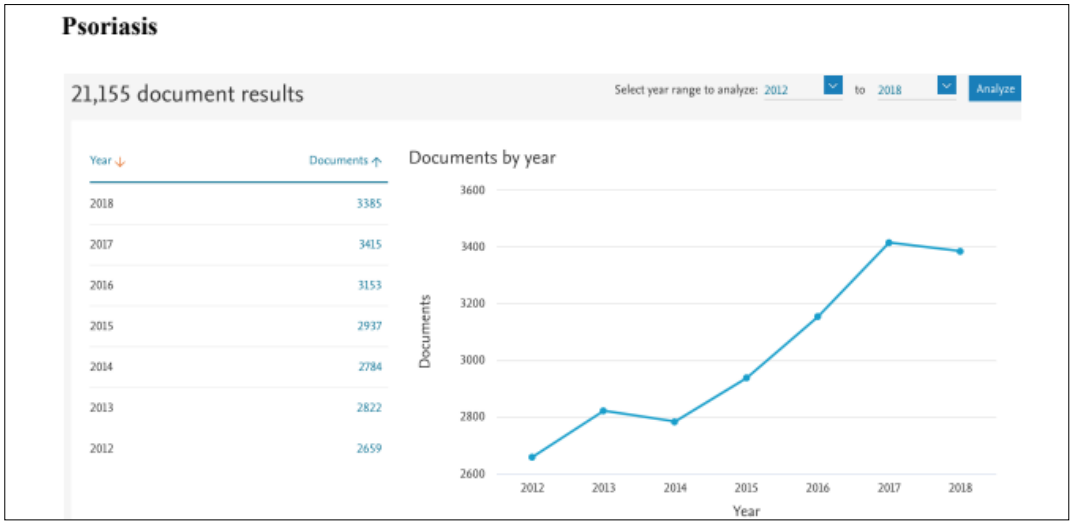
GRAPHIC 4.2: Total number of documents between 2012 and 2018 – Eczema



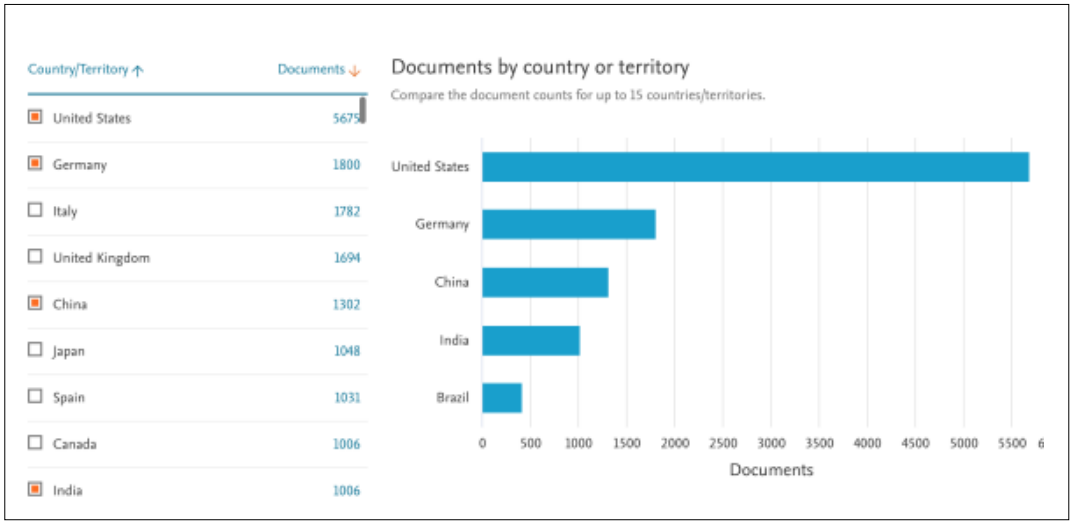
GRAPHIC 5.1: Total number of documents between 2012 and 2018 – Nonmelanoma skin cancer



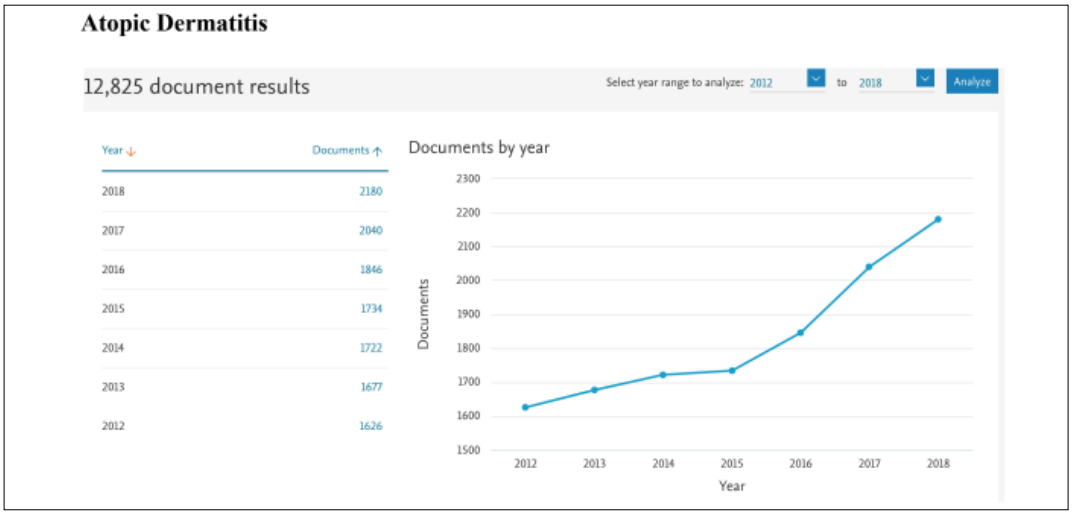
GRAPHIC 5.2: Total number of documents between 2012 and 2018 – Nonmelanoma skin cancer



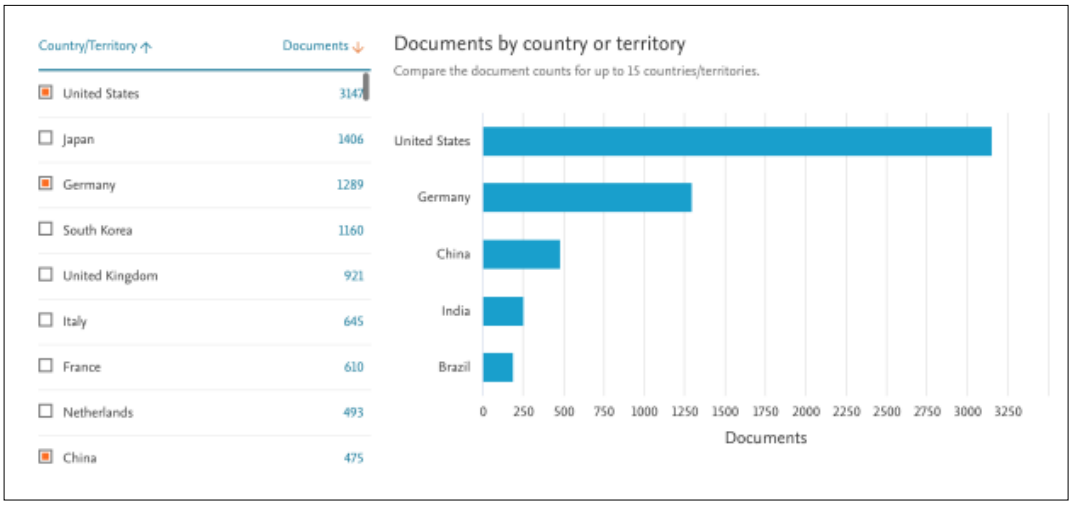
GRAPHIC 6.1: Total number of documents between 2012 and 2018 – Psoriasis



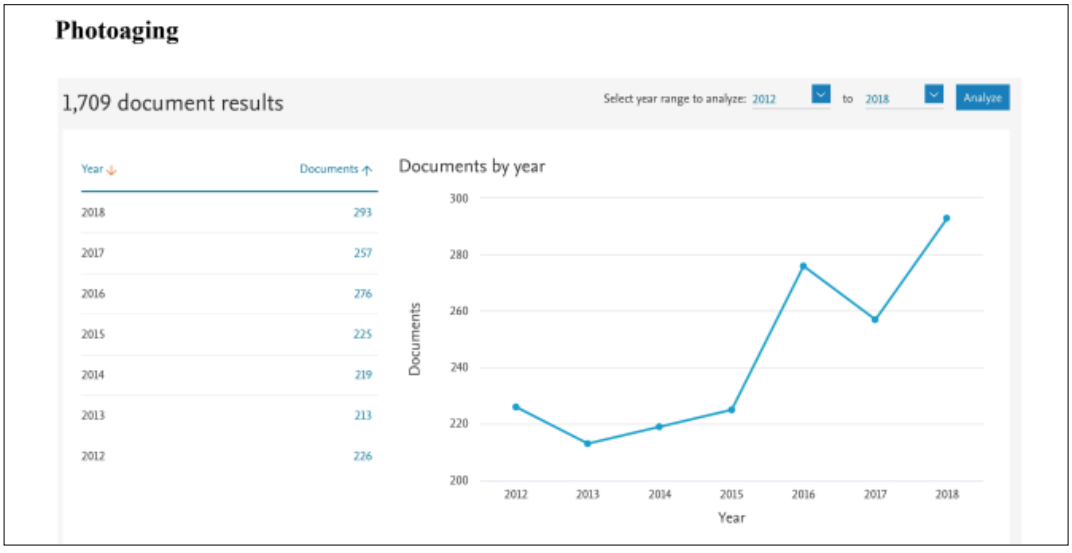
GRAPHIC 6.2: Total number of documents between 2012 and 2018 – Psoriasis



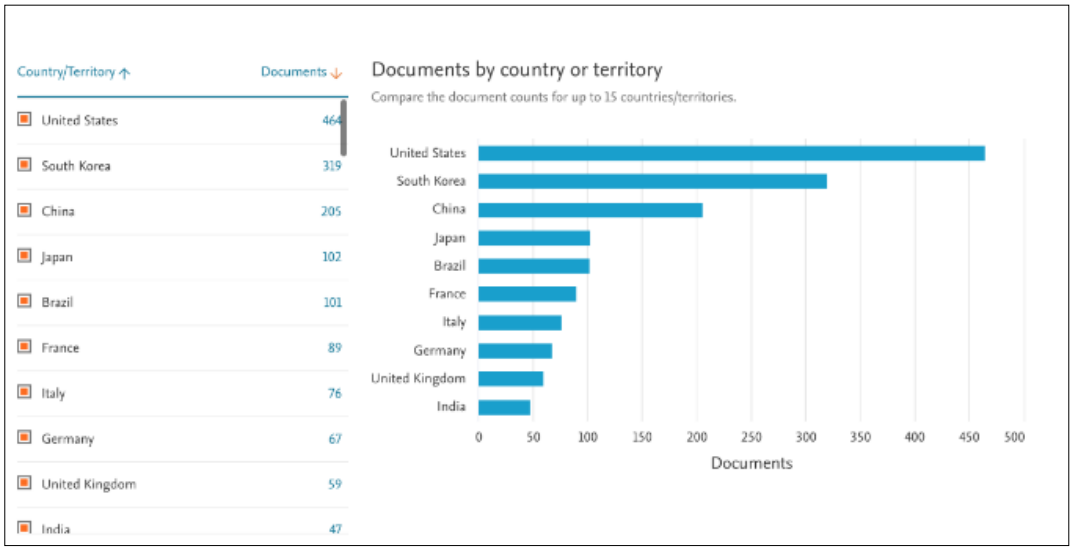
GRAPHIC 7.1: Total number of documents between 2012 and 2018 – Atopic dermatitis



GRAPHIC 7.2: Total number of documents between 2012 and 2018 – Atopic dermatitis



GRAPHIC 8.1: Total number of documents between 2012 and 2018 – Photoaging



Graphic 8.2: Total number of documents between 2012 and 2018 – Photoaging

Results of the survey carried out on 04/03/2021:
TITLE-ABS-KEY ("Skin aging") AND (LIMIT-TO (AFFILCOUNTRY, "Brazil") AND (LIMIT-TO (PUBYE AR, 2020) OR LIMIT-TO (PUBYEAR, 2019) OR LIMIT-TO (PUBYEAR, 2018) OR LIMIT-TO (PUBYEAR, 2017) OR LIMIT-TO (PUBYEAR, 2016) OR LIMIT-T O (PUBYEAR, 2015) OR LIMIT-TO (PUBYEAR, 2014) OR LIMIT-TO (PUBYEA R, 2013) OR LIMIT-TO (PUBYEAR, 2012)

Of the 10 most cited articles, three had as their central theme the relationship between skin aging and oral or dietary supplementation ("Carotenoids and polyphenols in nutricosmetics, nutraceuticals, and cosmeceuticals";[12] "Oral supplementation of specific collagen peptides has beneficial effects on human skin physiology: A double-blind, placebo-controlled study";[13] and "Oral intake of specific bioactive collagen peptides reduces skin wrinkles and increases dermal matrix synthesis"[14]).

Also, four articles addressed the study of substances in cosmetics that can alter skin aging ("Cosmetic attributes of algae - A review";[15] "Plant extracts and natural compounds used against UVB-induced photoaging";[16] "Oral intake of specific bioactive collagen peptides reduces skin wrinkles and increases dermal matrix synthesis";[14] and "Anti-aging cosmetics: Facts and controversies"[17]).

Thus, studies on the relationship between skin aging and oral supplementation and the study of cosmetic substances are relevant topics in Brazil.

From the search in Scopus1 using the term "photoaging", the search was limited to Brazil and analyzed the 20 most cited documents between 2012 and 2020.

Results of the survey conducted on 07/31/2021:
TITLE-ABS-KEY (photoaging) AND (LIMIT-TO) (AFFILCOUNTRY , "Brazil") AND (LIMIT-TO) (PUBYEAR, 2020) OR LIMIT-TO (PUBYEAR, 2019) OR LIMIT-T O (PUBYEAR, 2018) OR LIMIT-TO (PUBYEAR, 2017) OR LIMIT-TO (PUBYEA R, 2016) OR LIMIT-TO (PUBYEAR, 2015) OR LIMIT-TO (PUBYEAR, 2014) O R LIMIT-TO (PUBYEAR, 2013) OR LIMIT-TO (PUBYEAR, 2012)

Of the 20 most cited documents, seven had as their central theme the study of the photoprotective properties of some compounds ("Plant extracts and natural compounds used against UVB-induced photoaging";[16] "Low-dose oral isotretinoin versus topical retinoic acid for photoaging: A randomized, comparative study";[18] "Rutin increases the critical wavelength of systems containing a single UV filter and with good skin compatibility";[19] "Dihydrocaffeic acid prevents UVB-induced oxidative stress leading to the inhibition of apoptosis and MMP-1 expression via p38 signaling pathway";[20] "Mechanism of Aloe Vera extract protection against UVA: Shelter of lysosomal membrane avoids photodamage";[21] "Comparison of the effects of carboxytherapy and radiofrequency on skin rejuvenation";22 and "Use of Flavonoids and Cinnamates, the Main Photoprotectors with Natural Origin"[23]).

Therefore, according to the semantic analysis of the most cited Brazilian articles, the study of compounds with photoprotective properties is relevant research in Brazil on photoaging.

Once the most relevant topics to be studied are exposed, it is also necessary to study the possible forms of international collaboration.

Forms of collaboration

The classification used to define the types of collaboration will be that of FAPESP. According to this Foundation, here are the possible collaborations.[24, 25] (Table 2 and 3).

Discussion of analysis

In the search on Scopus,[1] between 2012 and 2020, using the term "photoaging", Brazil appears as the fifth largest producer of publications on the subject. It is important to note that the United States ranks first, but South Korea and China are, respectively, the second and third largest producers.

Table 2: FAPESP scholarships in the country and scholarships abroad

Scholarships in the country and abroad	
Scholarships in the country	Young Investigator
Scientific initiation	Improvement in Public Education
Master's degree	Scientific Journalism
Doctoral degree	Participation in courses
Doctoral (Direct)	**Scholarships abroad**
Post-doctoral	Research Internship Abroad (BEPE)
Technical Training	Research Abroad (BPE)

Table 3: FAPESP research grants

Research grants
Regular
Thematic project
Young investigator
Engineering Research Centers (CPE)
Research, Innovation And Dissemination Centers (CEPID)
Multi-User Equipment Program (EMU)
Organization of scientific meeting
São Paulo School Of Advanced Science (ESPCA)
Participation in Scientific Meeting
Visiting researcher
Sectorial Consortia for Research and Innovation (CONSITEC)
Research Partnership for Technological Innovation Program (PITE)
Support of Intellectual Property Rights Program (PAPI)
Public Policy Program
Improvement in Public Education
FAP-Books Program
Innovative Research in Small Business (PIPE)
Publications
Equipment repair
Technical Reserve for Support of Connectivity to the ANSP network
Technical Reserve For Program Coordination
Technical Reserve For Research Institutional Infrastructure

In the search for the term "skin aging", in the same period, the first three producers are the United States, South Korea, and China, respectively, while Brazil is the ninth. Thus, more in-depth studies on photoaging, with better methodological quality, can be a source of collaboration with Asian countries, especially South Korea.

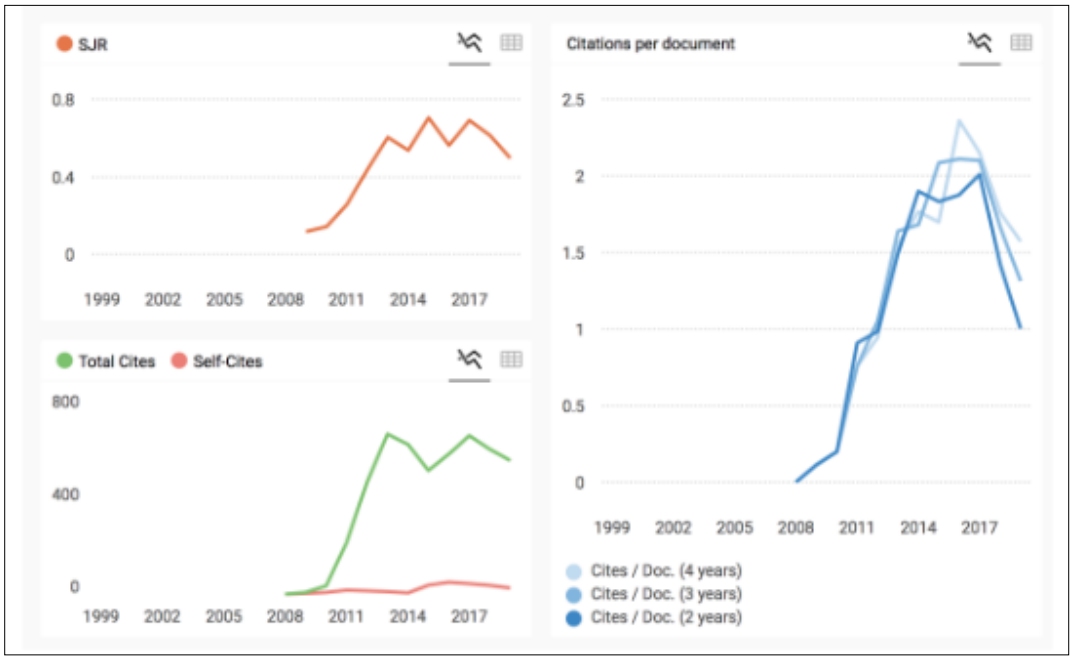
The South Korean journal "Annals of Dermatology", which is in Q2 of Scimago with an index of 0.496, has shown high growth in the last ten years in the SJR indicator, documents citations, and international collaborations.[1] (Graphics 9.1 and 9.2).

According to the UOL news story "K-Beauty: all about the Korean cosmetics boom + list of brands",[26] the beauty industry in South Korea was valued at US$ 11 billion in 2016, and the country exported more than US$ 2.64 billion in cosmetics. In 2015, the country overtook Japan and the US to become the second largest cosmetics exporter to China, behind only France. Korea is the fifth country with higher investment in Research & Development (R&D) in the beauty industry. Furthermore, the news also states that the Ministry of Health and Welfare will support the expansion of investment in R&D for anti-aging products and other cosmetics. Also, in 2016, LVMH purchased a stake in Clio Cosmetics, a Korean company, for US$ 50 million, and Goldman Sachs, along with Bain Capital Private Equity, acquired a majority stake in the Carver Korea brand for US$ 307 million, according to Reuters.

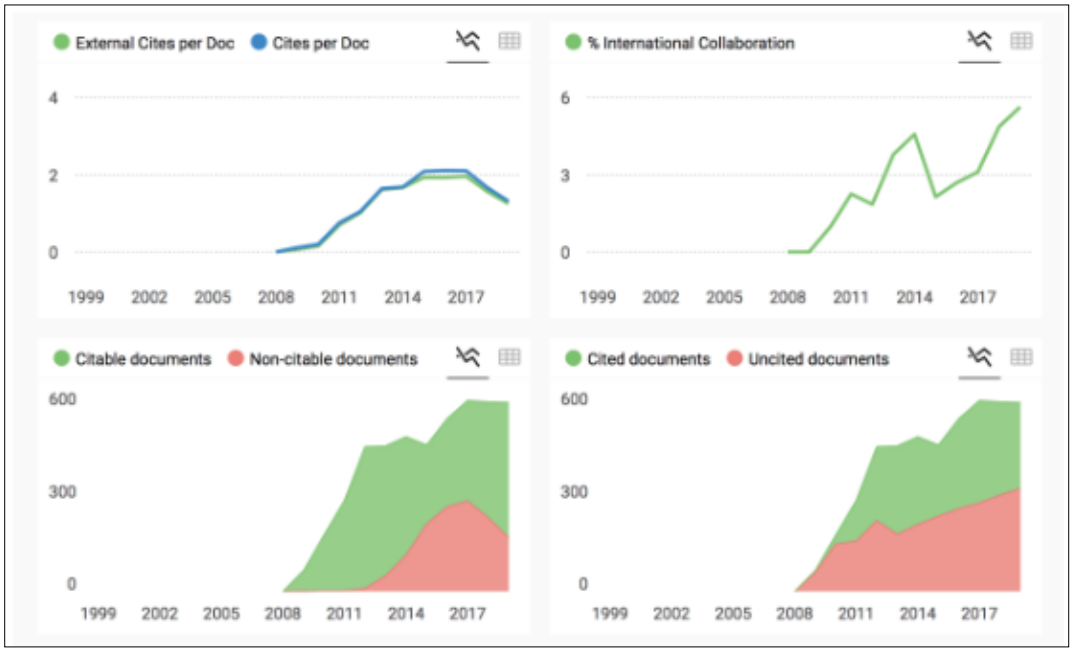
The expansion of investments in anti-aging products in South Korea is in line with the main topics researched in Brazil about skin aging and photoaging. Thus, South Korea is an essential potential international collaborator in Brazilian Dermatology.

Therefore, according to the analysis of the data collected, an effective form of international collaboration would be the researchers' exchange between Brazil and South Korea, elaborating studies on the relationship between skin aging and oral supplementation and studying new substances for cosmetic use that act in the prevention and control of skin aging, in addition to new compounds with photoprotective properties. Thus, it is coherent to highlight that the appropriate forms of international collaboration are:

The Visiting Researcher Grant, according to FAPESP, "intends to cover, in whole or in part, the expenses related to the visit of an experienced researcher, linked to the research institution abroad or in other States of Brazil, to a research institution in the State of São Paulo, for a continuous period not exceeding one year. The main objective is to facilitate collaboration between researchers in de research projects in progress, or about to be started, at the host institution". This aid would enable to invite Chinese and Korean professors to teach at universities in the State of São Paulo and encourage them to seek graduation or master's students to conduct research in South Korea through the Research Internship Abroad Scholarship (Bolsa Estágio de Pesquisa no Exterior - BEPE). The scholarship intends to support short and medium-term research internships by FAPESP



Graphic 9.1: SJR of the South Korean newspaper "Annals of Dermatology" in documents citations



Graphic 9.2: SJR of the South Korean newspaper "Annals of Dermatology" in international collaborations

Scientific Initiation, Master's, Direct Doctorate, Doctoral, and Post-Doctoral fellows, and it must be enjoyed during the scholarship in the country.

Brazilian doctors must also conduct research in South Korea through the Research Scholarship Abroad (Bolsa de Pesquisa no Exterior - BPE), considering the possibility of a lasting partnership and knowledge exchange. According to FAPESP, this scholarship "is intended for the researcher with the title of doctor or equivalent qualification, proven by its summary, linked to a research institution in the State of São Paulo, to conduct research activities in an institution abroad".

Given the forms of collaboration mentioned above, it is necessary to identify possible authors, universities, and funders most suitable for researchers' exchange.

Conclusion

This research aimed to build effective strategies for the insertion and scientific interaction of Brazil with notable countries in Dermatology relevant themes. In this context, we must consider:

1) The Brazilian scientific production in Dermatology can be categorized as small, little internationalized and cited, compared to prominent countries.

2) "Photoaging" and "skin aging" are prevalent dermatoses, with the possibility of reducing public health expenses through prevention and early treatment that may reduce the incidence of non-melanoma skin cancers (basal and squamous cell carcinomas).

3) South Korea proved to be an essential potential research collaborator due to the number of publications on "photoaging" and "skin aging", the growth in the number of international collaborations in the last ten years, and the high investments in anti-aging products and other cosmetics in the world.

4) To specify the possibilities for funding scholarships, we used the FAPESP classification.

5) According to the analysis of the data collected, an effective form of international collaboration would be the exchange of researchers between Brazil and South Korea through FAPESP modalities of Visiting Researcher Grant, Research Internship Abroad Scholarship (BEPE), and Research Abroad Scholarship. Abroad (BPE). Through these funds, it will be possible to exchange professors, undergraduate, and master's students between these two countries.

Final considerations

The results presented are the viable conclusion of the study conducted. Collaboration with other countries, other types of partnership, study topics, and forms of funding should be considered to construct more effective strategies for the insertion and scientific interaction of Brazil with notable countries in the Dermatology field. The results of this research cannot be generalized, and all Brazilian Dermatology funding efforts should not be aimed exclusively at South Korea since there are several significant markets for different reasons. The choice of South Korea in this study is mainly due to a large number of Korean publications on "photoaging" and "skin aging", increased international collaborations in the last ten years, and high investments in research and development in anti-aging products and other cosmetics in the country. As a result of the country's intense investment in anti-aging products and other cosmetics, the Korean beauty industry was valued at US$ 11 billion, and the country exported more than US$ 2.64 billion in cosmetics, in addition to having conducted multi-million dollar transactions with Western companies. Therefore, we expect that research on photoaging and skin aging can value the Brazilian cosmetics industry and increase international investments in the country. ●

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