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[Translated article] Bibliometric Study of the Advances Made in Clinical Dermatological Research in Spain from 2015 through 2021: Update of the MaIND Project and Interactive Online Map

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Abstract

Introduction: A clinical dermatological research was conducted in Spain from 2005 through 2014 as part of the MaIND project with the provinces or centers with the highest number of published articles. However, a low level of evidence in scientific production was confirmed as the overall result. The aim of this study is to update the Spanish clinical dermatological research in bibliometric terms from 2015 through 2021 with comparisons between both periods of time.
Material and methods: We conducted a bibliometric study to replicate the methodology used in the article to be updated. We included articles whose corresponding authors' affiliation was a Spanish dermatological center, which met the criteria for clinical research in dermatology, including a level of evidence ≤ 4.
Results: A total of 1,674 out of the 10,199 articles met the inclusion criteria. An interactive map representing quantitative and qualitative indicators calculated for the 2005-2021 is presented here. In the study period, we found an increasing trend both in the number of published articles ($P < .002$) and in the mean number of citation-years per article ($P < .01$). A total of 22 of the articles had a level of evidence > 4, with a positive trend towards more articles having a higher level of evidence ($P < .03$). *ACTAS DERMOSIFILOGRÁFICAS* still maintains its position as the journal with the highest number of articles received (18%, a total of 302 articles).

Conclusions: The results of this study show that, in Spain, the scientific production of dermatology represents an upward trend in quantity, impact, and level of evidence.

Estudio bibliométrico sobre la evolución de la investigación clínica dermatológica española entre 2015 y 2021: actualización del proyecto MaIND y mapa interactivo en línea

Resumen

Introducción: La investigación clínica dermatológica en España llevada a cabo entre los años 2005 y 2014 fue evaluada mediante el proyecto MaIND, mostrando aquellas provincias o centros con un mayor número de trabajos publicados, aunque como resultado global se detectó un bajo nivel de evidencia en la producción científica. El objetivo de este estudio es realizar una actualización de la investigación clínica dermatológica española en términos bibliométricos entre los años 2015 y 2021, permitiendo la comparación entre ambos periodos de tiempo.

Material y métodos: Estudio bibliométrico replicando la metodología usada en el artículo que se pretende actualizar. Se incluyeron aquellos artículos en los que la dirección del autor de correspondencia fuese un centro dermatológico español y que cumpliesen los criterios de investigación clínica en dermatología, incluyendo tener un nivel de evidencia ≤ 4.

Resultados: De los 10.199 artículos encontrados, 1.674 cumplieron los criterios de inclusión. Se presenta un mapa interactivo representando los indicadores cuantitativos y cualitativos medidos para el periodo 2005-2021. En el periodo estudiado existe una tendencia ascendente en cuanto al número de artículos publicados (p < 0,002) y a la media de citas-año por artículo (p < 0,01). El 22% de los artículos presentan un nivel de evidencia superior a 4, existiendo una tendencia positiva a un mayor porcentaje de artículos con nivel de evidencia superior (p < 0,03). La revista *ACTAS DERMOSIFILIOGRÁFICAS* sigue manteniéndose como la que recibe un mayor número de artículos (18%, 302 artículos).

Conclusiones: Los resultados del presente estudio muestran que la producción científica de la dermatología en España presenta una tendencia ascendente en cantidad, impacto y nivel de evidencia.

Introduction

Bibliometric research analyzes data drawn from scientific publications to quantify research activity, its quality, or its subject matter.[1] There are examples of studies on a field of knowledge, such as dermatology in general,[2] in diseases,[3] or in a geographical area.[4]

In the field of dermatology, there are bibliometric studies on geographical areas, such as the one published by Gjersvik et al.[5] who evaluated scientific output in Nordic countries, or that of Peña Pérez et al.[6] who measured the scientific output of Spanish dermatology in high-impact journals.

Molina-Leyva et al.[7] conducted an analysis of dermatological scientific output in Spain from 2005 through 2014, showing results such as the low level of evidence and describing the central themes of dermatological research in Spain during that period: melanoma, psoriasis, and atopic dermatitis. They also published a map of Spanish dermatological clinical research centers.[8]

The aim of this study was to evaluate—both qualitatively and quantitatively—the dermatological scientific output in Spain from 2015 through 2021, building upon the previous work by Molina-Leyva et al.[7] and creating an updated interactive map of Spanish institutions and centers active in dermatological clinical research from 2005 through 2021. In addition, possible changes between the 2 time periods (2005–2014 vs 2015–2021) were compared.

Materials and methods

Study design and search strategy

We conducted a bibliometric study based on clinical research articles published from 2015 through 2021. The methodology used in the previous study[8] for the years 2005–2014 was replicated to compare both works. The same database (Scopus)[8] and the same search strategy were used: (AFFIL-COUNTRY (spain OR espana OR spanien OR espagne OR espanha) AND AFFILORG (dermat*)) AND PUBYEAR > 2014 AND PUBYEAR < 2022. Search was conducted in September 2022, and the articles were processed using Rayyan software,[9] which helps in the article selection phase and allows the automatic drawing of certain bibliometric data.

Selection criteria

For the final selection and classification of the manuscript sample based on the level of evidence, one of the researchers (AAR) conducted a title and abstract review of all the articles drawn. The full text was reviewed when necessary. In case of doubt, a second researcher (MAD) reviewed them, and decisions were made by consensus.

The articles included met the following inclusion criteria: 1) a definitive publication date from 2015 through 2021, both years included; 2) the corresponding author's affiliation was a Spanish dermatological institution or center; 3) clinical research articles, defined by the following criteria: a) the study population consisted of patients or healthy individuals (including biological samples, medical images, lab test results, etc.) or health care systems; b) the research question had to solve clinical practice problems, including research on prevalence, etiology, diagnosis, treatment, prognosis, prevention, pharmacoeconomics, and health care systems; c) a level of evidence ≤ 4 according to the Centre for Evidence-Based Medicine (CEBM, Oxford, 2011).[10] Therefore, case reports, non-systematic reviews, and publications based on expert opinions without explicit evaluation methodology, or those based on laboratory research or basic principles were excluded.

The exclusion criteria were: 1) articles on non-dermatological topics; 2) non-definitive publication dates; 3) retracted articles; 4) congress presentations and abstracts.

Study variables

Variables such as authors and affiliations, corresponding author, year of publication, journal, or volume were automatically drawn using Rayyan software. Other variables, including the number of citations per article or journal quartile, were manually drawn by the authors. The following variables were calculated at the center, provincial, and national levels: 1) *Quantitative indicators*: number of articles, annual productivity in terms of articles per year, and number of articles per journal and year. 2) *Qualitative indicators*: total number of citations, mean citations per article, mean citations-per-year per article, journal quartile, and the articles level of evidence according to the CEBM.

Statistical analysis and preparation of the interactive map

We conducted a descriptive analysis of quantitative and qualitative indicators using conventional statistics: absolute and relative frequencies or means and standard deviations. Their distribution throughout the period was observed and compared with the results for the previous period (2005–2014). Homogeneity comparisons were drawn using the chi-square test and trend tests using linear trend tests for scores. Graphical representations of trends of the number of articles per year, citations, citations-per-year, and levels of evidence were shown. The statistical analysis was performed using Stata (version 17.0). Finally, an interactive bibliometric map was prepared using Microsoft Power BI® (2005–2021).
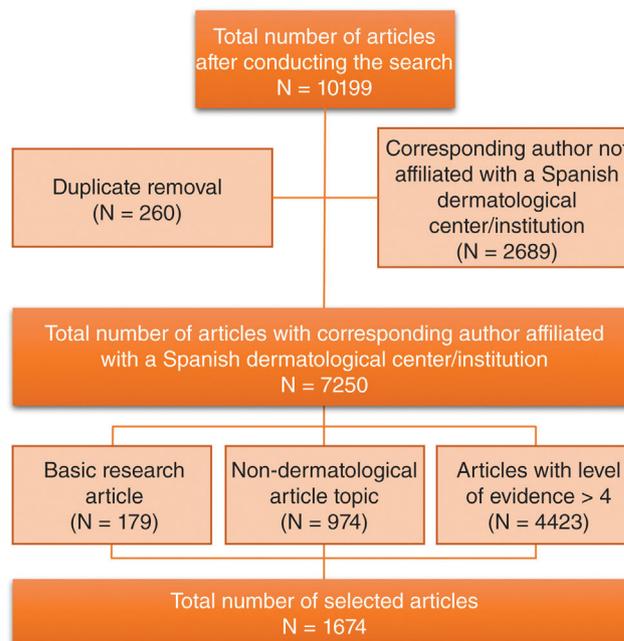

Figure 1 Flowchart with articles included and excluded in the study along with the reasons for exclusion.

The study did not require the approval from any ethics committees as it was a literature review.

Results

The search returned a total of 10,199 articles published from 2015 through 2021. After removing duplicates and selecting based on the corresponding author, 7250 articles with correspondence addresses in a Spanish center or institution remained of which 1674 articles (23%) met the inclusion criterion of being considered clinical research in dermatology (fig. 1).

Figure 2 illustrates the number of articles and centers by year of publication plus the mean number of articles published per center. An upward trend ($p < 0.002$) in the number of articles published from 2015 through 2021 can be seen, with 2021 being the year with the most published articles (n = 326). The year 2020, when the COVID-19 pandemic was declared, saw the largest annual increase in publications (25%). This upward trend was also statistically significant from 2005 through 2014 ($p < 0.049$). The number of centers that published, at least, 1 article and the mean number of articles per center also increased.

Regarding the impact of research, Table 1 shows that the total number of citations for each year is higher in years further from the present time (except for 2020), which is somehow expected because older articles have had more time to be cited. However, if we look at total number of citations-per-year—which considers the number of years since publication—and the mean citations-per-year per article, an upward trend is observed in both parameters during the study period ($p < 0.01$). Since 2005 (fig. 3) we can also see a growing trend in previous years ($p < 0.01$) with a less pronounced slope. This graph highlights the peak in
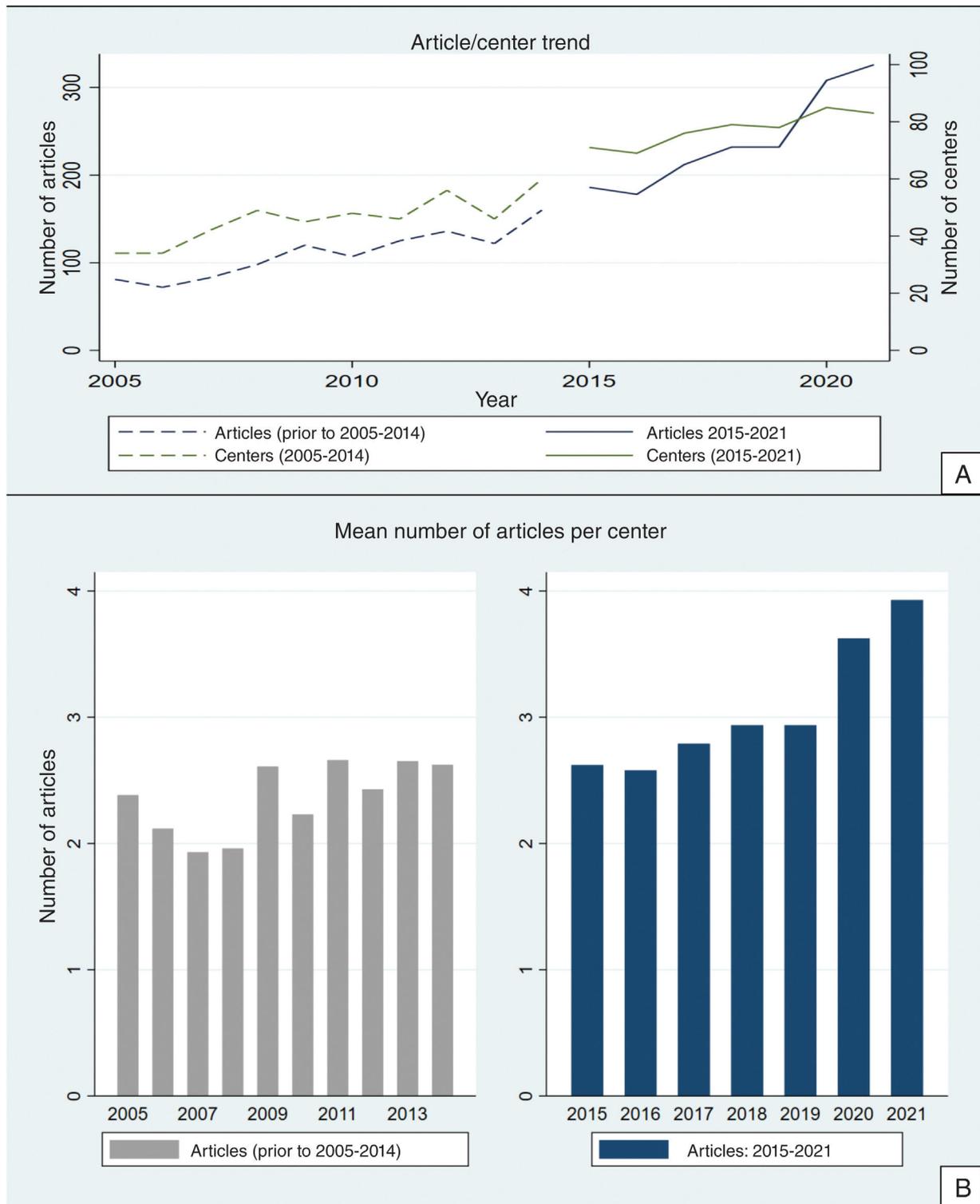
Figure 2 a) Annual growth of the number of published articles and centers with any publication during the studied period (2015-2021) and the previous period (2005-2014). b) Mean number of articles published per center in the studied period (2015-2021) and the previous period (2005-2014).

citations in 2020, which almost tripled vs the previous year (1330 citations-per-year vs 533 citations-per-year).

The CEBM level of evidence for the articles is shown in Figure 4. The largest percentage of articles accumulates in

level of evidence 4 (case series, cross-sectional studies, or low-quality cohort or case-control studies), accounting for 78% of all articles selected from 2015 through 2021. However, there is a trend toward a higher percentage of articles

Table 1 Total citations of clinical research articles and citations adjusted per year since publication.

Year	Total citations	Citations/Year	Articles	Mean citations /Year per article (SD)
2015	2688	336	186	1.8 (1.9)
2016	2370	339	178	1.9 (2.5)
2017	2818	470	212	2.2 (2.6)
2018	2003	401	232	1.7 (2.0)
2019	2131	533	232	2.3 (3.0)
2020	3991	1,330	308	4.3 (18.1)
2021	1679	840	326	2.6 (4.7)
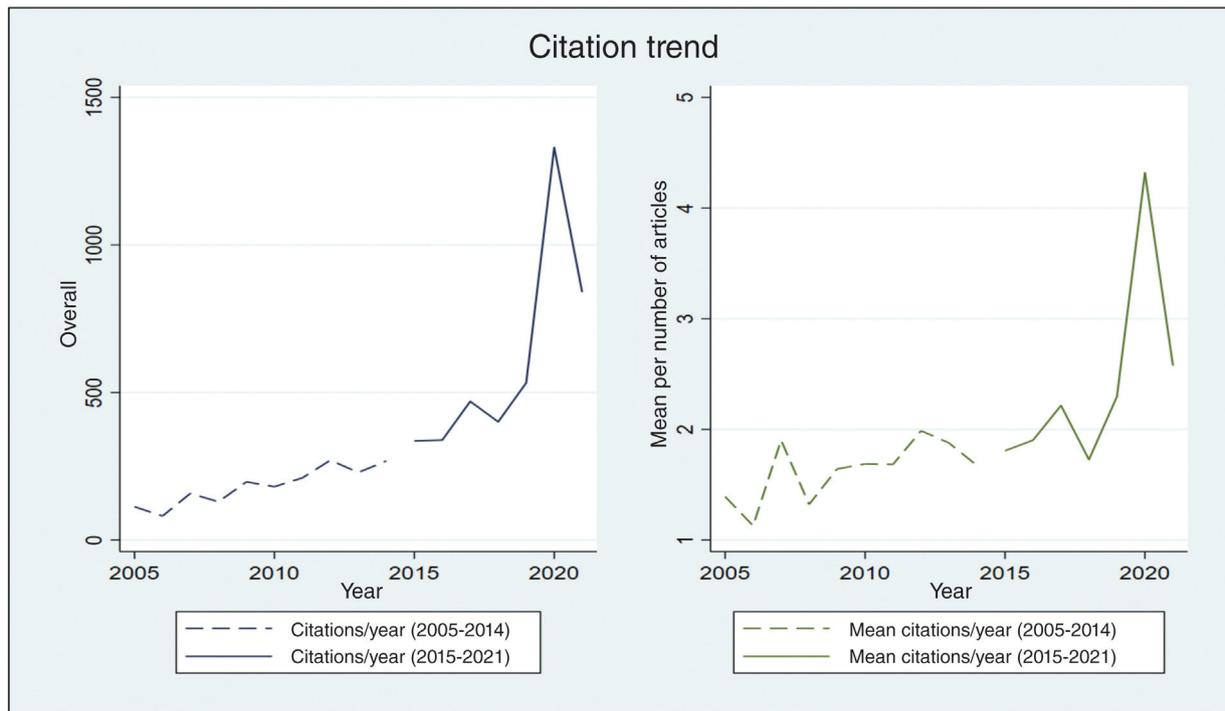
Figure 3 Number of citations per year in the studied period (2015-2021) and the previous period (2005-2014).

with a higher level of evidence (p < 0.03), which was not seen from 2005 through 2014. In conclusion, when comparing both periods, we saw an increase in the percentage of articles with a level of evidence > 4 and, therefore, probably of greater validity.

Regarding journals, we saw that a little more than two-thirds (71%) of the articles are published in journals with an impact factor, and almost one-third (32%) in journals ranked in the first quartile of their category, 14% in the second, 19% in the third, and only 6% in the last quartile. In the 2005–2014 period, nearly 45% of all articles were published in journals without an impact factor, with differences between both periods (p < 0.001).

Figure 5 shows the ranking of the 20 journals where most articles are published and their changes in position between the 2 periods. *ACTAS DERMOSIFILIOGRÁFICAS* remains the journal that receives the most articles (18%, a total of 302), although this percentage has decreased by more than 10% vs the previous period (30%). In second place remains the *Journal of the European Academy of Dermatology*, with 10% of the articles. Journals such as *Dermatologic Surgery* have

disappeared from this ranking, being replaced by others, such as *Dermatologic Therapy* or *The Australasian Journal of Dermatology*.

Figure 6 illustrates the cover of the interactive bibliometric map of dermatology in Spain (available online: https://aedv.es/investigacion/proyectos-de-investigacion /maind-mapa-de-centros-de-investigacion-clinica-dermato-logica-espanola) where the quantitative and qualitative indicators measured from 2005 through 2021 are represented. In the map, each circle represents the number of articles for a specific center, and each color corresponds to a province, with the option to select by this or that criterion or by year(s). Additionally, the map displays the mean number of citations per article (total or adjusted for elapsed time), the number and percentage of articles published in each journal quartile, the number of articles based on the CEBM level of evidence, or the journals with more publications. For example, if we select the entire period from 2005 to 2021 without applying any other filters, the provinces with more articles are, in descending order, Madrid (n = 716), Barcelona (n = 539), and Valencia (n = 298).

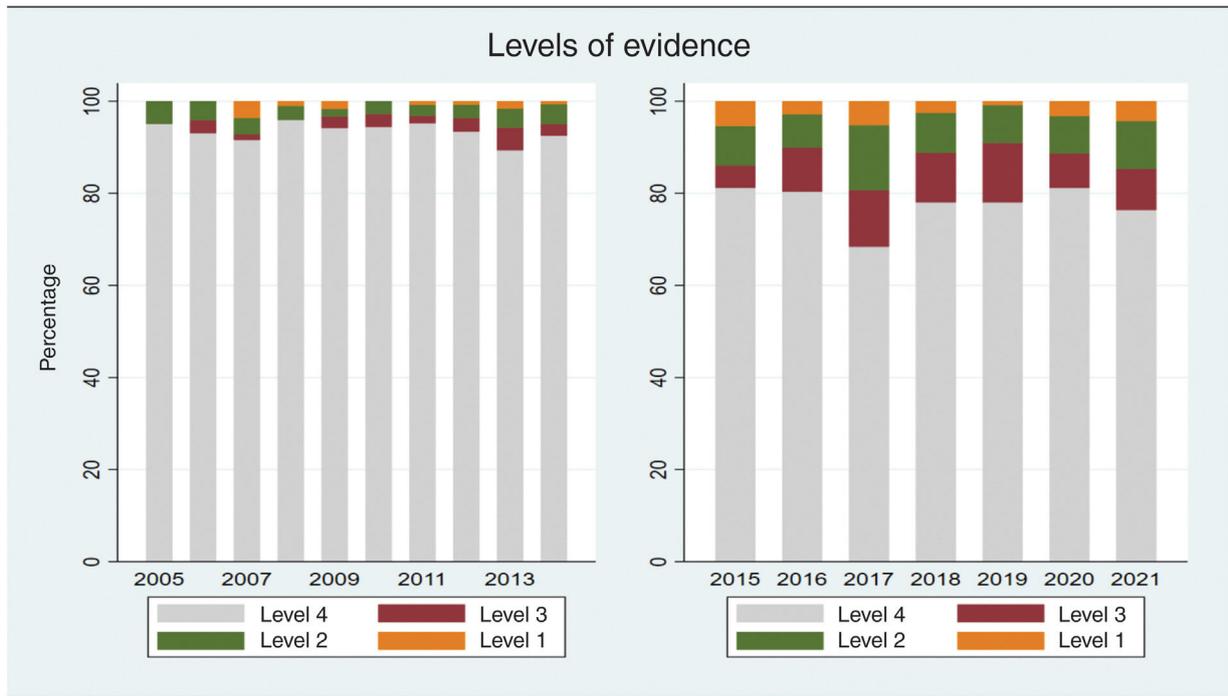**Figure 4** Level of evidence according to the Centre for Evidence-Based Medicine (CEBM) of clinical research articles in the studied period (2015-2021) and the previous period (2005-2014).
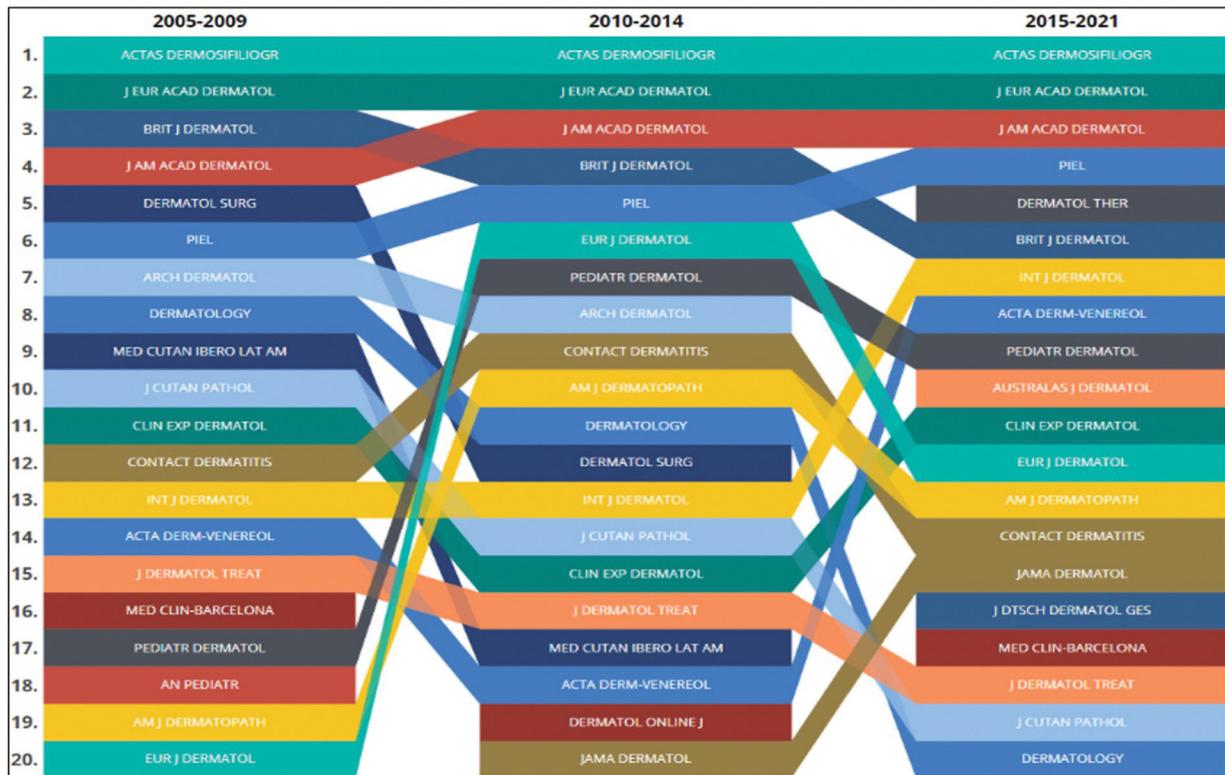

Figure 5 Ranking of the 20 journals with the largest number of publications according to the studied period. Note that the journal *Archives of Dermatology* changed its name to *JAMA Dermatology* in 2013.

Figure 6 Interactive map with the scientific production in clinical dermatological research by Spanish provinces and centers. Available online: https://aedv.es/investigacion/proyectos-de-investigacion/maind-mapa-de-centros-de-investigacion-clinica-dermatologica-espanola/.

Discussion

We present an update of a bibliometric study on the research activity of Spanish dermatological centers and institutions from 2015 through 2021, comparing the results with those previously published (2005-2014).[7,8] As a new feature, we present an online interactive map that facilitates the reader's visualization and interpretation of bibliometric data to draw comparisons of productivity and impact across multiple provinces or centers.

Among the results obtained, a continuous growth in scientific production stands out, both in the number of publications and in the number of centers that have made a publication. Of note that this increase occurs in both the public and private sectors. There is a significant increase in production vs the previously studied period, which confirms that Spanish dermatologists are increasingly involved not only in research but also in clinical practice. The highest increase in publications was reported in 2020 and happened at the same time the COVID-19 pandemic began, an increase mainly attributed to COVID-19-related publications.[11] In 2020, Spain ranked 3rd as the country with the largest number of COVID-19-related publications in dermatological

journals.[12] In a recent bibliometric study of dermatological publications recorded in Scopus,[2] Spain ranks 8th worldwide as the country with the highest number of articles.

The growing trend in the impact made by Spanish clinical dermatological research is also noteworthy, seen in the mean number of citations per year per article. This data is consistent with the higher impact factor (Journal Impact Factor [JIF]) of dermatology journals from 1997 through 2017,[13] associated with an increase in citations and a growing proportion of citations from non-dermatology journals, reflecting a rising influence of dermatological research. Furthermore, the increase in the mean number of citations per year per article reported in 2020 may also be influenced by the COVID-19 pandemic, as it has been reported that COVID-19 articles are cited at significantly higher rates than non-COVID-19 articles included in the same journal.[14]

Regarding scientific evidence levels, more articles with higher levels of evidence are being published, which was not the case in the previous period. A recent study shows that from 2007 through 2018, there has been an increase in the number of systematic reviews or meta-analyses—considered high-level evidence studies—within the top 10 dermatology journals.[15] Additionally, if we analyze the percentage of articles excluded from 2015 through 2021 for not meeting the minimum required scientific evidence, we find that our results show a lower percentage (73% out of 6097 articles) vs the previous period[7] (84% out of 6909 articles). The

increase in the proportion of higher-level evidence studies reflects better methodological quality in the conducted research, with greater structural support given the complexity of these studies. Of note the role of the Spanish Academy of Dermatology and Venereology (AEDV) through its Research Unit (RU) in this regard. The main objectives of this RU are to promote the participation of AEDV members in multicentric and methodologically sound studies, increase independent scientific production and visibility of such members, working groups, and AEDV, as well as to enhance collaboration between centers regarding research to improve the representativeness and quality of studies.[16] Since its creation back in 2012, the AEDV RU has contributed to the publication of 61 articles that met the study inclusion criteria, having a significant impact on the scientific community, with a mean 8.3 citations per article. Furthermore, more than half of these articles have a high level of evidence, with 26% and 41% being classified as evidence level 1 and 2, respectively.

Regarding the journals where Spanish dermatologists publish, *ACTAS DERMOSIFILIOGRÁFICAS* remains the primary scientific dissemination outlet. Moreover, these articles have a growing level of evidence, usually published as original articles. A recent study has established a relationship between the publication of original articles and the higher impact factor of journals.[17] These 2 facts, along with the previously noted increase in citations per article, may have contributed to the recent acquisition of the impact factor by the above-mentioned journal. On the other hand, of note that there has been a decline in the ranking of journals in the field of dermatopathology, such as *The American Journal of Dermatopathology* or *The Journal of Cutaneous Pathology*. However, the overall number of articles published in these journals in the most recent study period is similar or greater than in the previous period, revealing that the increase in scientific production follows a greater interest in fields other than pathological anatomy, and that production in this specialty remains stable.

The results of this study have the following main limitations: 1) The exclusion of studies in which the corresponding author's address is not a Spanish dermatological center. These articles include international multicentric studies, such as clinical trials on drugs whose inclusion would presumably alter the results regarding citations and evidence levels. However, this criterion was followed to make the results comparable with previous publications (considering that in the previous period Scopus only recorded the corresponding author's address and not that of the other participants, making it impossible to identify these articles). 2) The classification of the levels of evidence of each article by a single evaluator, with participation from a second evaluator only in doubtful cases. The participation of more than 1 evaluator would provide greater validity to the obtained results. In any case, acknowledging these limitations, this study provides a unique source of information on Spanish dermatological research.

Results allow us to assess the scientific production of dermatology in Spain and show an upward trend in the number of articles, level of evidence, and impact. Ultimately, an encouraging growth to which AEDV is contributing.

Conflicts of interest

None declared.

Acknowledgements

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