A Scientometric Analysis of Mechanical Cardiopulmonary Resuscitiation Device Publications

İlter AĞAÇKIRAN [1]*, Serkan GÜNAY [2], Merve AĞAÇKIRAN [2], Mehmet Cihat DEMİR [3], Ümit Can YÜREKLİ [1], Seval KOMUT [1], Ahmet ÖZTÜRK [1], Ali Kemal ERENLER [1]

ABSTRACT

Aim: Today, the use of automatic chest compression devices is increasing. The aim of this study is to identify popular publications about chest compression devices, save time for researchers, and summarize the important points of chest compression devices using the scientometric analysis method.

Material and Methods: All data were collected using the Web of Science Core Collection between July 1-8, 2023. Articles related to the topic were selected using the keywords "automated chest compression device" or "mechanical chest compression device". All articles in the database were manually scanned and analyzed. The distribution of relevant articles in the database was analysed according to scientific journals. Global research productivity, international collaborations, and research themes were analyzed using the scientometric method.

Results: A total of 589 articles were identified in the WoS. Out of these, 439 (74.407%) were original articles, followed by 63 (10.678%) review articles and 30 (5.085%) editorial materials. When examining the distribution of research articles by country, the United States (US) topped the list with 171 articles, followed by Germany (n=77). Although the UK ranked third in terms of the number of publications with 53 articles, it ranked first in terms of the number of citations. (n=3465). An assessment of the top 20 publishing journals revealed that the Resuscitation Journal led in terms of publication count (n=133), citation count (n=5906), and average citations per publication (n=44.41).

Conclusion: Our bibliometric study analyzed 589 articles on mechanical cardiopulmonary resuscitation. This can help researchers identify trending topics and areas of interest more quickly. More research is needed to fully understand the effectiveness and best tools for saving lives in emergency situations.

Keywords: Automatic chest compression device; cardiac arrest; scientometric.

Mekanik Kardiopulmoner Resüsitasyon Cihazı Yayınlarının Santometrik Analizi

ÖZ

Amaç: Günümüzde otomatik göğüs kompresyon cihazlarının kullanımı giderek artmaktadır. Bu çalışmanın amacı göğüs kompresyon cihazları hakkında popüler yayınları belirleyip araştırmacılara zaman kazandırmak ve göğüs kompresyon cihazlarının önemli noktalarını scientometrik analiz yöntemi ile özetlemektir.

Gereç ve Yöntemler: Tüm veriler 1-8 Temmuz 2023 tarihleri arasında Web of Science Core Collection aramasıyla toplanmıştır. "Otomatik göğüs kompresyon cihazı" veya "Mekanik göğüs kompresyon cihazı" anahtar kelimeleri girilerek konuyla ilgili makaleler çıkarılmıştır. Veritabanındaki tüm makaleler manuel olarak taranmış ve analiz edilmiştir. Veritabanındaki konuyla ilgili makalelerin dağılımı bilimsel dergilere göre incelenmiştir. Global araştırma üretkenliği, uluslararası işbirlikleri ve araştırma konuları, scientometric yöntemi kullanılarak analiz edilmiştir.

Bulgular: WoS'da toplam 589 makale belirlenmiştir. Bunların 439'u (%74,407) orijinal makaleler, buna 63 (%10,678) derleme makaleleri ve 30'u (%5,085) editoryal materyallerdir. Araştırma makalelerinin ülkelere göre dağılımını incelediğimizde, Amerika Birleşik Devletleri (ABD) 171 makale ile listenin başında yer almakta, onu Almanya (n=77) takip etmektedir. İngiltere, makale sayısı açısından 53 ile üçüncü sırada yer almasına rağmen, atıf sayısı açısından birinci sırada yer almıştır (n=3465). En çok yayın yapan ilk 20 derginin değerlendirilmesi sonucunda, Resuscitation Dergisi yayın sayısı (n=133), atıf sayısı (n=5906) ve yayına başına düşen ortalama atıf sayısı (n=44,41) açısından önde gelmektedir.

1 Hitit University, School of Medicine, Department of Emergency Medicine, Corum, Turkey
2 Corum Erol Olcok Training and Research Hospital, Department of Emergency Medicine, Corum, Turkey
3 Duzce University, School of Medicine, Department of Emergency Medicine, Duzce, Turkey

Sorumlu Yazar / Corresponding Author: İlter AĞAÇKIRAN e-mail: ilteragackiran@hitit.edu.tr

Sonuç: Bibliyometrik çalışmamız mekanik kardiyopulmoner resusitasyon üzerine 589 makaleyi analiz etti. Bu, araştırmacıların trend konuları ve ilgi alanlarını daha kısa sürede belirlemelerine yardımcı olabilir. Acil durumlarda hayat kurtarmak için etkinliğini ve en iyi araçları tam olarak anlamak için daha fazla araştırmaya ihtiyaç vardır.

Anahtar Kelimeler: Otomatik göğüs kompresyon cihazı; kardiyak arrest; santometrik.

INTRODUCTION

Cardiac arrest is a health issue characterized by the cessation of the heart, with cardiopulmonary compression being the most effective method of reversal (1). The characteristics of high-quality manual chest compression include compressing the chest wall by at least 5 cm but not more than 6 cm, maintaining a frequency of 100-120 per minute, providing 2 breaths following 30 chest compressions, and allowing the chest to recoil after each compression (2). With technological advancements, automatic chest compression devices that embody these characteristics have been developed and are increasingly being used in many patients experiencing cardiac arrest (3-7). These automatic chest compression devices are primarily designed based on two technologies: one applies compression directly to the center of the chest bone, while the other uses a band to encircle and compress the chest (8,9). However, there is no proven superiority between these two types of devices in both in-hospital and out-of-hospital cardiac arrests (10,11). Nevertheless, it is still observed that automatic chest compression devices are not more beneficial than manual chest compressions (12-14). The Scientometric analysis involves the statistical analysis of scientific articles and other scientific publications on a specific topic (15,16). The number of publications in the literature is constantly increasing (17). In this growing body of knowledge, scientometric analyses focus on the most cited and popular articles, providing readers with quicker access to information (18). Despite the increasing number of studies on automatic chest compression devices in recent years, there is still a lack of scientometric studies on this topic in the literature. We believe that conducting a scientometric study in this area would shed light on researchers looking to conduct new studies on mechanical chest compression devices and that such a study could serve as a roadmap for researchers.

The aim of this study is to provide guidance to researchers planning to work on chest compression devices by conducting a scientometric analysis of the studies related to chest compression devices and to contribute to the literature by examining the leading publications in this field.

MATERIAL AND METHODS

This study is based on publications related to automatic chest compression devices in the Web of Science© (WoS) database. This platform enables researchers to obtain scientometric and statistical information on a specific subject. From July 1 to July 8, 2023, the literature was reviewed and the articles related to the topic were selected using the keywords "automated chest compression device" or "mechanical chest compression device". All articles in the database were manually scanned and analyzed. All articles relevant to the topic were included in the study. From the database, we investigated the distribution of articles on the subject according to scientific journals. The number of articles, the number of citations, and the citations per publication were calculated for each journal. Global research productivity, international collaborations, and research themes were analyzed using the scientometric method. In addition, we analyzed the abstracts of the articles, and if necessary, their full texts. The analysis was independently conducted by the authors, and disagreements were resolved through discussions. Document types (article, review article, editorial material, meeting abstract, proceeding paper, letter, early access, note) were identified. The top 10 authors who published the most articles were listed. Article languages, funding agencies and research areas were listed based on the number of publications. Similarly, the top 10 countries and 20 journals were listed based on the number of publications. Impact factors of the journals were also obtained from the official sites of the journals. The number of citations and citations per publication were identified in terms of countries and journals.

Data were entered into the Microsoft© Excel Program and results were presented in numbers and percentages. As no living subject was involved in the study, ethical approval was not required.

RESULTS

A total of 645 articles were identified in the WoS database by inputting the terms "Automatic chest compression device" or "Mechanical Chest compression device". Upon detailed manual scrutiny of these articles, 56 were excluded due to irrelevance or redundancy, leaving 589 articles for inclusion in the study. Out of these, 439 (74.407%) were original articles, followed by 63 (10.678%) review articles, and 30 (5.085%) editorial materials. Among the most prolific authors, Perkins GD (n=24) and Wik L (n=24) occupied the top position, succeeded by Deakin CD (n=16) in the third place. English was the dominant language for publications, accounting for 553 (93.729%) of the articles. The leading funding agency was identified as the United States Department of Health Human Services. Emergency medicine and general internal medicine emerged as the primary research areas. Please refer to Table1 for detailed information.

When examining the distribution of research articles by country, the United States (US) topped the list with 171 articles, followed by Germany (n=77). Although the UK ranked third in terms of the number of publications with 53 articles, it held the premier position in terms of citations (n=3465). The US followed closely with 3228 citations. The Netherlands boasted the highest number of citations per publication at 66.6. The US also stood out in terms of the H-index, registering a score of 30. For a comprehensive comparison of countries, please see Table2. The peak years for publications in the field were 2015, 2014, 2020, and 2021 (Figure1).

Table 1. Analysis of articles according to document types, authors, funding agencies, affiliations and research area

Document Types	Number	%
Article	439	74.407
Review Article	63	10.678
Editorial Material	30	5.085
Meeting Abstract	23	3.898
Proceeding Paper	23	3.898
Letter	17	2.881
Early Access	6	1.017
Note	1	0.169
Authors		
Perkins GD	24	4.068
Wik L	24	4.068
Deakin CD	16	2.712
Quinn T	13	2.203
Gates S	12	2.034
Rubertsson S	12	2.034
Kramer-johansen J	11	1.864
Lall R	11	1.864
Sunde K	11	1.864
Aramendi E	10	1.695
Languages		
English	553	93.729
German	27	4.576
Spanish	4	0.678
French	3	0.508
Italian	1	0.169
Russian	1	0.169
Turkish	1	0.169
Funding Agencies		
United States Department Of Health Human Services	26	4.407
National Institutes Of Health (NIH) USA	25	4.237
National Institutes Of Health Research (NIHR)	13	2.203
NIH National Heart Lung Blood Institute (NHLBI)	13	2.203
European Commission	10	1.695
Spanish Government	9	1.525
Basque Government	7	1.186
National Natural Science Foundation Of China (NSFC)	7	1.186
Zoll Medical	7	1.186
Uppsala University	6	1.017
Affiliations		
University of Oslo	33	5.593
University of Warwick	26	4.407
Lund University	18	3.051
Medical University of Vienna	15	2.542
Ulm University	15	2.542
University of Texas System	15	2.542
Skane University Hospital	14	2.373
Uppsala University	14	2.373
Heart of England NHS Foundation Trust	13	2.203
University of Bern	13	2.203
Research Area		
Emergency Medicine	285	48.305
General Internal Medicine	235	39.831
Cardiovascular System Cardiology	84	14.237
Engineering	39	6.610
Anesthesiology	29	4.915
Public Environmental Occupational Health	19	3.220
Respiratory System	13	2.203
Research Experimental Medicine	11	1.864
Surgery	11	1.864
Science Technology Other Topics	10	1.695
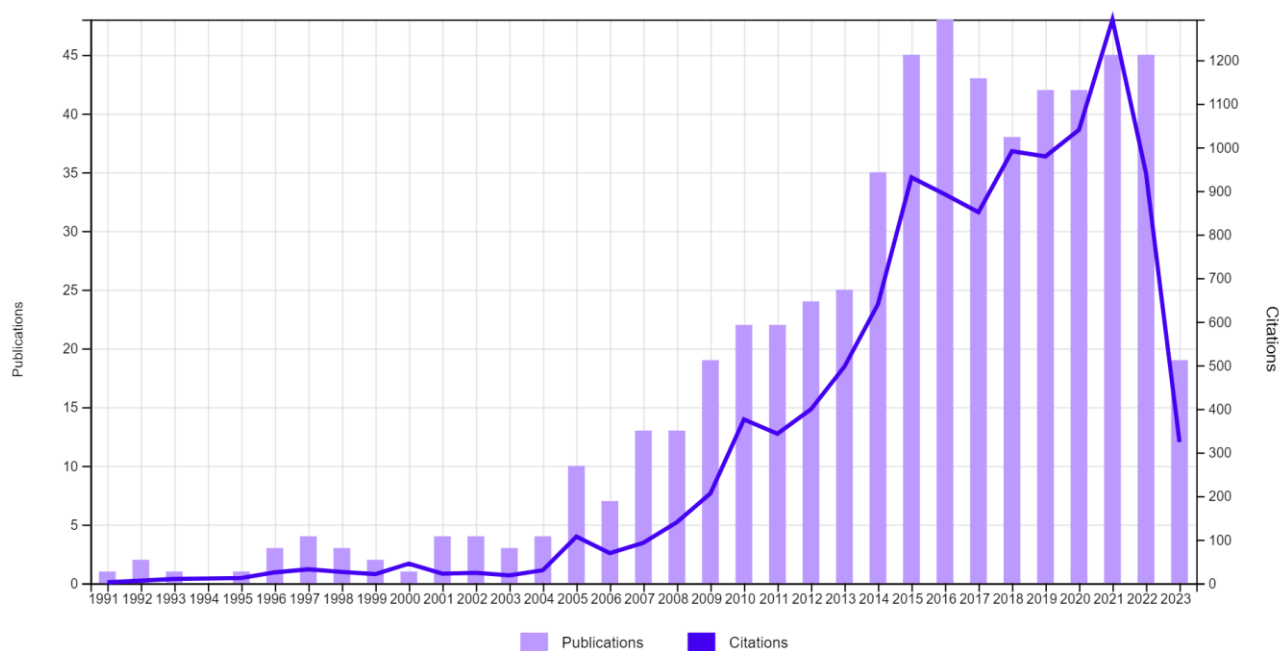
Figure 1. Publications and citations of the years

Table 2. Comparison of countries according to number of articles and citations

Countries	Number of Articles	Total Citations	Citations per Publication	Top 3 years of publication (n)	H-Index
USA	171	3228	18.88	2019 (14), 2020 (13), 2015 (12)	30
Germany	77	2004	26.03	2021 (10), 2014 (7), 2022 (7)	16
England	53	3465	65.38	2015 (9), 2018 (6), 2014 (5)	20
Sweden	47	1742	37.06	2009 (5), 2019 (5), 2011 (4)	20
Norway	42	3209	76.4	2010 (3), 2012 (3), 2019 (3)	20
South Korea	29	250	8.62	2022 (6), 2019 (4), 2021 (4)	10
Austria	28	644	23	2016 (5), 2015 (3), 2021 (3)	15
Italy	28	1330	47.5	2022 (6), 2019 (4), 2017 (3)	9
Switzerland	26	220	8.46	2016 (5), 2013 (3), 2015 (3)	9
Netherlands	25	1665	66.6	2015 (5), 2014 (4), 2011 (3)	12

An assessment of the top 20 publishing journals revealed that the Resuscitation journal led in terms of publication count (n=133), citation count (n=5906), and average citations per publication (n=44.41). The American Journal of Emergency Medicine (Am J Emerg Med) ranked second with 28 publications, while the Scandinavian Journal of Trauma Resuscitation Emergency Medicine (Scand J Trauma Resusc Emerg Med) held the third position with 19 publications. In terms of citation count, Scand J Trauma Resusc Emerg Med came second (n=383) and Am J Emerg Med ranked third (n=319). Detailed information about the journals can be found in Table3.

Table 3. Comparison of journals in terms of number of articles and citations

Journal	Number of Articles	Number of Citations	Citations per Publication
Resuscitation	133	5906	44.41
American Journal of Emergency Medicine	28	319	11.39
Scandinavian Journal of Trauma Resuscitation Emergency Medicine	19	383	20.16
Circulation	15	308	20.53
Current Opinion in Critical Care	12	217	18.08
Journal of Emergency Medicine	12	67	5.58
Annals of Emergency Medicine	11	226	20.55
Critical Care Medicine	11	197	17.91
Notfall Rettungsmedizin	11	27	2.45
Prehospital Emergency Care	11	74	6.73
Anaesthesist	9	84	9.33
Journal of Clinical Medicine	6	7	1.17
Journal of the American Heart Association	6	202	33.67
PLOS ONE	6	26	4.33
BMJ Open	5	35	7
Emergency Medicine Journal	5	63	12.6
Open Access Emergency Medicine	5	10	2
Respiratory Care	5	60	12
European Heart Journal	4	85	21.25
Hong Kong Journal of Emergency Medicine	4	13	3.25

DISCUSSION

In the WoS database, there are a total of five hundred and eighty-nine articles. The earliest article related to automatic chest compression devices in WoS was published in 1991 by Andstat et al., titled "Direct mechanical ventricular actuation for cardiac arrest in humans - a clinical feasibility trial," which introduced a device applied directly to the open heart (19). Looking at the distribution over the years, the years with the most publications are 2016 with 48 articles, followed by 2015, 2021, and 2022 with 45 articles each. Based on these results, we can say that automatic chest compression devices have become more popular in the last decade. The areas where most studies are conducted are, as expected, Emergency Medicine and General Internal Medicine, due to both fields encompassing the Critical Care area. Emergency departments are especially critical for urgent interventions and are the first point of care for patients with cardiac arrest. Therefore, it is expected that most studies in this field are conducted in emergency settings. On the other hand, the follow-up care for these patients in intensive care units is managed by anesthesiologists and intensive care specialists. It is surprising to see a lower number of studies in anesthesiology, which is part of the Critical Care field. In the WoS, the majority of the articles are original articles, totaling four hundred and thirty-nine, followed by review articles and editorial materials. The authors who have written the most articles on this topic are

Gavin Perkins and Lars Wik, each with twenty-four articles. Gavin Perkins is a professor of critical care, while Lars Wik is a researcher in prehospital services. The most common language used is English, with 553 articles, followed by German. This indicates that the articles are written in a common language. The institutions that support these studies the most are located in the USA. However, the University of Oslo has published the most studies. The majority of the studies were conducted in the USA, but the publications from the UK have received the most citations. Despite these ratios, Norway has the highest citation rate per publication. Citations are one of the most important criteria indicating the value of an article(20). The fact that publications from the UK receive more citations suggests that higher quality publications are produced there. Additionally, the high citation rate per publication for Norwegian publications, despite their low number, suggests that they are of higher quality. The journal with the most articles published is Resuscitation, which also has the most citations. This journal is followed by the American Journal of Emergency Medicine and the Scandinavian Journal of Trauma Resuscitation Emergency Medicine. Examining these journals, we see that they are Emergency Medicine journals aiming to contribute to the literature in this field. Therefore, it is possible to conclude that Emergency Medicine journals are more focused on publishing contributions to this area.

The article with the most citations was published by Perkins G et al. in the Lancet journal (21). This study is a blind randomized controlled trial conducted on out-of-hospital cardiac arrests in the UK. It compared the LUCAS-2 device with the LUCAS device and mechanical CPR with manual CPR, finding no superiority in either comparison. The second most cited article was written by Rubertsson S et al (22). This multicenter randomized clinical trial found no difference between mechanical CPR and manual CPR. The third most cited article, by Wik L et al., is about a study involving 4219 patients over approximately two years in three US cities and two European cities, using a load-distributing band device (23). The study concluded that automatic chest compression devices produced similar results to manual CPR and did not differ in neurological survival. The fourth most cited article, written by Hoke R and Chamberlain D, examined studies involving injuries to chest bone structures during CPR but did not yield any results related to mechanical CPR due to a lack of data (24). The fifth most cited article, by Steen S et al., used technology that applies compression to the middle bone of the chest on experimental animals and laboratory mannequins. The study suggested that the LUCAS device could be an alternative to manual CPR, but manual CPR would not lose its value (25).

According to the citation counts of the examined 589 articles, the most impactful studies are, in order, Perkins G et al. (21), Rubertsson S et al. (22), Wik L et al. (23), Hoke R et al. (24), and Steen S et al. (25), Cave D et al. (26), Steen et al. (27). We can suggest that physicians and researchers who wish to publish on mechanical CPR should initially review these publications. These sources will be helpful in identifying key points and areas for improvement in their own studies and publications. When we look at the trending keywords in the research, the most frequently encountered words are cardiopulmonary device, survival, ventricular fibrillation, LUCAS, quality, blood-flow, and perfusion pressure.

Upon reviewing the literature, no previous bibliometric study related to mechanical CPR has been encountered. In our study, all scientific articles published on mechanical CPR from the first article to July 2023 were analyzed comprehensively. To our knowledge, our study is the first detailed bibliometric research conducted on the topic of mechanical CPR.

Regarding the limitations of our study, the WoS database was used. Our analyses do not cover other databases such as Scopus, PubMed, or Google Scholar. This choice was made considering the extensive network of journals in the WoS database, as well as its inclusion of many important studies from PubMed, Scopus, and Google Scholar (28). When we look at the literature, it is observed that WoS is used in most bibliographic studies (29-32).

In conclusion, in this bibliometric study related to mechanical CPR, which has seen an increasing number of articles in recent years, we shared a summary of 589 articles. We believe that this detailed analysis will be a guide for those interested in this topic. Additionally, it will serve as a quick reference for those currently working on mechanical CPR, showing the past, present, and future of this field. It will also help those planning new studies to see which topics are trending, which topics are prominent, and which topics need to be worked on.

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