

# A bibliometric analysis of studies conducted over the last 10 years on cardiovascular disease risk identification and prevention in primary care

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## ABSTRACT

**Objectives:** This bibliometric analysis was conducted to determine the trends of studies on cardiovascular disease risk identification and prevention in primary care from 2013 to 2024 and visualize the latest developments.

**Methods:** The data were collected in February-March 2024 from the database “Web of Science Core Collection,” the analysis was carried out using the VOSviewer program. The change in the number of publications of the published articles by year, author, country, and institution citation analyses, country, institution, and author collaboration analyses, journal and author co-citation analyses, and keyword analyses were evaluated.

**Results:** Five hundred and ninety-two authors from 64 countries and 377 institutions contributed to 443 studies published in 80 journals between 2013 and 2024 on determining and preventing cardiovascular disease risk in primary care. "BMC Family Practice" was the journal in which most articles were published, and "Circulation" was the most cited. The first three countries that support published articles most are the United States, England, and Australia. Focusing on the topics "blood-pressure control", "coronary-artery calcium", "physician-pharmacist collaboration", "low-density lipoprotein cholesterol", "health-risk assessment", "pollution", "primary care", "coronary heart disease", "prevention", "cardiovascular disease" and "mortality" will help fill the gap in the field.

**Conclusions:** This bibliometric analysis has shown increasing interest in studies related to cardiovascular disease risk and prevention in primary care. Primary prevention guidelines are important resources in addressing risk factors. Global collaborations and long-term studies are necessary in this field, led by developed countries with a high disease burden.

**Keywords:** Cardiovascular diseases, bibliometrics, primary care, CVD risk, risk identification, risk prevention, data visualization

Cardiovascular diseases (CVD), the most common non-communicable disease worldwide, are the general name for a group of disorders of the heart and blood vessels and conditions such as coro-

nary heart disease, cerebrovascular disease, and rheumatic heart disease [1]. Cardiovascular diseases account for the death of nearly 18 million people globally each year. The occurrence of cardiovascular

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diseases has almost doubled in the past two decades, according to the World Health Organization (WHO) [2]. The leading causes of these diseases include risk factors such as high blood pressure, obesity, smoking, a sedentary lifestyle, and an unhealthy diet [3].

Public health strategies to reduce cardiovascular disease morbidity and mortality include population-level risk factor reduction and individual-based primary and secondary prevention and treatment. Cardiovascular disease risk refers to the likelihood of experiencing fatal or nonfatal CVD events, such as the risk of myocardial infarction or stroke, within the next decade [4]. Individual-based primary prevention targets high-risk groups and prevents the onset of CVD by reducing the risk factor. Secondary prevention and treatment aims at early diagnosis and treatment to prevent disease progression in people with established CVD [5].

To prevent cardiovascular diseases, it is necessary to promptly identify people at high risk for primary prevention, which includes healthy nutrition and lifestyle interventions, or for treatments, including drug interventions. Over the past two decades, numerous prediction models have been developed that mathematically combine multiple predictors to predict the risk of developing CVD [6]. For example, tools such as Framingham [7], SCORE [8], and QRISK (9) are among the most commonly used. Some of these prediction models are included in the clinical guidelines for therapeutic management. Health policymakers are increasingly advocating these models [6].

The national and international guidelines published for the prevention of cardiovascular diseases recommend lifestyle changes such as healthy eating, increasing physical activity, quitting smoking and losing weight [4, 9-12]. Finding ways to implement proven interventions to reduce CVD risk factors in at-risk populations can reduce CVD health inequalities in primary care [13]. Community-based CVD prevention programs are another effective method recommended to reduce medical care costs and the disease burden attributable to CVDs [14]. Therefore, there has been a shift towards community-based programs to prevent CVD in recent years. Thanks to this approach, even minor improvements in general risk factors can significantly decrease the CVD burden [15]. Studies conducted in this field over the last ten years show that community-based interventions improve CVD risk

factors, especially by reducing blood pressure, serum LDL-C and triglyceride levels, obesity indices, and blood sugar, leading to a successful improvement in CVD risk factors. It is also emphasized that the impact of these programs on CVD varies depending on the type of intervention and different cultural and physical environments [16].

In recent years, the rapid increase and change in the direction of studies on determining and preventing CVD risk in primary care make it difficult for researchers to follow the results of current studies. Therefore, there is an increasing need to identify trends, map recent developments, and identify research gaps regarding CVD risk identification and prevention in primary care. In addition, it is essential to evaluate the studies carried out in this field in recent years to increase confidence in the results of risk identification and prevention studies on the subject and to contribute to primary healthcare policies.

Bibliometric analysis is an analytical method used to obtain formal and quantitative data about a field's current status. It makes it easier to monitor academic trends through visualization software. The bibliometric approach aims to provide quantitative data about research performance [17]. The researchers' experiences and knowledge inspire the comments based on these metrics in the field. Researchers use bibliometric analysis for various reasons, including uncovering emerging trends in article and journal performance, patterns of collaboration and research components, and exploring the intellectual structure of a particular field in the existing literature [18]. In other words, bibliometric analysis is used to map scientific knowledge in a field by making sense of large volumes of unstructured data. Therefore, well-done bibliometric studies can create solid foundations for advancing a field in new and meaningful ways. They enable academics to gain a general perspective from a single source, identify knowledge gaps, derive new ideas for research, and position their research [19].

As far as is known in the literature, no bibliometric analysis is related to the determination and prevention of CVD risk performed in primary care. This bibliometric analysis reflects the current evidence by analyzing the bibliometric properties of articles published on CVD risk identification and prevention in primary care. It allows researchers and policymakers to obtain information about the structure of their field, under-

stand the research gaps, and evaluate future studies on CVD risk identification and prevention in primary care. It will contribute to developing innovative ideas regarding studies.

*Research Questions*

- What is the distribution of publications and citations over the years?
- What are the most influential publications in the field on the subject?
- What are the most productive journals in the relevant field?
- How are publications distributed by country and what are the collaborations between countries?
- How is the analysis of keywords used by authors in publications?
- What are the trending topics of publications by year?
- What is the thematic map of the publications?

**METHODS**

**Purpose**

This bibliometric analysis was conducted to identify the trends of studies on cardiovascular disease risk identification and prevention in primary care from 2013 to 2024 and visualize the latest developments.

**Design**

This study conducted a bibliometric analysis of studies on cardiovascular disease risk identification and prevention in primary care. Bibliometric analysis is a powerful statistical tool that allows quantitative and qualitative evaluation of articles [19].

**Data and Analysis**

Different tools and software are used to perform bibliometric analysis in the literature. The VOSviewer program was used in this study. VOSviewer is a software tool for creating maps based on data sets and visualizing and exploring these maps [20]. The analysis was performed on articles published between 2013 and 2024. Only documents identified as articles in Web of Science were included in the analysis; other documents such as recommendations, guidelines, reviews, letters, or editorials were excluded. The research focused on original articles to seek new contributions to the literature. The reason for not including non-English studies is that language barriers may complicate the data processing and analysis process. It was excluded to avoid technical difficulties due to language differences when analyzing the data.

On 04.03.2024, 533 results were found in the search by selecting "all fields" in Web of Science with the keyword sequence in Table 1. Four hundred forty-eight journal articles from different disciplines, eight

**Table 1. Keyword sequence**

Category	Derivation
Cardiovascular disease	Cardiac Events, Heart Diseases
CVD	Cardiac disease
Risk assessment	Risk Evaluation
	Risk Estimation
	Risk Assessments
	Risk Analyses
Primary prevention	Risk Protection
Primary Care	Preventive health
	Public Health
	Public Health Practice
	Primary health care

(TS=("\* Cardiovascular disease\*" OR "\*CVD\*" OR "Cardiac Events" OR "Heart Diseases" OR "Cardiac disease")) AND (TS=("Risk evaluation" OR "Risk estimation" OR "Risk Assessments" OR "Risk Analyses" OR "Risk assessment")) AND (TS=(" Primary Care" OR "Preventive health" OR "Public Health" OR "Public Health Practice" OR "Primary health care"))

editorial content, 76 early appearance studies, 75 review articles, and four book-type works were accessed, according to years, the oldest being 2013 and the newest being 2024. In terms of disciplines, the vast majority of the studies were conducted in the fields of Medicine (134), Public Health (108), Cardiovascular Systems (88), Primary health care (56), Peripheral Vascular Disease (34), Endocrinology Metabolism (31), Health Science Services (25), Environmental Sciences (22). Out of 533 results, 443 original articles were analyzed using author, citation, journal, country, institution, and keyword analysis.

In order to expand the scope of the study with more analytical techniques, Bibliometrix software was used to reveal the research focuses (trend topics) and thematic trends (thematic map) of the studies [21].

### Ethics

Since this study was not conducted on any individual and used document analysis as the data collection method, ethics committee approval is not required.

## RESULTS

The number of publications of the 443 included studies varies between 3 and 47 by year. The most publications (n=47, 10.6%) were made in 2016 and 2020, and the least were published in 2012 (excluding

2024=3 articles). The number of articles by year is given in Fig. 1.

### Co-authorship of Authors

In the co-authorship analysis of the authors, a network diagram was created to determine the most connected and collaborative authors by selecting the criteria of at least 1 document and at least 1 citation. According to the analysis made among the names with the highest connections, eight are combined in a single cluster and have 92 connections. It is also seen that the most cited authors (Roger S. Blumenthal with 8100 citations, Erin D. Michos with 8100 citations, and Michelle A. Albert with 9039 citations) are not the most connected. The authors who produce the most documents do not appear to be among the most connected either (Rod Jackson, Sue Wells, and Andrew Kerr, respectively) (Fig. 2.).

### Citation Analysis of Authors

To identify citation networks, a network map was created for author citation analysis with the criteria of at least 1 document and at least 1 citation. In the analysis made on 592 units that were seen to be connected, a total of 20 clusters, 7580 connections and a total connection strength of 11234 were detected. The most cited authors were Roger S. Blumenthal with 8100 citations, Erin D. Michos with 8100 citations, and Michelle A. Albert with 9039 citations. In terms of total connection strength, Rod Jackson ranks first with

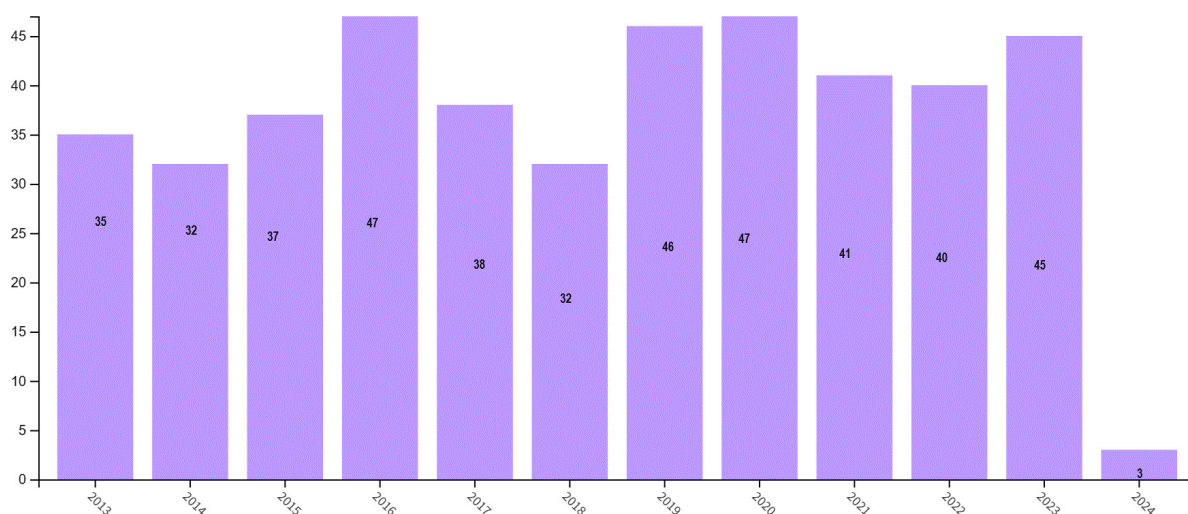
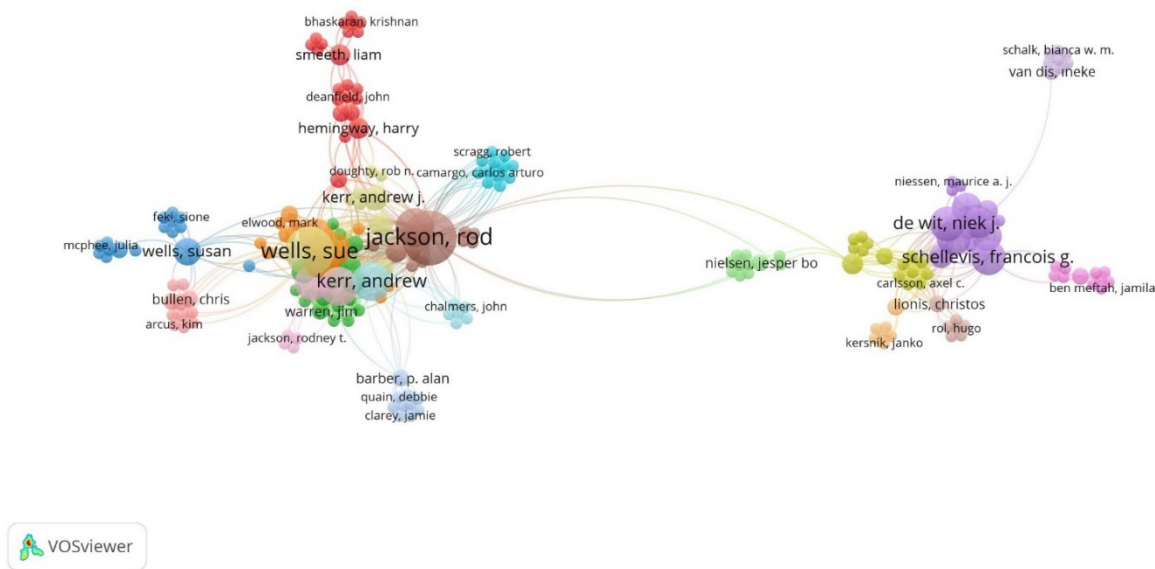


Fig. 1. The number of publications in 2013-2024.



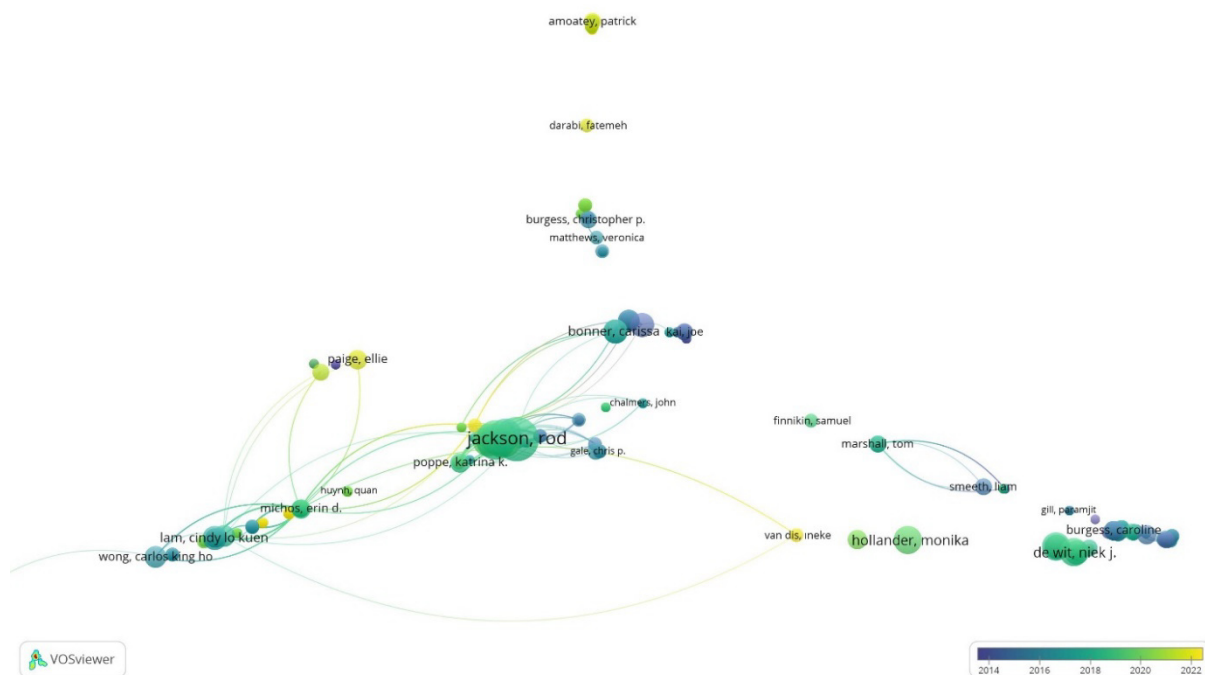
**Fig. 2. Co-authorship of authors.**

626 connections, Sue Wells ranks second with 576 connections, and Matire Harwood ranks third with 436 connections (Fig. 3).

### Citation Analysis of Countries

In order to create a network map of the citations received by publications according to their country of origin, an analysis was made on 64 observation units that have a relationship between them within the scope

of the criterion of publishing at least 1 document and receiving 1 citation by a country. Eight clusters, 213 connections, and 458 total connection strengths were identified. The countries with the most citations were the USA (11765 citations), Ireland (8067 citations) and Italy (5653). Regarding total connection power, the USA ranks first, Australia ranks second, and the Netherlands ranks third. In terms of the number of works, the order is as follows: USA (127 publications),



**Fig. 3. Citations of authors.**

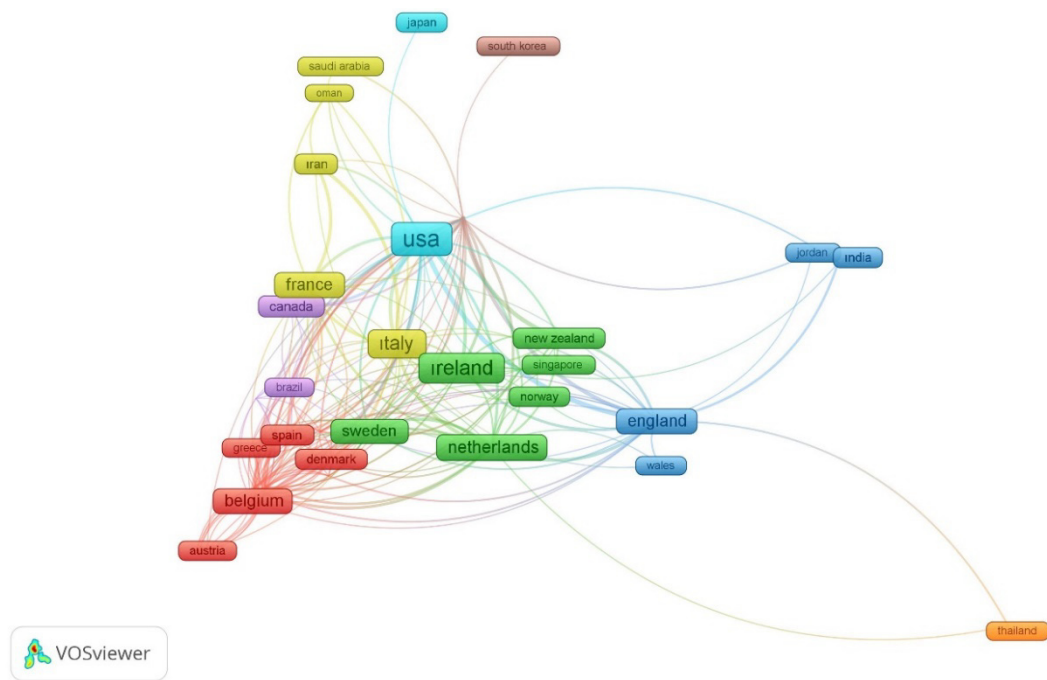


Fig. 4. Citations of countries.

England (93 publications) and Australia (48 publications) (Fig. 4).

### Citation Analysis of Organizations

To create a network map of organizational citations, an analysis was made on 377 observation units that have a relationship with each other within the

scope of the criteria of publishing at least one document and receiving 1 citation by an organization. While Auckland University (31 publications), Cambridge University (15 publications), Sydney University (14) are represented by publications, the address organizations of the most cited publications are The University of North Carolina (8078 citations), North-

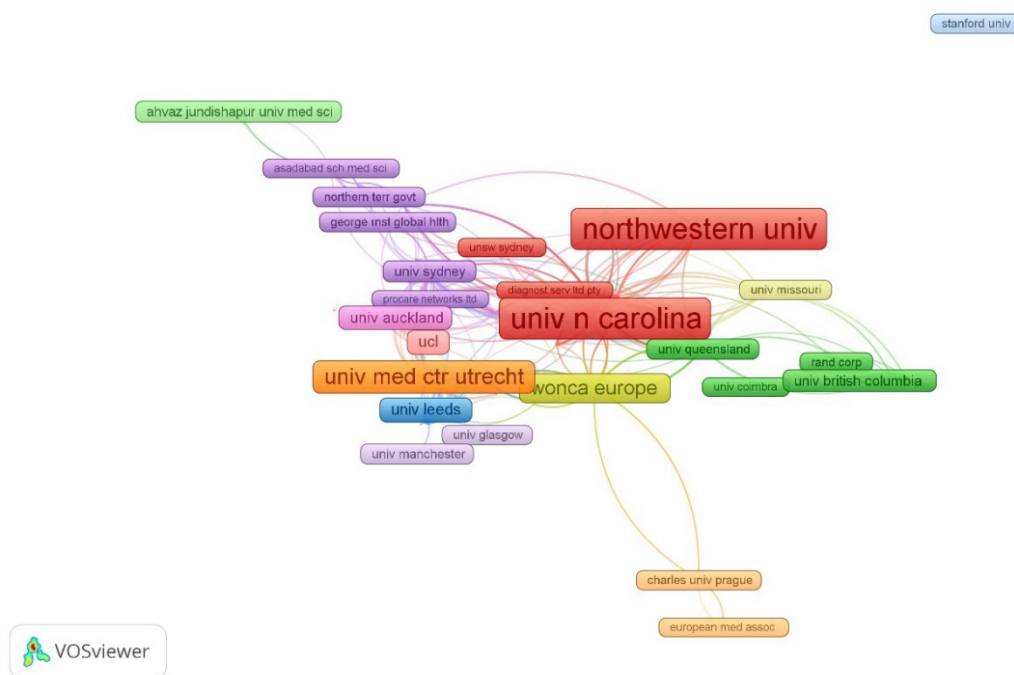


Fig. 5. Citation of organizations.

**Table 2. Top 5 most cited publications**

Publication title	Author	Year	Journal	Total citations
2019 ACC/AHA Guideline on the Primary Prevention of Cardiovascular Disease: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines	Arnett <i>et al.</i> [26]	2019	Circulation	7886
2016 European Guidelines on cardiovascular disease prevention in clinical practice	Piepoli <i>et al.</i> [9]	2016	Atherosclerosis	5320
Global, Regional, and National Comparative Risk Assessment of 84 Behavioural, Environmental and Occupational, and Metabolic Risks or Clusters of Risks for 195 Countries and Territories, 1990-2017: A Systematic Analysis for the Global Burden of Disease Study 2017	GBD 2017 Risk Factor Collaborators [29]	2018	Lancet	2686
Global, regional, and national comparative risk assessment of 79 behavioural, environmental and occupational, and metabolic risks or clusters of risks in 188 countries, 1990–2013: a systematic analysis for the Global Burden of Disease Study 2013	GBD 2013 Risk Factors Collaborators [30]	2015	Lancet	1898
Association Between Dietary Factors and Mortality From Heart Disease, Stroke, and Type 2 Diabetes in the United States	Micha <i>et al.</i> [31]	2017	JAMA	677

Western University (8051 citations) and Johns Hopkins University (8031 citations). Of 18 clusters, 2690 connections and total connection strength were determined as 3298 (Fig. 5).

### Citation Analysis of Documents

According to the analysis made with 114 units selected with the criterion of having received at least one citation and had connections between them, 18 clusters and 144 connections were obtained. When we look at the articles published on determining and pre-

venting cardiovascular disease risk in primary care, it can be seen that Arnett (2019), Piepoli (2016), and Stanaway (2018) are among the top three most cited documents (Table 2).

### Citation Analysis of Journals

According to the analysis made with 231 units with links between them, selected with the criterion of having at least one citation, 15 clusters, and 148 links were obtained. When we look at the articles published on determining and preventing the risk of cardiovas-

**Table 3. Top 5 journals with the most citations and publications**

Journal	Number of citations	Journal	Number of publications
1 Circulation	8130	1 BMC Family Practice	12
2 Lancet	4745	2 BMC Public Health	12
3 European Heart Journal	3138	3 Plos One	11
4 Atherosclerosis	2202	4 British Journal of General Practice	11
5 Lancet Diabetes & Endocrinology	788	5 BMJ Open	10

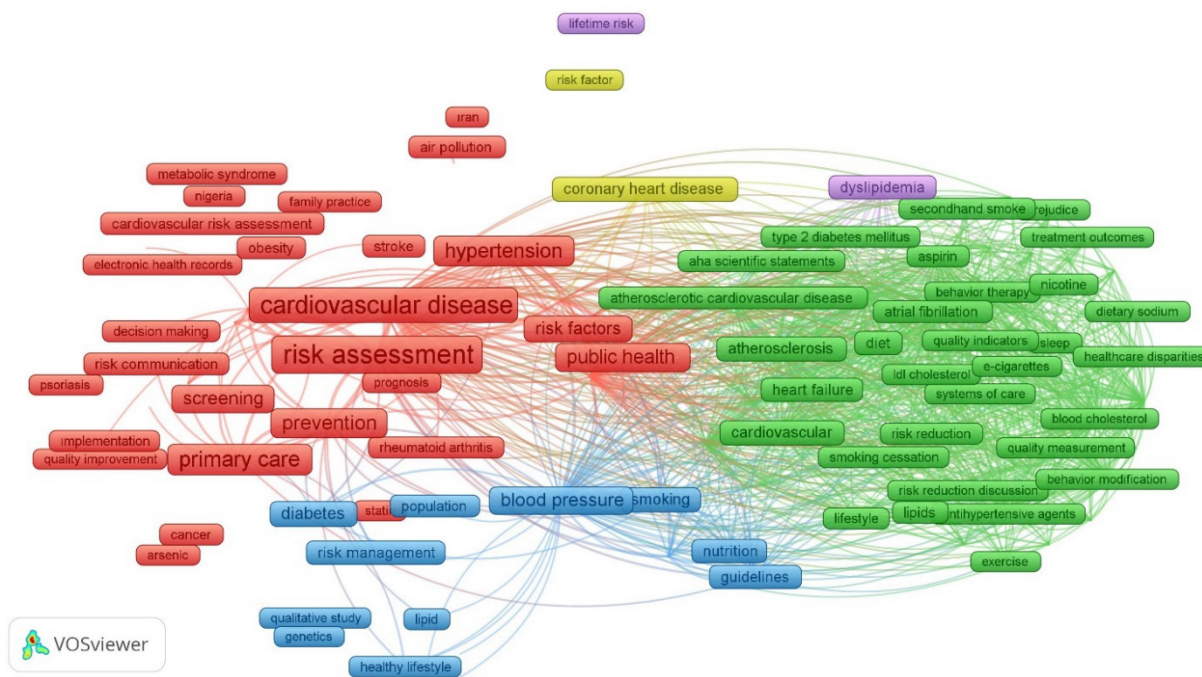


Fig. 6. Co-occurrence of all keywords.

cular disease in primary care, the most cited journals are *Circulation* and *Lancet*, which appears to be in the top three of the *European Heart Journal*. The journals with the most publications on the subject are *BMC Family Practice*, *BMC Public Health*, and *Plos One*, respectively (Table 3).

### Co-occurrence of All Keywords

When we look at the most frequently used keywords in documents on determining and preventing cardiovascular disease risk in primary care, risk assessment with 95 repetitions, cardiovascular disease with 77 repetitions, primary care with 48 repetitions,

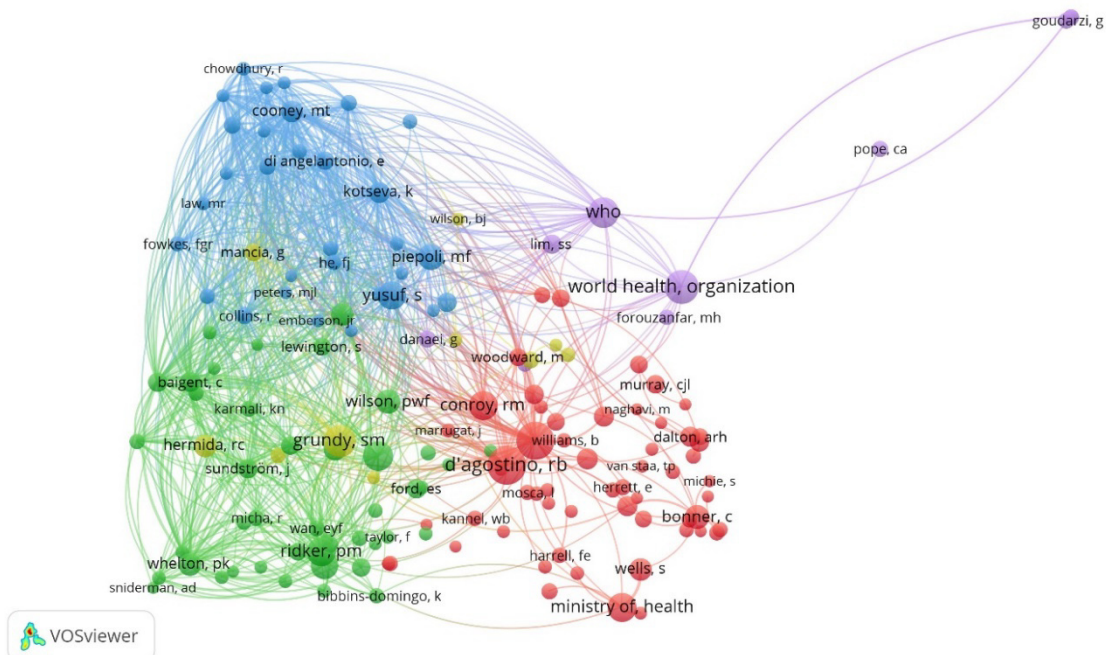
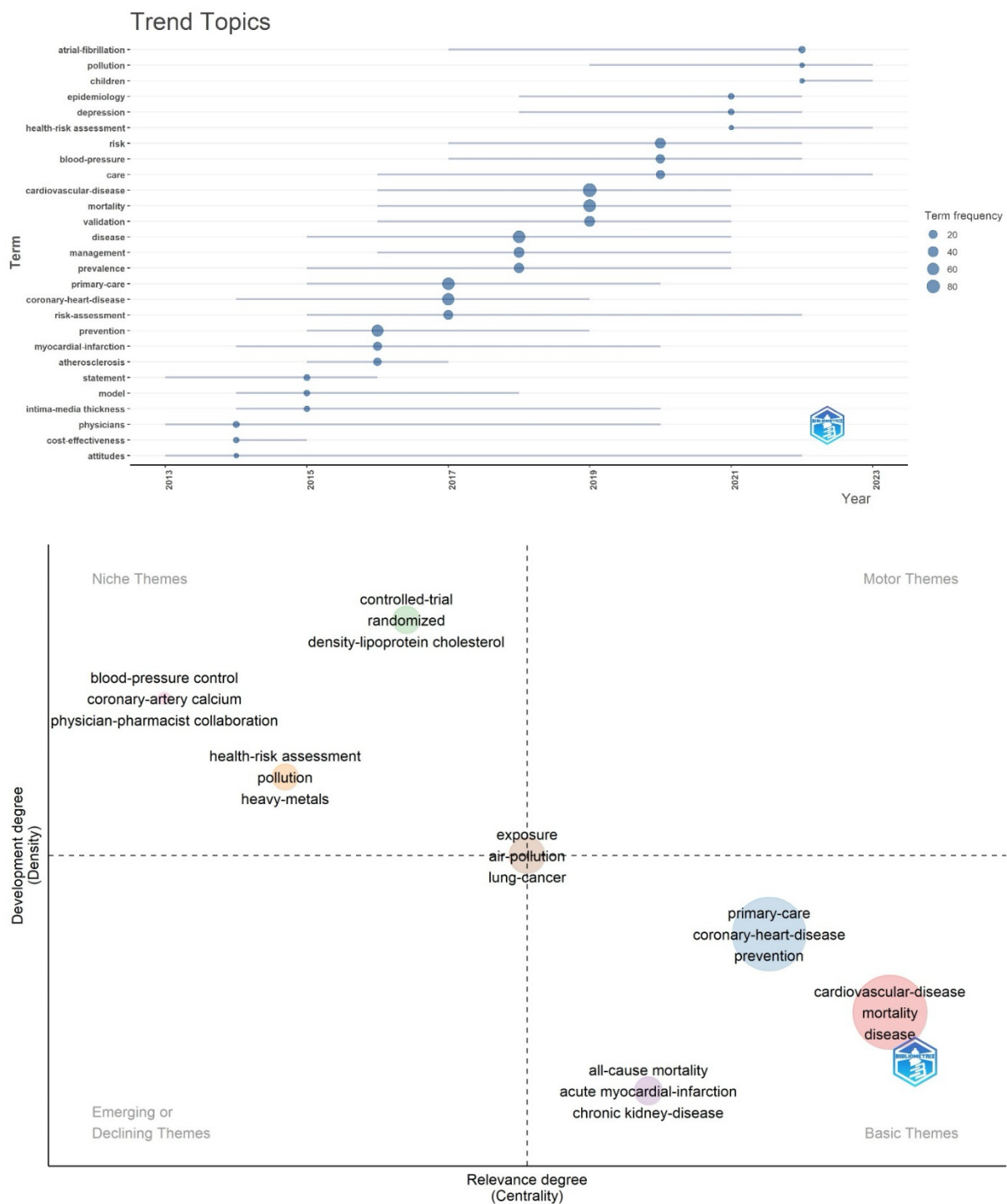


Fig. 7. Co-citation of co-authors.





**Fig. 8. Trending topics and thematic map.**

and 42 repetitions. It contains the words hypertension and prevention with 37 repetitions. The strongest statements regarding total connection strength were risk assessment, cardiovascular disease, hypertension, blood pressure, and primary care. As a result of the analysis made with 143 observation units that were seen at least three times and had a relationship between them, a

total of 5 clusters, 3024 connections, and 8482 total connection strength were detected (Fig. 6).

### Co-citation of Co-authors

Different sources cited in a publication are called co-citation. According to the analysis performed on 152 units with the minimum number of citations se-

lected as 10, a total of 5 clusters, 5322 links and 33389 total link strength were detected. The most commonly cited authors were identified as D'agostino (96), Hippisley-cox (92) and World Health Organization (73) (Fig. 7).

### Trending Topics and Thematic Map

Fig. 8 presents the worldwide trend topics of studies on the subject by year. When we examined the trend topics of the last year, "children", "atrial-fibrillation" and "pollution" were global trends. The topics "blood-pressure control," "coronary-artery calcium," "physician-pharmacist collaboration," "density-lipoprotein cholesterol," "randomized," "health-risk assessment," "pollution," "heavy-metals" were niche themes that did not have a widespread impact. Not much work has been done on the topics in niche themes. There is potential here and researchers may want to evaluate this potential. The basic themes were "primary-care, coronary-heart-disease, prevention, cardiovascular-disease, mortality, disease." These themes were central, but the number of publications was still low (Fig. 8).

## DISCUSSION

In this study, bibliometric analysis of 443 studies published on cardiovascular disease risk determination and prevention in primary care was performed using the VOSviewer program, and important publications, influential authors, authors' affiliations, leading countries and current trends regarding CVD risk assessment in primary care were determined. The unique value of this study is that there is no study in the literature that identifies the trends of studies on cardiovascular disease risk identification and prevention in primary care and visualizes countries, author collaborations, and citation networks. It is thought that this study will provide important information about the management of heart diseases in primary care and will make the current trends clear and understandable.

According to the analysis, it is seen that there has been an increase in the studies on determining and preventing the risk of cardiovascular disease in primary care in the last five years. However, it varies from year to year. The increasing number of publications in this field in recent years shows that the literature is deep-

ening and expanding. According to WHO, more than four of the deaths caused by CVD, which is the leading cause of death in the world, are caused by heart attack and stroke [1]. Additionally, CVDs not only contribute significantly to the rising healthcare costs but also impose a high socio-economic burden on the general population. The review by Flora and Nayak emphasized that CVDs also create a high socio-economic burden on the general population [22]. Determining the risk of a heart attack is crucial as it can help in reducing the chances of deaths by up to 80%. Early risk-specific measures can be taken to prevent heart attacks, which can significantly reduce the socio-economic burden on the general population. This highlights the importance of increasing research and developing strategies to combat cardiovascular diseases.

When we look at the partnership and citation analysis of the authors who contributed to the studies, it is seen that the number of citations and the link status do not show parallelism. Co-authorship is when two or more authors share their talents and resources by adopting one of the collaborative methods and collaborating to create a scientific work. One of the methods used to investigate co-authorship collaborations is an analysis of co-authorship networks [23]. Therefore, it is seen that there is a different process than the number of citations of authors. In this study, the most cited authors (Roger S. Blumenthal, Erin D. Michos, and Michelle A. Albert) and the most connected authors (Rod Jackson, Sue Wells, and Andrew Kerr) differ. Studies on determining and preventing cardiovascular disease risk in primary care were carried out by authors from 64 different countries, and the most publications were made in the USA, England and Australia, respectively. According to the American Heart Association (AHA) in the United States, CVD tops the disease burden list, and projections show that by 2035, 45% of the U.S. adult population will be diagnosed with cardiovascular disease, costing more than \$1 trillion annually [24]. It has been observed that cardiovascular diseases are a leading cause of premature deaths, accounting for one in four such deaths in the UK. Similarly, in Australia, these diseases cause about a quarter of the disease burden and two-thirds of all deaths. This highlights the severity of the situation [25]. The rising prevalence of CVD across the world, particularly in developed countries, has resulted in a high disease burden that is costly. However, research

shows that about 85% of CVD cases can be prevented if primary care is given priority. This highlights the importance of continued research in this field.

Although there are 997 different institutions contributing to the research studies, universities are the top contributors. The universities with the most citations are The University of North Carolina, North Western University, and Johns Hopkins University, respectively. However, the universities with the most publications vary depending on the countries in which they are located. Auckland University (31 publications), Cambridge University (15 publications), and Sydney University are among the top universities with the most publications. It is observed that the countries that produce the most publications are the USA, Australia, and England.

Upon examining the most cited publications, it is evident that the top 10 publications were published between 2015 and 2019. These studies are primarily focused on CVD prevention and evaluation and have been carried out by extensive research teams over multiple years of work. These studies have significantly contributed to the field and have led the way in this area. Among these studies, the guidelines published by two leading associations, AHA and the European Society of Cardiology, are of utmost importance [9, 26]. The increase in the number of citations can be attributed to the use of high-evidence recommendations and practices in studies pertaining to the identification and prevention of cardiovascular disease risk in primary care. These guidelines also provide guidance for planned studies.

Topics such as "blood-pressure control," "coronary-artery calcium," "physician-pharmacist collaboration," "density-lipoprotein cholesterol," "randomized," "health-risk assessment," "pollution," "heavy-metals" constitute the trending topics that need to be focused on in this field. When we look at the topics, it can be stated that the basic CVD risk factors, such as hypertension, high cholesterol, and atherosclerosis, are still not adequately addressed and that future research is needed in this field. Another notable trending topic is the increasing air pollution due to the effects of global warming. Air pollution and heavy metals can increase the risk of cardiovascular diseases (CVD) by causing hardening and inflammation of the arteries [27]. Therefore, it is essential to consider these factors in primary healthcare. Wang, Lin *et al.* con-

ducted a bibliometric analysis and concluded that the literature includes studies on complications of cardiovascular risk, risk factors, and pharmacological prevention strategies [28]. The findings align with the results of this study. Additionally, the significance of pharmacological prevention strategies for CVD risk supports the trending topic of "physician-pharmacist collaboration" in our study.

The risk assessment conducted by researchers in randomized controlled studies, with a high level of evidence, and in planning studies that address risk factors such as hypertension, high cholesterol, air pollution, and heavy metals that cause atherosclerosis, will make significant contributions to the field. Collaborating with primary healthcare providers and policymakers to plan primary healthcare policies can help fill the gap in the field.

In publications related to determining and preventing the risk of cardiovascular disease in primary care, the most frequently used keywords are risk assessment, cardiovascular disease, primary care, hypertension, and prevention. This indicates that researchers working on this topic are primarily focused on identifying the risk of cardiovascular disease in primary care settings and the risk factors associated with it, including hypertension, dyslipidemia, diabetes, and smoking. The practices are based on guidelines and the main focus is on risk assessment and prevention.

It is worth noting that the WHO ranks among the top three co-cited organizations in publications related to determining and preventing cardiovascular disease risk in primary care. This is mainly due to the valuable resources that WHO offers, including prevalence and incidence data published on its website, high-evidence recommendations, and guidelines created by large working groups, which many authors frequently use.

### Limitations

The first limitation of the research is that it only includes studies on identifying and preventing cardiovascular disease (CVD) risk that have been published in journals indexed in the "Web of Science Core Collection" database. The bibliometric analysis did not include any relevant studies published in non-indexed journals. The second limitation of the research is that the research only considered studies published in English, which may have excluded relevant studies published in other languages.

## CONCLUSION

This bibliometric analysis examined the current state of research on identifying and preventing cardiovascular disease risk in primary care. The study identified the top contributing authors, institutions, collaborations, and trends in the field, finding that interest in this area has increased in recent years. The analysis showed that most studies focused on keywords such as "risk assessment," "cardiovascular disease," "primary care," "hypertension," and "prevention." If researchers focus on trending topics in future research like "blood-pressure control," "coronary-artery calcium," "physician-pharmacist collaboration," "low-density lipoprotein cholesterol," "health-risk assessment," "pollution," "primary care," "coronary heart disease," "prevention," "cardiovascular disease," and "mortality," it will help address the existing gap in the field. This area continues to be an active area of study for researchers. This bibliometric analysis has shown that guidelines published in the field of cardiovascular disease risk in primary care are crucial resources. Risk factors are also of great importance, and studies in this field require long-term global collaborations. Developed countries with a high disease burden are leading the field. Therefore, it is believed that addressing more risk factors, focusing on less addressed issues, and increasing global cooperation in studies planned in this field will contribute to expanding international literature in this area.

### *Authors' Contribution*

Study Conception: ADA; Study Design: ADA; Supervision: ADA; Funding: ADA; Materials: ADA; Data Collection and/or Processing: ADA; Statistical Analysis and/or Data Interpretation: ADA; Literature Review: ADA; Manuscript Preparation: ADA and Critical Review: ADA.

### *Conflict of interest*

The author disclosed no conflict of interest during the preparation or publication of this manuscript.

### *Financing*

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