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Scientometric Evaluation of the Itch Mite, *Sarcoptes scabiei* (Acari: Sarcoptidae): The Last Four Decades of Global Academic Output on Scabies

Sarcoptes scabiei (Acari: Sarcoptidae), Uyuzunun Scientometrik Değerlendirmesi: Uyuz Üzerine Küresel Akademik Çıktının Son Kırk Yılı

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ABSTRACT

Objective: Scabiosis, the infestation of the skin with *Sarcoptes scabiei*, is a neglected tropical disease, with at least 200 million people being infested with the parasite at any time. It is estimated that scabies is responsible for 0.07% of the total burden of disease worldwide. Objective of this study is to perform a scientometric analysis of *S. scabiei* literature using the Web of Science Core Collection database for the years 1981-2020.
Methods: All documents indexed between 1981 and 2020 in scabies literature were analyzed by using a search string including keywords of "scabies", "*Sarcoptes scabiei*" and "*S. scabiei*" in Web of Science Core Collection database. We excluded all materials including data on the bacterium species named Streptomyces scabies and *Streptomyces scabiei*.
Results: Overall, 2,933 articles were retrieved on scabies, 66.3% of which were original article. With 663 publications the USA was the most productive country, while The International Journal of Dermatology was the journal with the highest number of publications on scabies. Half of the most productive institutions and seven of the top ten prolific authors were also from Australia. The National Health and Medical Research Council of Australia was the most supportive funding agency. With 4,706 citations, 2020 was the year with most references on scabies. The most cited publication was "The Global Burden of Skin Disease in 2010: An Analysis of the Prevalence and Impact of Skin Conditions" by Hay et al. in the Journal of Investigative Dermatology with a total of 565 citations. The most collaborative country was Australia and the most cooperative institution was the University of Melbourne.
Conclusion: The majority of the studies were done in a given country while multicenter studies are very rare. It is recommended that more studies should be conducted on scabiosis in developing countries where the problem of scabies is the biggest.
Keywords: *Sarcoptes scabiei*, scabies, scientometric evaluation, bibliometrics

ÖZ

Amaç: Uyuz, derinin *Sarcoptes scabiei* ile enfestasyonudur. Herhangi bir zaman diliminde en az 200 milyon insan bu parazit tarafından enfeste edilmekte olup, küresel öneme sahip ihmal edilmiş bir tropikal hastalıktır. Uyuzun dünya çapındaki toplam hastalık yükünün %0,07'sinden sorumlu olduğu tahmin edilmektedir. Bu çalışmanın amacı; 1981-2020 yılları için Web of Science Core Collection veritabanını kullanarak uyuz etkeni *S. scabiei* ile ilgili literatürünün scientometrik analizini yapmaktır.
Yöntemler: Web of Science Core Collection veritabanında "scabies", "*Sarcoptes scabiei*" ve "*S. scabiei*" anahtar kelimelerini içeren bir arama dizisi kullanarak, uyuz literatüründe 1981-2020 yılları arasında indekslenen tüm belgeler analiz edilmiştir. *Streptomyces scabiei* adlı bakteri türleri hakkındaki veriler araştırmanın kapsamına alınmamıştır.

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Türkiye PARAZİTOLOJİ Dergisi

Bulgular: Genel olarak, uyuzla ilgili 2,933 makale işleme alındı ve bunların %66,3'ü orijinal makaleydi. Altı yüz altmış üç yayın ile ABD en üretken ülke olurken, The International Journal of Dermatology uyuz konusunda en fazla yayına sahip dergi oldu. En üretken kurumların yarısı ve en üretken on yazarın yedisi de Avustralya'dandı. En çok atıf alan yayın, Journal of Investigative Dermatology'de toplam 565 atıf ile Hay ve ark.'nın yayınladığı "The Global Burden of Skin Disease in 2010: An Analysis of Prevalence and Impact of Skin Conditions" olmuştur. En işbirlikçi ülke Avustralya ve en işbirlikçi kurum Melbourne Üniversitesi idi.

Sonuç: Çalışmaların çoğu belirli bir ülkede yapılmış olup çok merkezli çalışmalar oldukça nadirdir. Uyuz sorununun en çok görüldüğü gelişmekte olan ülkelerde bu konuda daha fazla çalışma yapılması önerilir.

Anahtar Kelimeler: *Sarcoptes scabiei*, skabies, uyuz, scientometrik değerlendirme, bibliometric

INTRODUCTION

Scabiosis is the infestation of the skin with the itch mite, *Sarcoptes scabiei*. It is a neglected tropical disease of global significance, with at least 200 million people being infested with the parasite at any time. It has been estimated that scabies is responsible for 0.07% of the total burden of disease worldwide. This ectoparasite was held responsible for >0.21% of disability-adjusted life years from all conditions studied by Global Burden Disease in 2015 and ranked in the 101st place (1).

Depending on the country or population examined, the prevalence of scabies ranges between 0.2% and 71%, while it mostly affects people living in humid and hot areas such as in Central and South America (2-8).

The prevalence of scabies among children from low-income countries ranges between 0.2% and 24% while in endemic tropical regions the prevalence is estimated between 10-25% and in the Pacific region as high as 50% (9). Scabies prevalence in Aboriginal and Torres Strait Islander children in Australia is estimated to be as high as 33%, while this population group also have very high rates of secondary complications such as impetigo, rheumatic heart disease and post-streptococcal glomerulonephritis (10). A total of 34% of Aboriginal and Torres Strait Islander Australians are under the age of 18 years, compared with just 18% of non-Aboriginal Australians. This younger age profile likely contributes to the high prevalence of scabies among those children as there is a higher risk of transmission due to poor hygienic conditions and lack of social distancing (11).

In American Samoa, located in the South Pacific Ocean, 1,139 children with scabies (incidence 29.3/1.000 children aged ≤14 years) were identified during the years 2011-2012. Overall, 53% of the children has a bacterial superinfection while 15.3% had one or more re-infestations (9).

Scabies may also cause emotional and social problems. In the Fortaleza slams, capital of Ceara State, Brazil, a modified dermatology life quality index was used to assess the quality of life in 58 children with scabies. Overall, 46.6% of the children had the feeling of shame, 29.3% dressed differently, 36.8% restricted their leisure activities, 17.9% felt social exclusion, 25% stigmatization and 26.3% teasing by other children, when girls perceived more restrictions than boys (12).

Scabies is however also a public health issue in developed countries, especially among immunocompromised, disabled individuals and residential and nursing care home residents. In Europe, outbreaks occurred in a further education college for persons with learning disabilities, in a school for children with learning disabilities, in a workshop for handicapped children, in a day care center, and in a kindergarten (13,14).

In humans, the variety *var. hominis* usually burrows in the interdigital areas of the hands, wrists, feet and ankles, around the nipples in females and on the penile shaft in males. The antigens of the mites elicit a pruritic hypersensitivity reaction 3-6 weeks after the initial infestation. A polymorphic papular rash can be seen, especially in areas such as the waist, thighs, lower buttocks, lower legs, ankles and wrists. The damage done to the skin through scratching could lead to superinfections with pathogenic bacteria such as *Streptococcus pyogenes* and *Staphylococcus aureus*, as a result of which sepsis, indirect effects on renal and cardiovascular complications can develop, leading sometimes even to death (7). Ordinary scabies is characterized by a low number of mites (usually less than 15 per patient), while the crusted scabies is a rather rare form of the disease characterized by the presence of thousands of mites. The latter is a hyperkeratotic skin condition with formation of thick and scaly crust and involves face, eyelids, neck, and scalp, when mites can also be found under the hand nails of the affected subjects, and secondary infections are common (2,3,15,16).

Sarcoptic mange is known from over 100 domestic and wild mammal species, and also in these cases the clinical symptoms depend on the immune status of the host animal. Immunocompetent animals usually develop strong type I and IV hypersensitivity reactions while they are infested with a low number of mites. However, with the time the skin becomes thickened, greyish in color and it is characterized by a marked eosinophilia in epidermis and dermis accompanied with an extensive alopecia. Immunocompromised animals develop a general hyperkeratosis with a large number of mites and an underlying chronic dermal inflammation (17).

Scientometrics also known as bibliometrics and as "science of science" is a popular statistical branch providing information on publication trends and patterns in a certain academic area (18). Scientometric studies reveal holistic evaluation on productivities of the authors, institutions and countries producing academic documents. Although scabies is a common disease and there has been an increasing interest in scientometrics in the last decades, only few publications exists on the scientometric assessment on scabies literature (19,20). This study aims to perform a holistic analysis of scabies literature.

METHODS

We analyzed all documents indexed between 1981 and 2020 in scabies literature by using a search string including keywords of "*scabies*", "*Sarcoptes scabiei*" and "*S. scabiei*" in Web of Science (WoS) Core Collection database. We chose WoS database since it was reported that it was the most reliable source in academic literature evaluation (21). We excluded all materials including data on the bacterium species named *Streptomyces scabies* and *Streptomyces scabiei*.

Statistical Analysis

For statistical analysis of data for percentages, frequencies and trend analysis MS Office Excel 2020 were used. The info map revealing countries producing scabies publications was generated in a free web source titled Paintmaps (22). All literature data of the indexed documents were downloaded from WoS database using the export option for scientometric network analysis and text files were created to be processed in VOSviewer literature analyze section. Scientometric network images were created by using VOSviewer version 1.6.11 (www.vosviewer.com, Centre for Science and Technology Studies, Leiden University, The Netherlands) (23).

Ethical approval and patients' consents are not needed for this research since neither human nor animal included.

RESULTS

General Features of the Literature

Our main search with the keyword string retrieved 2,933 articles, 806 of which were open access documents. The most indexed article type was original article (66.3%) followed by letter, review, and editorial material (9.3, 8.4 and 6.7%, respectively; Table 1). The most studied areas were Dermatology, Infectious Diseases, and Internal Medicine (34.7, 12.1 and 11.9%, respectively; Table 1). English was the main language of the literature covering 87.6% of all publications followed by German, French and Spanish (4.5, 4.4 and 1.6%, respectively).

Only one item was indexed under the topic "Scabies" in the WoS Core Collection between 1975 and 1979, which was a poetry titled "Scabies" and published in 1977 in Malahat Review. In 1981 there were 24 documents in WoS database and the year in which the most papers were published was recorded as 2020 with 233 items (Figure 1). We chose 1981 as the starting year for our study since we examined four decades of medical literature on the topic of scabies.

Productivities of Countries, Source Titles, Authors and Institutions

The USA was the most productive country with 663 documents (22.6%) followed by Australia, France, Germany, the United Kingdom (UK) and India (11.9, 8.2, 6.7 and 6.4%, respectively; Figure 2). Scabies articles were produced all over the world except in the majority of countries in Africa (Figure 3). The most contributor source titles were International Journal of Dermatology, Journal of The American Academy of Dermatology and British Journal of Dermatology (n=101, 97 and 70 items, respectively: Table 1). The most prolific author was Currie BJ from Australia with 59 papers (Table 1). Half of the most productive institutions were from Australia and seven of the top ten prolific authors were also from Australia (Table 1).

National Health and Medical Research Council of Australia, United States Department of Health Human Services and National Institutes of Health (USA) were the most supportive funding agencies (n=77, 68 and 58 studies, respectively).

Citation Analysis

H-index of scabies literature between 1981 and 2020 was calculated as 77 and total number of citations was 43,873 (25,830 without self-citations). Average citations per item were noted as 14.96. Top year according to citation number by year was 2020 with 4,706 records. The most cited document of scabies literature was an original article titled "The Global Burden of Skin Disease in 2010: An Analysis of the Prevalence and Impact of Skin Conditions" by Hay et al. (24) published in 2014 in the Journal of Investigative Dermatology with a total of 565 citations (Table 2) (1-3,24-30).

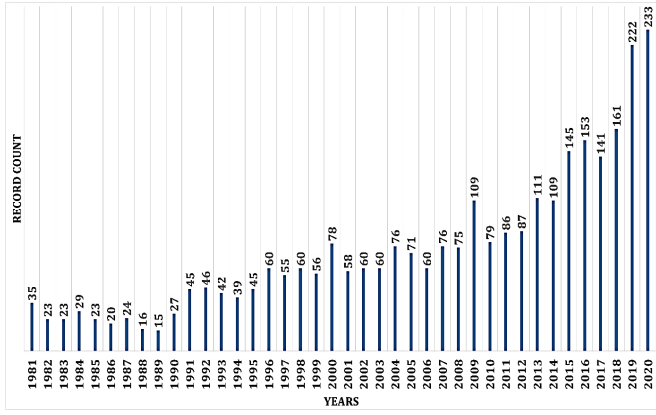

Figure 1. Number of publications on scabies between the years 1981 and 2020

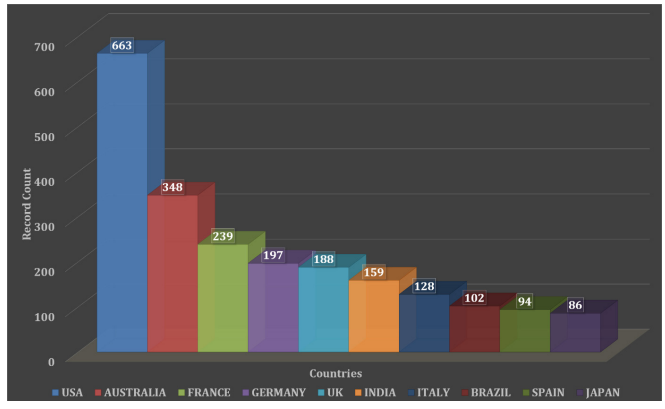

Figure 2. Countries with the highest number of publications on scabies

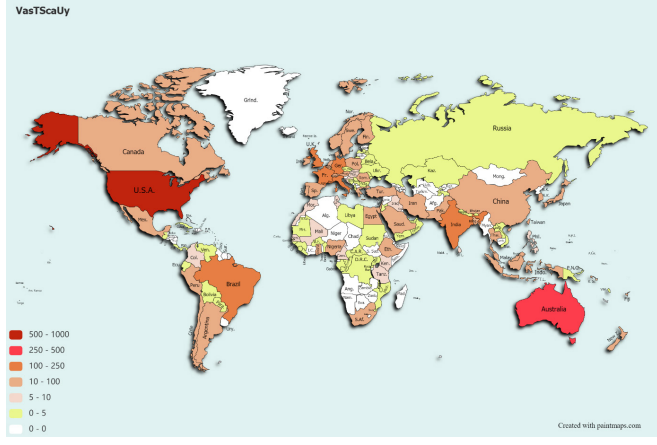

Figure 3. Distribution of scabies articles according to the country in which they were written

Table 1. Top ten document types, research areas, source titles, authors and organizations in scabies literature between 1981 and 2010

Document type		**Number**	**%[a]**	
Original article		1,944	66.280	
Letter		272	9.274	
Review		247	8.421	
Editorial material		197	6.717	
Meeting abstract		166	5.660	
Note		57	1.943	
Proceeding paper		57	1.943	
Book chapter		37	1.262	
News		7	0.239	
Biographical item		3	0.102	
Research area				
Dermatology		1,019	34.743	
Infectious diseases		356	12.138	
Internal medicine		349	11.899	
Occupational health		270	9.206	
Parasitology		235	8.012	
Veterinary sciences		223	7.603	
Tropical medicine		220	7.501	
Pediatrics		172	5.864	
Pharmacology		113	3.853	
Immunology		112	3.819	
Journal name				
International Journal of Dermatology		101	3.444	
Journal of The American Academy of Dermatology		97	3.307	
British Journal of Dermatology		70	2.387	
PLOS Neglected Tropical Diseases		65	2.216	
Annales de Dermatologie et de Venereologie		59	2.012	
Hautarzt		56	1.909	
Pediatric Dermatology		55	1.875	
American Journal of Tropical Medicine and Hygiene		49	1.671	
Archives of Dermatology		39	1.330	
Journal of Dermatology		37	1.262	
Author	**Institution**	**Country**	**Number**	**%**
Currie BJ	Royal Darwin Hospital	Australia	59	2.012
Fischer K	Queensland Institute of Medical Research	Australia	56	1.909
Chosidow O	Paris-Est Créteil University	France	47	1.602
Steer AC	Murdoch Children's Research Institute	Australia	44	1.500
Walton SF	University of the Sunshine Coast	Australia	44	1.500
Arlian LG	Wright State University	USA	39	1.330
Morgan MS	Wright State University	USA	33	1.125
Romani L	University of New South Wales	Australia	30	1.023
Engelman D	University of Melbourne	Australia	29	0.989
Kemp DJ	Queensland Institute of Medical Research	Australia	28	0.955
Organizations		**Country**	**Number**	**%**
Charles Darwin University		Australia	119	4.057
Menzies - School of Health Research		Australia	119	4.057
QIMR Berghofer Medical Research Institute		Australia	114	3.887
Assistance Publique - Hôpitaux de Paris		France	91	3.103
University of Melbourne		Australia	77	2.625
University of London		UK	65	2.216
University of California System		USA	64	2.182
University of Queensland		Australia	59	2.012
Murdoch Children's Research Institute		Australia	58	1.977
Wright State University		USA	50	1.705
Total		**2.933**	**100**	

[a]Total percentage may exceed 100% because certain items were included in more than one category, UK: United Kingdom, USA: United States of America

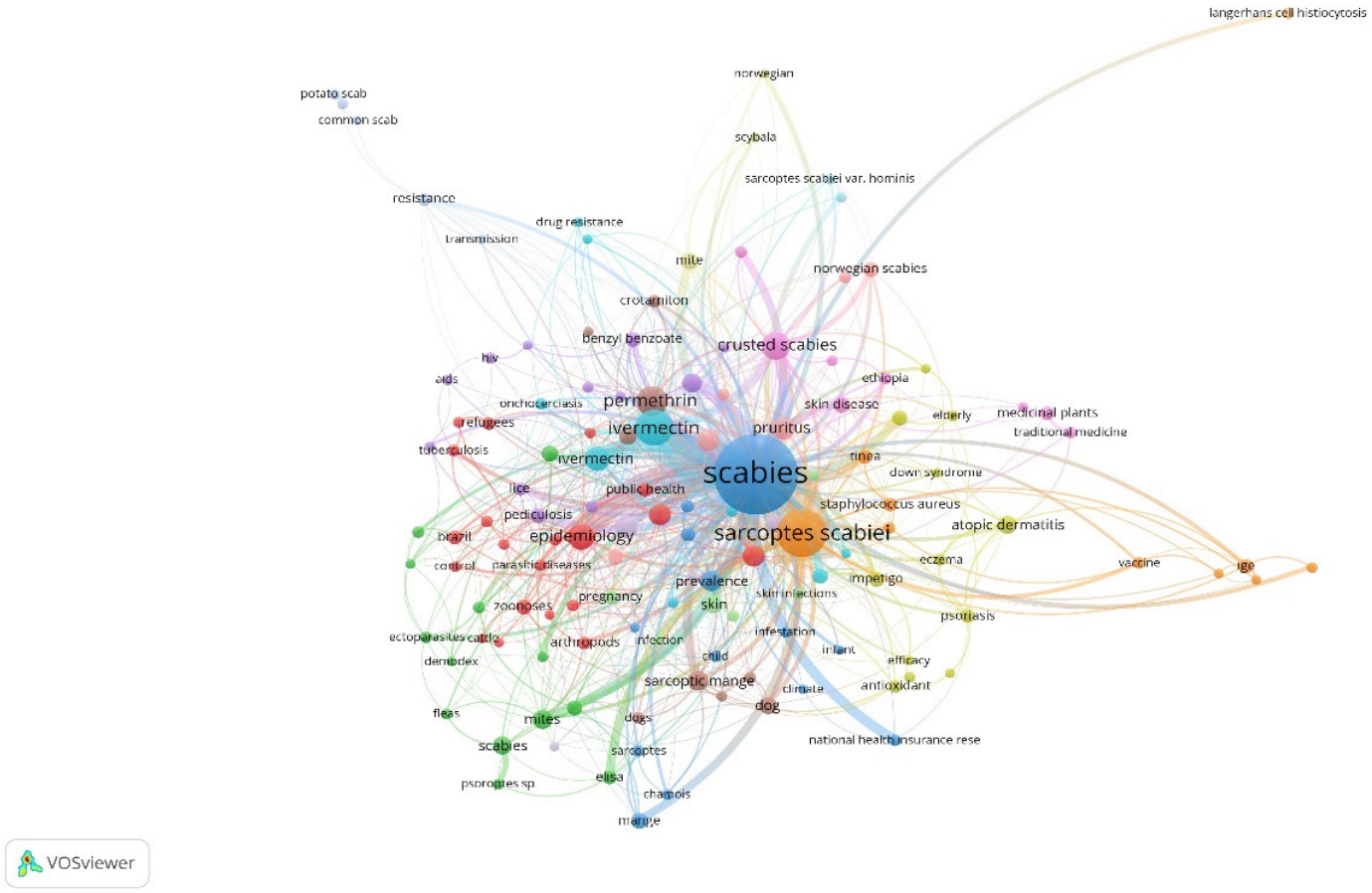

Figure 4. Scientometric network analysis of keywords in a starburst pattern where the keyword "scabies" is centered in

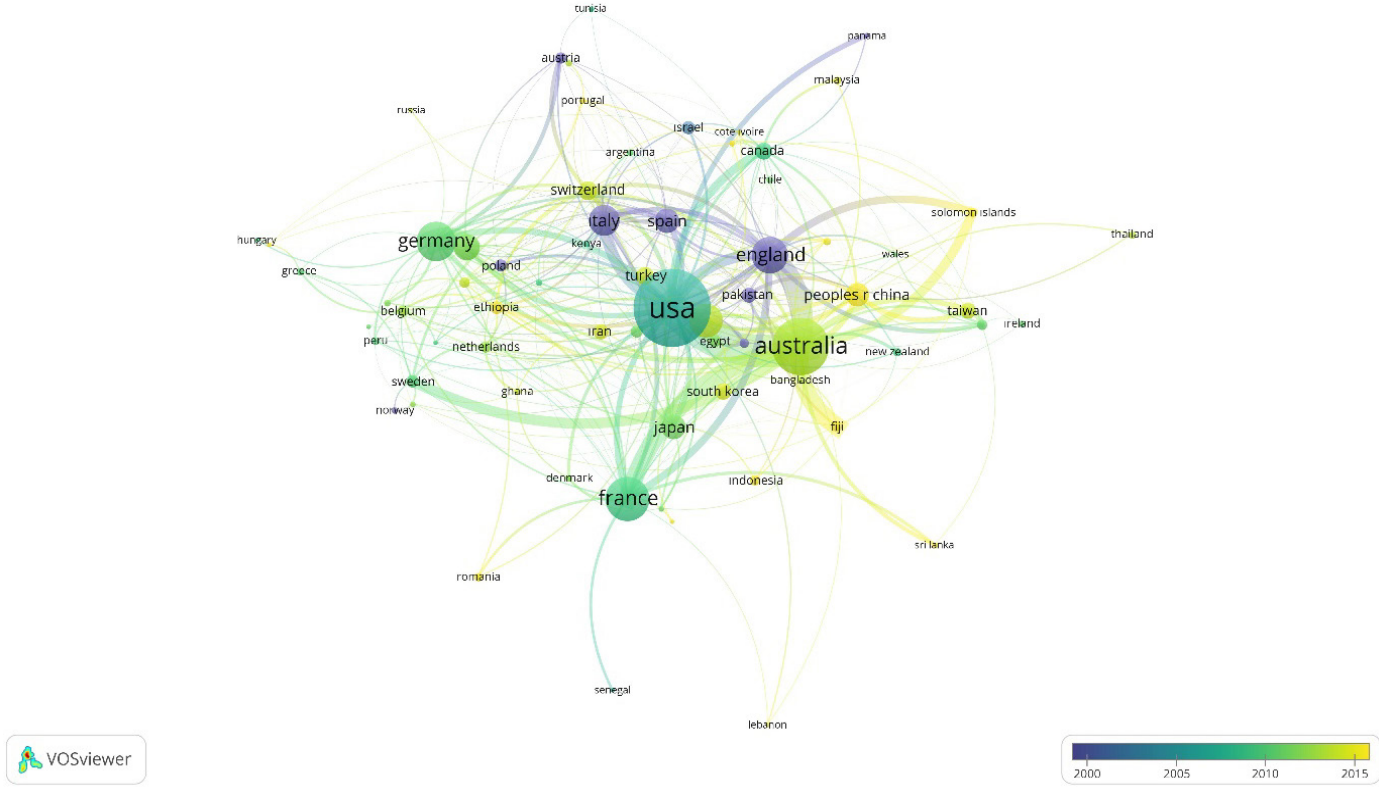

Figure 5. The most collaborative countries which published articles on scabies

Scientometric Networks

The most indexed keywords were "scabies", "*Sarcoptes scabiei*", "ivermectin", "permethrin", "crusted scabies" and "epidemiology" (Table 3). Scientometric network analysis of keywords revealed a starburst pattern that the keyword of "scabies" centered in (Figure 4). The most collaborative countries were Australia, the USA, the UK, France, and Germany (Figure 5). It was noted that top five cooperative institutions were from Australia, i.e., University of Melbourne, Charles Darwin University, University of Queensland, Menzies - School of Health Research, and Murdoch Children's Research Institute (Figure 6).

DISCUSSION

In the present study using the Web of Science Core Collection database 2,933 articles were detected. A search by Google Scholar using the words "*Sarcoptes scabiei*" gave 16,900 hits (17,300 when not in brackets), while the number of publications on this subject in PubMed was 1,218 and 1,220 when used in brackets and without, respectively.

Romani et al. (30) searched Medline, Embase, and LILACS for the years 1985-2014 regarding the prevalence of scabies and impetigo, and found 2.409 articles, 48 of which were relevant for their analyses. With the exception of North America to which no data were available, scabies prevalence was between 0.2-71.4%. With the exception of Europe and Middle East the prevalence of scabies was >10%, while it was highest in the Pacific and Latin American regions. More children than adolescents and adults were infested with scabies, who also showed the highest percentages of impetigo, when the highest prevalence (49.0%) was seen in Australian aboriginal communities.

Bansal (19) using the PubMed retrieved 1,460 articles relevant to scabies between the years 2001 and 2015. The number of publications on scabies increased from 95 in 2001 to 137 in 2015.

Table 2. The ten most cited manuscripts in scabies literature between 1981 and 2020 (1-3,24-30)

Article	Author	Journal	Total citation	Average citations per year
The global burden of skin disease in 2010: An analysis of the prevalence and impact of skin conditions	Hay et al. 2014 (24)	Journal of Investigative Dermatology	565	70.63
Scabies and pediculosis	Chosidow, 2000 (25)	Lancet	265	12.05
Scabies	Chosidow, 2006 (2)	New England Journal of Medicine	252	15.75
The treatment of scabies with ivermectin	Meinking et al. 1995 (26)	New England Journal of Medicine	230	8.52
Scabies: A ubiquitous neglected skin disease	Hengge et al. 2006 (27)	Lancet Infectious Diseases	215	13.44
Problems in diagnosing scabies, a global disease in human and animal populations	Walton & Currie, 2007 (28)	Clinical Microbiology Reviews	200	13.33
Scabies	Heukelbach & Feldmeier, 2006 (3)	Lancet	199	12.44
Global skin disease morbidity and mortality an update from the Global Burden of Disease Study 2013	Karimkhani et al. 2017 (1)	JAMA Dermatology	192	38.4
Crusted scabies: clinical and immunological findings in seventy-eight patients and a review of the literature	Roberts et al. 2005 (29)	Journal of Infection	191	11.24
Prevalence of scabies and impetigo worldwide: a systematic review	Romani et al. 2019 (30)	Lancet Infectious Diseases	177	25.29

Table 3. The 20 most used keywords in scabies literature. Keyword (total link strength)

1.	Scabies (372)	11.	Dermoscopy (21)
2.	*Sarcoptes scabiei* (116)	12.	Mite(s) (19)
3.	Ivermectin (73)	13.	Diagnosis (17)
4.	Permethrin (51)	14.	Skin (14)
5.	Crusted scabies (39)	15.	Lindane (13)
6.	Epidemiology (35)	16.	Dog (12)
7.	Children (23)	17.	Impetigo (12)
8.	Pruritus (23)	18.	Atopic dermatitis (11)
9.	Prevalence (22)	19.	Norwegian scabies (11)
10.	Sarcoptic mange (22)	20.	Outbreak (11)

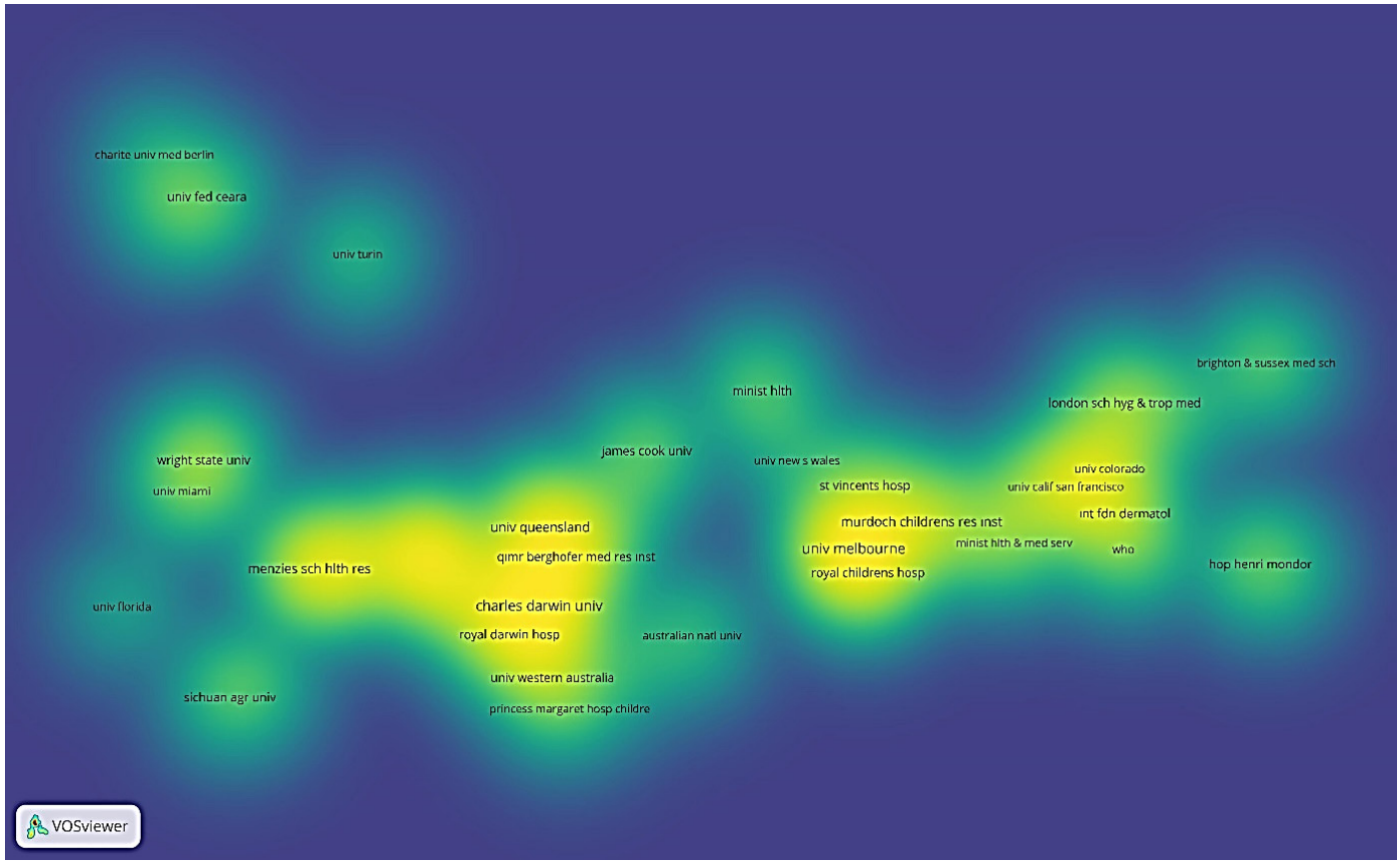

Figure 6. The institutions worldwide were the scabies articles were created

With 46 articles, Veterinary Parasitology topped the list of journals with the highest number of publications on scabies, followed by International Journal of Dermatology (27 articles) and Pediatric Dermatology (25 articles), while the first six most prolific authors on scabies were from Australia (B.J. Currie, S.F. Walton, K. Fischer, JS McCarthy, D.C. Hold and D.J. Kemp).

Singh et al. (20) using the Scopus Database for the years 2009-2018, found 2,268 publications on scabies, most of them coming from USA, followed by India, Australia, UK and France. The most cited articles were published in the Lancet and Journal of Investigative Dermatology. The top 5 organizations were from Australia. Top authors contributing in this field include O. Chosidow with 28 publications, followed by K. Fischer B.J. Currie and A.C. Stier. Among the top scorer countries, the US and the UK has maximum collaboration of six and five countries each, towards scabies research.

Using Medline, Embase, WoS and Scopus, Rinaldi and Porter (31) found 353 publications on mass drug administration for endemic scabies, 12 of which was used for the evaluation of their study.

A systematic search of the databases CAB Direct, PubMed, Scopus, WoS, Embase, and Discovery revealed 2,205 publications on the treatment of sarcoptic mange in wildlife. Using Endnote X6 to remove the duplicates, 1.687 publications remained, 28 of which were relevant for the study (32).

To evaluate the cost-effectiveness of scabies interventions and using PubMed, Medline, Embase, CINAHL, and the Cochrane Library for the years 2000-2017, van der Linden et al. (7) identified 821 articles, 30 of which were include in their study.

Using Medline, Embase and Cochrane databases for the years 1946-2013, Thompson et al. (33) identified 239 articles regarding the diagnosis of scabies in therapeutic trials.

When the number of publications is evaluated by years, a linear increase from 1981 to 2020 can be seen, which in agreement with a scientometric analysis done with house dust mites and hirudotherapy (18,34).

With the exception of India and Brazil, the highest number of publications were done by scientists from developed countries such as USA, Australia, France, Germany, UK, Spain and Japan, which is in agreement with publications done on house dust mites (34).

The fact that Australia is leading in all aspects of scabies publications seems to be related to the fact that the infestation rate with scabies in the indigenous people of this continent is very high and accordingly a lot of attention has been paid to this ectoparasitosis (35,36).

Overall, it can be said that scientometric analysis using different databases, different years and keyworks can give different results, including the most prolific countries, authors and journals.

As limitations of the study, it could be indicated that publications from PubMed, Google Scholar, and Scopus were not included. In addition, WoS database uses only journals with high impact factors. It might be that some publications were included more than once, however it should be also noted that WoS is one of the most reliable databases (37,38).

CONCLUSION

The majority of the studies were done in a given country while multicenter studies are very rare. It is recommended that more studies should be conducted on scabiosis in developing countries where the problem of scabies is the biggest.

* Ethics

Ethics Committee Approval: Ethical approval and patients' consents are not needed for this research since neither human nor animal included.

Informed Consent: Ethical approval and patients' consents are not needed for this research since neither human nor animal included.

Peer-review: Internally and externally peer-reviewed.

* Authorship Contributions

Concept: K.Y.M., E.Ş., A.T.Ö., Design: K.Y.M., E.Ş., A.T.Ö., Data Collection or Processing: K.Y.M., E.Ş., A.T.Ö., Analysis or Interpretation: K.Y.M., E.Ş., A.T.Ö., Literature Search: K.Y.M., E.Ş., A.T.Ö., Writing: K.Y.M., E.Ş., A.T.Ö.

Conflict of Interest: No conflict of interest was declared by the authors.

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