



**BIBLIOMETRIC ANALYSIS OF GLOBAL TRENDS IN CARDIAC REHABILITATION FOR PATIENTS WITH ACUTE CORONARY SYNDROME**

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**ABSTRACT**

Cardiac Rehabilitation (CR) is a structured, multidisciplinary program for managing cardiovascular disease that includes education, physical exercise, risk factor modification, and psychosocial support for heart patients, including those who have experienced Acute Coronary Syndrome (ACS). This study aims to analyze global research trends and examine cardiac rehabilitation from 1964 to 2025. A bibliometric analysis was conducted on publications in the Scopus database, The search strategy: in this review was based on the following terms: ‘Cardiac Rehabilitation’ and its alternative keywords (‘Acute Coronary syndrome’, "Cardiac Rehabilitation. These terms were combined using the Boolean operator ‘AND’ to generate a broad range of results. using visualization, co-occurrence, and trend analysis through VOSviewer software (version 1.6.20). The United States made the largest contribution. The most frequently used keywords were "cardiac rehabilitation," "rehabilitation," and "secondary prevention." The most significant publication increases in 2025 (102 publications), 2021 (101 publications), and 2024 (94 publications). The results show fluctuations in research activity, with a significant increase from 2021 to 2025. Further research should focus on developing technology-based rehabilitation models that are accessible from home and affordable, particularly in low-income countries. As telemedicine, which is still seldom discussed and published.

Keywords: acute coronary syndrome; bibliometric; cardiac rehabilitation; telemedicine; vos viewer

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**INTRODUCTION**

Acute Coronary Syndrome (ACS) is one of the type coronary heart disease, which remains the leading cause of morbidity and mortality globally. ACS encompasses conditions such as ST-elevation myocardial infarction (STEMI), non-STEMI, and unstable angina, all linked to coronary blood flow obstruction that presents a high risk of serious cardiovascular events, including sudden death. The high morbidity and mortality rates within this patient group necessitate comprehensive interventions to improve the long-term prognosis of ACS patients (Ji et al., 2019). Alongside the increasing prevalence of ACS, measures are needed to reduce the negative impact of this disease, including cardiac rehabilitation.

Cardiac Rehabilitation (CR) is a structured, multidisciplinary cardiovascular disease management program that incorporates education, physical exercise, risk factor modification, and psychosocial support for heart patients, including those with ACS. Several clinical studies have demonstrated that CR reduces cardiovascular mortality, enhances functional capacity, and improves the quality of life in ACS patients, while also helping to reduce the incidence of recurrent infarction and hospitalization following an acute event (Craciun et al., 2023). Thus, CR has proven for patients with ACS patients in managing their disease and preventing further complications.

Despite the well-established benefits of CR, the level of its implementation and participation worldwide—especially in relation to ACS—continues to show significant variation. This highlights the need to understand research trends, scientific focus, and shifts in academic attention within the

field of cardiac rehabilitation, particularly among ACS patients, to gain a comprehensive view of the literature's dynamics (Guozhen et al., 2021). Thus, research trend analysis through bibliometric methods is essential to explore potential future developments in CR.

Bibliometric analysis is an effective method for revealing scientific trends, the impact of publications, and collaboration networks between researchers and institutions in a particular field of research. Most bibliometric studies focus on cardiac rehabilitation research in general or on exercise rehabilitation for coronary heart disease (CHD), but direct bibliometric analysis explicitly combining ACS is still limited or has not been widely published. Although there are many studies on exercise rehabilitation for patients with CHD, approaches that specialise in ACS in bibliometric analysis are still very limited. This article introduces a way to explore literature linking ACS with CR using bibliometric analysis, which can provide insights and knowledge about cardiac rehabilitation in ACS. Using this approach on the cardiac rehabilitation literature, particularly that related to ACS, it is possible to identify patterns of scientific development, the most frequently appearing keywords, leading journals and authors, and future research directions. This is important as a basis for researchers, clinicians, and policymakers to understand the need for the development of more effective cardiac rehabilitation science and practice (Guozhen et al., 2021). This study aims to analyze global research trends and examine cardiac rehabilitation from 1964 to 2025.

## **METHOD**

### **Design**

Bibliometric analysis is a research method used to identify publication trends, map knowledge structures, and analyze themes and topic clusters to identify knowledge gaps and opportunities for further research (Donthu et al., 2021). The bibliometric approach was used to map the research literature, drawing on metadata extracted from a single database, Scopus, over a 61-year period (1964–2025). The literature search was conducted on 24 December 2025.

A literature search : was conducted on Scopus, the largest database (Abushamma et al., 2021) and the most comprehensive and multidisciplinary database commonly used in this type of review (Pranckut, 2021). Scopus provides different citation impact metrics and offers simple bibliometric tools that are easy to understand and use. (AIRyalat et al., 2019).

### **The search strategy**

In this review was based on the following terms: 'Cardiac Rehabilitation' and its alternative keywords ('Acute Coronary syndrome\*', "Cardiac Rehabilitation. These terms were combined using the Boolean operator 'AND' to generate a broad range of results. These terms were used to screen titles and abstracts to identify relevant articles. The search was limited to medicine, nursing, original articles, reviews, and English.

### **Inclusion criteria for article selection in this review**

Inclusion criteria included articles discussing cardiac rehabilitation in patients with ACS published between 1964 and 2025, articles in English, original articles, and review articles. Exclusion criteria include editorials, book chapters, notes, letters, conference papers, short surveys, conference reviews, retracted articles, errata, and articles 'in press', non-English publications, articles written in languages other than English, as well as studies unrelated to cardiac rehabilitation and ACS.

### **Data Selection**

The selection process was carried out in stages. After the initial search, the results obtained were filtered based on the title and abstract to identify relevant articles that met the inclusion criteria. Irrelevant articles are excluded at this stage. Relevant data, including year of publication, authorship, institutional affiliation, country of origin, number of citations, and keywords, are extracted into a Microsoft Excel Comma Separated Values File (CSV) for analysis

### Data Synthesis

VOSviewer software version 1.6.20 was used to perform bibliometric analysis (Saiz-Alvarez, 2024). This application helps visualise bibliometric maps based on the co-occurrence of terms in titles and abstracts (Donthu et al., 2021). VOSviewer provides three main types of visualisation, namely network visualisation, overlay visualisation, and density visualization (Saiz-Alvarez, 2024).

### Ethical Considerations

This study utilised bibliometric analysis, a method that analyses published literature, which does not involve direct interaction with human or animal subjects, thus requiring no ethical approval. Nevertheless, research ethics standards were adhered to, particularly in maintaining the integrity and transparency of the review process.

## RESULT

### Publication Trends

Based on a search of the Scopus database, 1,429 articles on cardiac rehabilitation in ACS patients were identified, published between 1964 and 2025, consisting of 911 research articles and 200 review articles (Figure 1). Over the past decade, the number of publications discussing cardiac rehabilitation in ACS patients has fluctuated, with an increase in 2021–2025, as shown in Figure 2. The graph indicates that the overall research trend is increasing but not yet stable, with publication peaks in 2025 (102 publications), 2021 (101 publications), and 2024 (94 publications) as seen in Figure 1

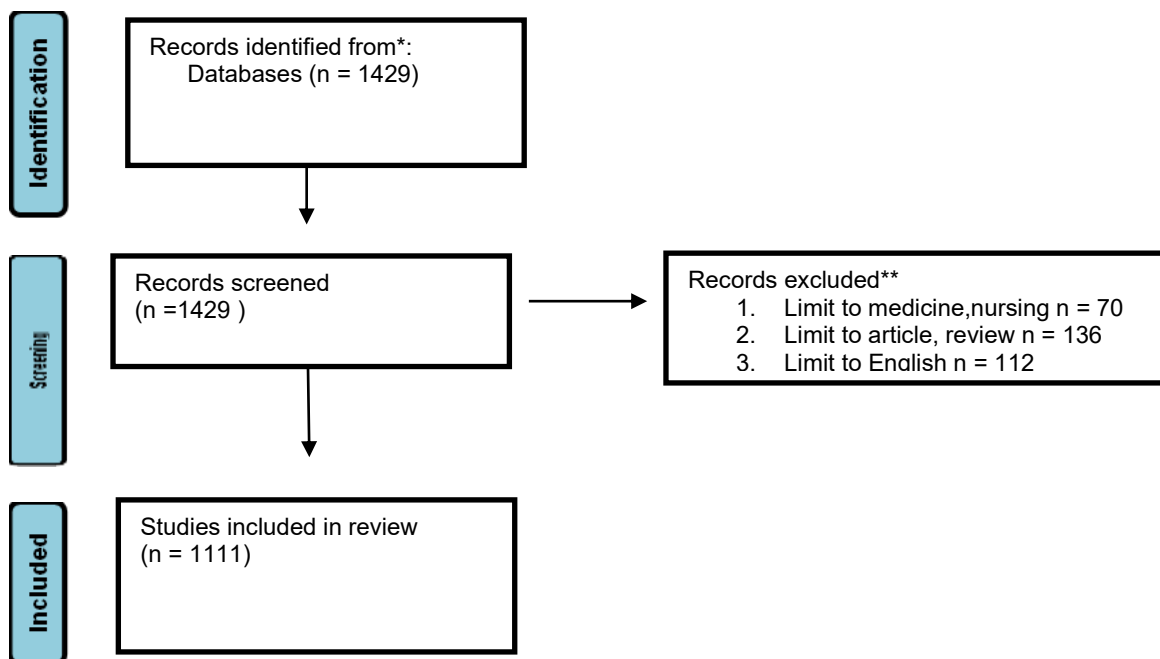


Figure 1. Prisma Flowchart for study selection

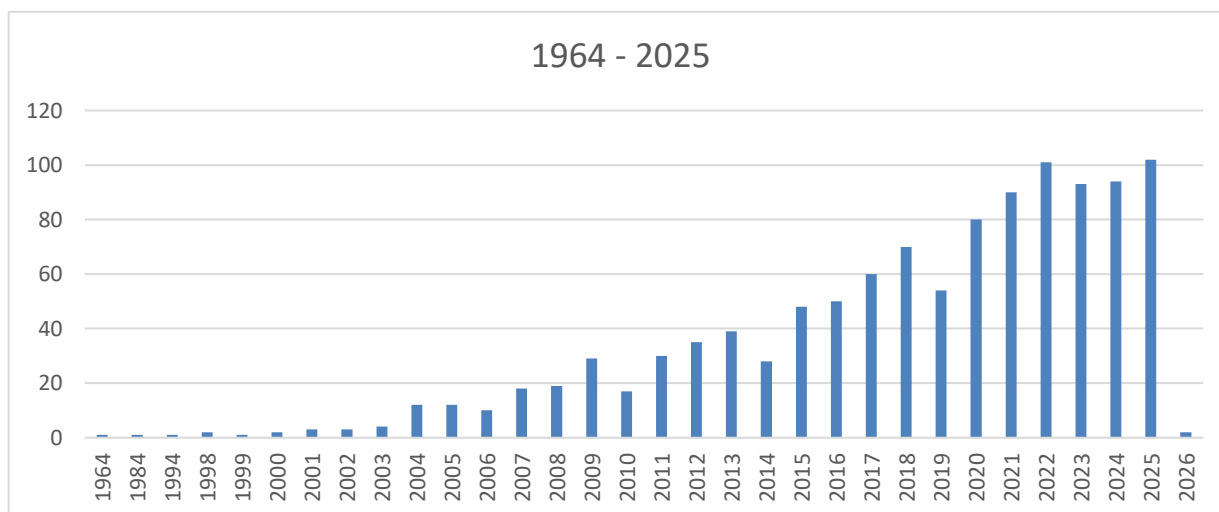


Figure 2. Publication trends from 1964 to 2025

There are 98 countries that have published research on this topic. The United States of America is the country with the most publications, namely 216 articles, as shown in Figure 2. The research collaboration network is visualised using VOSviewer, which shows strong collaboration between the United States, Australia, and Europe (Figure 2). The dominance of institutions from developed countries confirms the existence of a global research capacity gap, highlighting the need for increased contributions from developing countries.

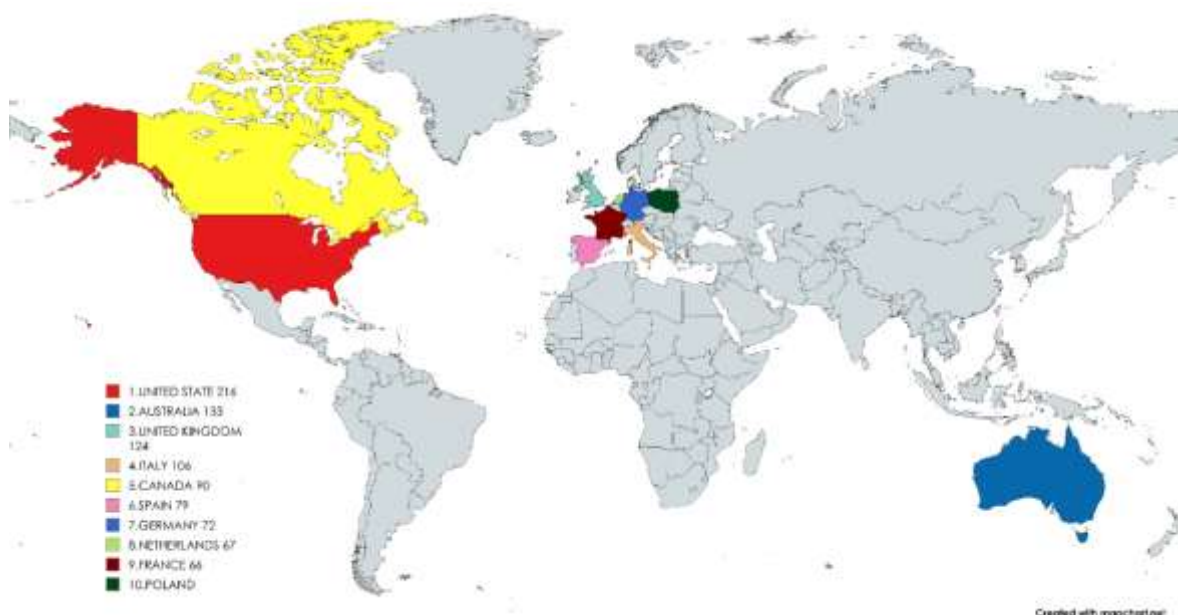


Figure 3. Mapchart of the 10 countries with the most publications

The ten publications with the highest number of citations are presented in Table 2. The most cited publication is the work (Ibanez et al., 2018) published in the European Heart Journal with 8,434 citations. Next, second place is occupied by the publication (Roffi et al., 2016) published in the European Heart Journal with 5,245 citations. Third place is the publication (Steg et al., 2012) published in the European Heart Journal with 4,945 citations (Table 1)

Table 1  
10 articles with the most citations

No.	Document Title	Author/Years	Source	Cited by	Quartile
1.	2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation	Borja Ibanez, Stefan James, Stefan Agewall, Manuel J. Antunes, Chiara Bucciarelli-Ducci, Hector Bueno, etc.2018.	European Heart Journal	8,434	Q1
2	2015 ESC Guidelines for the management of acute coronary syndromes in patients presenting without persistent st-segment elevation: Task force for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation of the european society of cardiology (ESC).	Marco Roffi, Carlo Patrono, Jean-Philippe Collet, Christian Mueller, Marco Valgimigli, Felicita Andreotti, etc, 2016	European Heart Journal	5,245	Q1
3.	ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation	Gabriel Steg, Stefan K. James, Dan Atar, Luigi P. Badano, Carina Blo¨mstrom-Lundqvist, Michael A. Borger, etc.2012.	European Heart Journal	4,945	Q1
4.	2013 ESC guidelines on the management of stable coronary artery disease	Gilles Montalescot, Udo Sechtem, Stephan Achenbach, Felicita Andreotti, Chris Arden, Andrzej Budaj, etc. 2013.	European Heart Journal	4,264	Q1
5.	European Guidelines on cardiovascular disease prevention in clinical practice (version 2012)	Joep Perk, Guy De Backer, Helmut Gohlke, Ian Graham, Zeljko Reiner, W.M. Monique Verschuren. Etc. 2012.	European Heart Journal	3,605	Q1
6.	2023 ESC Guidelines for the management of acute coronary syndromes	Robert A. Byrne, Xavier Rossello, J. Coughlan, Emanuele Barbato, Colin Berry, Alaide Chieffo, etc. 2023.	European Heart Journal	3,055	Q1
7.	AHA/ACCF secondary prevention and risk reduction therapy for patients with coronary and other atherosclerotic vascular disease: 2011 update: A guideline from the American Heart Association and American College of Cardiology Foundation	Sidney C. Smith, Jr, Robert O. Bonow, Mark A. Creager, Raymond J. Gibbons, Loren F. Hiratzka, Donald M. Lloyd-Jones, etc. 2011.	Circulation	1,395	Q1
8.	2014 ESC/EACTS Guidelines on myocardial revascularization	Philippe Kolh, Stephan Windecker, Fernando Alfonso, Jean-Philippe Collet, Jochen Cremer, Volkmar Falk, etc. 2014.	European Journal of Cardio-Thoracic Surgery	728	Q1
9.	The role of cardiac rehabilitation in improving cardiovascular outcomes	Rod S Taylor, Hasnain M. Dalal, Sinéad T. J. McDonagh. Etc. 2022.	Nature Reviews Cardiology	419	Q1
10.	The prognostic effect of cardiac rehabilitation in the era of acute revascularisation and statin therapy: A systematic review and meta-analysis of randomized and non-randomized studies The Cardiac Rehabilitation Outcome Study (CROS)	Bernhard Rauch, Constantinos H Davos, Patrick Doherty, Daniel Saure, Maria-Inti Metzendorf, Annett Salzwedel, etc.2016	European Journal of Preventive Cardiology	273	Q1

Figure 4 displays a network visualisation that forms four main clusters with different colours: turquoise/light blue, red, yellow, and blue. The key themes that emerge in each cluster include: Core Cluster in turquoise blue, Cardiac Rehabilitation. Clinical-Coronary Intervention Cluster: PCI & Clinical Risk, red. Acute Coronary Disease & Exercise Capacity Cluster: ACS/SCAD & Exercise Tolerance (yellow), Implementation & Behavioural Change Cluster: Secondary Prevention & Care Delivery (blue/purple).

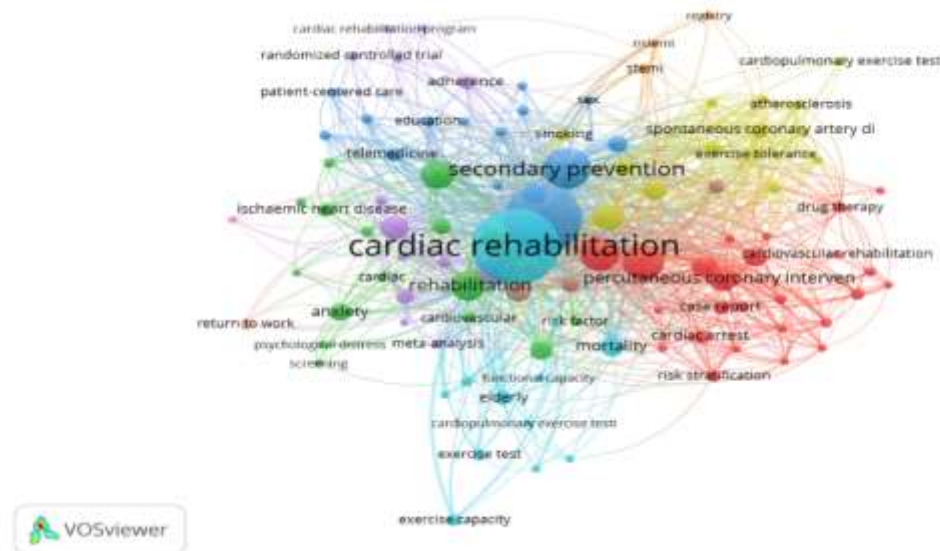


Figure 4  
Network Visualization Of Themes

### Trend and Future Research

In overlay visualisation, the colour of the node indicates the time or year when the topic appeared most frequently in publications. This helps to see how the popularity or relevance of a topic has changed over time. Green indicates that the keyword appeared more frequently in literature published in 2016. Blue and yellow indicate more recent years (2020-2022). Newer keywords usually have a more blue or yellow colour, indicating that the topic is more relevant or has been discussed more in recent years. Purple and bright yellow indicate that the keyword has become more popular in more recent years. The size of each node represents the frequency or popularity of the topic in the literature. The larger the node, the more frequently the topic appears in publications. For example, the topic 'cardiac rehabilitation' has a large node, indicating that it is a dominant topic in research related to cardiac rehabilitation.



acute coronary syndrome, with an average follow-up of 4.2 years (Rouleau et al., 2024). However, although the ESC guidelines strongly support the use of cardiac rehabilitation (Class I), a major challenge is limited access, especially in developing countries, where participation in cardiac rehabilitation is often low.

Studies show that patient education, which is an integral part of cardiac rehabilitation, can help in changing healthy lifestyles and minimising risk factors such as hypertension, diabetes, and smoking, all of which contribute to the occurrence of ACS (Ambrosetti et al., 2021). However, the inability to access rehabilitation programmes due to logistical and cost issues means that the benefits of rehabilitation are not equally available worldwide.

In addition, the increase in multimorbidity among patients with heart failure and chronic heart disease complicates the development of rehabilitation programmes that can accommodate the diverse needs of patients. CR is considered vital for maintaining quality of life and supporting long-term prognosis in patients with Heart Failure with Preserved Ejection Fraction (HFpEF), which often coexists with other conditions such as Atrial Fibrillation (AF) (Hirashiki & Shimizu, 2025).

## **CONCLUSION**

This study presents a comprehensive bibliometric analysis of global research trends on Cardiac Rehabilitation for patients with Acute Coronary Syndrome (ACS) from 1964 to 2025. The results indicate fluctuating trends, with a significant increase in research activity from 2021 to 2025. The United States stands as the leading contributor. Three key research areas have been identified: Cardiac rehabilitation, "secondary prevention," and rehabilitation. Future research should focus on developing technology-based rehabilitation models that can be accessed from home and are affordable, particularly in low-income countries. This model could serve as a solution to address the limited access to hospital-based cardiac rehabilitation, which remains a major barrier for many patients.

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