Observational Study

Medicine

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Global research trends on systemic lupus erythematosus and thyroid cancers (1964–2023)

A scientometric and visualized study

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Abstract

Over the past 3 decades numerous studies have reported an association between systemic lupus erythematosus (SLE) and thyroid cancers. However, there has been no scientometric analysis in this area of research. To perform a comprehensive scientometric analysis of the global literature published on the association between SLE and thyroid cancers. The data on publications within thyroid cancers in SLE patients were retrieved from the Scopus database using a defined search strategy from its first publication in 1964 to 2023. To conduct a collaboration mapping analysis among keywords, authors, journals, and territories, VOSviewer was utilized. Our final research resulted in 246 scientific publications with 8072 citations, which were published in 198 journals affiliated to 48 countries. A global upward trend has been observed in the last 20 years, with the highest number of publications in the year 2022 (n = 28; 11.4%). The United States led the global productivity ranking with 74 publications (30.1%), followed by China with 25 publications (10.2%). The most popular journals in this field were "Arthritis Research and Therapy" and "Frontiers in Endocrinology," while the most co-cited journal was "Autoimmunity Reviews." The top 3 most prolific authors were Bernatsky, S., Clarke, A.E., and Ramsey-Goldman, R with 9 publications each. This first scientometric study comprehensively offered an overview of the status of thyroid cancers in SLE patients, assessing scholarly productivity in this domain over a period of 50 years.

Abbreviations: CPP = citations per publication, JCR = journal citation reports, POP = proportion of publications, SLE = systemic lupus erythematosus.

Keywords: Research productivity, research trends, scientometric study, systemic lupus erythematosus, thyroid cancer, visualization

1. Introduction

Systemic lupus erythematosus (SLE) is a chronic disorder, marked by the presence of autoantibodies resulting in multi-system organ dysfunction. Several studies indicated an overall increased cancer incidence, a major cause of morbidity, mortality, and reduced quality of life in SLE patients. According

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The authors have no conflicts of interest to disclose.

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

The ethical committee of Endocrinology and Metabolism Research Institute (EMRI), affiliated with Tehran University of Medical Sciences (TUMS), approved the study (reference IR.TUMS.EMRI.REC.1401.146).

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to published literature, there is growing evidence to reveal the positive association of SLE and the risk of developing some malignancy types, notably hematologic and thyroid cancers.[1–6]

Thyroid cancer is the most frequent malignant neoplasm in the endocrine system. According to a study conducted in the United States by L. Rahib and colleagues, it is anticipated that due to the global upward trends in the incidence, thyroid carcinoma could become the fourth most prevalent cancer by 2030.[7,8] Over the last 3 decades, several studies demonstrated the higher rates of thyroid cancers in SLE patients as compared with the matched general populations, however, the results still remain inconclusive.[9–12] Clarke et al conducted a meta-analysis, which reported that SLE patients have a one and a half (≥1.5) times increased risk of thyroid carcinoma versus the general populations.[13]

To the best of our knowledge, the existing literature lacks a scientometric study focusing on the assessment of research productivity on SLE and thyroid cancers, and a comprehensive analysis is required to address this gap. Reviewing the scientific publications could be useful for monitoring the process and details of scientific content and technical details that are effective in better management and targeted planning of study design and direction of appropriate dissemination of results.

This study aimed to present the current state of knowledge and pinpoint the research gaps to appraise global research productivity on thyroid cancers in patients with SLE, providing valuable insights for researchers and clinicians to identify areas for future investigation.

2. Methods

The present study is a scientometric analysis of scientific publications on SLE and thyroid cancers, reviewing publication trends, numbers, types, citations, collaborative countries, institutions, journals, references, authors, and keywords with global indices. As the most comprehensive health and biomedicine discipline, "Scopus" database was systematically searched, using a defined search strategy for all scientific publications related to the association between SLE and thyroid cancers. Papers published were considered the main index of scientific products, while citations were detected as a proxy for the quality and application of the papers. Benefitting from the MeSH categories and Emtree, the terms "Lupus" and "Thyroid cancer," were used to design and complete the search strategy (Appendix 1) (see Table, Supplemental Digital Content, http://links.lww.com/MD/M983, which illustrates the search strategy for SLE and thyroid cancers research productivity.). There was no limitation for language or time of publications. To prevent errors resulting from database upgrade, all the literature utilizes in this study was retrieved and downloaded on January 6, 2024. The ethical committee of Endocrinology and Metabolism Research Institute (EMRI), affiliated with Tehran University of Medical Sciences (TUMS), approved the study (reference IR.TUMS.EMRI.REC.1401.146).

Tables of frequency, the time, and other various graphs were used to visualize the results. Microsoft Office Excel 2023 software was used to manage data and analyze annual publications. The indices for qualitative assessment included publications, proportion of publications (POP), citations, and citations per publication (CPP). The POP was calculated as the number of publications divided by the total number of publications. The CPP was defined as the number of citations divided by the number of publications. Furthermore, VOSviewer software (version 1.6.20) was used to draw visualization maps and visualize the relationships between countries, authors, journals, and keywords. Through this software and by considering thresholds involving at least one fractionally counted paper for each keyword, maps of related articles were created. For each term meeting the considered threshold, a relevance score was calculated, and based on this score, the most relevant terms were selected. The resulting map was created based on information from the title, abstract, and keywords.

3. Results

3.1. Publications and citations

This study identified a total of 246 scientific documents that met the inclusion criteria and were published on the

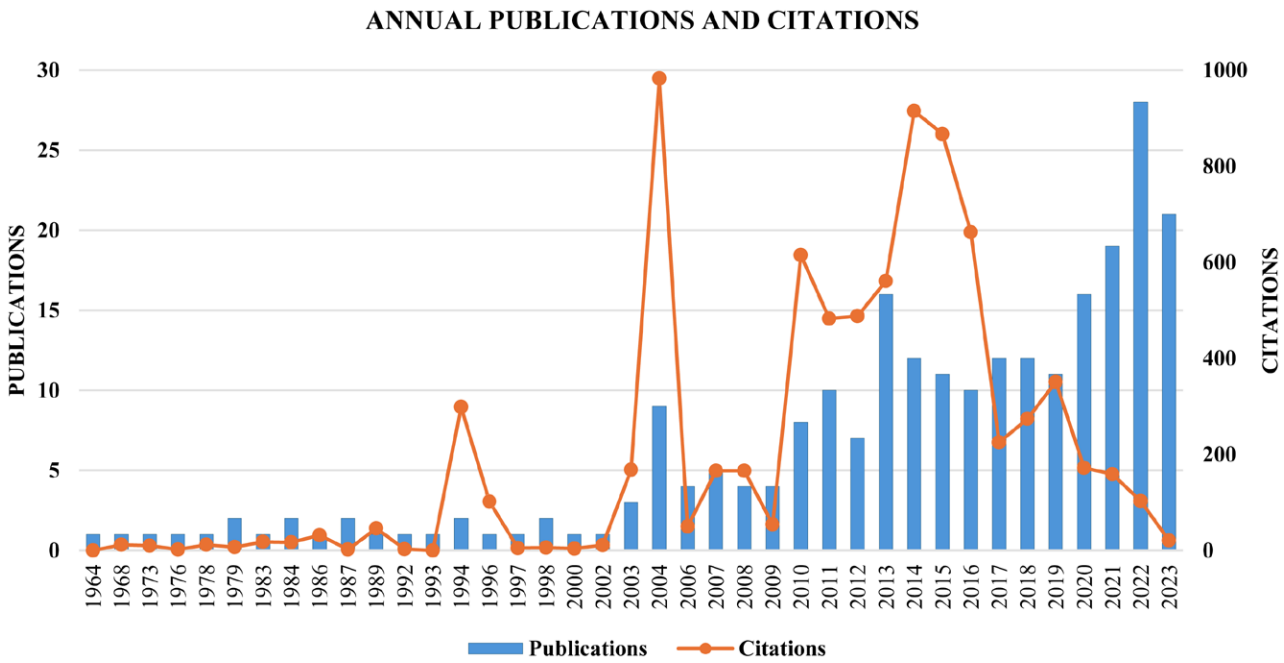

Figure 1. Annual trends of global publications and citations in SLE and thyroid cancers research field. Each bar in blue represents the number of every year's publications. Each node in yellow indicates the number of every year's citations.

association between SLE and thyroid cancers from 1964 to 2023. The earliest publications date back to 1964. All documents had gone through the final stage of the publication process and were fully released. A total of 8072 citations were found among the 246 publications retrieved for this topic. The annual distribution of publications and citations, reflecting the developmental trend of global research on this domain are shown in Figure 1. This figure highlights the increasing interest and clinical significance toward the association between lupus disease and thyroid cancers, particularly over past 2 decades. The growth in the number of publications has been notable, with an observed increase of over 10 publications yearly from 2013 to 2023. The year 2022 contributed the highest number of publications, with 28 publications (11.4%). In terms of citations, the year 2004 ranked as the top year with the highest number of citations (983; 12.2%) followed by 2014 (915; 11.3%), 2015 (867; 10.7%), and 2016 (663; 8.2%), respectively. According to the findings, 90.6 % of total citations within this topic contributed to the documents published between 2004 and 2023. This emphasizes the substantial influence of recent publications on the overall landscape of citations for this research field.

3.2. Document types and languages

During the time period analyzed, the most prevalent type of related documents associated with lupus disease and thyroid cancers was the document type "Article," accounting for 57.3% of all knowledge products. Subsequently "Review" (35.4%) and "Letter" (2.9%) constituted the next most prevalent document types (Fig. 2). The document types "Article" and "Review" collectively represent 92.7% of total publications. In terms of language, 237 (96.3%) papers were published in English, with 4 (1.6%) in Japanese, 2 (0.8%) in French and German, and 1 (0.4%) in Arabic, Chinese, and Spanish.

3.3. Subject areas

Table 1 lists the top 5 subject areas among the existing 16 areas in terms of productivity. This table provides a comprehensive overview of the most prolific areas of lupus disease and thyroid cancers research. Most of the distributed papers belong to the field of medicine (204; 82.9%), followed by biochemistry, genetics, and molecular biology (66; 26.8%), and immunology and microbiology (33; 13.4%). Our findings demonstrate that the field of immunology and microbiology has the highest citation/publication rate, with a rate of 68, respectively. Although the field of medicine led in terms of the number of publications and had the earliest publication start, it was observed that the citation/publication rate was lower compared to the other top 4 fields. This finding indicates that the quality of publications pertaining to the relationship between SLE and thyroid cancers in the field of medicine may necessitate further advancement.

3.4. Countries/territories

Considering the role of universities and other scientific institutes in the publication of papers, the top 3 impactful countries with the highest publication rates are the United States, China, and Italy, with 74 (30.1%), 25 (10.2%), and 23 (9.4%) publications, respectively (Figure 3 and Table 2). Based on citation analysis, the United States is the top contributing country with 2056 citations, followed by Italy with 1602 citations, and the United Kingdom with 1312 citations (Table 2). Furthermore, Citation/publication rate analysis reveals that although Germany ranked ninth globally, its citation/publication rate (72.3) was higher than other countries.

Figure 4 demonstrates cooperation among countries. The citation density visualization was constituted by including 20 countries with a minimum threshold of 1 document and 1 citation, resulting in 6 clusters, 106 links, and a total link strength of 428 (Fig. 4). Each node in the network represents a country, with node size is proportional to the number of citations.

3.5. Institution analysis

Among the organizational affiliations in publications on the link between SLE and thyroid cancers, 782 independent institutions were identified. The Northwestern University Feinberg School of Medicine (10; 4.1%), the University of Calgary, and the University of Pisa (9; 3.7%) had the highest frequency of publications, as illustrated in Figure 5. Table 3 presents the top 10 most prolific institutions, with half of them being situated in the United States. The University of Pisa has made a significant contribution in terms of citations and citation/publication rate, with 1306 citations and a rate of 145.1, respectively. This outstanding performance highlights the university's robust research presence and its profound impact on this domain.

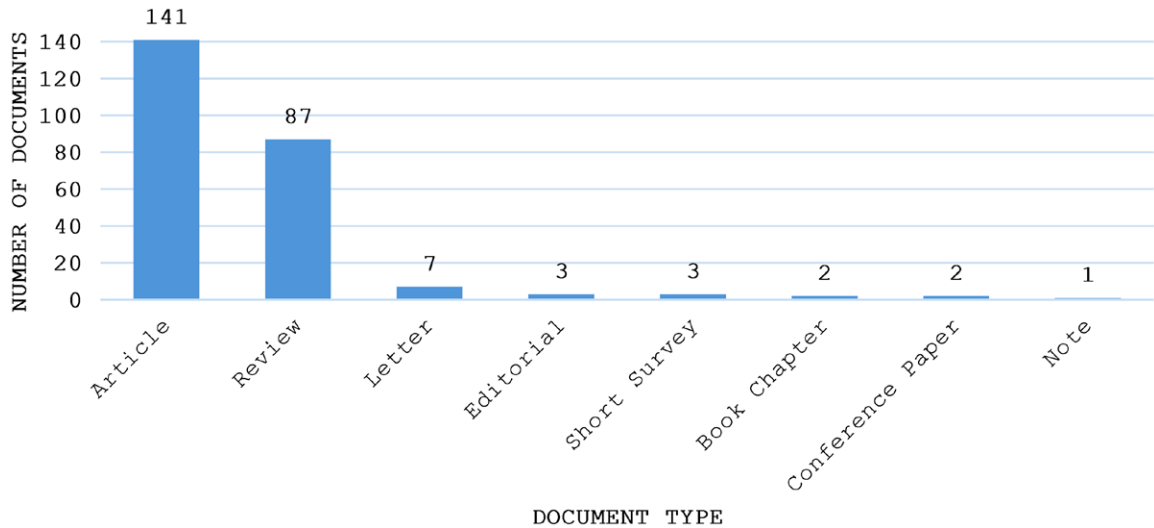

Figure 2. The global distribution of SLE and thyroid cancers research productivity by document type.

Table 1

The top 5 productive subject areas in SLE and thyroid cancers research.

Rank	Subject area (n = 16)	Publications	Proportion of publications	Citations	Citations per Publication	Publication Year start
1	Medicine	204	82.9%	6529	32	1964
2	Biochemistry, Genetics and Molecular Biology	66	26.8%	2805	42.5	1987
3	Immunology and Microbiology	33	13.4%	2245	68	1968
4	Pharmacology, Toxicology and Pharmaceutics	19	7.7%	723	38.1	1996
5	Multidisciplinary	5	2%	310	62	1989

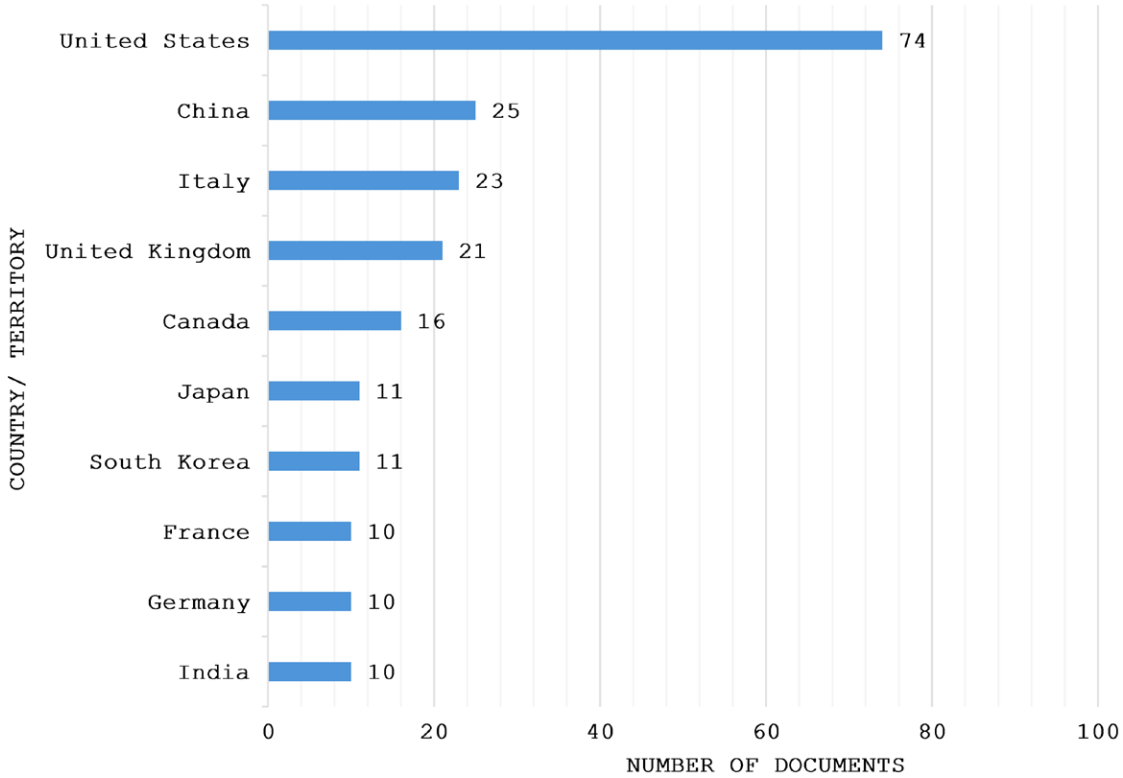

Figure 3. The global distribution of SLE and thyroid cancers research productivity by country/territory.

Table 2

Top 10 productive countries/territories in SLE and thyroid cancers research.

Rank	Country/territory (n = 48)	Publications	Proportion of publications	Citations	Citations per publication	Publication year start
1	United States	74	30.1%	2056	27.8	1986
2	China	25	10.2%	367	14.7	2008
3	Italy	23	9.4%	1602	69.7	1996
4	United Kingdom	21	8.5%	1312	62.5	1964
5	Canada	16	6.5%	804	50.3	1976
6	Japan	11	4.5%	133	12.1	1984
7	South Korea	11	4.5%	417	37.9	2011
8	France	10	4.1%	306	30.6	1973
9	Germany	10	4.1%	723	72.3	1979
10	India	10	4.1%	65	6.5	2012

3.6. Trend of journals

Table 4 illustrates the top 10 prolific source titles (journals) preferred by the researchers. The impact factor, quartile and categories were retrieved from the Journal Citation Reports (JCR). Eight of the 10 listed journals within this area of research were ranked as JCR quartile one, signifying their high quality. The journals "Arthritis Research and Therapy" and "Frontiers in Endocrinology" ranked at the top of the list by publishing the highest number of documents, with 5 publications each. The analysis ranked "Autoimmunity Reviews," "Lupus," "Medicine (United States)," and "Plos One" at the second position, with 4 publications each. Four journals were also found at the third position, due to an equal number of publications. The citation and citation/publication rate analysis among the top 10 journals, ranked the journal "Autoimmunity Reviews" at the top position with a total number of 1066 citations and a rate of

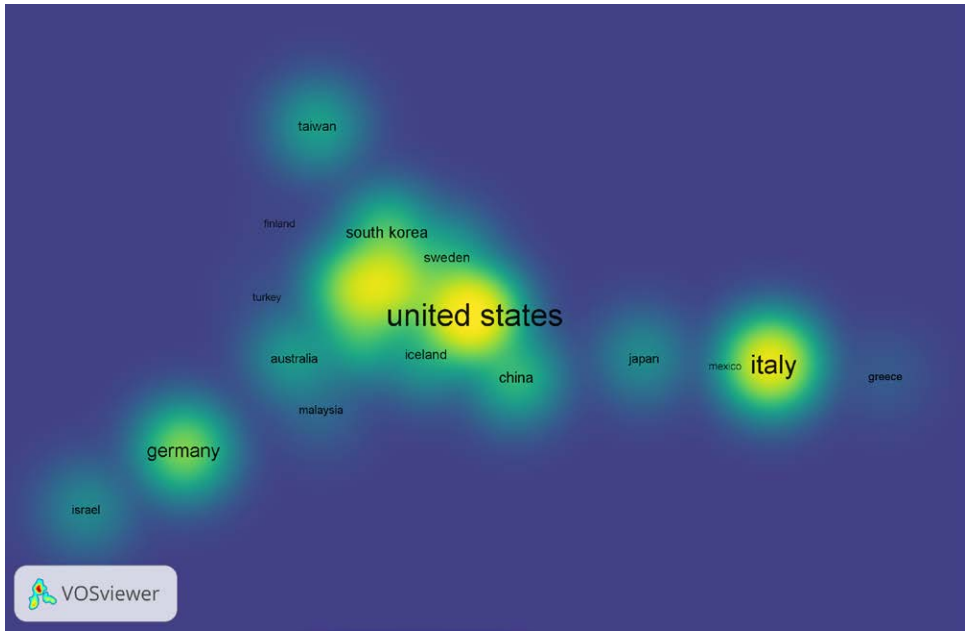

Figure 4. Visualized citation density among the countries/territories.

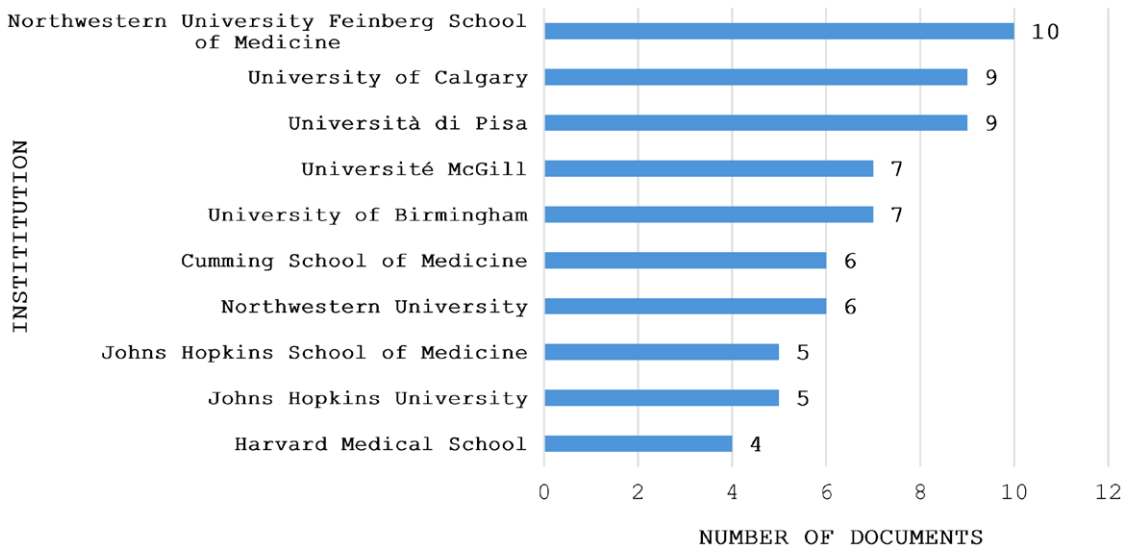

Figure 5. The global distribution of SLE and thyroid cancers research productivity by institution.

Table 3

Top 10 productive institutions in SLE and thyroid cancers research field.

Rank	Institution (n = 782)	Country	Publications	Citations	Citations per publication	Publication year start
1	Northwestern University Feinberg School of Medicine	United States	10	401	40.1	2013
2	University of Calgary	Canada	9	399	44.3	2013
3	University of Pisa	Italy	9	1306	145.1	1996
4	University of McGill	Canada	7	523	74.7	2013
5	University of Birmingham	England	7	374	53.4	2003
6	Cumming School of Medicine	Canada	6	153	25.5	2015
7	Northwestern University	United States	6	303	50.5	2013
8	Johns Hopkins School of Medicine	United States	5	268	53.6	2013
9	Johns Hopkins University	United States	5	45	9	2009
10	Harvard Medical School	United States	4	458	114.5	2010

266.5, respectively. Figure 6 demonstrates cooperation among journals. The citation analysis network was formed by including 28 journals with a minimum of 1 publication and 1 citation, leading to the 7 clusters, with a total link of 89, and a total link strength of 106. Each circle in the network represents a journal, with circle size is proportional to the number of citations. The lines connecting the nodes denote cooperation between journals.

3.7. Analysis of authors

A total of 1334 authors have contributed to research in the field of SLE and thyroid cancers. Table 5 displays the top 10 most productive authors, including their total publications, citations, and H-index. Among these authors, Bernatsky, S. from the University of McGill, Clarke, A.E. from the Cumming School of Medicine, and Ramsey-Goldman, R. from the Northwestern University Feinberg School of Medicine secured the top position with 9 publications each. Additionally, Alessandro Antonelli ranked at the top position in citation analysis with 1119 total citations (13.9%). Furthermore, Caroline P. Gordon from the University of Birmingham had the highest H-index (H-index = 88). Notably, 4 out of the top 10 productive authors on this topic were affiliated with the University of Pisa.

Figure 7 illustrates coauthor collaboration and publication output of each author. We built a collaborative network based on whose number of published documents is more than or equal to 2. A total of 27 authors met the threshold within the formation of 3 clusters, 178 links, and a total link strength of 335. The size of the nodes represents the number of publications and the lines connecting the nodes represent cooperation between the researchers.

3.8. References

The top 10 highly cited publications in the research field of SLE and thyroid cancers are presented in Table 6. These 10 documents collectively account for 3284 citations, which is 40.7% of the total citations. Each of these publications has received more than 180 citations.

3.9. Analysis of author keywords

In this study, 613 keywords were collected from various authors. Keywords with minimum co-occurrence equal to 3 were filtered to map co-occurrence network graph (Fig. 8). A total of 34 keywords met the threshold, resulting in 8 clusters, 106 links, and a total link strength of 169. Each circle in the

Table 4

Top 10 productive journals in SLE and thyroid cancers research field.

Rank	Journal (n = 198)	Publications	Citations	Citation per publication	IF 2022	JCR quartile	SJR 2022	Publication year start
1	Arthritis Research and Therapy	5	171	34.2	4.9	Q1	1.59	2013
2	Frontiers in Endocrinology	5	40	8	5.2	Q1	1.28	2017
3	Autoimmunity Reviews	4	1066	266.5	13.6	Q1	2.55	2006
4	Lupus	4	68	17	2.6	Q2	0.82	2013
5	Medicine (United States)	4	104	26	1.6	Q3	0.46	2016
6	Plos One	4	264	66	NA	Q1	0.89	2013
7	Current Opinion in Rheumatology	3	87	29	5.1	Q1	1.49	2004
8	Frontiers in Immunology	3	63	21	7.3	Q1	2.02	2019
9	International Journal of Molecular Sciences	3	147	49	5.6	Q1	1.15	2019
10	Journal of Clinical Endocrinology and Metabolism	3	86	28.7	5.8	Q1	1.78	2009

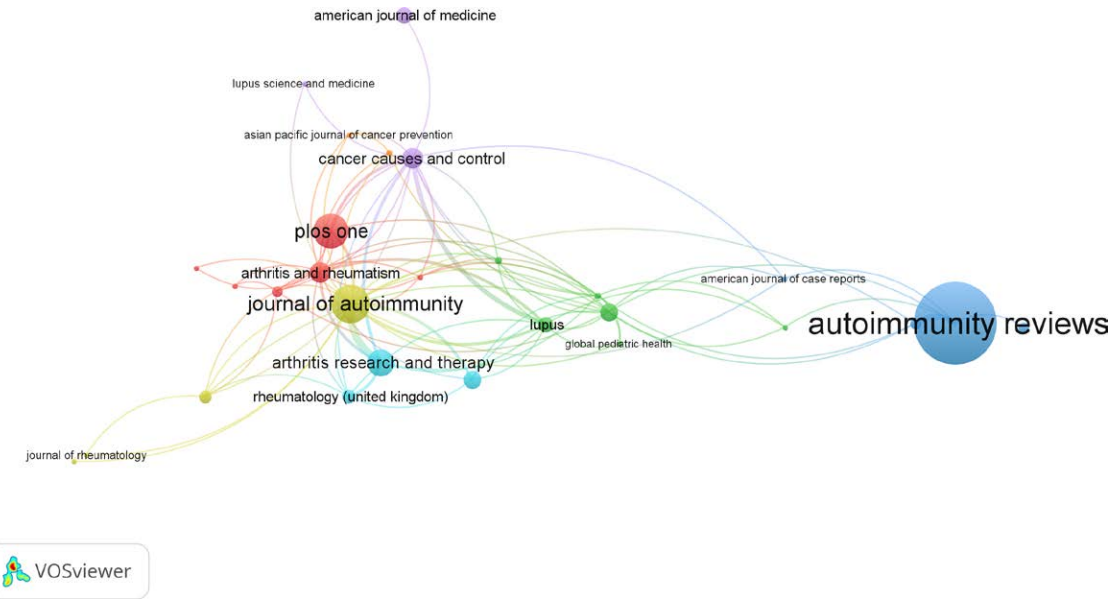

Figure 6. The citation analysis network of journals.

Table 5

Top 10 productive authors in SLE and thyroid cancers research field.

Rank	Author name (n = 1334)	Affiliation	Country	Publications	Citations	H-index
1	Bernatsky[22,26]	University of McGill	Canada	9	398	63
2	Clarke[13,22,26]	Cumming School of Medicine	Canada	9	406	74
3	Ramsey-Goldman[22,26]	Northwestern University Feinberg School of Medicine	USA	9	398	79
4	Antonelli[15,16]	University of Pisa	Italy	6	1119	83
5	Fallahi[15,16]	University of Pisa	Italy	5	1112	72
6	Ferrari[15,16]	University of Pisa	Italy	5	1112	57
7	Gordon[22]	University of Birmingham	United Kingdom	4	273	88
8	Joseph[22,26]	McGill University	Canada	3	246	84
9	Labrecque[22,26]	Erasmus Medical Center	Netherlands	3	246	17
10	Mosca[35]	University of Pisa	Italy	3	134	67

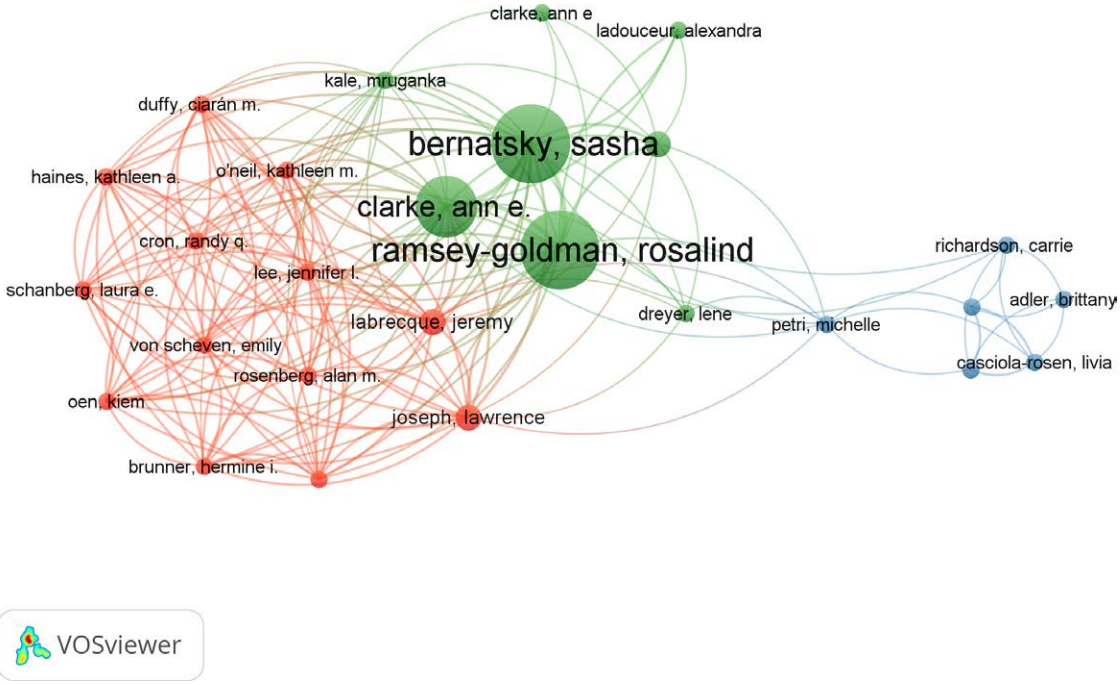

Figure 7. Co-authorship map of authors.

network represents a keyword, with the circle size corresponding to the number of occurrences.

4. Discussion

This study conducted a comprehensive scientometric analysis to provide an up-to-date overview of global research trends on scientific documents published in the research field of lupus disease and thyroid cancers. The analysis investigated various aspects of research productivity and collaboration, including the number of publications, citations, publication types, prominent countries, institutions, journals, authors, references, keywords, and publication trends.

As of 2023, a total of 246 papers have been published on the association between SLE and thyroid cancers, with an average annual growth rate of 5.2%, and a rate of 9.2% specifically from 2006 to 2023. Our analysis revealed a growing trend in the number of publications, particularly since 2010, with 78.5% of the total documents being published onwards. Similar to the number of publications, the increasing pattern in the number of citations is evident particularly from 2004. Our analysis reported that 90.6% of total citations within this domain contributed to the documents published within the last 2 decades. *This upward trend and research productivity emphasizes the need for proactive measures to investigate and address the correlation between SLE and thyroid cancers.* Among the highly cited papers in this field, Bernatski et al[22] reported an increased incidence of thyroid cancers in SLE patients, as demonstrated by an international cohort study. This finding was further supported by numerous other studies, including a systematic review by Zhang et al, which revealed the positive association between SLE and thyroid cancer risk.[9,11,24] *Additional comprehensive studies are required to delve deeper into the underlying mechanisms linking SLE and cancer risk to develop targeted interventions and treatment strategies.*

Based on the results of document type analysis, the predominant types of publications were original articles (57.3%) and reviews (35.4%). The substantial frequency of original articles and review papers underscores the importance of both primary research and comprehensive literature reviews in advancing knowledge within the research domain of thyroid cancers in SLE patients. Majority of the distributed papers belonged to the field of medicine (82.9%), followed by biochemistry, genetics, and molecular biology (26.8%), and immunology and microbiology (13.4%). *This distribution also reflects the interdisciplinary nature of this research field. The study's focus on the interdisciplinary nature of research in this area highlights the significance of bridging knowledge gaps through collaborative efforts spanning various disciplines.*

Table 6

Top 10 highly cited publications in SLE and thyroid cancers research field.

Rank	Publication title (n = 246)	Journal of publication	Publication year	Citations
1	The diagnosis and medical management of advanced neuroendocrine tumors[14]	Endocrine Reviews	2004	556
2	Autoimmune thyroid disorders[15]	Autoimmunity Reviews	2015	547
3	Chemokine (C-X-C motif) ligand (CXCL)10 in autoimmune diseases[16]	Autoimmunity Reviews	2014	448
4	The management of hyperthyroidism[17]	New England Journal of Medicine	1994	297
5	A transcriptional signature and common gene networks link cancer with lipid metabolism and diverse human diseases[18]	Cancer Cell	2010	282
6	The German etanercept registry for treatment of juvenile idiopathic arthritis[19]	Annals of the Rheumatic Diseases	2004	267
7	Irreversible protein kinase inhibitors: Balancing the benefits and risks[20]	Journal of Medicinal Chemistry 2	2012	262
8	The wonderful colors of the hematoxylin-eosin stain in diagnostic surgical pathology[21]	International Journal of Surgical Pathology	2014	223
9	Cancer risk in systemic lupus: an updated international multi-center cohort study[22]	Journal of Autoimmunity	2013	218
10	Diagnosis, Prevention, and Management of Statin Adverse Effects and Intolerance: Canadian Consensus Working Group Update (2016)[23]	Canadian Journal of Cardiology	2016	184

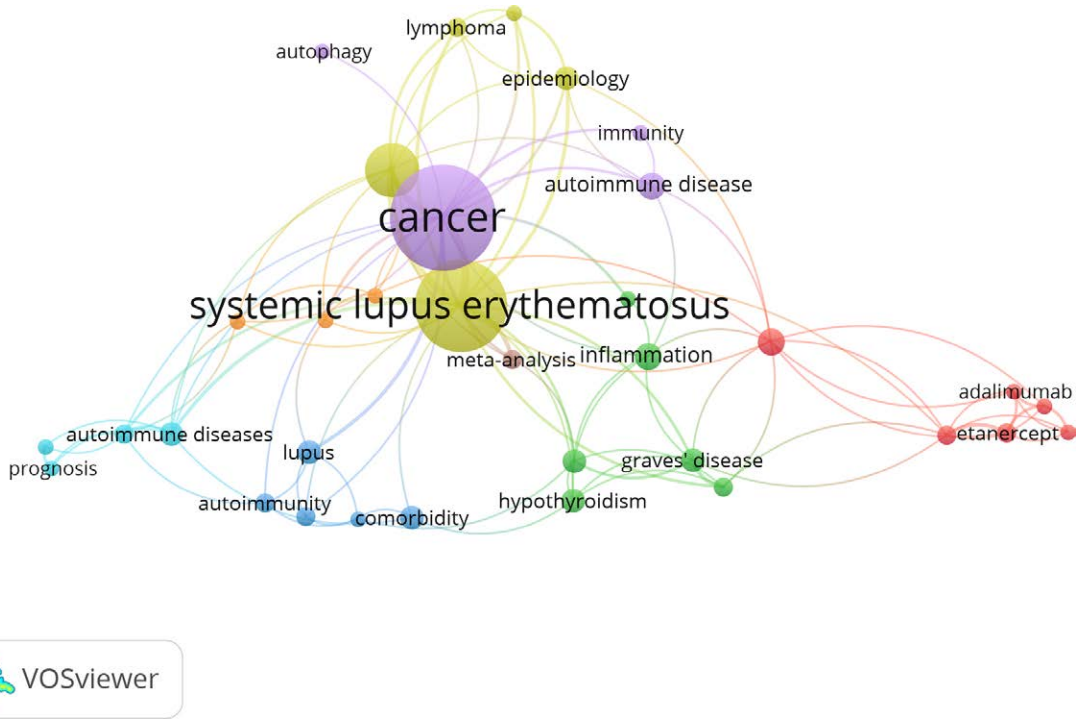

Figure 8. Co-occurrence map of author keywords.

According to the results of journal analysis, Arthritis Research and Therapy, Frontiers in Endocrinology, Autoimmunity Reviews, and Lupus, were the highest ranked journals in publishing related articles regarding this topic, respectively.[25–28] Considering that 8 of the top 10 most productive journals in this field of research were situated in Q1, it is evident that research in this area has attained a relatively advanced stage.

The incidence and prevalence of lupus disease vary significantly by country and region, leading to diverse impacts on the global research landscape and priorities. In a comprehensive systematic analysis and modeling study by Tian and colleagues published in 2023, the highest prevalence of SLE was reported in the United Arab Emirates, Barbados, and Brazil.[29] *Our research results showed a lack of published literature from the United Arab Emirates and Barbados, with only 5 publications from Brazil addressing the association between SLE and thyroid cancers*. Our findings also reported the 4 countries with the highest productivity in terms of the number of scientific publications were the United States, China, Italy, and the United Kingdom. These countries have contributed significantly to the advancement of knowledge within this domain. Based on previous studies, a variety of factors including, research funding levels, language proficiency, quality of journals, and internet access have been shown to impact on disparity in the publication outputs in the field of medicine.[30,31] *The identification of certain countries as leading contributors in this research area underscores the necessity for policymakers to allocate sufficient research and clinical funding toward further advancements in understanding the link between SLE and thyroid cancers*. Furthermore, according to the citation/publication rate analysis, Germany rate of 72.3 was higher than other countries, despite ranking ninth globally. This can be attributed to the high quality of Germany publications.

Our finding also revealed the most prevalent institutions that have played a crucial role in shaping the landscape of this research domain were Northwestern University Feinberg School of Medicine, University of Calgary, and University of Pisa. The fact that half of the top 10 most prolific institutions were situated in the United States, demonstrates a robust research community in the association between lupus disease and thyroid cancers in this country. *These insights emphasize the pivotal*

influence of policymaker decisions in promoting collaboration, allocating resources effectively, and driving advancements in comprehending and addressing this correlation.

Following the systematic comprehensive approach, the present scientometric study benefited from many strengths. *Initially, we focused on a specific domain to clarify the exact situation of knowledge production, providing the valuable information into the research gaps and potential avenues for further investigation*. Second, we employed Scopus database, the most comprehensive international database for the broadest coverage, which is commonly used in the most of the previous scientometric studies.[32–34] Third, we assessed collaboration between different authors, keywords, journals, and territories within related research fields. The findings develop beneficial insights into the current research landscape, which can shape the future research directions for researchers. *Our paper was limited by relying solely on the Scopus database, which may have resulted in the exclusion of relevant data. In the future, we aim to broaden our search strategy to encompass a wider range of databases, ensuring a comprehensive and exhaustive review of the current literature on the relationship between SLE and thyroid cancers.*

5. Conclusion

Our study is the first scientometric analysis to investigate global research trends on the association between lupus disease and thyroid cancers. *Our findings provide insightful perspectives on the growing tendency for research within this domain, underscoring its increasing scientific importance and clinical relevance. Moving forward, future research should prioritize longitudinal studies to monitor the progression of thyroid cancers in SLE patients over an extended period. Collaborative efforts between researchers and policymakers are crucial for designing evidence-based public health initiatives that raise awareness about the increased risk of thyroid cancers in patients with SLE and promote timely detection through screening programs.*

Considering the heightened risk of thyroid cancer in SLE, it is imperative to implement comprehensive prevention and detection strategies into clinical practice. Healthcare providers should maintain a high level of vigilance when screening patients with SLE who are at risk of developing thyroid cancer. This may involve a collaborative approach that integrates the expertise of rheumatologists, endocrinologists, and oncologists to enhance patient care and outcomes. By incorporating our recommendations, researchers, clinicians, and policymakers can collaborate to address critical knowledge gaps, refine clinical practice, and influence forthcoming research endeavors in this significant area of study.

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