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Hotspots and Frontiers in Arrhythmias During Pregnancy: A Bibliometric Analysis

Fei Liu[1], Chunhua Tu[1], Xiaoping Peng[2,3], Yuan Wen[2,3]

[1]Department of Gynecology and Obstetrics, The First Affiliated Hospital of Nanchang University, Nanchang, Jiangxi, 330006, People's Republic of China; [2]Department of Cardiology, The First Affiliated Hospital of Nanchang University, Nanchang, Jiangxi, 330006, People's Republic of China; [3]Hypertension Research Institute of Jiangxi Province, Nanchang, Jiangxi, 330006, People's Republic of China

Correspondence: Yuan Wen, Email ywenjx@163.com

Background: Arrhythmias in pregnancy have become an increasingly significant concern for maternal and fetal well-being, reflecting a rising prevalence trend. This bibliometric analysis sought to delineate global research trajectories, pinpoint principal contributors, and underscore nascent areas of interest in this domain.

Methods: We retrieved publications concerning arrhythmias in pregnant women from 1996 to 2025 from the Web of Science Core Collection. A bibliometric analysis was performed utilizing VOSviewer, CiteSpace, and the R package "bibliometrix" to delineate co-authorship networks, institutional collaborations, and patterns of keyword co-occurrence.

Results: In total, 1042 publications were identified with an annual growth rate of 4.9%. The USA led in total publications (300, 28.8%). Productive institutions featured the University of Toronto (95) and Harvard University (94). The *American Journal of Cardiology* contributed the highest number of articles (25). Roos-Hesselink JW was identified as a foremost researcher, with 23 publications and an H-index of 19. Keyword analysis revealed "management" as a central theme, while "outcome", "long QT syndrome", and "cardiovascular disease" were emerging themes.

Conclusion: This bibliometric study presents a thorough overview of international research on arrhythmias in pregnant women. It identifies key contributors, influential institutions, and developing research topics, offering potential insights for optimizing pregnancy management, enhancing clinical outcomes, and progressing the treatment of cardiovascular and heart-related conditions during gestation.

Keywords: arrhythmia, pregnancy, bibliometric analysis, VOSviewer, CiteSpace

Introduction

Pregnancy entails a unique physiological state characterized by complex adaptations, including an accelerated maternal metabolism and an approximate 45% expansion in blood volume to meet the escalating demands of placental circulation.[1] This augmented blood volume places considerable strain on the cardiovascular system, leading to an elevated heart rate and increased cardiac output.[2] Consequently, cardiovascular disease (CVD) has become a primary cause of maternal mortality in Western nations during pregnancy.[3] The United States has experienced a dramatic surge in maternal mortality, with rates escalating from 17.4 to 32.9 deaths per 100,000 live births between 2018 and 2021.[4] Notably, this period also saw a parallel rise in pregnancy-associated arrhythmias, with an incidence of 67 cases per 100,000 pregnancies,[5] suggesting that arrhythmias during pregnancy may be associated with adverse maternal and fetal outcomes.[6,7]

Arrhythmia, characterized by abnormal electrical activity in the heart, presents in diverse forms, such as excessively rapid, slow, irregular, or premature heartbeats.[8] Clinical manifestations span from benign palpitations to severe symptoms like syncope, seizures, or sudden cardiac death.[9] Common arrhythmias documented during pregnancy encompass atrial fibrillation, atrial flutter, supraventricular tachycardia, and sinus tachycardia.[10,11] These conditions not only imperil maternal health but are also linked to adverse fetal outcomes, including intrauterine growth restriction, preterm birth, and stillbirth.[10,12]

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Progress in diagnostic techniques and therapeutic interventions, alongside the trend of increasing maternal age, has led to a greater incidence of pregnancy-associated arrhythmias.[13] Current research has pinpointed specific risk factors, for instance, mitral valve prolapse, which correlates with an increased likelihood of malignant ventricular arrhythmias during the perinatal phase compared to non-pregnant individuals.[14,15] The rising occurrence of hereditary arrhythmias further emphasizes the necessity for specialized management approaches during pregnancy, as advancements in genetic testing and treatment options present new avenues for care.[16] Despite these advancements, considerable knowledge deficits and inconsistencies in management strategies persist, calling for determining the current hotspots and future frontiers in this field, which can guide researchers in field to optimize identified outcomes in the future.[17]

Bibliometric analysis offers a potent methodological tool for the systematic assessment of research trends and patterns within a specific discipline. Through the application of mathematical and statistical methods, this type of analysis yields insights into research categories, which can help researchers identify current areas of concern and guide future research trends.[18,19] Although such analysis has been conducted on cardiovascular disease (CVD) in gestational diabetes mellitus (GDM) patients,[20] regarding arrhythmias in all pregnant women, the existing literature has not yet fully mapped the developmental course, research hotspots, and collaborative networks in this area. This study endeavors to conduct a bibliometric analysis of research on arrhythmias during pregnancy, concentrating on comprehending developmental paths, identifying principal research hotspots, and detecting emerging trends.

Materials and Methods

Data Sources and Search Strategies

We performed a systematic literature search within the Web of Science Core Collection (WoSCC) due to its focus on high-quality, globally peer-reviewed academic publications, primarily traditional academic literature, including journal articles, conference proceedings, and books.[21] Additionally, the WoSCC database is multidisciplinary and comprehensive, offering a complete citation network and key bibliometric indices (eg, Journal Citation Reports (JCR), impact factor (IF), and H-index).[22] Therefore, we selected it to obtain global academic information for bibliometric analysis according to previous studies.[23–25] The search query employed was: (TS=(Pregnan* OR gestational)[26,27] AND TS=(Arrhythmia* OR Arrythmia OR "Cardiac Dysrhythmia")).[28] The inclusion criteria were: 1) English language; 2) published between January 1, 1996 (the earliest publication year in this field), to July 31, 2025; 3) articles related to arrhythmias during pregnancy meeting the search formula. Additionally, records such as reviews, editorial materials, letters, and meeting abstracts were excluded. To mitigate potential variations arising from database updates, the literature retrieval was conducted on a single day (July 31, 2025). All information was collected in text format, encompassing the number of publications and citations, titles, author information, institutions, countries/regions, keywords, and journals.

Statistical Analysis

Statistical analysis and data visualization were performed utilizing VOSviewer (version 1.6.20), CiteSpace (version 6.3.R1), and the R package "bibliometrix" (version 4.4.1). VOSviewer, a multifaceted software, was instrumental in constructing collaboration networks among institutions, authors, and publications,[29] enabling the visualization and examination of intricate academic relationships, including co-authorship, co-citation, and keyword co-occurrence networks. CiteSpace served to identify emerging trends and keyword bursts.[30] In the generated visualizations, node size corresponds to publication volume, line thickness signifies relationship strength, and node color indicates publication time, thus illuminating significant research developments chronologically. The "bibliometrix" R package was utilized for trend mapping and ranking analyses, aiding in the assessment of publication and citation patterns across authors, institutions, and countries.[31] This package also supported the creation of trend charts and longitudinal examinations of the field's evolution. Several bibliometric indices, such as the H-index, G-index, and M-index, were applied to gauge the academic influence of authors and journals.[32] Furthermore, journals were classified using JCR according to their IF, which reflects the average citations per article, offering insight into their relative prominence in this field.[33]

Results

The Publication Trends

An initial search yielded 1498 studies. Following the exclusion of reviews, meeting abstracts, early access articles, and other non-relevant document types 1042 studies were retained for detailed analysis (Figure 1). These publications involved 5667 authors from 1064 institutions spanning 76 countries and regions. The articles appeared in 400 journals and collectively cited 27,903 references (Figure 2A). A sustained increase was observed from 1996 to 2024, despite intermittent variations, with an annual growth rate of 4.9%. Specifically, publication volume remained relatively constant between 1996 and approximately 2007, with 10 to 25 articles annually. Post-2007, a notable surge occurred, reaching a peak of 78 publications in 2021. This pattern highlights escalating interest and consistent contributions to this research domain (Figure 2B).

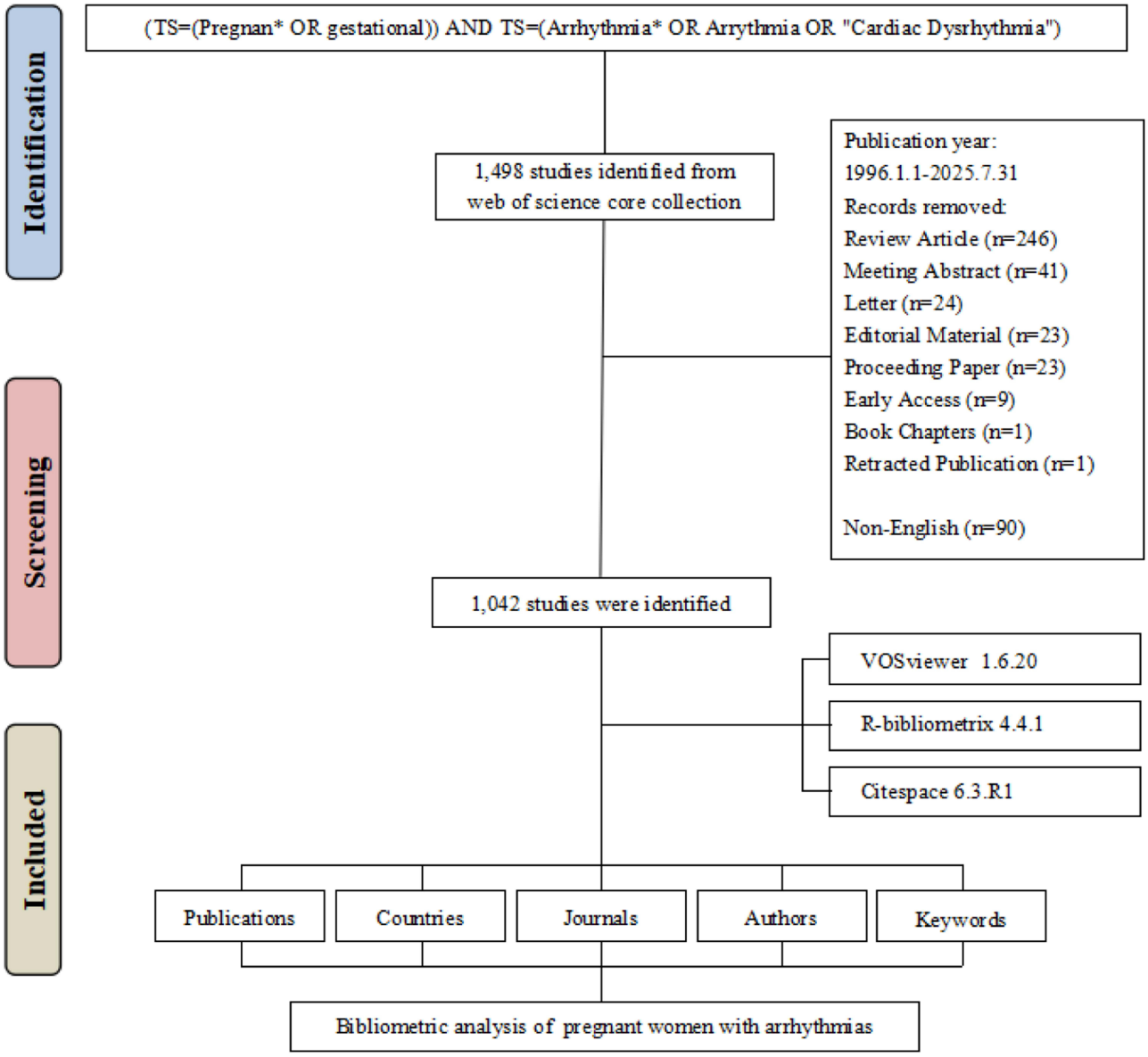

Figure 1 Flowchart of data screening process.

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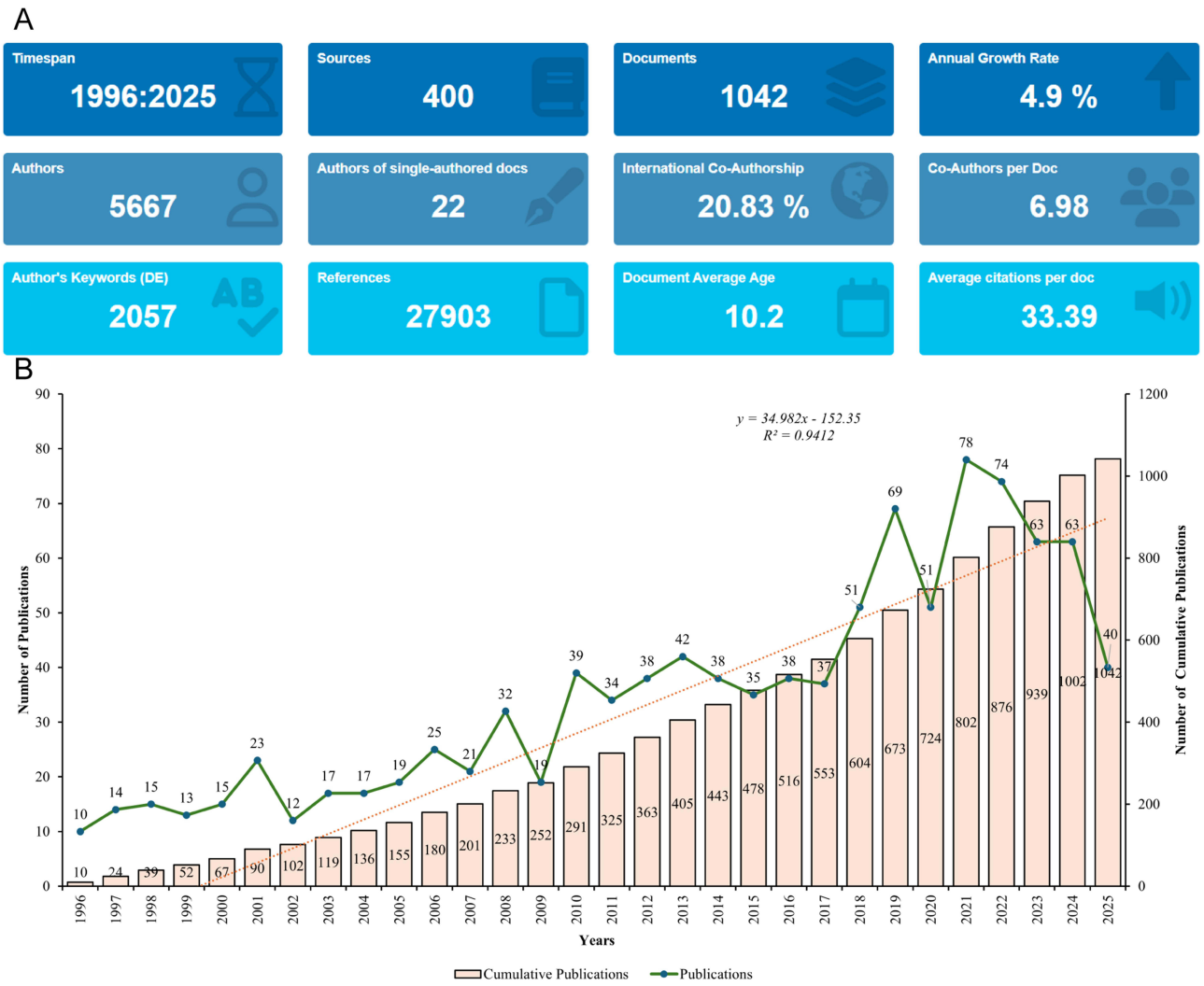

Figure 2 (**A**) Comprehensive overview of arrhythmia in pregnant women. (**B**) Annual growth of publications on arrhythmia in pregnant women from 1996 to 2025.

Analysis of Leading Countries

As detailed in Table 1, the USA was at the forefront with 300 articles (28.8%), trailed by the United Kingdom (68 articles, 6.5%) and Canada (67 articles, 6.4%). The USA also recorded the highest total citations (TC) at 8919, followed by the United Kingdom (6212) and Germany (3247). United Kingdom distinguished itself with the highest average citations per article (91.4), while Germany and Netherlands also showed high averages (79.2 and 58.3 citations per article, respectively). International collaborations were also evident; the USA had the largest number of multiple-country publications (MCP, n=49), signifying considerable international cooperation, followed by the United Kingdom (n=24) and Canada (n=19) (Table 1 and Figure 3). Among the 69 countries participating in international collaborations, the USA contributed the most collaborative publications (n=269), succeeded by the United Kingdom (215) and the Netherlands (193) (Figure S1).

Analysis of Leading Institutions

Figure 4 displays the top 10 most prolific institutions. The University of Toronto headed the list with 95 publications, followed by the University of California system (n=94) and Imperial College London (n=68). A co-authorship analysis was performed to further examine inter-institutional collaboration. Among 91 institutions engaging in international collaborations with at least 6 articles, the University of Toronto demonstrated the highest number of collaborations (link

Table 1 Publication and Citation Profiles of Leading Countries

Country	Articles	Freq	SCP	MCP	MCP_Ratio	TP	TP_Rank	TC	TC_Rank	Average Citations
USA	300	0.288	251	49	0.163	1272	1	8919	1	29.7
UK	68	0.065	44	24	0.353	341	2	6212	2	91.4
Canada	67	0.064	48	19	0.284	275	3	3232	4	48.2
China	64	0.061	56	8	0.125	212	6	481	10	7.5
Japan	63	0.06	56	7	0.111	261	4	800	8	12.7
Netherlands	50	0.048	33	17	0.34	227	5	2916	5	58.3
Italy	47	0.045	37	10	0.213	177	8	920	7	19.6
Germany	41	0.039	31	10	0.244	204	7	3247	3	79.2
Turkey	35	0.034	35	0	0	95	12	303	15	8.7
Australia	26	0.025	17	9	0.346	101	11	408	13	15.7
Sweden	24	0.023	11	13	0.542	102	10	414	12	17.2
Korea	19	0.018	16	3	0.158	53	16	139	23	7.3
France	17	0.016	15	2	0.118	112	9	515	9	30.3
Poland	16	0.015	14	2	0.125	56	14	248	17	15.5
India	15	0.014	13	2	0.133	35	21	183	20	12.2
Brazil	14	0.013	12	2	0.143	43	17	248	16	17.7
Israel	13	0.012	11	2	0.154	54	15	431	11	33.2
Austria	10	0.01	6	4	0.4	42	19	162	21	16.2
Finland	10	0.01	8	2	0.2	43	18	305	14	30.5
Spain	10	0.01	7	3	0.3	70	13	150	22	15

Notes: Articles: Publications of Corresponding Authors only. Freq: Frequence of Total Publications. SCP: Single Country Publications. MCP: Multiple Country Publications. MCP_Ratio: Proportion of Multiple Country Publications. TP: Total Publications. TP_rank: Rank of Total Publications. TC: Total Citations. TC_rank: Rank of Total Citations. Average Citations: The average number of citations per publication.

strength=77), followed by Erasmus MC (link strength=60) and University of Amsterdam (link strength=55). This indicates extensive engagement across various countries, fostering knowledge and expertise exchange. The collaboration network also underscored the pivotal role of American and European institutions (Figure S2).

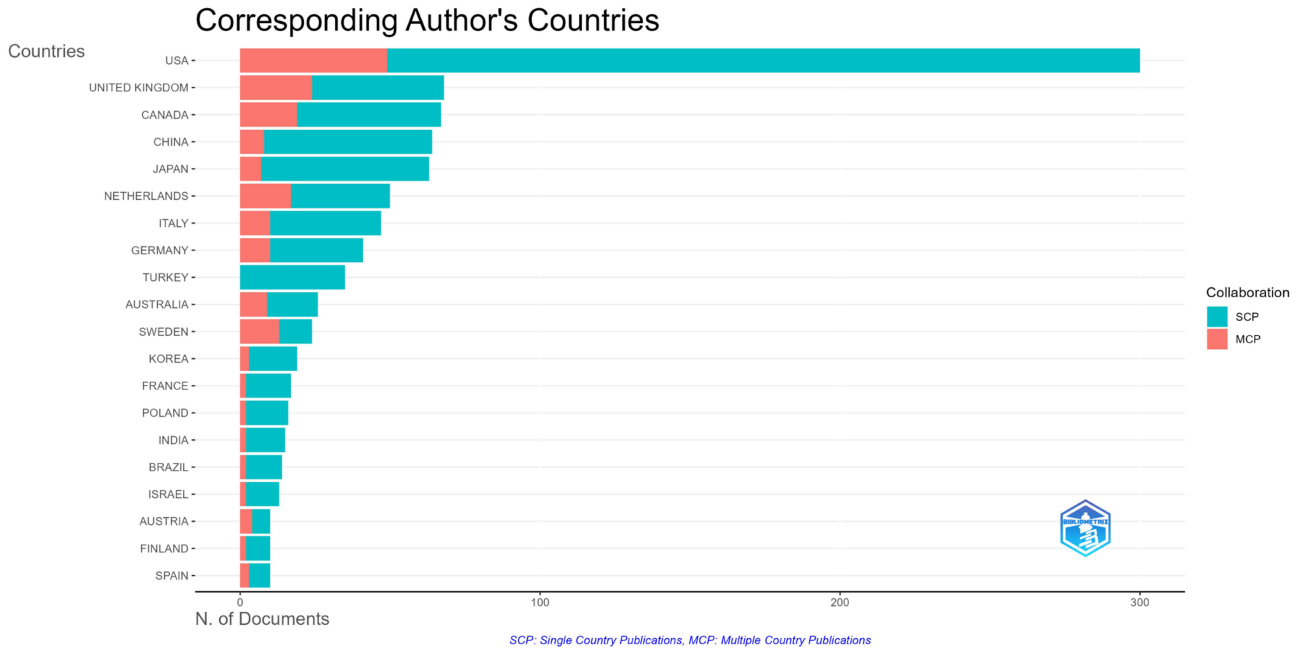

Figure 3 Distribution of corresponding authors' publications by country in arrhythmia in pregnant women.

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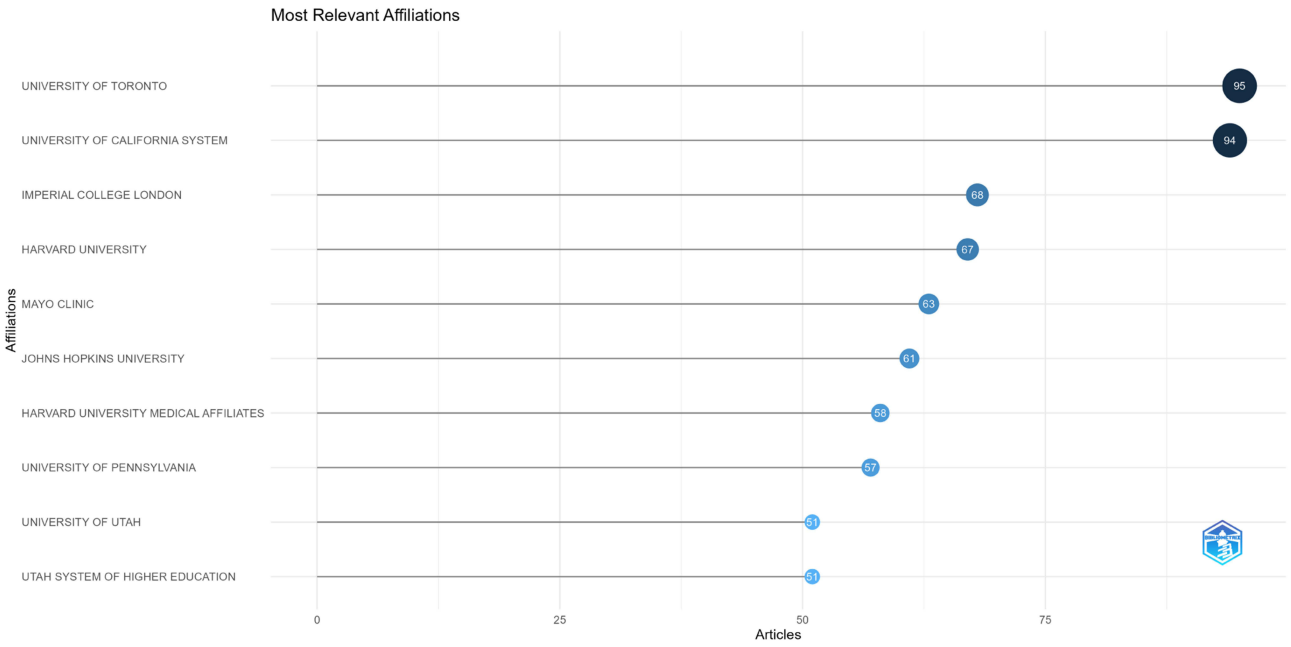

Figure 4 Top 10 institutions by article count and rank in arrhythmia in pregnant women.

Analysis of Authors

Table 2 summarizes that Roos-Hesselink JW was the leading author with 23 publications and an H-index of 19, ranking first in total publications (TP) and H-index. Silversides CK followed with 21 publications (H-index 16), and Pieper PG.

Table 2 Publication and Citation Profiles of High-Impact Authors

Author	H-Index	G-Index	M-Index	PY_Start	TP	TP_Frac	TP_Rank	TC	TC_Rank
Roos-Hesselink JW	19	23	0.864	2004	23	2.43	1	3673	2
Pieper PG	16	17	0.762	2005	17	1.87	3	6620	1
Silversides CK	16	21	0.8	2006	21	2.09	2	2198	3
Strasburger JF	13	14	0.433	1996	14	3.21	5	518	12
Johnson MR	12	16	0.6	2006	16	1.64	4	1916	4
Siu SC	11	13	0.44	2001	13	1.52	6	1771	5
Gatzoulis MA	10	11	0.476	2005	11	1.67	9	1226	9
Mulder BJM	10	10	0.476	2005	10	1.34	11	1175	10
Cuneo BF	9	13	0.45	2006	13	1.76	6	366	14
Danielsson BR	9	9	0.31	1997	9	2.41	14	236	15
Joglar JA	9	9	0.333	1999	9	1.06	14	1466	7
Sköld AC	9	9	0.333	1999	9	1.93	14	209	19
Webster WS	9	12	0.31	1997	12	3.37	8	187	20
Colman JM	8	9	0.32	2001	9	0.89	14	1665	6
Grewal J	8	8	0.5	2010	8	0.74	19	849	11
Ikeda T	8	11	0.571	2012	11	0.99	9	217	17
Katsuragi S	8	10	0.571	2012	10	0.89	11	214	18
Mital S	8	8	0.5	2010	8	0.54	19	1405	8
Wakai RT	8	10	0.4	2006	10	2.24	11	223	16
Williamson C	8	9	0.348	2003	9	1.13	14	503	13

Notes: H-index: The H-index of the author, which measures both the productivity and citation impact of the publications. G-index: The G-index of the author, which gives more weight to highly-cited articles. M-index: The M-index of the author, which is the H-index divided by the number of years since the first published paper. TP: Total Publications. TP_rank: Rank of Total Publications. TC: Total Citations. TC_rank: Rank of Total Citations. Average Citations: The average number of citations per publication. PY_start: Publication Year Start, indicating the year the journal started publication.

with 17 publications (H-index 16). The highest TC were linked to Pieper PG. (6620 citations), followed by Roos-Hesselink JW (TC=3673) and Silversides CK (TC=2198). These researchers are pivotal to the field's advancement, having made significant contributions to core study areas. Collaborative relationships among 66 researchers with a minimum of 4 articles are depicted in Figure S3. Circle size signifies publication count, and color denotes cluster affiliation. Close collaboration among numerous authors formed a total of 5 clusters. Joglar Jose A. exhibited the highest collaboration levels with other authors (link strength=98), followed by Mital Seema (link strength=97) and Burke Michael A. (link strength=95) (Figure S3).

Analysis of Journals

The analyzed articles were disseminated across 400 journals. The *American Journal of Cardiology* led with 25 total publications (IF = 2.1), followed by the *International Journal of Cardiology* (n = 22; IF = 3.2) and the *Journal of the American College of Cardiology* (n = 22; IF = 22.3). Regarding TC, *Circulation* had the highest count (2625 citations), followed by the *Journal of the American College of Cardiology* (n = 2085) and the *American Journal of Cardiology* (n = 1170) (Table 3). The journal co-occurrence network included 68 journals with at least four occurrences. The three journals with the greatest total link strength in this network were *European Heart Journal* (link strength = 303), *Circulation* (link strength = 270), and the *Journal of the*

Table 3 Bibliometric Indicators of High-Impact Journals

Journal	H-Index	G-Index	M-Index	IF 2024	JCR 2024	TP	TP_Rank	TC	TC_Rank	PY_Start
Circulation	18	18	0.6	38.6	Q1	18	7	2625	1	1996
Journal of the American College of Cardiology	17	22	0.567	22.3	Q1	22	3	2085	2	1996
American Journal of Cardiology	16	25	0.552	2.1	Q3	25	1	1170	3	1997
European Heart Journal	16	19	0.571	35.6	Q1	19	5	1048	4	1998
Heart	14	18	0.5	4.4	Q1	18	8	870	5	1998
International Journal of Cardiology	13	22	0.684	3.2	Q2	22	2	517	9	2007
American Journal of Obstetrics and Gynecology	11	14	0.379	8.4	Q1	14	13	828	6	1997
PLoS One	10	16	0.625	2.6	Q2	16	10	175	36	2010
Prenatal Diagnosis	10	15	0.357	2.7	Q1	15	12	218	25	1998
Journal of Maternal-Fetal & Neonatal Medicine	9	13	0.429	1.6	Q3	21	4	124	48	2005
Pediatric Cardiology	9	16	0.31	1.4	Q3	19	6	256	18	1997
Cardiology in The Young	8	13	0.286	NA	NA	14	15	139	45	1998
Journal of Cardiovascular Electrophysiology	8	11	0.267	2.6	Q2	11	19	244	20	1996
Journal of the American Heart Association	8	15	0.8	5.3	Q1	16	9	241	21	2016
Obstetrics and Gynecology	8	8	0.276	4.7	Q1	8	31	604	7	1997
Physiological Measurement	8	10	0.381	2.7	Q2	10	23	93	67	2005
Reproductive Toxicology	8	10	0.296	2.8	Q2	10	24	87	73	1999
Ultrasound in Obstetrics & Gynecology	8	16	0.276	6.3	Q1	16	11	421	11	1997
American Journal of Perinatology	7	13	0.233	1.2	Q3	14	14	110	55	1996
Circulation Journal	7	10	0.304	3.7	Q1	10	20	177	33	2003

Notes: H-index: The H-index of the journal, which measures both the productivity and citation impact of the publications. G-index: The G-index of the journal, which gives more weight to highly-cited articles. M-index: The M-index of the journal, which is the H-index divided by the number of years since the first published paper. TP: Total Publications. IF 2024: Impact Factor in 2024, indicating the average number of citations to recent articles published in the journal. JCR 2024: The quartile ranking of the journal in the Journal Citation Reports in 2024, indicating the journal's ranking relative to others in the same field (Q1: top 25%, Q2: 25–50%, Q3: 50–75%, Q4: bottom 25%). TP: Total Publications. TP_rank: Rank of Total Publications. TC: Total Citations. TC_rank: Rank of Total Citations. PY_start: Publication Year Start, indicating the year the journal started publication.

Table 4 Top 20 Keyword Co-Occurrence Network Analysis

Keyword	Occurrences	Total Link Strength
Management	125	364
Women	111	344
Risk	116	326
Pregnancy	151	319
Arrhythmias	116	274
Outcomes	86	260
Complications	58	202
Diagnosis	76	198
Congenital heart-disease	55	180
Disease	59	134
Heart-disease	45	121
Therapy	42	114
Heart	42	105
Mortality	27	102
Tachycardia	37	97
Delivery	25	94
Fetal	33	93
Predictors	24	92
Prevalence	24	88
Population	23	87

American College of Cardiology (link strength = 198) (Figure S4A). Similarly, the journal coupling network also comprised 68 journals with at least four couplings. In this network, the top three journals by total link strength were the *Journal of the American College of Cardiology* (link strength = 6803), *European Heart Journal* (link strength = 5999), and *Circulation* (link strength = 5286) (Figure S4B).

Analysis of Keywords

Keyword analysis offers significant insights into research trends and focal areas within this discipline. Larger nodes, for instance "management" (125 occurrences, 364 total link strength), signify terms appearing frequently across numerous studies, emphasizing their core importance. The network also indicated that topics such as "risk" (116 occurrences, 326 total link strength) create interconnected clusters, implying their relevance across a wide array of studies. Color-coding within the network denotes the average publication year, with yellow nodes representing newer research areas. Topics like "outcomes" (86 occurrences, 260 total link strength) and "risk" (116 occurrences, 326 total link strength) have surfaced as more recent investigative focal points (Table 4 and Figure 5).

The keyword burst analysis, shown in Figure 6, pinpointed the top 20 keywords exhibiting the strongest citation bursts, indicative of emerging trends. "Arrhythmias" displayed the most significant citation burst (burst strength = 8.41, 1997–2007). Other keywords with notable citation bursts included "supraventricular tachycardia" (burst strength = 7.13, 1996–2010), "delivery" (burst strength = 5.53, 2016–2018), and "congenital heart disease" (burst strength = 5.35, 2009–2011). These bursts signal shifts in research priorities and the rise of evolving trends. More recent terms, namely "outcome" (burst strength = 5.2, 2019–2021), "long QT syndrome" (LQTS; burst strength = 4.82, 2022–2023), and "cardiovascular disease" (burst strength = 5.33, 2020–2025), have achieved prominence, pointing to significant ongoing advancements in these areas (Figure 6).

Discussion

Overall Findings

This bibliometric investigation mapped research trends concerning arrhythmia in pregnant women between 1996 and 2025, offering a panoramic view of publication and citation metrics, leading countries, institutions, journals, and

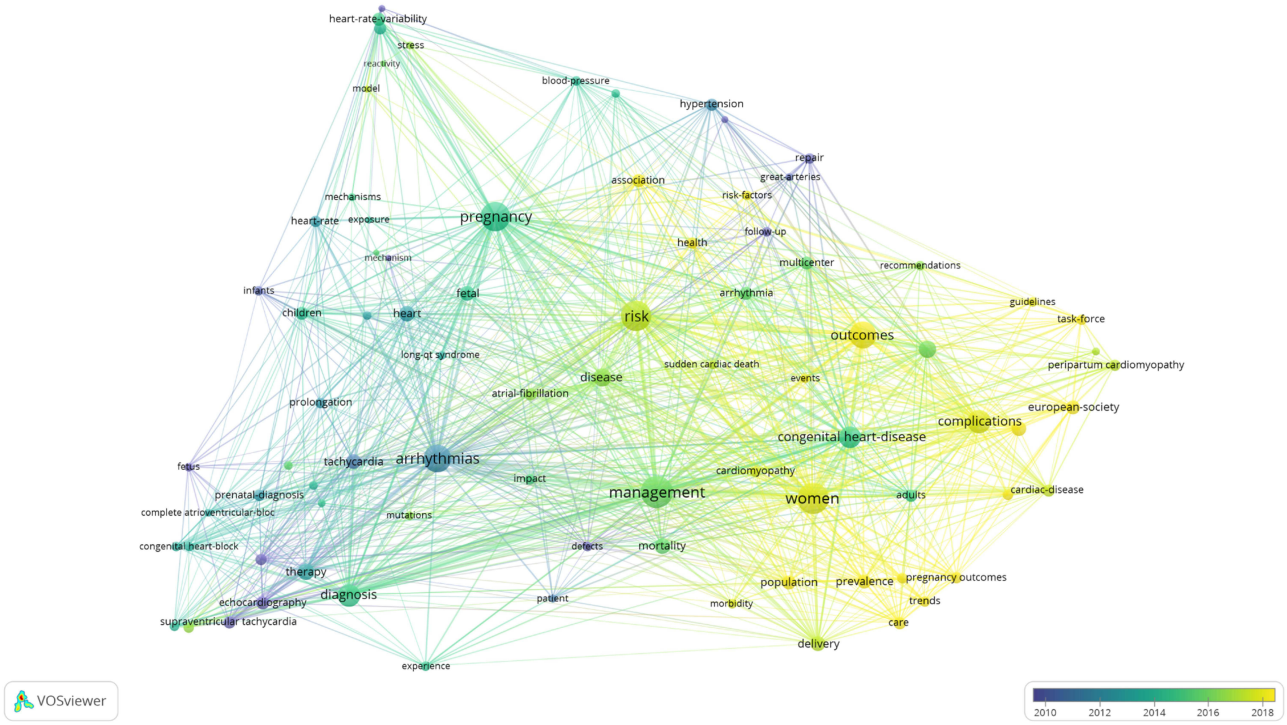

Figure 5 Keyword co-occurrence overlay visualization in arrhythmia in pregnant women.

principal research topics. The findings indicate a substantial upturn in academic interest over this period, evidenced by 1042 published documents and an annual growth rate of 4.9%. A notable surge occurred after 2007, suggesting a growing concern on higher risk of arrhythmias during pregnancy.[34,35] The study underscored the paramount importance of pregnancy management in arrhythmia-related research, identifying significant contributions from a varied group of authors, institutions, and journals.

Authors, Countries, and Institutions

The data revealed that 5667 authors contributed to this specialty, with a mere 22 documents being single-authored, underscoring the highly collaborative character of this research area. The USA takes precedence in both publication volume and citations, marking its influential role in propelling research in this field. Since 1996, the Heart Rhythm Society (HRS) in the USA has formulated expert consensus documents that have steered clinical practice in managing cardiac arrhythmias. More recently, the newest HRS-led expert consensus statement was compiled in partnership with various authoritative bodies,[17] suggesting its robust partnerships with other countries. Other influential countries include the United Kingdom and Canada, both also demonstrating robust international collaborative activities. Furthermore, institutions such as the University of Toronto, the University of California, and Imperial College London emerged as key contributors, are also from these leading countries. These findings highlighted that global and regional partnerships remain essential for advancing specialized research fields.

The examination of leading journals showed that *Circulation* and the *Journal of the American College of Cardiology* were the foremost publications, characterized by high impact factors and citation counts. These two journals, associated with the American Heart Association and the American College of Cardiology, respectively, function as crucial platforms for sharing vital findings on arrhythmias and present researchers with significant venues for future submissions.[8,36]

Keywords and Burst Terms

The analyses of keyword co-occurrence and burst detection provide vital insights into thematic evolution and research trends. “Management” was a frequently occurring term across multiple studies, indicating important gaps in knowledge

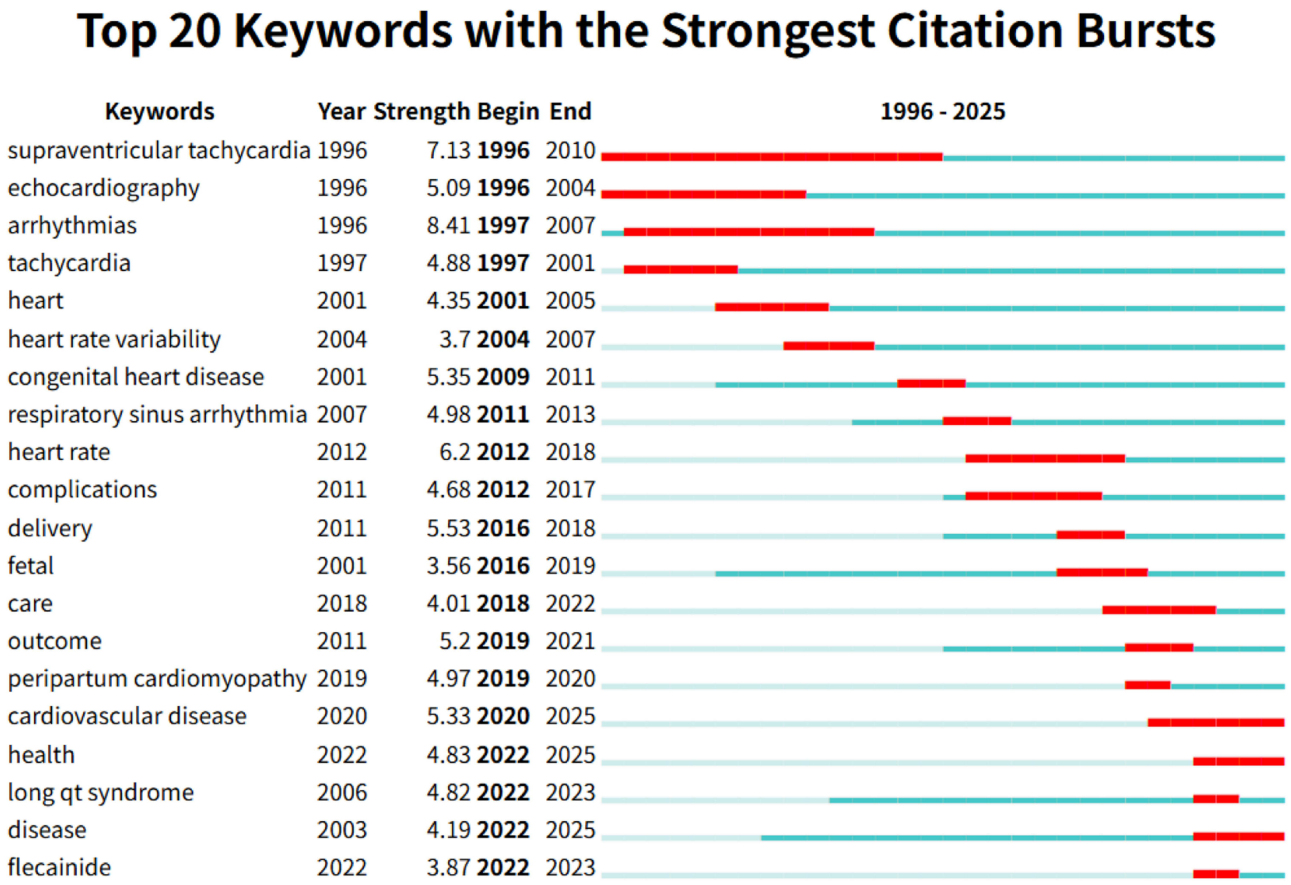

Figure 6 Citation burst analysis of keywords on arrhythmia in pregnant women.

and areas of uncertainty remain by recent guideline.[17] Varied management strategies are warranted based on arrhythmia type. For atrial fibrillation and atrial flutter, rhythm control is generally preferred during pregnancy, often initiated with a beta-blocker.[37] If a rate control approach is necessary, an oral beta-blocker is advised. Caution is urged with beta-blockers, class I antiarrhythmic drugs, and sotalol if systemic ventricular function is compromised.[38] Concerning ventricular tachycardia, an implantable cardioverter-defibrillator is recommended if an indication arises during gestation.[39] For patients with bradyarrhythmias, symptomatic bradycardia management includes repositioning the mother to a left lateral decubitus position. Persistent symptoms may necessitate a temporary pacemaker.[38] Notably, the use of antiarrhythmic and anticoagulant therapies during pregnancy remains evidence-poor, largely relying on anecdotal experience due to the exclusion of pregnant populations from clinical trials. This underscores the need for dedicated studies focusing on pregnant patients through observational research, registry analyses, and systematic evidence synthesis, as highlighted by several recent expert consensuses.[13,17,40]

Citation burst terms over the past five years indicated emerging trends of this field, which were also the frontiers in the future. Keywords with potent citation bursts since 2020, such as “outcome”, “long QT syndrome”, and “cardiovascular disease”, merit specific consideration:

“Outcomes” (2019–2021) emphasized the adverse events of maternal and fetal in managing arrhythmias in pregnant individuals. While procainamide, adenosine, digoxin, and β-blockers are generally deemed safe for pregnant women, comprehensive evidence regarding fetal toxic effects is scarce for most agents.[41] Ethical considerations often preclude clinical trials in pregnant women, resulting in a dearth of evidence on the clinical outcomes of these medications during pregnancy. For certain drugs, teratogenicity or other adverse effects are well-established; specifically, β-blocker therapy may potentially lead to fetal growth restriction.[42] Consequently, given the typically benign and non-sustained nature of

most pregnancy-related arrhythmias, drug therapy might be deferred to minimize adverse fetal outcomes, particularly during the first trimester.

Recent research has increasingly centered on "LQTS" (2022–2023), particularly due to the amplified risks of arrhythmias it presents to pregnant women. Women with inherited LQTS are highly susceptible to life-threatening arrhythmias like Torsades de Pointes, with risk escalating during the postpartum phase.[43,44] In women with LQTS, treatment with β-blockers at appropriate doses is recommended throughout pregnancy and the high-risk postnatal period.[45] However, data on fetal outcomes in such pregnancies remain limited. Moreover, recent studies indicate a higher incidence of fetal death in LQTS-complicated pregnancies compared to the general population.[46] An elevated risk has been noted in maternal LQTS pregnancies versus paternal LQTS pregnancies, suggesting uteroplacental dysfunction secondary to the channelopathy, rather than fetal arrhythmias, as a potential underlying cause.[46] While β-blockers are fundamental to LQTS treatment, prior studies suggest their use can result in lower birth weights compared to untreated women. Thus, rigorous monitoring via ultrasound, especially color Doppler assessments of uteroplacental circulation and fetal growth, is advised for pregnant women with LQTS.[47]

From 2020 to 2025, the term "cardiovascular disease" signifies a wider focus on heart conditions among pregnant women. The prevalence of CVD in this demographic is rising, attributable to better survival rates among women with congenital heart disease and the global trend of pregnancy at older ages.[5] Cardiac disease is estimated to complicate about 1–2% of pregnancies.[48] CVD is a significant contributor to morbidity and mortality during pregnancy and the postpartum period, responsible for up to 15% of maternal deaths.[49] Accumulating evidence has identified distinct sex-specific risk factors associated with reproductive and pregnancy history. These factors are increasingly acknowledged in cardiovascular and obstetrical society guidelines; premature menopause and adverse pregnancy outcomes, in particular, are now recognized as risk-enhancing factors for CVD.[38,50] These observations suggest that optimizing the management of cardiac diseases, not solely arrhythmias, is crucial for the health of pregnant women.

Notably, implementing guideline-based arrhythmia management in low-income countries faces significant barriers, including shortages of trained specialists, inadequate infrastructure, and limited access to device and ablative therapies.[51] Several key interventions have been proposed by World Heart Federation for these regions: (1) capacity building for frontline healthcare workers in arrhythmia detection, (2) implementation of telemedicine solutions for diagnosis and management, (3) development of tailored training programs for both providers and patients at national levels, and (4) creation of simplified, context-appropriate arrhythmia management guidelines for pregnant women.[52]

Clinical Implications

Pregnant patients experiencing severe arrhythmias need a multidisciplinary care strategy, which should be in place outlining antepartum, intrapartum, and postpartum care. Notably, cardio-obstetrics is an emerging multidisciplinary subspecialty, with cardiology, maternal fetal medicine, pediatrics, and anesthesia, focused on optimizing outcomes in high-risk pregnancies. This collaborative approach emphasizes precise peripartum planning and communication to ensure optimal maternal and fetal outcomes.[7,15]

Preconception counseling is essential given that most pregnancy-related arrhythmias develop during the antenatal period.[53] Three validated risk stratification systems are currently used to identify high-risk population, such as the CARPREG score (for cardiac disease in pregnancy), ZAHARA score (for congenital heart disease), and the modified WHO (mWHO) classification system.[54] Moreover, integrating machine learning and artificial intelligence into diagnostic algorithms will enhance the identification of high-risk individuals during the antenatal period, enabling targeted monitoring.

The treatment of arrhythmias is guided by their etiology and clinical presentation. Patients with hemodynamically significant sustained arrhythmias should receive immediate stabilization with intravenous fluids, medications, or electrical cardioversion. Asymptomatic arrhythmias usually do not warrant therapy unless they pose a serious risk.[40]

Antiarrhythmic therapy in pregnancy presents multiple safety concerns. The first trimester (especially weeks 5–9) represents the highest risk window for teratogenic effects, making drug avoidance preferable during this phase.[55] When drug treatment is essential, practitioners should prescribe the fewest possible medications from those with documented pregnancy safety data. The current evidence has established the side effect profiles of class I through IV antiarrhythmic

drugs in pregnancy.[40] Additionally, pregnancy-associated arrhythmia management lacks robust evidence, with available data restricted to small observational studies and registry reports (eg, ROPAC) that document existing practices. Systematic research expansion through prospective trials, comprehensive registries, and dedicated funding remains imperative.[56]

Significance and Limitations

This investigation offers a valuable resource for researchers by delineating key trends, prominent journals, and influential institutions. It facilitates the identification of research hotspots, leading publications, and collaborative opportunities, thereby guiding future research paths in arrhythmia and pregnancy. Furthermore, pinpointing emerging topics and mapping co-occurrence networks enables researchers to remain current with the latest advancements in this vital field.

Nevertheless, this study possesses several limitations. Firstly, like other bibliometric investigations, this study was limited to English-language publications indexed in the WoSCC, which may have introduced linguistic and database bias. As a result, relevant studies published in non-English languages or indexed in other bibliographic platforms may have been overlooked, potentially underrepresenting contributions from non-English-speaking countries. Future research could incorporate multilingual and multi-database strategies to broaden coverage and minimize regional bias. Secondly, exclusion of articles published before the time frame may affect the results, potentially restricting the comprehensiveness of research trends. Lastly, dependence on citation data does not capture the impact of recent studies that, while potentially influential, may not have yet accrued substantial citation counts.

Conclusion

This bibliometric study assessed and analyzed research trends related to arrhythmia in pregnant women through a combination of publication and citation metrics. The analysis illuminated key research domains, such as pregnancy management and clinical outcomes, while also identifying emergent topics like LQTS. This work furnishes valuable insights into the field, providing researchers with direction on potential research hotspots, influential authors, and key journals for subsequent investigation. From a clinical standpoint, the findings emphasize the necessity of refining management strategies for arrhythmias during pregnancy, with significant implications for both maternal and fetal health.

Data Sharing Statement

All data generated or analysed during this study are included in this published article.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors declare that they have no conflicts of interest related to this study.

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