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Original Research

A bibliometric analysis of gut microbiota and thyroid cancer studies: Global trends, research gaps, and future directions

Gut microbiota and thyroid cancer

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Abstract

Aim: Thyroid cancer is one of the most prevalent cancers in the World. Although previous bibliometric studies have explored the role of gut microbes in various cancers, none have specifically focused on thyroid cancer. This study aimed to identify research trends and key topics in the relationship between gut microbiota and thyroid cancer.

Material and Methods: Publications published from 2007 to 2024 were retrieved from the Web of Science Core Collection database and screened based on the inclusion criteria. The VOSviewer software was used to analyze publication trends by country, institution, author, citation counts, and journal.

Results: A total of 429 studies were selected from the 417,039 studies identified between 2007 and 2024. The number of publications has increased steadily and will peak by 2023. These studies received 10,079 citations, averaging 592.88 citations per year. Frontiers in Endocrinology were the most productive journals. China had the highest citation count (831). Key research hotspots included “gut microbiota,” “thyroid cancer,” “inflammation,” and “selenium.” China and Italy were central in cooperative networks, with Tongji and Peking University being the most productive institutions. The most prolific authors are Jiang Wen, Lv Zhongwei, and Gao Dingwei.

Discussion: Research on the link between gut microbiota and thyroid cancer has grown significantly over the past two decades, with China and the USA leading. Strengthening institutional collaborations and focusing on emerging topics like “bacteria” and “Hashimoto’s thyroiditis” is recommended for future research.

Keywords

Gut Microbiota, Microbiome, Thyroid Cancer, Bibliometric Analysis

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Introduction

The International Agency for Research on Cancer (IARC), affiliated with the World Health Organization, published World Cancer Statistics on February 8, 2022. According to the Globocan 2022 database, accessible through IARC, China ranks 1st (24.6%), the Republic of Korea 2nd (23.2%), and Tükiye 3rd (15.6%) in thyroid cancer worldwide (available at: https://gco.iarc.fr/en)

Our country, Türkiye, is endemic to thyroid diseases, particularly along the Black Sea coast, where genetic factors, iodine deficiency, and the Chornobyl disaster have played significant roles. Currently, thyroid nodules are found in approximately 50-60% of the population, and follow-up criteria are typically based on patient history, thyroid hormone levels, ultrasound characteristics, and biopsy results [1].

The gut microbiota composition refers to the diversity and balance of millions of microorganisms (bacteria, viruses, fungi, and other microbes) in the intestine. These microorganisms form the microbiota ecosystem in the body and play an important role in digestion-nutrient absorption, immune system regulation, protection against diseases, brain-gut axis relationship, metabolic health, inflammation, autoimmunity, and chronic disease formation [2].

The human microbiota comprises trillions of microbes, and the relationship between cancer and the microbiota is very complex [3]. Microbiota refers to collective microbial communities that live in specific environments, including bacteria, fungi, viruses, and protozoa [4]. With the evolution of technologies such as cell culture, metagenomics, and metabolomics, increasing evidence over the past two decades has shown that gut microbiota is crucial for host metabolic health and immune homeostasis [4, 5].

Evidence has shown that gut microbiota is closely associated with thyroid cancer [6]. Bibliometric analysis is a statistical method based on public literature databases (e.g., Web of Science) that is used to analyze and visualize research trends [7].

Bibliometric analysis has become one of the most widely used methods for assessing the credibility, quality, and impact of scholarly works [8, 9]. A large number of publications on microbiota and thyroid cancer have been published in recent years; however, no systematic studies have been conducted through bibliometric econometric analysis of the association between gut microbiota and thyroid cancer analysis has not been systematically studied. This bibliometric analysis can help researchers to understand the current research situation, trends, and hotspots in this field. In this study, we aimed to uncover emerging trends in articles, journals, keyword performance, and collaboration patterns between authors and institutions, and to explore hot research topics and future directions in the field of microbiota and thyroid cancer through a bibliometric analysis.

Material and Methods

Data sources

Ethical approval was not required for this study because it did not involve human or animal participants. In this study, we used the Web of Science Core Collection (WoSCC) database. This database was selected because it is the friendliest and easiest tool for bibliometric research and, contains numerous noteworthy and high-quality journals and thorough citation index records [10, 11].

Search strategy

All potentially relevant publications were collected based on title (TI) and topic (TS). The search strategy was as follows.

#1: (TI=(thyroid* OR thyroid cancer* OR thyroid nodule*)) AND (TI=(gut microbiota* OR microbiome* OR * microbiota*)) ;

#2: (TS=(thyroid* OR thyroid cancer* OR thyroid nodule*)) AND (TS=(gut microbiota* OR microbiome* OR * microbiota*))

Final : #1 OR #2

To capture as many data sources as possible, we use wildcards (*) that can replace any other character and allow keywords with variable endings [12, 13]. For example, "nodule*" would also return the terms of "nodule" and "nodules." nodules. The search articles were published in all the languages between 2007 and 2024.

Study selection

The selection criteria for this study are shown with a flowchart of the WOS screening process in Figure A1 in the Appendix. Briefly, we entered search terms for an initial search, and then excluded those that did not fit according to the following inclusion criteria: (1) the types of literature included types of articles, but not letters, comments, reviews, or conference abstracts; (3) the publication was from the WoSCC databases; (4) the search period was from 2007 to 2024. (5) For the selected publication, the subjects of the publication were patients with thyroid cancer and thyroid nodules, and the studies must also assess the correlation between subjects and gut microbiota. (6) To avoid bias due to daily updates of the database, we conducted and completed the search and screening of publications on the same day.

Data collection

All included publications were reviewed, and the studies were downloaded and exported in plain text file formats in WOSCC for analysis. The following indicators were extracted from the studies: the number of publications, citation frequency, country, institution, journal, author, and keywords.

Data analysis

The data were first evaluated using the results section of the WOS database. Descriptive statistics and treemap charts of the data were obtained. The data were exported in plain text format within the scope of query operators. The obtained data were imported into the VOSviewer software.

VOSviewer (version 1.6.17) was used to create, visualize, and explore a collaborative network map of countries, journals, and authors, with each point representing a country/region, institution, or author; the number of publications determining the size of the point; and the number of collaborations determining the strength of the links between the points.

Results

Analysis of publications, citation trends, and productive journals

A total of 417,039 records from January 1, 2007, to October 7, 2024, were identified. First, 261,787 records were included because the literature included studies on thyroid cancer. After adding "gut microbiota", the remaining 429 records were further assessed by topic reading. Finally, 429 studies that met the inclusion criteria were included in the bibliometric analysis (Figure A1). The number of annual and cumulative publications has significantly increased over the past 17 years. The number of publications peaked by 2023 (157). The distribution of publications by year is shown in Figure A2 in Appendix.

The number of citations has gradually increased from 2007 to 2024. The number of citations has increased since 2017. By 2023, it is expected to reach a high value (2,644 citations). A total of 429 articles were cited 10,079 times, and the average number of citations per year was 592,88. Of these studies, 279 (65.03%) were categorized as articles, 142 (%33.10) as review articles, and the remainder as other articles. The top ten leading journals in the field of microbiota and thyroid cancer research between 2007-2024 are shown in Table 1.

The most productive journal was Frontiers in Endocrinology (183 citations), followed by Nutrients (176), and Reviews of Endocrine and Metabolic Disorders (92). However, it ranked 10th in the number of most cited journals. These findings suggest that the relationship between microbiota and thyroid cancer has drawn increasing attention in recent years and that future research in this area may become a global hotspot.

Table 1. The top 10 leading journals in the field of microbiota and thyroid cancer research from 2007-2024

Journal	Documents	Citations	Total Link Strength
Frontiers in Endocrinology	6	183	26
Nutrients	3	176	18
Reviews in Endocrine & Metabolic Disorders	3	92	13
Endocrine	1	82	13
Clinical Science	1	61	6
International Journal Of Cancer	1	60	10
Journal of Advanced Research	1	44	9
Frontiers in Cellular and Infection Microbiology	2	37	11
Cancers	2	15	11
Biochimica Et Biophysica Acta-Molecular Basis of Disease	1	1	11

a)

b)

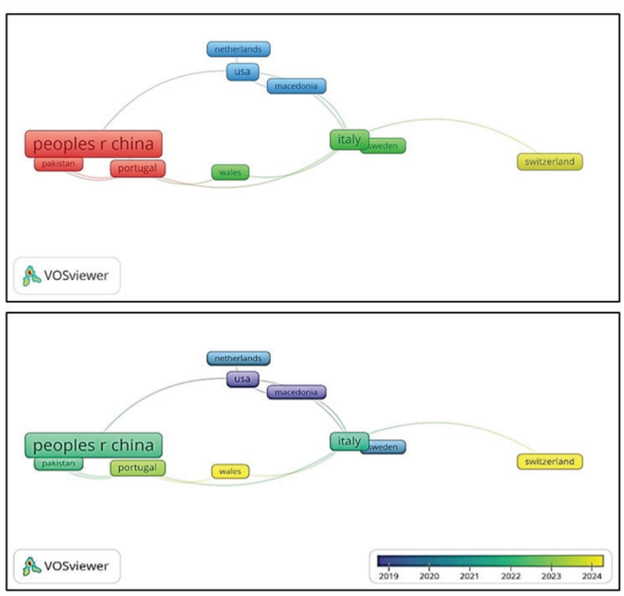

Figure 1. The collaboration relations network between countries/regions. (a) Cooperation network among the countries/regions (Dots represent countries, with larger dots indicating a high number of publications, clusters are marked using different colors and links represent cooperation between countries). (b) The time-overlay map of the cooperation network among the countries/regions

Countries/regions analysis

63 countries/regions have published studies on the microbiota and thyroid cancer. The top 10 most productive countries are shown in Figure A3 using the treemap in Appendix. China ranked first with 168 articles, followed by the US (80), Italy (51), and Poland (17). China had the highest citation rate (831), followed by the USA (258) and Italy (219).

a)

b)

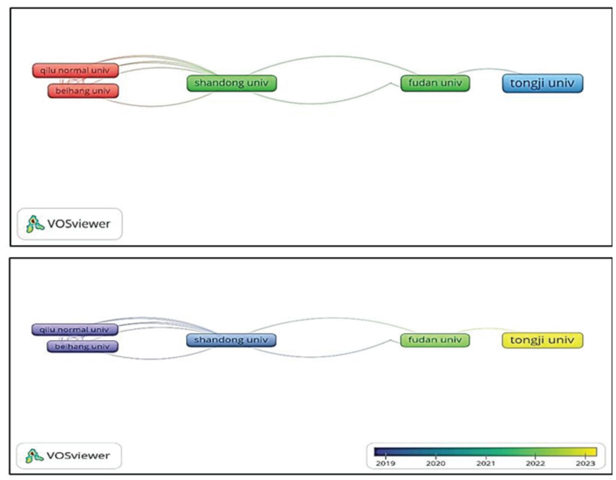

Figure 2. The collaboration of institutions. (a) The collaboration of institutions (Dots represent countries, with larger dots indicating a high number of publications, clusters are marked using different colors and links represent cooperation between institutions). (b) The time-overlay map of the collaboration of institutions

a)

b)

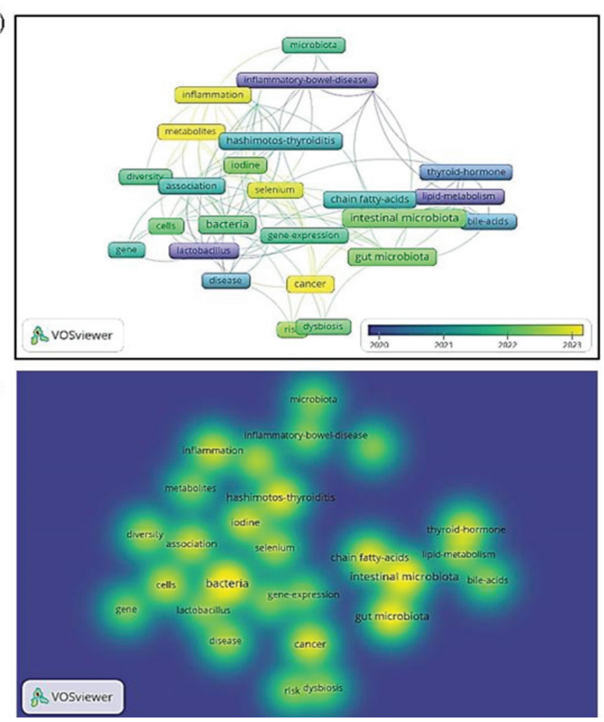

Figure 3. Keyword analyses. (a) The time-overlay visualization of keywords. (b) VOSviewer density visualization of keywords

Among the 108 countries in the network, China and Italy are the most central and stand out as two countries with the strongest connections. Italy has established limited strong collaborations with the USA, Portugal, and Germany in this field. The results are shown in Figure 1.

Contribution of institutions and authors

This study evaluates the most productive universities and institutions. Tongji University contributed the most articles (5), followed by Sapienza University Rome (3), and other institutions. In addition, Peking University had the highest total number of citations (205), followed by Tianjin University (179) and other institutions. The institution with the highest total link strength (8) was obtained from Shandong University. The largest set of connected items consists of 11 items, and institutions are classified into three groups marked with different colors. The results are shown in Figure 2.

In the present study, we evaluated the most productive authors. Jiang.Wen and Lv. Zongwei was the most productive author, with five publications, followed by Li.dan (4) and Yu. Xiaqing (4). Pang. Yanlı, Qi. Xinyu, and Qiao. Jie had the highest total number of citations (205), whereas Jiangxi had the highest total link strength. Wen and Lv. Zhongwie (39). Co-authorship analysis was performed using the VOSviewer software. A total of 345 authors and four major collaborations were included. Jiang. Wen was the most productive author, and Lv.zhongwei, Gao.Dingwei, Luo.giong and Li.dan had strong influences. The collaboration of authors and co-cited authors is shown in Figure A4. In Figure A4, (a) represents the cooperation network among the co-cited authors, and (b) shows the VOSviewer density visualization of the co-cited authors, where dots represent authors (larger dots indicate a higher number of publications), clusters are marked with different colors, and links illustrate cooperation between authors.

Keywords visualization

Keyword co-occurrence analysis examines the co-occurrence relationships between keywords that reflect the prominent topics in a specific publication group. In this study, 429 studies that met the inclusion criteria were exported as plain text files from the WOS database, and keyword analysis was performed using VOSviewer with a threshold value of 18. A total of 346 keywords were identified after combining the duplicate and synonymous keywords. As shown in Figure 3, “gut microbiota” and “thyroid cancer” were the most prominent keywords. All keywords were divided into four main clusters: the relationship between gut microbiota and thyroid cancers, gut microbial, bacteria, and dysbiosis. These clusters reveal the most dominant research themes in this field.

Discussion

Studies have shown that gut microbiota dysfunction is closely associated with thyroid cancer, resulting in an increasing number of studies investigating the relationship between the gut microbiome and thyroid cancer over the past two decades. However, no bibliometric analysis has been conducted in this field.

This study focused on the gut microbiota and thyroid cancer findings by screening eligible studies and analyzing 429 studies published in the Web of Science database from 2007 to 2024. This study showed that 2023 was a significant year in the field of microbiota and thyroid cancer research, with a significant increase in annual publications and total citations. The temporal trends in total citations are broadly in line with the number of annual publications, peaking in 2023 and declining over the last year because of proximity to the time of data collection.

Influential countries, governments, authors, and journals in this field were analyzed. China and the USA are the two main publishing countries in this field, accounting for 57.8% of all the research. China is the most productive country and publishes the majority of its articles. The disparity in this domain may be due to the following reasons. First, considering China’s large land area and population, there are many research institutions, resulting in a high volume of publications. Most importantly, China ranks 1st in the world in terms of the incidence of thyroid cancer [5, 14].

Thyroid cancer and, “thyroid cancer” and “intestinal microbiota” were the most prominent keywords. Additionally, “bacteria”, “inflammation”, and “Hashimoto’s thyroiditis” are the latest hotspots.

In recent years, studies have increasingly highlighted the significance of microbiota in various diseases. Numerous studies have demonstrated its association with several types of cancer, including colorectal, gastric, and pancreatic cancers, as well as conditions such as rheumatoid arthritis, malnutrition, Parkinson’s disease, and liver cirrhosis. A review of bibliometric analysis studies revealed that while there are numerous analyses exploring the relationship between microbiota and nearly all types of cancer, no bibliometric study specifically examining the link between microbiota and thyroid cancers has been identified in the literature [15-18]. One of the advantages of this study is that it fills the scientific gap.

The WoSCC database is constantly and dynamically updated and provides effective and reliable information [19-20]. In this study, a bibliometric analysis was performed to determine global trends and topics that had not yet been examined in light of data obtained from the WoSCC database, which contains high-quality literature information [21]. Publications were obtained solely by searching the WoSCC database using specific query operators, which may have resulted in an over-representation of studies from English-speaking countries. Additionally, keyword analysis depends on indexed keywords, potentially leading to inaccurate subject representations. This might also hinder the investigation of the possible links between changes in population rates and variations in thyroid cancer prevalence across different countries. This can be considered as a limitation of the present study. Despite these limitations, this study provides a comprehensive review of research on the relationship between thyroid cancer and the microbiota, while identifying key trends for future research.

This study analyzed the relationship between the microbiota and thyroid cancer; however, this relationship should be further investigated in the context of causality. Future studies should be supported by laboratory and clinical studies to elucidate the biological mechanisms underlying this relationship. Future studies can also compare the relationship between microbiota and thyroid cancer in different geographic regions and ethnic groups, which could help to understand better the regional differences in the prevalence of thyroid cancer and provide a clearer picture of global trends. Multidisciplinary studies that integrate genomic and metabolomic data can be conducted to better understand the relationship between the microbiota and cancer. In this way, how microbiota contributes to cancer development at the molecular level can be examined in more detail.

Scientific Responsibility Statement
The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and Human Rights Statement
All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or compareable ethical standards.

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Conflict of Interest
The authors declare that there is no conflict of interest.

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