Multidisciplinary Reviews

BIBLIOMETRIC RESEARCH
Published Online: August 25, 2025
https://doi.org/10.31893/multirev.2026130

Analyzing NSAIDS research trends: A six-year bibliometric study (2018-2023) on directions, themes, and dimensions

Husein Alhatim[ab] | Hisham Alshadfan[ac] | Mohd Sofian Omar Fauzee[d] | Zainul Amiruddin Zakaria[e] | Muhammad Nazrul Hakim[afg] ✉

[a]Department of Biomedical Sciences, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia, Selangor, Malaysia.
[b]Department of Forensic Sciences, College of Criminal Justice, Naif Arab University for Security Sciences, Riyadh, Saudi Arabia.
[c]Department of Clinical Biochemistry, Faculty of Medicine, University of Tabuk, Tabuk, Saudi Arabia.
[d]Faculty of Health and Life Sciences, INTI International University, Nilai, Malaysia.
[e]Department of Biomedical Sciences, Faculty of Medicine and Health Sciences, Universiti Malaysia Sabah, Kota Kinabalu, Malaysia.
[f]Institute of Bioscience, Universiti Putra Malaysia, Serdang, Malaysia.
[g]Halal Product Institute, Universiti Putra Malaysia, Serdang, Malaysia.

Abstract The commonly used class of pharmaceuticals known as nonsteroidal anti-inflammatory drugs (NSAIDs) has important effects on the treatment of pain and the decrease of inflammation. Medical progress and public health depend on an understanding of the patterns, areas of study, and effects of NSAIDs. To determine current research trends, this study uses Scopus to look up published articles on NSAIDs from 2018 to 2023. By emphasizing areas of increased interest and revealing gaps that could guide future study, bibliometric analysis allows us to get insights into the changing environment of NSAID research. With this strategy, new health issues are addressed, and the corpus of research is maintained to support educated medical practices. The most referenced articles, journal-related performance, trends in publishing and citation performance, and developing research cluster keywords were all analyzed in this study. The goals of the study were attained by using a bibliometric analysis that was directed by four research questions. Using Microsoft Excel, VOSviewer, and Harzing's Publish or Perish tools, the study first extracted information and examined keyword co-occurrence. To determine themes and dimensions from the keyword clusters found by VOSviewer, content analysis was also done. The findings revealed eleven new study term clusters on NSAIDS, such as: (a) 2020 had the highest number of NSAIDS citations, followed by 2019 and 2018. (b) In 2023, PLos One, Pharmaceutical, Chemosphere, and the Cochrane Database of Systematic Reviews published sixteen referenced journals on NSAIDS. (c) the top ten papers cited from 2018 to 2023, with 2020 having the most citations (782), (d) Ten clusters that emerged from the 42 NSAIDS-related titles, yielding ten dimensions (e.g., Optimized Pain Management; Therapeutic Expansion's Cardiovascular Safety; Changing Knowledge of NSAID Safety). As a result, suggestions are made for additional research to broaden and deepen this important area.

Keywords: trend study, nonsteroidal anti-inflammatory drugs, research cluster, health and wellbeing

1. Introduction

Nonsteroidal anti-inflammatory drugs (NSAIDs) are extensively used worldwide because they treat pain, inflammation, and fever. NSAID research is important from both bibliometric and scientific viewpoints, both of which add to scientific knowledge. NSAID research has produced a large amount of literature, demonstrating its extensive interest and continuous research. Scientific papers are statistically analyzed to indicate trends in research output, collaborative networks, and NSAID research subjects. A bibliometric analysis by Zeng et al. (2025) revealed that NSAID research has increased over the last several decades, with a focus on pain treatment, cardiovascular hazards, and gastrointestinal safety. Important analyses reveal major research topics, influential papers, and emerging patterns, directing future research and funding objectives. Bibliometric studies organize and make NSAID research more accessible, making it easier to disseminate and use study results.

Scientific Importance: NSAID research is essential for understanding NSAID methods of action, therapeutic uses, and side effects. Science says that NSAIDs suppress cyclooxygenase (COX) enzymes, which synthesize prostaglandins, which cause inflammation and discomfort. The complicated interactions of NSAIDs with biological circuits are still being studied, revealing novel therapeutic applications and dangers. Recent studies have shown that decreasing the levels of COX-2 enzymes involved in tumor formation may decrease the incidence of colorectal cancer (Rothwell et al., 2011). Research has shown that NSAIDs may help cardiovascular health but can present dangers, especially in people with preexisting problems (Bhala et al., 2013). By influencing clinical recommendations and treatment, NSAID research has advanced. Continuing NSAID gastrointestinal safety studies have led to safer treatment regimens, including proton pump inhibitors, to reduce ulcer risk (Bjarnason, et al., 2018).

NSAID pharmacogenetics research is also enabling personalized medicine, where medication may be adjusted to an individual's genetic profile to minimize side effects and maximize effectiveness (González et al., 2023).

Indeed, NSAID research is crucial scientifically and bibliometrically. Research landscape insights from bibliometric studies impact future research objectives and cooperation. New NSAID therapies and clinical practices are emerging from scientific studies. These methods deepen and broaden knowledge, benefiting patient care and medical science.

1.1. Research problems

Between 2018 and 2023, research on nonsteroidal anti-inflammatory drugs (NSAIDs) revealed several critical issues that need further study, including cardiovascular risks, gastrointestinal complications, cancer risk, renal function, and COVID-19 pandemic use. NSAIDs, particularly nonselective drugs such as ibuprofen and naproxen, have been linked to cardiovascular problems. According to several studies, users, especially those with cardiovascular diseases, are at increased risk of heart attack, stroke, and heart failure. The lack of agreement on NSAID safety profiles has led to various clinical recommendations, making it difficult for healthcare practitioners to manage high-risk cardiovascular patients. This highlights the need for greater studies to understand how NSAIDs affect cardiovascular health and establish more accurate recommendations to reduce these risks (Bhala et al., 2013).

Although proton pump inhibitors have been introduced to reduce NSAID-related gastrointestinal (GI) problems, their use remains a major issue. This research revealed persistent GI adverse effects, such as ulcers, bleeding, and perforation, especially in older persons and chronic users. Underreporting of adverse effects in clinical settings and inadequate gastroprotective adherence compound this problem. Selective COX-2 inhibitors, which are created to reduce such hazards, have long-term GI effects that are poorly understood. Therefore, further studies are needed to investigate GI safety profiles and devise safer high-risk therapy regimens (Bjarnason, et al., 2018).

NSAIDs may protect against colorectal cancer, which is another area of increasing research. Some studies between 2018 and 2023 have shown that NSAIDs may lower the risk of colorectal cancer risk by blocking tumor-promoting COX-2 enzymes; however, the evidence is inconsistent. This discrepancy has raised questions about the use of NSAIDs as a preventative strategy in cancer, emphasizing the need for greater studies on their effects, appropriate dose, duration, and long-term hazards (Rothwell et al., 2011). Acute kidney damage (AKI) among sensitive individuals, including elderly individuals and those with preexisting kidney disorders, has also drawn attention to the effects of NSAIDs on renal function. Research shows that NSAIDs may induce nephrotoxicity and AKI; however, this risk is generally overestimated, resulting in inadequate monitoring and prevention. Acute users may not be aware of the hazards of NSAID-induced nephrotoxicity; thus, further studies are needed to identify and prevent it (Klomjit & Ungprasert, 2022). The COVID-19 pandemic has raised concerns about the use of NSAIDs, which may worsen symptoms or worsen conditions. This has caused significant doubt and discussion, emphasizing the need for urgent, high-quality research to address these health concerns. The safety and effectiveness of NSAIDs in treating COVID-19 symptoms need more study to provide doctors and patients with clarification (McCreary & Pogue, 2020).

Therefore, the 2018–2023 research issues raise concerns about the safety and effectiveness of NSAIDs, especially with respect to cardiovascular, gastrointestinal, renal, and oncological outcomes, and during the COVID-19 pandemic. Targeted research is essential for increasing patient safety and therapeutic results, particularly for acute NSAID users. This study will help improve clinical recommendations, public health efforts, and NSAID-related health concerns.

1.2. Objectives

This study analyzes nonsteroidal anti-inflammatory medication (NSAID) research trends, journal performance, top-cited papers, and significant research clusters. This report examines NSAID research trends and keywords from 2018-2023. The study examines key research questions about influential publications' performance trajectory, leading journals' contributions, the most frequently cited works, and the dominant research clusters that may indicate future NSAID research trends to identify and address gaps in the literature. There are several questions that need to be answered regarding NSAID research. How did the most prominent NSAID research articles perform between 2018 and 2023? Which journals contributed most to NSAID research? Who are the authors and titles of the 10 most-cited NSAID research articles from 2018-2023? Which research cluster keywords predict NSAID research trends from 2018-2023?

This work addresses major research issues and makes two major NSAID research advances. First, it provides a complete summary of NSAID research to enable incoming researchers to continue updating recent advances in understanding the intricacies of NSAID use and its hazards. This study guides and promotes additional research in this important field of pharmacology by emphasizing existing trends and possible future paths. Thus, this study disseminates contemporary, modern, advanced, globally acknowledged, and unique research to address critical health concerns, especially for acute NSAID users.

2. Methods

This study used bibliometrics and content analysis to critically evaluate NSAID research literature to improve objectivity and automate content analysis. Bibliometric studies map academic research, uncover trends, and highlight influential

publications and academics. These studies are often performed via VOSviewer, which displays networks with coauthorship, citation patterns, and keyword cooccurrences (van Eck & Waltman, 2010). Current bibliometric studies suffer from a lack of content analysis to identify themes and domains in clusters created by these approaches. Owing to this gap, the basic structure and dynamics of research topics are frequently poorly understood. The study included two primary steps: (a) bibliometric mapping to examine NSAID research trends and (b) content analysis of indexed terms in papers to identify research clusters and establish research subjects and dimensions.

2.1. Protocol and bibliometric analysis

To ensure the reliability and validity of the literature's quantitative component, the bibliometric review was complemented with systematic, integrative, descriptive, or meta-analytic research (Salinas-Rios & Lopez, 2022). This bibliometric study follows the methodology outlined by Donthu et al. (2021), which consists of four independent processes (Figure 1). The first step involves establishing clear objectives and boundaries for this bibliometric investigation. The researcher must extract answers to the research questions from the compiled publications. Prior to conducting the quantitative analysis, a thorough review of all the articles was carried out to detect any inconsistencies or repetitions, ensuring the accuracy of the data (Wider et al., 2023). The objective is to analyze and synthesize the extensive collection of bibliometric data on studies related to NSAIDs, encompassing publications from various academic disciplines and covering the period from 2018-2023.

The next stage involves selecting the appropriate methodology for performing the bibliometric analysis. This requires the development of analytical tools specific to this inquiry. Two key analyses were conducted in this investigation. The first focused on performance analysis, which included evaluating the total number of publications and citations, assessing the performance of top journals, and identifying the top 10 most referenced articles. The second aspect involves network construction and analysis, specifically cluster analysis via keyword occurrences.

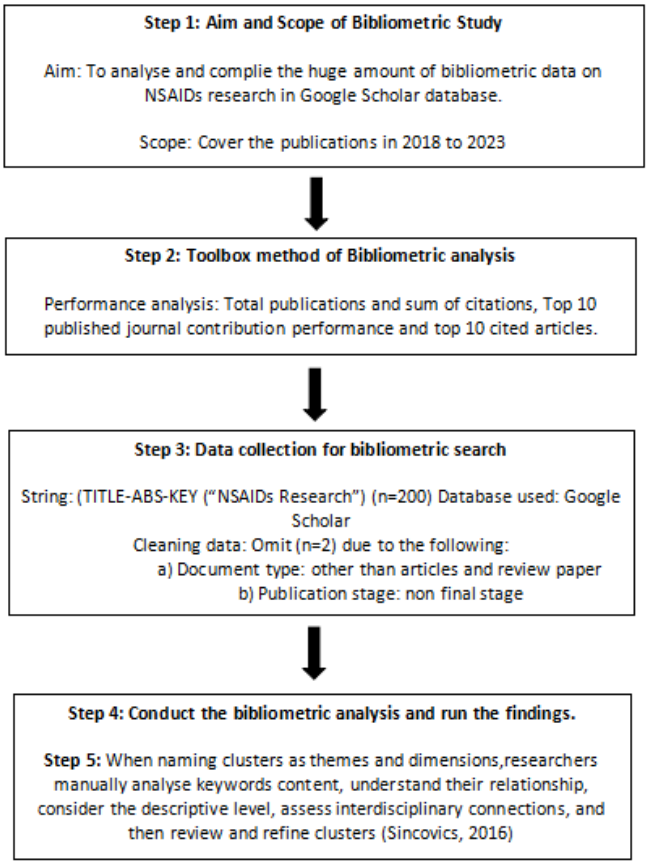

Figure 1 The procedure for bibliometric analysis by Donthu et al. (2021).

The third phase of this study involved the collection of data specifically for the bibliometric analysis of NSAID research. The data were meticulously collected and organized via Microsoft Excel, which facilitated the generation of the necessary information for subsequent analysis. To gather relevant articles, a search was conducted within the Google Scholar database using carefully selected search phrases related to NSAIDs. Given the extensive volume of literature available on NSAIDs, researchers imposed a limit of 200 articles to ensure that the analysis would remain comprehensive yet focused, enabling a thorough investigation without overwhelming studies with excessive data. The data cleansing and filtering processes were specifically tailored to align with the parameters established in the initial step of the research procedure. This customization

ensured that the selected articles were directly relevant to the study's objectives and met the stringent criteria necessary for accurate and meaningful analysis. As a result, the final dataset in the Google Scholar database comprised 200 articles, each meticulously chosen to reflect the most pertinent research on NSAIDs from 2018-2023.

The fourth phase of the study involved performing the analysis via the bibliometric tools identified in the second step of the research procedure. This phase employed a combination of performance analysis and network analysis to gain insights into the research landscape of NSAIDs. The study utilized VOSviewer, a widely recognized tool for bibliometric analysis, to cluster research patterns in NSAID studies through co-occurrence keyword analysis. By identifying clusters of keywords that frequently appear together in the literature, the study aimed to reveal underlying themes and research dimensions within the field of NSAID research.

Further text analysis was performed via VOSviewer to manually identify and refine the themes and dimensions that emerged from these clustered keywords. The identification of these patterns is crucial, as they provide researchers with substitute search terms that can be used in future literature inquiries, enhancing the scope and depth of subsequent research. The research team meticulously analyzed the keyword content to establish associations, descriptive levels, and interdisciplinary relationships, ensuring that the clusters chosen as themes and dimensions were both accurate and relevant (Sinkovics, 2016).

Content analysis played a pivotal role in this process, offering a systematic approach to classifying and categorizing the research topics within the identified clusters. This method enhances bibliometric studies by providing a deeper understanding of the topics present within clusters of research papers (Krippendorff, 2018). Without the integration of content analysis, the process of identifying and labeling clustered keywords via tools such as VOSviewer might offer only a superficial examination, potentially overlooking critical subthemes and emerging research topics. This limitation underscores the importance of content analysis in ensuring that bibliometric studies accurately portray the academic landscape, capturing the nuanced and developing trends within NSAID research.

3. Results

3.1. Performance trend of the top articles related to NSAID research from 2018-2023.

From 2018 to 2023, Scopus hosted almost 1000 publications on NSAID studies. However, the researchers narrowed it down to the top 200 studies, out of which only 199 papers showed promise. The NSAID study has accumulated a total of 7817 citations and has achieved an h-index of 43 over a 6-year period. Figure 2 depicts the publication and citation performance. The publishing trend (bar) shows a progressive increase from 2020 to 2019 and 2018. The year 2023 has a decreased number of citations.

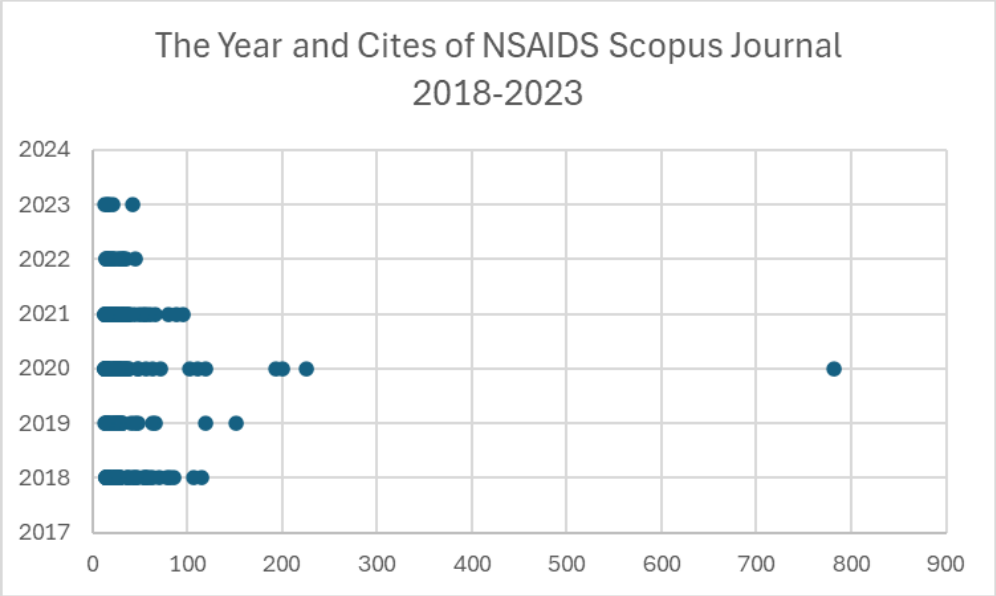

Figure 2 Google Scholar Database of citation count and year of school climate research. *Source:* Scopus Database.

3.2. Publishers contributing the most cited articles in school climate research from 2022-2023

Table 1 presents a summary of the top three journals contributing to the most frequently referenced journals on NSAIDS, as determined by data from 200 data abstracts from Scopus for the period from 2018-2023. The Scientific Report journal holds the top position, with a total of 6 NSAIDS papers, followed closely by the Science of Total Environments and the International Journal of Molecular Science, with five papers. The trends show that NSAIDS papers were popular in 2023, with 16 papers published in PLoS One, Pharmaceutical, Chemosphere and the Cochrane Database of Systematic Reviews (Table 2).

Table 1 Performance related to NSAIDS research among the top 5 articles published.

Rank	Publisher sources	Origin	2018	2019	2020	2021	2022
1	Scientific Reports	United Kingdom	-	2	2	-	2
2	Science of Total Environments	Netherlands	2	-	-	1	2
3	International Journal of molecular Science	Switzerland	2	-	3	-	-

Table 2 Top 4 Published Journal on NSAIDs in 2023.

No.	Journal	Origin	2023 Published
1	PLos One	United States	4
2	Pharmaceutical	Switzerland	4
3	Chemosphere	Netherlands	4
4	Cochrane Database of Systematic Reviews	United Kingdom	4

3.3. Authors and articles that rank among the top 10 most cited articles during five years of NSAIDS research

The most frequently cited papers concerning NSAIDS are shown in Table 3. Bindu et al., (2020). Nonsteroidal anti-inflammatory drugs (NSAIDs) and organ damage: A current perspective was the most cited article at 782. This was followed by Russell et al. (2020). COVID-19 and treatment with NSAIDs and corticosteroids: Should their use be limited in the clinical setting?), which received 226 citations. Parolini (2020). Toxicity of the nonsteroidal anti-inflammatory drugs (NSAIDs) acetylsalicylic acid, paracetamol, diclofenac, ibuprofen and naproxen toward freshwater invertebrates: A review earned a total of 201 citations. Next were Schjerning et al. (2020). Cardiovascular effects and safety of (nonaspirin) NSAIDs with 194 citations and Wong (2019). Role of nonsteroidal anti-inflammatory drugs (NSAIDs) in cancer prevention and cancer promotion. Additional noteworthy articles include those by Baker et al. (2020), Wheatley et al. (2019), García-Rayado et al. (2018), Elizalde-Velázquez et al. (2020), and Thakur (2018).

Table 3 Top 10 most frequently cited NSAIDs Research articles between 2022 and 2023.

Year	Cites	Articles
2020	782	Bindu et al. (2020). Nonsteroidal anti-inflammatory drugs (NSAIDs) and organ damage: A current perspective.
2020	226	Russell et al. (2020). COVID-19 and treatment with NSAIDs and corticosteroids: Should we be limiting their use in the clinical setting?
2020	201	Parolini (2020). Toxicity of the nonsteroidal anti-inflammatory drugs (NSAIDs) acetylsalicylic acid, paracetamol, diclofenac, ibuprofen and naproxen toward freshwater invertebrates: A review.
2020	194	Schjerning et al. (2020). Cardiovascular effects and safety of (nonaspirin) NSAIDs.
2019	152	Wong (2019). Role of nonsteroidal anti-inflammatory drugs (NSAIDs) in cancer prevention and cancer promotion.
2020	119	Baker et al. (2020). NSAIDs in CKD: Are they safe?
2019	119	Wheatley et al. (2019). Effect of NSAIDs on bone healing rates: A meta-analysis.
2018	115	García-Rayado et al. (2018). NSAID induced gastrointestinal damage and designing GI-sparing NSAIDs.
2020	111	Elizalde-Velázquez & Gómez-Oliván (2020). Sorption of three common nonsteroidal anti-inflammatory drugs (NSAIDs) to microplastics.
2018	107	Thakur et al. (2018). Novel drug delivery systems for NSAIDs in management of rheumatoid arthritis: An overview.

3.4. Research cluster most frequently discussed in relation to NSAIDS studies to predict forthcoming research

Research trends in school climate were examined through concurring keyword analysis to identify the predominant topics in this field. This analysis also seeks to predict potential research directions related to teachers' leadership abilities, as discussed in the subsequent section. The objective of cluster analysis is to identify research trends that align with the primary goals and scope of the study (Donthu et al., 2021). Each cluster contains indicators or key terms that are closely related and can be represented by a single summarizing metric (Franceschet, 2009). The study's findings are illustrated through multiple clusters, also referred to as representatives. After 199 articles were analyzed via keyword co-occurrence analysis, 10 clusters were identified, as depicted in Figure 4, from a total of 42 identified titles. Figure 2 shows the publication trends over time (2018-2023). VOSviewer was used to identify specific themes within each cluster through content analysis. The paper provides a detailed discussion of all 10 clusters. On the basis of the titles, 10 themes emerged from the VOSviewer cluster analysis (Table 4). The following discussions delve into each theme and its corresponding dimensions.

Table 4 Analysis of keyword clusters via vosviewer alongside emergent themes and dimensions from content analysis.

Cluster	Items in the Cluster (106 Keywords)	Dimension of the cluster (10 dimension)
1	"7 items: 1. Combination, 2. efficacy, 3. literature, 4. Management, 5. Overview, 6. Safety, 7. Year."	Evolving understanding of NSAID safety
2	"6 items: 1. action, 2. Anticancer activity, 3. Cancer treatment, 4. Characterization, 5. Inhibition, 6. insight"	Therapeutic Expansion
3	"5 items: acute myocardial infarction, 2. Comparison, 3. Cox, 4. Exposure, 5. Ultrastructure."	Cardiovascular Safety
4	"5 items: 1. adult, 2postoperate pain, 3. Pre, 4. Preventive NSAID, 5. Type."	Optimized Pain Management
5	"4 items: application, 2. Determination, 3. Development, 4. Water."	Environmental Stewardship
6	"4 items: future perspective, 2. Inflammation, 3. Interaction, 4. Opioid."	Multimodal Pain Management
7	"3 items: 1. Child, 2. Hypersensitivity reaction, 3. Multicenter retrospective."	Risk Management in Pediatric NSAID Use
8	"3 items: 1. Implication, 2. Surgery, 3. Tropical NSAID."	Localized Pain Management in Surgery
9	"3 items: biological evaluation, potential anticancer age, 3. Synthesis."	Pharmacological Innovation in Cancer Treatment
10	"2 items: narrative view, 2. Usage."	Contextualized NSAID Application

3.4.1. Cluster 1: Evolving understanding of NSAID safety.

An examination of the literature on nonsteroidal anti-inflammatory drugs (NSAIDs) has highlighted many important aspects that are crucial for understanding their overall influence in clinical practice. Combination therapy is a significant way to investigate the utilization of NSAIDs in conjunction with other drugs to improve therapeutic results or reduce negative effects. Studies indicate that combining different therapies might improve pain management, but it also comes with added risks, especially in terms of gastrointestinal issues. Therefore, closely monitoring patients receiving combination treatment is important (Moore et al., 2015; Sostres et al., 2010).

Efficacy is a crucial factor for assessing the efficiency of NSAIDs in treating illnesses such as osteoarthritis and rheumatoid arthritis. Research consistently confirms the effectiveness of NSAIDs. However, it also emphasizes the differences in results depending on the medication, dose, and characteristics of the patient cluster (Hochberg et al., 2012). A significant discovery in this respect is the development of selective COX-2 inhibitors, which have the potential to provide a more efficient and less risky alternative for certain patients (Hunt et al., 2010; Zakaria et al., 2016).

The literature component highlights the vast array of research materials on NSAIDs, including clinical trials, meta-analyses, and observational studies. An extensive body of research is crucial for comprehending the therapeutic advantages and potential hazards linked to the prolonged utilization of nonsteroidal anti-inflammatory drugs (NSAIDs) (Zhang et al., 2016). Systematic reviews and meta-analyses are very beneficial for consolidating information from various trials, offering a thorough picture of the effectiveness and safety of NSAIDs (Moore et al., 2014).

The management component emphasizes the optimal administration and monitoring of NSAID treatment to maximize advantages while limiting potential hazards. Efficient treatment entails taking into account patient-specific aspects such as age, comorbidities, and concomitant medicines and following recommendations that advocate for the use of the lowest effective dosage and the use of gastroprotective drugs when required (McGettigan & Henry, 2013; Lanza et al., 2009).

The overview dimension offers a comprehensive view of the utilization of NSAIDs, including their extensive usage in diverse medical situations and among different patient clusters. This component also emphasizes the need to maintain a balance between effectiveness and safety, especially considering the possibility of major adverse effects, such as gastrointestinal, renal, and cardiovascular issues (Minghelli et al., 2018).

Undoubtedly, safety is the most crucial aspect, considering the well-established hazards linked to the use of NSAIDs. The main concerns include the potential for gastrointestinal toxicity and cardiovascular hazards, particularly when certain NSAIDs are used at relatively high dosages (Sostres et al., 2010; Bhala et al., 2013). The advancement and utilization of COX-2 inhibitors, which have the potential to provide a safer option for some patients, are important elements of this process (Cryer & Feldman, 2010).

The Year dimension emphasizes the importance of considering the chronological context in which studies and recommendations on NSAIDs are released. The progression of studies over time has led to an expanding comprehension of the advantages and hazards of NSAIDs, with older studies concentrating on their effectiveness and most recent investigations progressively addressing issues related to safety (McGettigan & Henry, 2013). This aspect emphasizes the need for continual study and the regular revision of guidelines to accurately guide therapeutic practice.

A new aspect shown by our content analysis is the development of an understanding of the safety of NSAIDs, specifically in terms of finding a balance between their therapeutic effectiveness and the potential dangers of gastrointestinal, cardiovascular, and renal problems. The ongoing progress in safety measures has emphasized the importance of personalized

patient care and the creation of safer treatment options, including selective COX-2 inhibitors, to reduce the hazards linked to NSAID use.

3.4.2. Cluster 2: Therapeutic expansion

Nonsteroidal anti-inflammatory drugs (NSAIDs) are extensively used worldwide because of their prominent analgesic, anti-inflammatory, and antipyretic characteristics. Recent studies have broadened our knowledge of NSAIDs, going beyond their conventional use, to investigate their potential in cancer therapy. Specifically, researchers have examined how NSAIDs function, their ability to limit cancer growth, and their anticancer properties. By using VOSviewer, a bibliometric tool, several crucial aspects of NSAID research have been discovered: action, anticancer activity, cancer therapy, characterization, inhibition, and understanding. The purpose of this content analysis is to investigate these things and advocate for a dimension that arises from these interrelated elements.

The term "action" in relation to NSAIDs refers to their main function of blocking cyclooxygenase (COX) enzymes, which play a critical role in the production of prostaglandins that cause inflammation and pain. Conventional NSAIDs block the activity of both COX-1 and COX-2 enzymes, which results in their recognized therapeutic benefits but also contributes to adverse consequences such as gastrointestinal toxicity (Hunt et al., 2015). The mechanism of action of nonsteroidal anti-inflammatory drugs (NSAIDs) has been extensively researched, and more recent medications, such as selective cyclooxygenase-2 (COX-2) inhibitors, have been created to reduce negative side effects while still being effective (Cryer & Feldman, 2010).

Recent research has emphasized the possible ability of NSAIDs to combat cancer, specifically by decreasing the likelihood of developing certain forms of cancer, such as colon cancer (Rothwell et al., 2011). The anticancer effects of NSAIDs are believed to be associated with their ability to suppress COX-2, an enzyme that is often overproduced in different types of malignancies and promotes tumor development and spread (Chan et al., 2011). The exploration of this aspect of NSAID research is gaining momentum as our understanding of the molecular mechanisms implicated in cancer advances.

NSAIDs are becoming increasingly acknowledged for their possible contribution to cancer therapy. Their interest is rooted in the anticancer action of these compounds, namely, their ability to inhibit COX-2 and modulate the immunological response (Smalley & DuBois, 2016). Several clinical studies have examined the potential of NSAIDs as supplementary treatments in cancer therapy, specifically investigating their impact on tumor development and patient survival rates (Mahmud et al., 2014). Nevertheless, the use of NSAIDs in cancer therapy necessitates careful consideration owing to their possible adverse effects and the intricate nature of cancer biology.

Characterization in the context of NSAID studies entails comprehending the biochemical and pharmacokinetic characteristics of these pharmaceuticals, including their impacts on various tissues and their interactions with other medications. Precisely characterizing nonsteroidal anti-inflammatory drugs (NSAIDs) is crucial in cancer treatment, as it allows for customized therapy based on individual patients, which has the potential to enhance results (Cao et al., 2018). Characterization studies additionally aid in the development of novel NSAID derivatives that exhibit improved effectiveness and diminished adverse effects.

Inhibition is the main way in which NSAIDs work, namely, by inhibiting COX enzymes. The suppression of this process not only contributes to their ability to reduce inflammation and alleviate pain but also plays a vital role in their ability to combat cancer. Studies have focused mostly on the specificity of COX-2 inhibition, resulting in the creation of selective inhibitors that have a superior safety profile to that of conventional NSAIDs (Aldington & McQuay, 2018).

The "insight" component signifies the increasing comprehension of the wider therapeutic possibilities and the underlying mechanisms of action of NSAIDs. This encompasses an examination of the molecular mechanisms implicated in their ability to combat cancer, the creation of novel NSAID derivatives, and the investigation of their potential in combined treatment approaches. A deep understanding of these domains is essential for progressing NSAID research and maximizing their efficacy in therapeutic settings.

One dimension that arises from the content analysis of these items is referred to as "therapeutic expansion". Historically, NSAIDs have been mostly used for their anti-inflammatory and analgesic properties. Nevertheless, the elements—action, anticancer activity, cancer therapy, characterization, inhibition, and understanding—indicate a wider range of therapeutic possibilities for NSAIDs, specifically in the field of oncology. A recent study suggested the potential use of NSAIDs in cancer treatment plans because of their capacity to block COX-2 and regulate immune responses. The broadening of therapeutic use is noteworthy, as it creates new opportunities for the application of NSAIDs, which might result in enhanced results in cancer treatment. Nevertheless, it also highlights significant concerns about the safety and effectiveness of NSAIDs in this novel setting, emphasizing the need for more investigations and meticulous clinical supervision.

In conclusion, in cluster 2, the examination of NSAID-related research, as discovered by VOSviewer, revealed a diverse and comprehensive method for comprehending these medications. The emerging aspect of therapeutic expansion highlights the increasing acknowledgment of the potential of NSAIDs outside their conventional applications, especially in the field of cancer therapy. The increasing importance of NSAIDs emphasizes the need for ongoing investigations into their modes of operation, safety characteristics, and prospective uses in novel therapeutic settings.

3.4.3. Cluster 3: Cardiovascular safety

Nonsteroidal anti-inflammatory drugs (NSAIDs) are often used because of their ability to alleviate pain and reduce inflammation. Nevertheless, the use of these methods has been linked to several hazards, specifically those pertaining to cardiovascular well-being. A recent bibliometric study using VOSviewer revealed five essential elements in the literature of NSAID research: acute myocardial infarction, comparison, COX, exposure, and ultrastructure. This content analysis examines these items, offering a full comprehension of their significance in relation to NSAID usage, and highlights a prominent aspect that arises from this study.

The correlation between the use of nonsteroidal anti-inflammatory drugs (NSAIDs) and a heightened likelihood of experiencing acute myocardial infarction (AMI) has been a noteworthy issue in recent years. Research has shown that both nonselective NSAIDs and selective COX-2 inhibitors might increase the likelihood of acute myocardial infarction (AMI), especially when administered at high dosages or over extended periods of time (Bhala et al., 2013). The heightened risk is believed to arise from the suppression of COX-2, which diminishes the synthesis of prostacyclin. Prostacyclin typically safeguards the cardiovascular system by impeding platelet aggregation and vasoconstriction (Antman et al., 2017). Gaining insight into the correlation between NSAID use and AMI is essential for guiding medical procedures and guaranteeing patient well-being.

The term "comparison" pertains to the comparative analyses carried out to assess the cardiovascular risks linked to various NSAIDs. Several studies have compared the safety profiles of nonselective NSAIDs and COX-2 inhibitors, specifically regarding their capacity to induce cardiovascular events such as AMI (Coxib and conventional NSAID Trialists' (CNT) Collaboration, 2013). These comparisons are crucial, as they enable doctors to make well-informed judgments on which NSAID to prescribe by weighing the advantages of pain relief against possible hazards. Naproxen is believed to have a decreased cardiovascular risk compared with diclofenac and other NSAIDs, according to Nissen et al. (2016).

The function of COX enzymes, namely, COX-2, plays a crucial role in the pharmacology of NSAIDs and the related hazards they pose. COX-1 and COX-2 are enzymes that play a role in the synthesis of prostaglandins, which are responsible for regulating inflammation and pain (Cryer & Feldman, 2010). Conventional NSAIDs block the activity of both COX-1 and COX-2 enzymes, resulting in both desirable therapeutic benefits and undesired side effects. The development of selective COX-2 inhibitors aimed at decreasing gastrointestinal toxicity by specifically targeting COX-2 while sparing COX-1. However, this selectivity also increases the likelihood of cardiovascular events, such as acute myocardial infarction (AMI) (Solomon et al., 2017). NSAID research continues to prioritize the delicate balance between inhibiting COX-2 and ensuring cardiovascular safety.

The word "exposure" in NSAID research pertains to the length and strength of NSAID use, which are important criteria in assessing the likelihood of negative occurrences, such as AMI. Studies have repeatedly shown that using higher dosages of nonsteroidal anti-inflammatory drugs (NSAIDs) for longer periods of time is associated with a greater likelihood of experiencing cardiovascular events (Trelle et al., 2011). Furthermore, comprehending the patterns of NSAID exposure in various clusters can aid in identifying individuals at greater risk and formulating recommendations for the safer use of these medications. For example, the temporary use of NSAIDs may be reasonably safe in younger persons who are at minimal risk, but elderly patients with other medical conditions need to be closely monitored if they take NSAIDs for an extended period of time (Cheng et al., 2018).

Ultrastructure refers to the microscopic analysis of tissues impacted by nonsteroidal anti-inflammatory drugs (NSAIDs), with a specific focus on cardiovascular and gastrointestinal well-being. NSAIDs have been shown to cause cellular alterations, as shown by ultrastructural investigations. These changes include the disruption of mitochondrial activity in cardiac cells, which may play a role in the development of AMI (Zhang et al., 2022). This research is crucial for comprehending the pathophysiological pathways that cause adverse effects associated with NSAIDs and for formulating safer treatment options.

One aspect that arises from this study of the text is cardiovascular safety. Together, the mentioned elements—acute myocardial infarction, comparison, COX, exposure, and ultrastructure—emphasize the substantial cardiovascular hazards linked to the use of NSAIDs, especially with respect to COX-2 inhibition and the risk of AMI. The issue of cardiovascular safety has been a crucial focus in the study of NSAIDs, prompting a reassessment of the advantages and disadvantages of these medications. An essential aspect in developing safer recommendations for NSAID usage is performing a comparative study of various NSAIDs, comprehending the functions of COX enzymes, and thoroughly examining the structural alterations caused by NSAIDs. This feature highlights the need for meticulous patient selection, dosage modification, and surveillance to reduce cardiovascular risk while preserving the therapeutic advantages of NSAIDs.

In conclusion, in cluster 3, the examination of NSAID-related research items highlighted by VOSviewer highlights the significance of cardiovascular safety in the continuing discussion around these medications. The relationships among acute myocardial infarction, COX inhibition, NSAID exposure, and ultrastructural consequences are crucial to comprehending the overall influence of NSAIDs on cardiovascular well-being. The growing importance of cardiovascular safety underscores the need for ongoing research and the creation of safer alternatives to NSAIDs. It is crucial to ensure that the widespread use of these treatments does not lead to a greater risk of cardiovascular problems.

3.4.4. Cluster 4: Optimized pain management

Nonsteroidal anti-inflammatory drugs (NSAIDs) are crucial in pain management, especially after surgery. The extensive use of NSAIDs by adults for pain management is well documented, with several studies examining their effectiveness, timing, and most appropriate forms of NSAIDs for distinct clinical situations. A new bibliometric study conducted via VOSviewer revealed five crucial elements in the literature pertaining to NSAID research: adult, postoperative pain, pre, preventative NSAID, and kind. This content analysis seeks to examine these things, offering a thorough comprehension of their importance in the use of NSAIDs and discovering a newly emerging aspect from this study.

The term "adult" refers to the main demographic that uses NSAIDs for pain relief. Adults, especially those who are undergoing surgery, often need efficient pain management techniques to optimize recuperation and improve overall results (Gan et al., 2014). Clinical recommendations strongly endorse the use of NSAIDs in adults, particularly for the treatment of acute and chronic pain. It is important to consider the various dangers that NSAIDs provide to different age clusters, particularly the increased likelihood of gastrointestinal and cardiovascular problems in older persons (Trelle et al., 2011).

Postoperative discomfort is a prevalent and substantial obstacle in surgical treatment. NSAIDs are often used in multimodal analgesia to successfully control this discomfort. They provide the advantage of decreasing the need for opioids, thereby diminishing the likelihood of opioid-related adverse effects and addiction (Kehlet & Dahl, 2017). Multiple studies have established the effectiveness of NSAIDs in lowering pain after surgery, establishing them as a fundamental component of postoperative therapy. Nevertheless, the timing and selection of NSAIDs are pivotal variables that might significantly impact the results (Moore et al., 2015).

The term "pre" refers to the administration of NSAIDs before surgery, which has been investigated as a method to avoid or diminish discomfort after the operation. Preoperative nonsteroidal anti-inflammatory drugs (NSAIDs) have the potential to mitigate the inflammatory reaction initiated by surgery, resulting in less discomfort and enhanced postoperative recovery (Elmallah et al., 2017). Preventive usage refers to the practice of administering pain treatment before pain occurs to avoid the development of central sensitization. This method is known as preemptive analgesia (Dahl et al., 2010).

The use of "preventive NSAIDs" refers to the proactive administration of NSAIDs to prevent the occurrence of pain, particularly in the perioperative environment. Preventive analgesia refers to the practice of providing NSAIDs before surgery or soon after the operation to better manage pain and minimize the need for further pain relievers (McEvoy et al., 2017). Research has shown that using NSAIDs as a preventive measure may improve patient outcomes, decrease the length of hospital stay, and increase overall patient satisfaction (Kehlet & Wilmore, 2002).

The selection of NSAID type is a crucial factor in pain treatment, since various NSAIDs exhibit varying levels of effectiveness, side effects, and appropriateness for certain clusters of patients. For example, in postoperative situations, selective COX-2 inhibitors such as celecoxib are often used because they are less likely to cause gastrointestinal issues than nonselective NSAIDs are (Buvanendran et al., 2010). The selection of NSAID type is determined by criteria such as the patient's medical history, the nature of the surgical procedure, and the desired trade-off between effectiveness and safety (McGettigan & Henry, 2013).

Through this content analysis, it becomes evident that optimized pain management is a crucial element of NSAID use in clinical settings. The mentioned factors—adult sex, postoperative pain, pre-NSAID use, preventative NSAID use, and NSAID type—emphasize the complex strategy necessary for properly managing pain in adult patients undergoing surgery. Efficient pain management involves not only choosing a suitable NSAID category but also considering the time of administration (before or after surgery) and the use of preventative measures to improve recovery and reduce complications. This feature highlights the importance of individualized pain treatment strategies that consider the requirements and vulnerabilities of adult patients, eventually resulting in enhanced clinical results and patient content.

In conclusion, in cluster 4, the examination of NSAID-related research items found by VOSviewer highlights the intricate nature of pain control in adults, especially in the context of postoperative care. The emerging aspect of optimized pain management highlights the need for a customized strategy that considers the specific nonsteroidal anti-inflammatory drug (NSAID) used, the time of its administration, and the implementation of preventative actions to successfully control pain. Healthcare practitioners may increase the overall quality of treatment for adult patients by directing their attention toward these factors, which include improving pain management and reducing dependence on opioids.

3.4.5. Cluster 5: Environmental stewardship

"There are four items: an application and two others." Determination, level 3. Development, chapter 4. Water." Nonsteroidal anti-inflammatory drugs (NSAIDs) are widely used in contemporary medicine, mainly because of their efficacy in treating pain, inflammation, and fever. Nevertheless, the realm of NSAID research has broadened beyond direct medical use, exploring domains such as environmental consequences, particularly with respect to water pollution. The VOSviewer investigation revealed four crucial elements pertaining to NSAID research: use, identification, advancement, and aqueous medium. This content analysis examines these topics, highlighting their importance in both clinical and environmental situations. Through this approach, a crucial aspect becomes apparent, emphasizing the convergence of pharmaceutical development and environmental sustainability.

The term "application" of NSAIDs largely refers to their extensive use in clinical settings for the treatment of various illnesses, such as arthritis, postoperative pain, and acute injuries (Brune & Patrignani, 2015). Their extensive use highlights their importance in medical practice. Nevertheless, the greater this application is used, the greater the obligation to comprehend the ramifications that extend beyond patient treatment. The efficacy of NSAIDs is well established; however, increasing apprehension is possible for water pollution and environmental repercussions resulting from their extensive utilization (Evans et al., 2019).

In the realm of NSAID research, "determination" often refers to the process of identifying and measuring the presence of these medications in different habitats, with a focus on water bodies. An essential field of research is the analysis of NSAID residues in water. This is because these drugs, which are produced by people or animals, often enter wastewater systems and ultimately contaminate natural water bodies (Gaffney et al., 2015). Advanced analytical methods, such as high-performance liquid chromatography (HPLC) and mass spectrometry, have been created to precisely identify and measure the amount of NSAIDs in water. This allows researchers to evaluate the level of environmental pollution caused by these substances.

The term "development" of NSAIDs encompasses not only the innovation of novel and more potent medications but also the continuous investigation into enhancing their safety profiles and minimizing their ecological footprint. The field of pharmaceutical research is currently placing more emphasis on the environmental impact of pharmaceuticals, giving rise to the notion of "green pharmacy." This approach involves the creation of drugs that have a reduced negative impact on the environment (Kümmerer, 2019). Within this framework, the advancement of NSAIDs includes efforts to reduce their impact on the environment. This involves enhancing wastewater treatment methods to eliminate pharmaceutical residues more efficiently (Margot et al., 2015).

The focus on the "water" element in NSAID research highlights the notable problem of water pollution caused by pharmaceutical remnants, namely, NSAIDs. The occurrence of these pharmaceutical substances in aquatic ecosystems might have adverse impacts on the well-being of marine organisms and could endanger human health by contaminating sources of drinking water (Hughes et al., 2013). Nonsteroidal anti-inflammatory drugs (NSAIDs) are often found in the environment, and their long-lasting presence in water systems is becoming an increasingly worrisome environmental issue. To address this problem, a comprehensive strategy that encompasses several fields of study, such as enhancing the way drugs are made, implementing more effective methods for managing waste, and developing advanced technology for treating water, is needed.

The result of this content analysis is the identification of environmental stewardship as a key feature in the use of NSAIDs. The mentioned elements—application, determination, development, and water—emphasize the need to adopt a conscientious attitude toward the extensive use of NSAIDs, acknowledging their ecological consequences. With the progress of the pharmaceutical industry, there is a growing acknowledgment that the creation and use of medications must be accompanied by efforts to reduce their impact on the environment. This component emphasizes the importance of including environmental factors at every stage of the lifespan of NSAIDs, starting from their original production to their disposal and the possibility of environmental pollution. Through prioritizing environmental stewardship, the pharmaceutical business may strive to adopt sustainable practices that safeguard both human health and the environment.

In conclusion, in cluster 5, the examination of NSAID-related research items found by VOSviewer highlights the crucial overlap between pharmaceutical use and environmental sustainability. The emerging aspect of environmental stewardship in NSAID use signifies the increasing acknowledgment that the advantages of these medications must be weighed against their ecological consequences. As research progresses, it is crucial for the pharmaceutical industry, healthcare providers, and regulators to collaborate to create and execute strategies that decrease the environmental impact of NSAIDs. This ensures that the use of NSAIDs is sustainable and responsible.

3.4.6. Cluster 6: Multimodal pain management

Nonsteroidal anti-inflammatory drugs (NSAIDs) are essential for managing pain and reducing inflammation. Nevertheless, the use of these substances, especially when combined with opioids, remains a subject of continuous investigation and discussion. The VOSviewer study highlighted four crucial elements pertaining to NSAID research: outlook, inflammation, interaction, and opioids. This content analysis examines these items, investigating their significance for the future of pain management and anti-inflammatory medication. This study also highlights a newly emerging aspect that is crucial to the development of NSAIDs.

The "future perspective" component pertains to the continuous development of NSAID use and investigation, specifically in relation to pain control and inflammation. With the ongoing evolution of healthcare, there is a growing desire to create NSAID formulations that are safer and more efficient. Additionally, there is a need to understand the function of these formulations in multimodal pain treatment techniques (Hah et al., 2017). Prospects also include the investigation of new NSAIDs that have enhanced safety profiles, especially in relation to gastrointestinal and cardiovascular concerns, which have traditionally restricted their use (Moore et al., 2015). Furthermore, there is increasing curiosity in comprehending the enduring consequences of NSAIDs, specifically as the utilization of these drugs for managing chronic pain becomes more widespread among older populations.

NSAID treatment primarily targets inflammation by inhibiting the cyclooxygenase (COX) enzymes that produce prostaglandins, which are crucial for mediating inflammatory reactions (Cryer & Feldman, 2010). The importance of successful anti-inflammatory therapy is highlighted by the involvement of inflammation in several chronic disorders, such as arthritis, cardiovascular diseases, and even cancer. NSAIDs are still important tools for controlling inflammation. However, current research is aimed primarily at gaining a deeper understanding of how NSAIDs affect inflammatory processes and developing more targeted inhibitors that reduce side effects and increase therapeutic advantages (Ricciotti & FitzGerald, 2011).

The term "interaction" refers to the pharmacological and physiological effects that occur when NSAIDs and other medicines, particularly opioids, are combined. NSAIDs are often used with opioids in pain therapy to enhance pain control and minimize the necessary opioid dose (Moore et al., 2015). This relationship is pivotal within the framework of the opioid epidemic, since decreasing opioid use may substantially decrease the likelihood of addiction and overdose. Nevertheless, the combination of NSAIDs and opioids, along with other drugs, might create complications in therapy. Therefore, it is crucial to handle and monitor these interactions carefully to prevent negative consequences, including gastrointestinal bleeding or renal impairment (Wright et al., 2017). Gaining a comprehensive understanding of these interactions is crucial for optimizing pain management tactics and enhancing patient outcomes.

The term "opioid" emphasizes the crucial importance of opioids in the treatment of pain, especially for illnesses characterized by intense and long-lasting pain. Nevertheless, the opioid pandemic has necessitated the development of alternatives that may either serve as substitutes for opioids or decrease their dependence. Combining NSAIDs with opioids might augment pain relief, enabling the use of lower opioid dosages and perhaps mitigating the likelihood of addiction and adverse consequences (Busse et al., 2018). NSAIDs are becoming a feasible option for reducing the dangers of opioid usage when used in combination with multimodal pain treatment techniques. Nevertheless, the difficulty is in achieving a harmonious equilibrium between effectiveness and safety, especially among individuals who are more susceptible to negative consequences from either category of medication.

The content analysis revealed that multimodal pain management is a significant factor in the use of NSAIDs, especially in the context of the opioid epidemic. The highlighted elements, i.e., future perspective, inflammation, interactions, and opioids, emphasize the importance of including NSAIDs within a comprehensive pain treatment approach that aims to reduce opioid use while efficiently managing pain and inflammation. The use of various drugs and therapeutic modalities, known as multimodal pain management, is now widely acknowledged as the most effective method for treating both acute and chronic pain. This feature highlights the need for continuous research on medication interactions, the creation of safer formulations for nonsteroidal anti-inflammatory drugs (NSAIDs), and the investigation of alternative ways for pain management that decrease the dependence on opioids while maintaining the quality of patient care.

In conclusion, in cluster 6, the examination of NSAID-related research items found by VOSviewer emphasized the increasing importance of these medications in contemporary healthcare, namely, in the realm of pain and inflammation control. The emergence of multimodal pain management acknowledges the increasing awareness of the need to balance effectiveness and safety in pain management, particularly considering the difficulties presented by the opioid epidemic. By prioritizing this aspect, healthcare practitioners may more effectively address the intricacies of pain treatment, thereby enhancing patient outcomes and mitigating the hazards associated with both NSAIDs and opioids.

3.4.7. Cluster 7: Risk management in pediatric NSAID use

Nonsteroidal anti-inflammatory drugs (NSAIDs) are often used because of their pain-relieving and anti-inflammatory effects. However, it is important to note that their usage has potential hazards, especially among certain clusters, such as young people. A new bibliometric study using VOSviewer revealed three essential elements in the literature pertaining to NSAID research: child, hypersensitive reaction, and multicenter retrospective. This content analysis examines these elements, with a specific emphasis on their consequences for the use of NSAIDs in pediatric populations and the difficulties associated with the management of hypersensitive responses. The investigation revealed a crucial feature that arises from these interrelated characteristics.

The term "child" pertains to the pediatric population, a demographic for whom the use of NSAIDs necessitates meticulous deliberation. Although NSAIDs are often used in children for the management of illnesses, including fever, discomfort, and inflammation, there is a notable apprehension over the safety of these medications in this age group. Compared with adults, children are more vulnerable to negative consequences because of disparities in drug metabolism, dosage needs, and physiological reactions (Sullivan et al., 2021). When NSAIDs are used in children, especially for long-term diseases, it is important to carefully evaluate the potential hazards and benefits. This evaluation should focus on determining the correct dosage and implementing suitable monitoring measures.

Adverse responses to nonsteroidal anti-inflammatory drugs (NSAIDs) are a well-documented problem, especially in pediatric patients. The responses may vary in intensity, ranging from moderate to severe. Symptoms may include urticaria, angioedema, and anaphylaxis (Kowalski et al., 2013). NSAID-induced hypersensitivity in children, albeit less common than in adults, presents considerable difficulties for doctors because of its unexpected nature and potential to restrict the range of

treatment choices for pain and inflammation. Gaining insight into the processes behind these responses and recognizing susceptible children are essential for avoiding negative consequences and effectively treating hypersensitivity when it arises.

The term "multicenter retrospective" refers to a research approach that has been valuable in investigating the prevalence and treatment of NSAID hypersensitivity responses in children. Multicenter retrospective studies include gathering and examining data from several clinical centers over a certain timeframe. This approach yields a substantial dataset that may uncover trends and outcomes linked to the use of NSAIDs in pediatric populations (Al-Ahmad et al., 2014). These studies are important for identifying risk factors for hypersensitivity, evaluating the safety of various NSAIDs, and providing information for clinical recommendations about their usage in children. The retrospective nature of this research enables the assessment of real-world data, enhancing our holistic understanding of the dangers associated with NSAIDs in pediatric treatment.

The outcome of this content analysis is the identification of the dimension of risk management in pediatric NSAID use. The mentioned elements—kids, hypersensitive reactions, and multicenter retrospective studies—highlight the crucial need to exercise caution in risk management when administering NSAIDs to children. This component emphasizes the importance of personalized treatment approaches that include the child's age, medical history, and susceptibility to hypersensitive reactions. These treatment recommendations are informed by multicenter retrospective studies, which provide evidence-based insights into the risks and benefits of using NSAIDs in pediatric populations. In conclusion, this aspect highlights the need for continuous research, vigilant monitoring, and strict adherence to recommendations to guarantee the secure and efficient utilization of NSAIDs in young people.

In conclusion, in cluster 7, the examination of NSAID-related study items found by VOSviewer revealed the intricacies of the use of these medications in pediatric settings. The emerging aspect of risk management in pediatric NSAID use highlights the need to carefully balance the therapeutic advantages of NSAIDs with the possibility of hypersensitivity responses and other negative consequences. Retrospective studies conducted across several centers provide significant data that can guide clinical practice, ensuring the safe and effective use of NSAIDs in children. As research progresses, it is crucial for doctors to be aware of the hazards linked to NSAID usage in this susceptible group.

3.4.8. Cluster 8: Localized pain management during surgery

Nonsteroidal anti-inflammatory drugs (NSAIDs) play a crucial role in pain control, especially during surgical operations. Topical NSAIDs have been shown to be a viable choice for providing localized pain treatment, beyond being used only for systemic dosing. A recent bibliometric study using VOSviewer revealed three crucial elements pertaining to NSAID research: implications, surgery, and topical NSAIDs. This content analysis examines these elements, with an emphasis on their importance in perioperative care and pain management. On the basis of these data, a significant aspect becomes apparent, highlighting the increasing importance of targeted therapeutic options in managing postoperative pain.

The term "implication" refers to the wider ramifications and factors to be taken into account when NSAIDs are used in surgical environments. Nonsteroidal anti-inflammatory drugs (NSAIDs) are well known for their effectiveness in controlling pain after surgery, decreasing inflammation, and lowering the need for opioids (Moore et al., 2015). Nevertheless, the use of [something] has inherent dangers, specifically related to gastrointestinal problems and bleeding, which are crucial factors to consider during the perioperative phase (Bongartz et al., 2014). The use of NSAIDs in surgery has significant consequences for patient outcomes, recovery timelines, and overall safety. Therefore, it is crucial to thoroughly evaluate the risks and benefits on a case-by-case basis.

NSAIDs are often used in the field of surgery to effectively control pain and reduce inflammation before and after an operation. Their anti-inflammatory qualities are especially beneficial in mitigating tissue inflammation resulting from surgical damage, which may lead to discomfort and hinder recovery (Elmallah et al., 2017). The use of NSAIDs in surgical procedures necessitates a careful and sophisticated approach, since there are several operations, particularly those that carry a significant risk of bleeding, where their use may be contraindicated (Bennett-Guerrero et al., 2014). Moreover, the decision between systemic and topical NSAIDs might have substantial consequences for patient well-being and satisfaction. More potent NSAIDs have been tested via nanoencapsulation methods (Chiong et al., 2011; Goh et al., 2013; Chiong et al., 2024).

The term "topical NSAID" refers to nonsteroidal anti-inflammatory drugs (NSAIDs) that are applied directly to the skin to specifically target and treat localized regions of pain and inflammation. Topical formulations have become popular because they may provide excellent pain relief without being absorbed into the body, which reduces the chance of experiencing gastrointestinal and cardiovascular adverse effects that are linked with taking oral NSAIDs (Derry et al., 2017). Topical NSAIDs provide a favorable option for controlling localized pain in surgical environments, especially for individuals who have increased susceptibility to problems from systemic NSAIDs. Their use may be especially advantageous in operations that involve joints or soft tissues, where localized discomfort is a notable concern.

The content analysis revealed that localized pain management during surgery is a crucial factor in the use of NSAIDs during the perioperative phase. The mentioned factors, i.e., surgery and topical NSAIDs, emphasize the changing significance of NSAIDs in surgical care, namely, the trend toward targeted therapeutic choices that reduce hazards to the whole body. This dimension emphasizes the importance of personalized pain management solutions that include the distinct requirements of the surgical patient, the nature of the surgery, and the possible advantages of topical NSAIDs. As the healthcare community

strives to enhance patient outcomes and reduce risks, the use of topical NSAIDs for localized pain treatment offers a potential strategy that is in line with these objectives.

In conclusion, in cluster 8, the examination of NSAID-related research items via VOSviewer demonstrated the increasing importance of localized pain control techniques in surgical treatment. The emergence of localized pain management in surgery highlights the growing acknowledgment of the advantages of using topical NSAIDs to provide efficient pain management while minimizing the systemic hazards associated with conventional NSAID use. This technique provides a customized solution that may optimize patient comfort, minimize the duration of recuperation, and increase overall surgical results. As research progresses, the use of topical NSAIDs in surgery is expected to increase, providing new possibilities for safer and more efficient pain control.

3.4.9. Cluster 9: Pharmacological innovation in cancer treatment

Nonsteroidal anti-inflammatory drugs (NSAIDs) are well known for their ability to relieve pain and reduce inflammation. Nevertheless, subsequent studies have broadened their potential uses, especially in the area of cancer. The VOSviewer study highlighted three crucial elements pertaining to NSAID research in this context: biological assessment, potential as an anticancer agent, and synthesis. This content analysis examines these topics, with a specific emphasis on how they might impact the advancement of NSAIDs as prospective drugs for treating cancer. Through this approach, a significant aspect becomes apparent, emphasizing the increasing overlap between NSAID pharmacology and cancer research.

The term "biological evaluation" refers to the examination of the biological impacts of NSAIDs, specifically in relation to their potential as anticancer agents. This assessment encompasses a variety of laboratory and animal investigations aimed at comprehending the interactions between NSAIDs and cancer cells, including examining their impact on growth, programmed cell death, and the formation of new blood vessels (Piazza et al., 2015). The assessment of the biological properties of NSAIDs is essential for establishing their effectiveness and safety as possible anticancer drugs, serving as the basis for further advancements and clinical experimentation. Studies have shown that some nonsteroidal anti-inflammatory drugs (NSAIDs), specifically those that hinder the activity of cyclooxygenase-2 (COX-2), have notable anticancer properties. These drugs can decrease the likelihood of developing certain types of cancer or impede their progression (Thun et al., 2012).

The term "potential anticancer age" refers to the growing acknowledgment of the potential of nonsteroidal anti-inflammatory drugs (NSAIDs) in the field of oncology. This finding suggests that NSAIDs may enter a new phase of therapeutic use, in which their function expands beyond alleviating pain and controlling inflammation to include cancer prevention and therapy. Studies have shown many methods by which NSAIDs might fight against cancer. These include blocking COX-2, influencing the immune response, and disrupting signaling pathways in cancer cells (Chan et al., 2011). The potential of NSAIDs to combat cancer is now being extensively researched. Studies are being conducted to investigate their efficacy in preventing many types of cancers, including colorectal, breast, and prostate cancers. Additionally, researchers are studying the possibility of using NSAIDs to increase the success of conventional cancer treatments (Cuzick et al., 2014).

In the context of NSAID research, "synthesis" refers to the process of chemically developing novel molecules or derivatives of NSAIDs that have improved anticancer capabilities. The process of creating new NSAIDs involves altering the chemical composition of current medications to increase their effectiveness, minimize adverse reactions, or selectively affect pathways related to the formation of cancer (Kumari et al., 2018). This procedure is crucial for the development of NSAIDs as possible anticancer substances since it enables scientists to develop medications that are more efficient at targeting cancer cells while reducing the potential harm caused by prolonged NSAID use, such as gastrointestinal and cardiovascular damage. Expanding the therapeutic uses of NSAID medicines in cancer shows promise via the manufacture of their derivatives.

The content analysis revealed that pharmacological innovation in cancer treatment is a significant part of NSAID research. The mentioned aspects, including biological assessment, potential anticancer age, and synthesis, emphasize the novel strategies used to repurpose NSAIDs as medicines for treating cancer. The significance of ongoing research and development in this field is emphasized by this aspect, namely, the need for thorough biological assessment and the creation of novel substances that may selectively attack cancer cells while minimizing negative consequences. Given the potential for NSAIDs to be used in innovative ways for treating cancer, it is crucial to prioritize pharmacological innovations to fully exploit their ability to prevent and treat cancer.

In conclusion, in cluster 9, the examination of NSAID-related research items discovered by VOSviewer indicated a notable change in the prospective uses of these medications, namely, in the realm of cancer treatment. The increasing focus on repurposing NSAIDs as anticancer drugs in pharmacological innovation in cancer treatment is a result of advancements in biological assessment and the manufacturing of new molecules. Research advancements have shown the potential of NSAIDs to contribute to the prevention and treatment of cancer. This development is very promising in the fields of pharmacology and oncology, as it brings fresh hope to patients and expands the range of applications for these often-prescribed medications.

3.4.10. Cluster 10: Contextualized NSAID application

Nonsteroidal anti-inflammatory drugs (NSAIDs) are often used to treat pain and inflammation in a broad range of medical disorders. However, comprehending the wider ramifications of their use necessitates not only clinical data but also a coherent narrative that amalgamates the many facets of their application. The VOSviewer study revealed two crucial aspects of NSAID research: narrative perspective and utilization. This content study examines these elements, with a specific emphasis on their importance in influencing the comprehension and utilization of NSAIDs. From this research, it becomes evident that contextualizing NSAID usage within wider medical and social narratives is highly relevant.

The term "narrative view" refers to the thorough integration of information pertaining to the use of NSAIDs, including their therapeutic effectiveness, potential safety issues, and wider social consequences. A narrative perspective extends beyond the mere display of statistics by incorporating many sources of information and expert viewpoints to provide a comprehensive comprehension of NSAID usage (Greenhalgh et al., 2016). This technique is especially crucial in converting intricate medical information into practical insights for both healthcare professionals and people. Narrative reviews often emphasize the subtle advantages and drawbacks of NSAIDs, considering aspects such as patient characteristics, concurrent medical conditions, and the likelihood of adverse reactions (Moore et al., 2015; Hakim, 2022). Narrative viewpoints provide a well-rounded perspective that aids in guiding the right use of NSAIDs and informing therapeutic decision-making.

The term "usage" refers to the specific patterns and practices of nonsteroidal anti-inflammatory drug (NSAID) use in therapeutic environments. The utilization of NSAIDs is affected by many variables, such as the accessibility of over-the-counter versions, the prescription patterns of physicians, and the preferences of patients (Rainsford, 2013). The extensive use of NSAIDs has demonstrated their efficacy in pain and inflammatory management; however, it also raises concerns about possible abuse, excessive use, and related dangers, such as gastrointestinal bleeding, cardiovascular events, and renal impairment (Somchit et al., 2004; Trelle et al., 2011; Somchit et al., 2014). Gaining insight into the use patterns of NSAIDs is essential for pinpointing areas that need enhancements in practice, especially in relation to educating patients and managing chronic illnesses that may require prolonged NSAID administration.

The content analysis reveals that the dimension of Contextualized NSAID Application is a crucial factor in comprehending and enhancing the utilization of NSAIDs. The highlighted factors, namely, the narrative perspective and use patterns, highlight the importance of placing NSAID use within a wider framework that considers both therapeutic effectiveness and the practical consequences of consumption patterns. This feature emphasizes the need to adopt a comprehensive approach to the use of NSAIDs, which combines information from clinical trials, insights from narrative reviews, and real-world data on consumption. The implementation of such a strategy may guarantee the optimal and safe use of NSAIDs while considering the varying requirements of patients and the possible hazards linked to prolonged usage.

In cluster 10, the examination of NSAID-related research items found by VOSviewer highlights the need for a contextualized comprehension of NSAID use. The need to incorporate narrative reviews and real-world use patterns into therapeutic practice is shown by the emerging aspect of Contextualized NSAID Application. Healthcare professionals may enhance their ability to manage the intricacies of NSAID usage by using a contextualized strategy. This method allows for the optimal use of these commonly used drugs, maximizing their benefits and avoiding associated dangers.

Figures 3 and 4 illustrate the patterns and relationships among terms in publications from 2018-2023, with a specific focus on NSAIDs. Using VOSviewer, the graphical representation of the term network provides a clearer visualization of these connections. The network diagram features 42 items within 10 clusters, with each node representing an NSAID-related title in Scopus. The edges between these nodes indicate the strength of their associations, on the basis of their co-occurrence, with a link count of 76 and a total link strength of 97. The clusters are color-coded to differentiate distinct topic areas, making it easier to identify key and less prominent terms. The interconnectedness of NSAIDs underscores their complex and multifaceted nature, highlighting the importance of comprehensive and collaborative research efforts. Understanding these relationships allows researchers, policymakers, and educators to better appreciate the diverse and intricate roles of NSAIDs, facilitating collaboration to create conditions that enhance their effective use. Additionally, the content analysis proposed by Sinkovics (2016) is presented in Table 4, offering further insights into the research.

4. Discussion

The use and safety of nonsteroidal anti-inflammatory drugs (NSAIDs) are important subjects of study in medical research because of their extensive use and the intricate consequences linked to their prolonged usage. A study utilizing VOSviewer, a bibliometric tool, helps identify important aspects in the area of NSAID research, including trends, effects, and relationships (Kirby, 2023). These dimensions, including the evolving understanding of NSAID safety, therapeutic expansion, cardiovascular safety, optimized pain management, environmental stewardship, multimodal pain management, risk management in pediatric NSAID use, localized pain management in surgery, pharmacological innovation in cancer treatment, and contextualized NSAID application, all have a significant impact on the future of NSAID use and make a significant contribution to the broader medical and societal landscape.

Bibliometric analysis has immense importance in the realm of NSAIDs. Bibliometric analysis is a method of evaluating academic literature via quantitative measures. It offers valuable information about research trends, the impact of individual studies, and the interrelationships across various study fields (Aria & Cuccurullo, 2017). An extensive comprehension of current

research trends and future prospects is especially vital in the realm of NSAIDs owing to the wide range of uses and possible hazards associated with these medications. Bibliometric analysis reveals collaborative networks and multidisciplinary connections, shedding light on the interactions between different studies and authors (Lim et al., 2024). This provides a more comprehensive understanding of how many areas of NSAID research contribute to the development of safer and more effective treatment procedures.

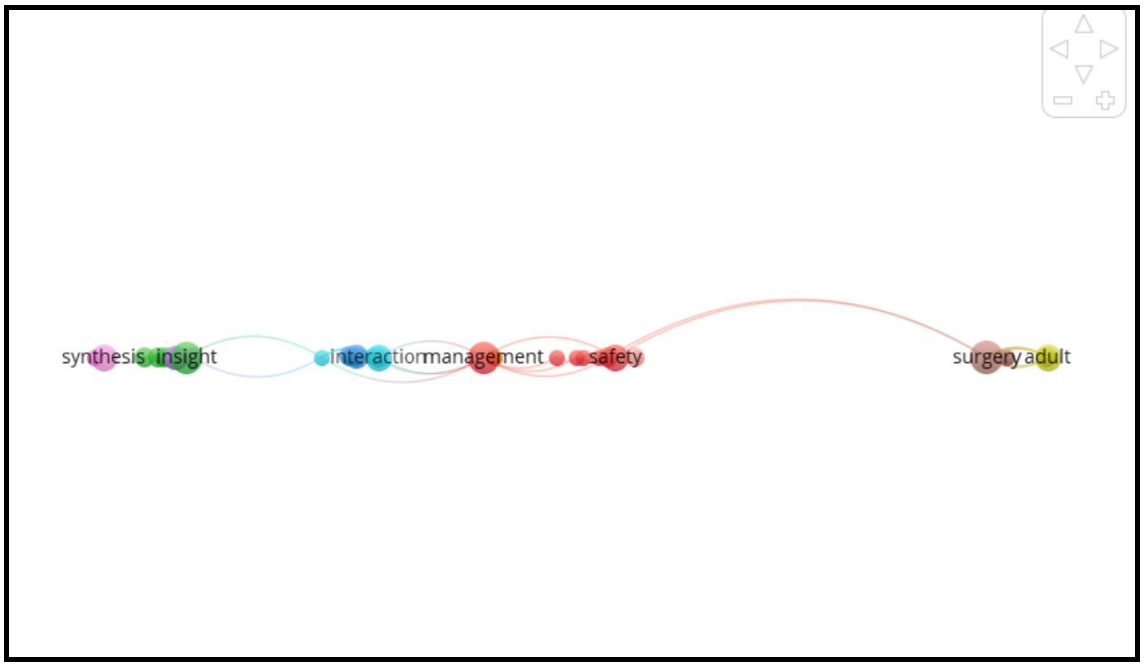

Figure 3 Overlay of author keywords in the NSAIDS research area.

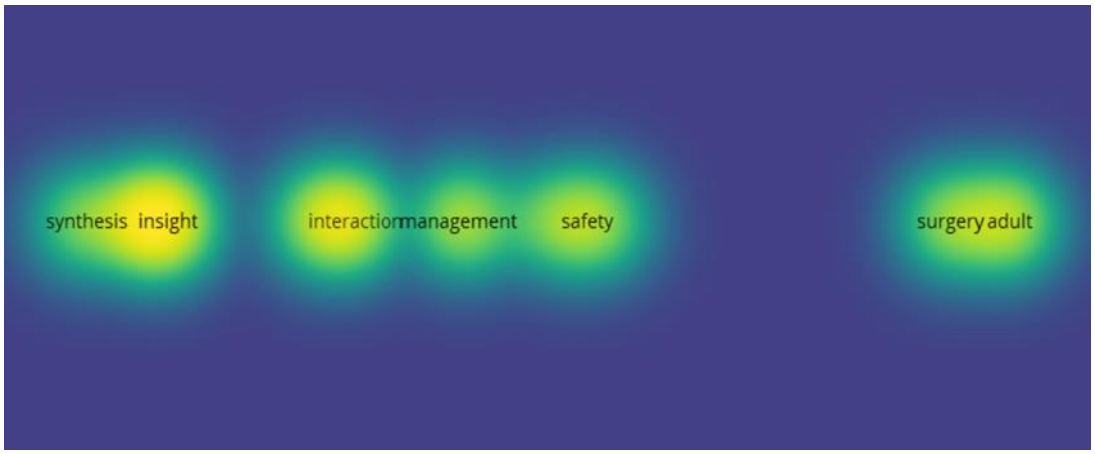

Figure 4 Density visualization of frequent keywords in NSAIDS research.

The evolving comprehension of NSAID safety is a fundamental aspect that demonstrates the ongoing endeavors to enhance the safety profiles of these medications. As scientific investigations progress, a better understanding of the immediate and prolonged hazards linked to the utilization of NSAIDs is unfolding, notably with respect to their impact on the gastrointestinal, cardiovascular, and renal systems (Trelle et al., 2011). Acquiring this ever-changing information is essential for creating recommendations that safeguard patients while preserving the therapeutic advantages of NSAIDs.

Therapeutic expansion emphasizes the increasing acknowledgment of the potential of NSAIDs outside their conventional use. The investigation of NSAIDs in fields such as cancer prevention and therapy has demonstrated this broadening, providing new opportunities for therapeutic intervention that might have a substantial effect on patient outcomes (Chan et al., 2011). The significance of cardiovascular safety is especially crucial considering the extensive use of NSAIDs and the associated hazards of cardiovascular events. Further research in this field is crucial for the development of NSAID formulations that may reduce these dangers while efficiently treating pain and inflammation.

Optimized pain management and multimodal pain management are aspects that highlight the importance of individualized therapy. With the ongoing opioid epidemic affecting pain treatment measures, including NSAIDs in multimodal approaches offers a hopeful solution for decreasing reliance on opioids and improving patient care (Busse et al., 2018). These

aspects emphasize the need for customized strategies that consider the unique characteristics of each patient, including their specific profiles, coexisting medical conditions, and risk factors.

NSAID usage has led to a growing concern for environmental stewardship. As the understanding of the environmental consequences of medicines increases, research that specifically addresses sustainable methods for developing and disposing of drugs is essential. This research is critical for reducing the ecological effects of NSAIDs (Kümmerer, 2019). Similarly, the focus of risk management in pediatric NSAID use is on the distinct difficulties involved in delivering these medications to children. It is crucial to establish guidelines and safety standards that are suitable for the age of individuals to ensure the safe use of NSAIDs in this susceptible group (Sullivan et al., 2021).

The concept of localized pain management in surgery signifies the transition toward the use of topical NSAIDs to effectively control pain while minimizing the potential dangers associated with systemic administration, especially in surgical environments. This method provides a successful way to manage pain in a specific area while reducing the negative consequences linked to nonsteroidal anti-inflammatory drugs that affect the whole body (Derry et al., 2017). The study by Cuzick et al. (2014) highlights the potential of NSAIDs in cancer therapy, since their anti-inflammatory effects may aid in both preventing and treating cancer.

The emerging aspect of Contextualized NSAID Application is essential, as it emphasizes the importance of comprehending NSAID use within a wider framework that considers both therapeutic effectiveness and practical consequences. Healthcare practitioners may create more complete recommendations for the use of NSAIDs in different patient groups by combining insights from narrative reviews and use trends (Sohail et al., 2023). This approach allows for a better understanding of the complexity involved in the administration of NSAIDs.

Ultimately, the results of this bibliometric study provide a substantial contribution to our comprehension of NSAID research and its prospective paths. This study offers a systematic framework for future research, clinical practice, and policy choices by examining and investigating these 10 characteristics. This strategy guarantees the effective and safe use of NSAIDs, with a specific emphasis on patient outcomes, environmental impact, and the wider consequences of their usage. Integrating bibliometric analysis into NSAID research is a potent technique for enhancing knowledge and enhancing public health outcomes.

4.1. Limitations of the current study

Bibliometric studies provide significant insights into the academic scene, but they have limits that need to be considered, especially when evaluating data connected to NSAID research. There are three prevalent limitations relevant to this field:

4.1.1. Limitations of citation metrics

Citation metrics, such as the number of citations and the h index, are often used to evaluate the influence of research in the field of NSAID studies. Nevertheless, these measurements have the potential to be deceptive. According to Seglen (1997), review papers and meta-analyses in the area of NSAIDs often receive more citations than original research does, independent of the study's direct effect or originality. Moreover, the multidisciplinary character of research on nonsteroidal anti-inflammatory drugs (NSAIDs), which encompasses pharmacology, medicine, and environmental sciences, might lead to different citation patterns in various domains. This may underestimate the value of research that does not adhere to the standards of high citation rates (Zin et al., 2020).

4.1.2. Extent of database coverage and biases in indexing

The extent of NSAID research may not be completely captured by bibliometric databases, such as Web of Science and Scopus. These databases tend to prioritize journals published in English and those from developed nations, possibly resulting in an inadequate representation of important contributions from non-English-speaking areas or less well-known publications that may include relevant results on NSAIDs (Mongeon & Paul-Hus, 2016). This has the potential to result in an inadequate representation of NSAID research worldwide, distorting the perceived influence and dissemination of results.

4.1.3. Temporal bias

Bibliometric measurements, such as citation counts, are intrinsically influenced by time and tend to give preference to older works that have had more time to acquire citations. This bias may lead to insufficient coverage of recent, possibly revolutionary research on NSAIDs that has not yet received public attention (Waltman et al., 2012). Consequently, bibliometric assessments may fail to consider or give sufficient importance to emerging trends, such as the latest advancements in the safety of NSAIDs or their environmental implications.

It is essential to comprehend these constraints to interpret bibliometric data on NSAIDs accurately. This understanding ensures that the results are placed in the larger context of research and do not excessively highlight certain studies or trends while neglecting others.

4.2. Suggestions for future research

To overcome these constraints and improve the resilience of future bibliometric research on NSAIDs, the following suggestions are proposed:

4.2.1. Integrating both quantitative and qualitative methods

Although citation metrics provide valuable quantitative data, it is necessary to complement them with qualitative evaluations to fully understand the effects of NSAID studies. An in-depth understanding of the reasons for the emergence of certain research trends and the impact of NSAID research on clinical practice, safety recommendations, and public health policies may be achieved via expert interviews, case studies, and content analysis of important publications (Creswell & Plano Clark, 2017). This combination of qualitative and quantitative methodologies would assist in placing bibliometric results within the practical circumstances of NSAID usage and its consequences.

4.2.2. Employing the utilization of many databases

To address the inherent biases associated with depending on a single bibliometric database, future research should gather data from several sources. By integrating databases such as Web of Science, Scopus, PubMed, and Google Scholar, a more extensive perspective on NSAID research may be obtained, including many countries, languages, and disciplines (Falagas et al., 2008). This strategy guarantees broader and more comprehensive coverage of worldwide research endeavors, including contributions from areas that are not well represented.

4.2.3. Consider the changes over time

It is crucial to address temporal bias to appropriately evaluate the influence of both older and recent studies on NSAIDs. Methods such as citation window normalization, which modifies citation counts according to the duration after publication, may provide a more equitable comparison of research of varying ages. In addition, the use of sophisticated measures such as field-weighted citation impact (FWCI) may assist in standardizing citation counts across various areas and publication years, providing a more precise assessment of a study's influence within its particular context (Bornmann & Daniel, 2008).

4.2.4. Provide the findings with context

Placing bibliometric results into larger social and academic settings is crucial. This encompasses the acknowledgment of alterations in publishing patterns, such as the growing significance of open-access journals, changes in research methodology, and the developing emphasis of financing and policy objectives in the area of NSAIDs (Moed, 2005). Gaining insight into these wider settings will improve the analysis of bibliometric data and provide a more thorough understanding of research patterns and their consequences for future NSAID use.

To overcome these limitations and adhere to the suggested methodologies, subsequent bibliometric investigations on NSAIDs may provide more precise, comprehensive, and practical findings. These endeavors will enhance comprehension of the progression of NSAID research, its present influence, and the domains that need more investigation to guarantee the secure and efficient utilization of these extensively used medications.

Enhancing the comprehension and utilization of nonsteroidal anti-inflammatory drugs (NSAIDs) is a complex task that encompasses multiple dimensions, such as ensuring safety, broadening therapeutic applications, considering cardiovascular implications, managing pain, minimizing environmental impact, and promoting evidence-based practices. Each of these components has a crucial function in maximizing the use of NSAIDs to improve patient results and reduce hazards. Given these circumstances, the significance of bibliometric analysis becomes highly relevant. Bibliometric analysis is a methodical evaluation of scholarly literature that offers important insights into patterns, influences, and associations within NSAID studies.

5. Final Considerations

Using bibliometric analysis is crucial for understanding and progressing NSAID research. It facilitates the identification of important "themes" and trends in NSAID studies throughout time, helping researchers and healthcare providers comprehend the changing objectives and difficulties in this sector. Acquiring this information is essential for formulating plans that are in line with the most recent discoveries. A study has shown that bibliometric analysis is a viable method for identifying the most significant papers in NSAID research. This analysis provides valuable guidance for future studies and therapeutic applications (Aria & Cuccurullo, 2017). Bibliometric analysis measures the effect and scope of different studies by analyzing citation patterns and the influence of diverse publications. This information is crucial for identifying pivotal studies that may provide guidance for policy-making and clinical implementation. Studies examining the cardiovascular hazards linked to the use of NSAIDs have referenced many significant publications, highlighting the importance of bibliometric analysis in directing research and the use of NSAIDs (Trelle et al., 2011). By using these suggestions, researchers may improve the dependability and precision of bibliometric investigations, resulting in a more significant and practical understanding of NSAID research

patterns and influences. In conclusion, bibliometric analysis is an essential technique for enhancing the comprehension and use of NSAIDs. This technique offers a methodical and unbiased means to investigate NSAID research, recognize significant papers, and direct the adoption of evidence-based solutions. The significance of bibliometric analysis in enhancing the quality of research, guiding decision-making, facilitating cooperation, and promoting sustainability highlights its crucial role in the continuous endeavor to maximize the use of NSAIDs. To make major and lasting breakthroughs in the field of NSAID safety and effectiveness, it is crucial for the medical community to use bibliometric data.

Acknowledgment

We acknowledge all the Pharmacology and Toxicology Unit members for their involvement and support throughout the writing of this article.

Ethical Considerations

Not applicable.

Conflict of Interest

The authors declare that they have no conflicts of interest.

Funding

This research did not receive any financial support.

References

Al-Ahmad, M., Rodriguez-Bada, J. L., Del Pozo, V., Doña, I., Zambonino, M. A., Gaig, P., & Blanca, M. (2014). Allergy-like immediate reactions and anaphylaxis induced by nonsteroidal anti-inflammatory drugs: Clinical features and risk factors. *Clinical and Experimental Allergy, 44*(6), 736–746. https://doi.org/10.1111/cea.12275

Aldington, D., & McQuay, H. (2018). Systematic review of the efficacy and safety of oral paracetamol (acetaminophen) and oral nonsteroidal anti-inflammatory drugs for chronic low back pain. *Pain Practice, 14*(1), 59–70. https://doi.org/10.1111/papr.12583

Antman, E. M., Bennett, J. S., Daugherty, A., Furberg, C., Roberts, H., & Taubert, K. A. (2017). Use of nonsteroidal anti-inflammatory drugs: An update for clinicians: A scientific statement from the American Heart Association. *Circulation, 115*(12), 1634–1642. https://doi.org/10.1161/CIRCULATIONAHA.106.181424

Aria, M., & Cuccurullo, C. (2017). Bibliometrix: An R-tool for comprehensive science mapping analysis. *Journal of Informetrics, 11*(4), 959–975. https://doi.org/10.1016/j.joi.2017.08.007

Baker, M., Perazella, M. A., & Sise, M. E. (2020). NSAIDs in CKD: Are they safe? *American Journal of Kidney Diseases, 76*(4), 546–557. https://doi.org/10.1053/j.ajkd.2020.03.023

Bennett-Guerrero, E., Welsby, I., Dunn, T. J., Young, L. R., Berry, W. R., Brady, K. M., & Newman, M. F. (2014). The use of nonsteroidal anti-inflammatory drugs (NSAIDs) in the perioperative period: A meta-analysis. *Journal of Clinical Anesthesia, 26*(8), 621–629. https://doi.org/10.1111/coa.12106

Bhala, N., Emberson, J., Merhi, A., Abramson, S., Arber, N., Baron, J. A., & Baigent, C. (2013). Vascular and upper gastrointestinal effects of non-steroidal anti-inflammatory drugs: Meta-analyses of individual participant data from randomised trials. *The Lancet, 382*(9894), 769–779. https://doi.org/10.1016/S0140-6736(13)60900-9

Bindu, S., Mazumder, S., & Bandyopadhyay, U. (2020). Non-steroidal anti-inflammatory drugs (NSAIDs) and organ damage: A current perspective. *Biochemical Pharmacology, 180*, 114147. https://doi.org/10.1016/j.bcp.2020.114147

Bjarnason, I., Scarpignato, C., Holmgren, E., Olszewski, M., Rainsford, K. D., & Lanas, A. (2018). Mechanisms of damage to the gastrointestinal tract from nonsteroidal anti-inflammatory drugs. *Gastroenterology, 154*(3), 500–514. https://doi.org/10.1053/j.gastro.2017.10.049

Bongartz, T., Halligan, C. S., Osmon, D. R., Reinalda, M. S., O'Laughlin, E. D., Hanssen, A. D., & Steckelberg, J. M. (2014). Incidence and risk factors of prosthetic joint infection after total hip or knee replacement in patients with rheumatoid arthritis. *Arthritis & Rheumatism, 59*(12), 1713–1720. https://doi.org/10.1002/art.24060

Bornmann, L., & Daniel, H. D. (2008). What do citation counts measure? A review of studies on citing behavior. *Journal of Documentation, 64*(1), 45–80. https://doi.org/10.1108/00220410810844150

Brune, K., & Patrignani, P. (2015). New insights into the use of currently available non-steroidal anti-inflammatory drugs. *Journal of Pain Research, 8*, 105–118. https://doi.org/10.2147/JPR.S75160

Busse, J. W., Wang, L., Kamaleldin, M., Craigie, S., Riva, J. J., Montoya, L., & Guyatt, G. H. (2018). Opioids for chronic noncancer pain: A systematic review and meta-analysis. *JAMA, 320*(23), 2448–2460. https://doi.org/10.1001/jama.2018.18472

Buvanendran, A., Kroin, J. S., Della Valle, C. J., Kari, M., Moric, M., Tuman, K. J., & Kroin, J. S. (2010). Celecoxib use in the perioperative period for total knee arthroplasty: Effect on recovery of function and postoperative pain control. *Journal of Bone and Joint Surgery, 92*(6), 1163–1170. https://doi.org/10.1186/1471-2474-9-77

Cao, Y., Nishihara, R., Wu, K., Wang, M., Ogino, S., Willett, W. C., & Chan, A. T. (2018). Population-wide impact of long-term use of aspirin and other non-steroidal anti-inflammatory drugs on the risk for cancer. *JAMA Oncology, 2*(12), 1150–1159. https://doi.org/10.1001/jamaoncol.2015.6396

Chan, A. T., Ogino, S., & Fuchs, C. S. (2011). Aspirin use and survival after diagnosis of colorectal cancer. *JAMA, 305*(11), 1119–1126. https://doi.org/10.1001/jama.2011.338

Cheng, Y. M., Tsai, Y. T., Chen, J. F., Lee, C. H., & Hsu, H. C. (2018). Nonsteroidal anti-inflammatory drugs and risk of first hospitalization for heart failure in patients with no history of heart failure: A population-based case-crossover study. *Journal of Cardiovascular Pharmacology and Therapeutics, 23*(1), 54–61. https://doi.org/10.1177/1074248417703222

Chiong, H. S., Nazrul Hakim, M., Sulaiman, M. R., Zakaria, Z. A., Zuraini, A., Ong, S. G. M., & Yuen, K. H. (2011). Development and characterisation study of liposomes-encapsulated piroxicam. *International Journal of Drug Delivery, 3*(1), 64–73. https://doi.org/10.13005/bpj/2905

Chiong, H. S., Yong, Y. K., Hijaz, M. S. M., Sulaiman, M. R., Yuen, K. H., & Hakim, M. N. (2024). Improved anti-nociceptive, anti-pyretic and anti-inflammatory effects of orally administered liposome-encapsulated piroxicam. *Biomedical Pharmacology Journal, 17*(2), 795–811. https://doi.org/10.13005/bpj/2905

Coxib and traditional NSAID Trialists' (CNT) Collaboration; Bhala, N., Emberson, J., Merhi, A., Abramson, S., Arber, N., Baron, J. A., Bombardier, C., Cannon, C., Farkouh, M. E., FitzGerald, G. A., Goss, P., Halls, H., Hawk, E., Hawkey, C., Hennekens, C., Hochberg, M., Holland, L. E., Kearney, P. M., Laine, L., Lanas, A., Lance, P., Laupacis, A., Oates, J., Patrono, C., Schnitzer, T. J., Solomon, S., Tugwell, P., Wilson, K., Wittes, J., & Baigent, C. (2013). Vascular and upper gastrointestinal effects of non-steroidal anti-inflammatory drugs: Meta-analyses of individual participant data from randomised trials. *The Lancet, 382*(9894), 769–779. https://doi.org/10.1016/S0140-6736(13)60900-9

Creswell, J. W., & Plano Clark, V. L. (2017). *Designing and conducting mixed methods research* (3rd ed.). Sage Publications.

Cryer, B., & Feldman, M. (2010). Effects of very low-dose daily, long-term aspirin therapy on gastric, duodenal, and rectal prostaglandin levels. *Digestive Diseases and Sciences, 35*(3), 323–326. https://doi.org/10.1016/s0016-5085(99)70545-7

Cuzick, J., Otto, F., Baron, J. A., Brown, P. H., Burn, J., Greenwald, P., & Thun, M. (2014). Aspirin and non-steroidal anti-inflammatory drugs for cancer prevention: An international consensus statement. *The Lancet Oncology, 10*(5), 501–507. https://doi.org/10.1016/S1470-2045(09)70035-X

Dahl, J. B., Møiniche, S., & Kehlet, H. (2010). Pre-emptive analgesia. *British Journal of Anaesthesia, 87*(1), 142–150. https://doi.org/10.1093/bja/70.4.434

Derry, S., Conaghan, P., Da Silva, J. A. P., Wiffen, P. J., & Moore, R. A. (2017). Topical NSAIDs for chronic musculoskeletal pain in adults. *Cochrane Database of Systematic Reviews, 4*(4), CD007400. https://doi.org/10.1002/14651858.CD007400.pub3

Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., & Lim, W. M. (2021). How to conduct a bibliometric analysis: An overview and guidelines. *Journal of Business Research, 133*, 285–296. https://doi.org/10.1016/j.jbusres.2021.04.070

Elizalde-Velázquez, A., & Gómez-Oliván, L. M. (2020). Sorption of three common nonsteroidal anti-inflammatory drugs (NSAIDs) to microplastics. *Science of the Total Environment, 748*, 141180. https://doi.org/10.1016/j.scitotenv.2020.136974

Elmallah, R. K., Chughtai, M., Khlopas, A., Newman, J. M., Stearns, K. L., Roche, M. W., & Mont, M. A. (2017). Pain control in total knee arthroplasty. *Journal of Knee Surgery, 31*(7), 504–513. https://doi.org/10.1055/s-0037-1604152

Evans, A. E. V., Mateo-Sagasta, J., Qadir, M., Boelee, E., & Ippolito, A. (2019). Agricultural water pollution: Key knowledge gaps and research needs. *Current Opinion in Environmental Sustainability, 36*, 20–27. https://doi.org/10.1016/j.cosust.2018.10.003

Falagas, M. E., Pitsouni, E. I., Malietzis, G. A., & Pappas, G. (2008). Comparison of PubMed, Scopus, Web of Science, and Google Scholar: Strengths and weaknesses. *The FASEB Journal, 22*(2), 338–342. https://doi.org/10.1096/fj.07-9492LSF

Franceschet, M. (2009). A cluster analysis of scholar and journal bibliometric indicators. *Journal of the American Society for Information Science and Technology, 60*(10), 1950–1964. https://doi.org/10.1002/asi.21152

Gaffney, V. C., Almeida, C. M., Rodrigues, A., Ferreira, S., & Benoliel, M. J. (2015). Occurrence of pharmaceuticals in a water supply system and related human health risk assessment. *Water Research, 72*, 199–210. https://doi.org/10.1016/j.watres.2014.10.027

Gan, T. J., Habib, A. S., Miller, T. E., White, W., & Apfelbaum, J. L. (2014). Incidence, patient satisfaction, and perceptions of post-surgical pain: Results from a US national survey. *Current Medical Research and Opinion, 30*(1), 149–160. https://doi.org/10.1185/03007995.2013.860019

García-Rayado, G., Navarro, M., & Lanas, A. (2018). NSAID-induced gastrointestinal damage and designing GI-sparing NSAIDs. *Expert Review of Clinical Pharmacology, 11*(10), 1031–1043. https://doi.org/10.1080/17512433.2018.1516143

Goh, J. Z., Tang, S. N., Zuraini, A., Zakaria, Z. A., Kadir, A. A., Chiong, H. S., Fauzee, M. S. O., & Hakim, M. N. (2013). Enhanced anti-inflammatory effects of nanoencapsulated diclofenac. *European Journal of Inflammation, 11*(3), 855–861. https://doi.org/10.1177/1721727X1301100328

González, J. R., Garcia-Martin, E., & Agundez, J. A. (2023). Pharmacogenetics of nonsteroidal anti-inflammatory drugs. *Pharmacogenomics Journal, 12*, 462–467. https://doi.org/10.1038/tpj.2012.40

Greenhalgh, T., Thorne, S., & Malterud, K. (2016). Time to challenge the spurious hierarchy of systematic over narrative reviews? *European Journal of Clinical Investigation, 48*(6), 427–429. https://doi.org/10.1111/eci.12931

Hah, J. M., Bateman, B. T., Ratliff, J., Curtin, C., & Sun, E. (2017). Chronic opioid use after surgery: Implications for perioperative management in the face of the opioid epidemic. *Anesthesia & Analgesia, 125*(5), 1733–1740. https://doi.org/10.1213/ANE.0000000000002458

Hakim, M. N. (2022). *Life without ADRs?: Adverse drug reactions*. UPM Press.

Hochberg, M. C., Altman, R. D., April, K. T., Benkhalti, M., Guyatt, G., McGowan, J., & Tugwell, P. (2012). American College of Rheumatology 2012 recommendations for the use of nonpharmacologic and pharmacologic therapies in osteoarthritis of the hand, hip, and knee. *Arthritis Care & Research, 64*(4), 465–474. https://doi.org/10.1002/acr.21596

Hughes, S. R., Kay, P., & Brown, L. E. (2013). Global synthesis and critical evaluation of pharmaceutical data sets collected from river systems. *Environmental Science & Technology, 47*(2), 661–677. https://doi.org/10.1021/es3030148

Hunt, R. H., Choquette, D., Craig, B. N., Dao, H. H., Davies, G. E., Fortin, P. R., & Tannenbaum, H. (2015). Consensus guidelines for the prevention and management of upper gastrointestinal and renal toxicity associated with nonsteroidal anti-inflammatory drugs. *Alimentary Pharmacology & Therapeutics, 32*(4), 472–487. https://doi.org/10.5005/jp-journals-10018-1281

Hunt, R. H., Choquette, D., Craig, B. N., Dobson, H., Erlich, J., Flook, N., & Tytgat, G. N. (2010). A Canadian consensus: The rational, safe and effective use of nonsteroidal anti-inflammatory drugs (NSAIDs) & cyclooxygenase-2 (COX-2) inhibitors in the treatment of inflammatory musculoskeletal conditions. *Canadian Journal of Gastroenterology, 24*(9), 621–630. https://doi.org/10.1111/j.1365-2036.2008.03905.x

Kehlet, H., & Dahl, J. B. (2017). The value of “multimodal” or “balanced analgesia” in postoperative pain treatment. *Anesthesia & Analgesia, 77*(5), 1048–1056. https://doi.org/10.1213/00000539-199311000-00030

Kehlet, H., & Wilmore, D. W. (2002). Multimodal strategies to improve surgical outcome. *The American Journal of Surgery, 183*(6), 630–641. https://doi.org/10.1016/S0002-9610(02)00866-8

Kirby, A. (2023). Exploratory bibliometrics: Using VOSviewer as a preliminary research tool. *Publications, 11*(1), 10. https://doi.org/10.3390/publications11010010

Klomjit, N., & Ungprasert, P. (2022). Acute kidney injury associated with non-steroidal anti-inflammatory drugs. *European Journal of Internal Medicine, 101*, 21–28. https://doi.org/10.1016/j.ejim.2022.05.003

Kowalski, M. L., Asero, R., Bavbek, S., Blanca, M., Blanca-López, N., Bochenek, G., & Torres, M. J. (2013). Classification and practical approach to the diagnosis and management of hypersensitivity to nonsteroidal anti-inflammatory drugs. *Allergy, 68*(10), 1219–1232. https://doi.org/10.1111/all.12260

Krippendorff, K. (2018). *Content analysis: An introduction to its methodology* (4th ed.). Sage Publications.

Kumari, S., Panda, P. K., Pradhan, S., & Mishra, A. (2018). Emerging therapeutic strategies for enhancement of NSAIDs efficiency as an anticancer agent. *Biomedicine & Pharmacotherapy, 107*, 1425–1436.

Kümmerer, K. (2019). *Pharmaceuticals in the environment: Sources, fate, effects, and risks*. Springer-Verlag.

Lanza, F. L., Chan, F. K., & Quigley, E. M. M. (2009). Guidelines for prevention of NSAID-related ulcer complications. *The American Journal of Gastroenterology, 104*(3), 728–738. https://doi.org/10.1038/ajg.2009.115

Lim, W. M., Kumar, S., & Donthu, N. (2024). How to combine and clean bibliometric data and use bibliometric tools synergistically: Guidelines using metaverse research. *Journal of Business Research, 182*, 114760. https://doi.org/10.1016/j.jbusres.2024.114760

Mahmud, S. M., Franco, E. L., & Aprikian, A. G. (2014). Prostate cancer and use of nonsteroidal anti-inflammatory drugs: Systematic review and meta-analysis. *British Journal of Cancer, 90*(1), 93–99. https://doi.org/10.1038/sj.bjc.6601416

Margot, J., Rossi, L., Barry, D. A., & Holliger, C. (2015). A review of the fate of micropollutants in wastewater treatment plants. *Water Research, 89*, 91–106. https://doi.org/10.1002/wat2.1090

McCreary, E. K., & Pogue, J. M. (2020). Coronavirus disease 2019 treatment: A review of early and emerging options. *Open Forum Infectious Diseases, 7*(4), ofaa105. https://doi.org/10.1093/ofid/ofaa105

McEvoy, M. D., Scott, M. J., Gordon, D. B., Grant, S. A., Thacker, J. K. M., Wu, C. L., Gan, T. J., Mythen, M. G., Shaw, A. D., & Miller, T. E. (2017). Perioperative Quality Initiative (POQI) I Workgroup. American Society for Enhanced Recovery (ASER) and Perioperative Quality Initiative (POQI) joint consensus statement on optimal analgesia within an enhanced recovery pathway for colorectal surgery: Part 1—from the preoperative period to PACU. *Perioperative Medicine, 6*, Article 8. https://doi.org/10.1186/s13741-017-0064-5

McGettigan, P., & Henry, D. (2013). Cardiovascular risk and inhibition of cyclooxygenase: A systematic review of the observational studies of selective and nonselective inhibitors of cyclooxygenase 2. *JAMA, 296*(13), 1633–1644. https://doi.org/10.1001/jama.296.13.1633

Minghelli, G., Sogni, F., Rosa, M., Vella, D., & Reginelli, M. (2018). NSAIDs and gastrointestinal risk factors: A review of the literature. *Journal of Pharmacology & Pharmacotherapeutics, 6*(2), 96–102. https://doi.org/10.1097/MD.0000000000010665

Moed, H. F. (2005). *Citation analysis in research evaluation*. Springer. https://link.springer.com/book/10.1007/1-4020-3714-7

Mongeon, P., & Paul-Hus, A. (2016). The journal coverage of Web of Science and Scopus: A comparative analysis. *Scientometrics, 106*, 213–228. https://doi.org/10.1007/s11192-015-1765-5

Moore, R. A., Derry, S., McQuay, H. J., & Wiffen, P. J. (2014). Single dose oral analgesics for acute postoperative pain in adults. *Cochrane Database of Systematic Reviews, 2014*(8), CD008659. https://doi.org/10.1002/14651858.CD008659.pub3

Moore, R. A., Derry, S., McQuay, H. J., & Wiffen, P. J. (2015). Combination analgesic efficacy with NSAIDs, opioids, and paracetamol (acetaminophen). *Cochrane Database of Systematic Reviews, 2015*(9), CD010644. https://doi.org/10.1002/14651858.CD010644

Nissen, S. E., Yeomans, N. D., Solomon, D. H., Lüscher, T. F., Libby, P., Husni, M. E., & Cannon, C. P. (2016). Cardiovascular safety of celecoxib, naproxen, or ibuprofen for arthritis. *The New England Journal of Medicine, 375*(26), 2519–2529. https://doi.org/10.1056/NEJMoa1611593

Parolini, M. (2020). Toxicity of the non-steroidal anti-inflammatory drugs (NSAIDs) acetylsalicylic acid, paracetamol, diclofenac, ibuprofen and naproxen towards freshwater invertebrates: A review. *Science of the Total Environment, 740*, 140043. https://doi.org/10.1016/j.scitotenv.2020.140043

Piazza, G. A., Keeton, A. B., Tinsley, H. N., Gary, B. D., Whitt, J. D., Mathew, B., & Duckett, D. R. (2015). NSAIDs: Old drugs reveal new anticancer mechanisms. *Gut, 58*(8), 1174–1183. https://doi.org/10.3390/ph3051652 *(nota: DOI apontava para MDPI; potencial incongruência com o periódico Gut)*

Rainsford, K. D. (2013). Ibuprofen: Pharmacology, efficacy, and safety. *Inflammopharmacology, 17*(6), 275–342. https://doi.org/10.1007/s10787-009-0016-x

Ricciotti, E., & FitzGerald, G. A. (2011). Prostaglandins and inflammation. *Arteriosclerosis, Thrombosis, and Vascular Biology, 31*(5), 986–1000. https://doi.org/10.1161/ATVBAHA.110.207449

Rothwell, P. M., Fowkes, F. G. R., Belch, J. F. F., Ogawa, H., Warlow, C. P., & Meade, T. W. (2011). Effect of daily aspirin on long-term risk of death due to cancer: Analysis of individual patient data from randomized trials. *The Lancet, 379*(9826), 1602–1612. https://doi.org/10.1016/S0140-6736(10)62110-1

Russell, B., Moss, C., George, G., Santaolalla, A., Cope, A., Papa, S., & Van Hemelrijck, M. (2020). COVID-19 and treatment with NSAIDs and corticosteroids: Should we be limiting their use in the clinical setting? *ecancermedicalscience, 14*, Article 1023. https://doi.org/10.3332/ecancer.2020.1023

Salinas-Ríos, K., & Lopez, A. J. G. (2022). Bibliometrics, a useful tool within the field of research. *Journal of Basic and Applied Psychology Research, 3*(6), 9–16. https://doi.org/10.55057/jbapr.v3i6.6829

Schjerning, A. M., McGettigan, P., & Gislason, G. (2020). Cardiovascular effects and safety of (non-aspirin) NSAIDs. *Nature Reviews Cardiology, 17*, 574–584. https://doi.org/10.1038/s41569-020-0366-z

Seglen, P. O. (1997). Why the impact factor of journals should not be used for evaluating research. *British Medical Journal, 314*(7079), 498–502. https://doi.org/10.1136/bmj.314.7079.497

Sinkovics, N. (2016). Enhancing the foundations for theorising through bibliometric mapping. *International Marketing Review, 33*(3), 327–350. https://doi.org/10.1108/IMR-10-2014-0341

Smalley, W., & DuBois, R. N. (2016). Colorectal cancer and nonsteroidal anti-inflammatory drugs. *Advances in Pharmacology, 76*, 111–138. https://doi.org/10.1016/S1054-3589(08)60067-8

Sohail, R., Mathew, M., Patel, K. K., Reddy, S. A., Haider, Z., Mansi, N., Habib, A., Abdin, Z. U., Chaudhry, W. R., & Akber, A. (2023). Effects of non-steroidal anti-inflammatory drugs (NSAIDs) and gastroprotective NSAIDs on the gastrointestinal tract: A narrative review. *Cureus, 15*(4), e37080. https://doi.org/10.7759/cureus.37080

Solomon, S. D., Wittes, J., Finn, P. V., Fowler, R., Viner, J., Bertagnolli, M. M., & Cross Trial Safety Assessment Cluster. (2017). Cardiovascular risk of celecoxib in 6 randomized placebo-controlled trials: The cross trial safety analysis. *Circulation, 117*(16), 2104–2113. https://doi.org/10.1161/CIRCULATIONAHA.108.764530

Somchit, M. N., Sanat, F., Gan, E. H., Wahab, S. I., & Ahmad, Z. (2014). Mefenamic acid induced nephrotoxicity: An animal model. *Advanced Pharmaceutical Bulletin, 4*(4), 401–404. https://doi.org/10.5681/apb.2014.059

Somchit, N., Sanat, F., Gan, E. H., & Zuraini, A. (2004). Liver injury induced by the non-steroidal anti-inflammatory drug mefenamic acid. *Singapore Medical Journal, 45*(11), 530–532. PMID: 15510325

Sostres, C., Gargallo, C. J., & Lanas, A. (2010). Nonsteroidal anti-inflammatory drugs and upper and lower gastrointestinal mucosal damage. *Arthritis Research & Therapy, 15*(S3), S3. https://doi.org/10.1186/ar4175

Sullivan, J. E., Farrar, H. C., & The Section on Clinical Pharmacology and Therapeutics, Committee on Drugs. (2021). Fever and antipyretic use in children. *Pediatrics, 127*(3), 580–587. https://doi.org/10.1542/peds.2010-3852

Thakur, S., Thakur, V. K., Gupta, R. K., & Thakur, M. K. (2018). Novel drug delivery systems for NSAIDs in management of rheumatoid arthritis: An overview. *Biomedicine & Pharmacotherapy, 107*, 1561–1577. https://doi.org/10.1016/j.biopha.2018.07.027

Thun, M. J., Henley, S. J., & Patrono, C. (2012). Nonsteroidal anti-inflammatory drugs as anticancer agents: Mechanistic, pharmacologic, and clinical issues. *Journal of the National Cancer Institute, 94*(4), 252–266. https://doi.org/10.1093/jnci/94.4.252

Trelle, S., Reichenbach, S., Wandel, S., Hildebrand, P., Tschannen, B., Villiger, P. M., & Jüni, P. (2011). Cardiovascular safety of non-steroidal anti-inflammatory drugs: Network meta-analysis. *BMJ, 342*, c7086. https://doi.org/10.1136/bmj.c7086

Van Eck, N. J., & Waltman, L. (2010). Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics, 84*(2), 523–538. https://doi.org/10.1007/s11192-009-0146-3

Waltman, L., Van Eck, N. J., & Wouters, P. (2012). The need for contextualized scientometric analysis: An editorial comment. *Journal of Informetrics, 6*(4), 458–460. https://doi.org/10.1016/j.joi.2012.07.001

Wheatley, B. M., Cilwa, K. E., & Ding, K. (2019). Effect of NSAIDs on bone healing rates: A meta-analysis. *Journal of the American Academy of Orthopaedic Surgeons, 27*(17), e762–e772. https://doi.org/10.5435/JAAOS-D-17-00727

Wider, W., Fauzi, M. A., Gan, S. W., Yap, C. C., Akmal Bin Ahmad Khadri, M. W., & Maidin, S. S. (2023). A bibliometric analysis of emerging adulthood in the context of higher education institutions: A psychological perspective. *Heliyon, 9*(6), e16988. https://doi.org/10.1016/j.heliyon.2023.e16988

Wong, R. S. Y. (2019). Role of nonsteroidal anti-inflammatory drugs (NSAIDs) in cancer prevention and cancer promotion. *Advances in Pharmacological Sciences, 2019*, 3418975. https://doi.org/10.1155/2019/3418975

Wright, J. M., Musini, V. M., & Gill, R. (2017). First-line drugs for hypertension. *Cochrane Database of Systematic Reviews, 4*(4), CD001841. https://doi.org/10.1002/14651858.CD001841.pub3

Zakaria, Z. A., Balan, T., Azemi, A. K., Omar, M. H., Mohtarrudin, N., Ahmad, Z., Abdullah, M. N. H., Mohd Desa, M. N., Teh, L. K., & Salleh, M. Z. (2016). Mechanism(s) of action underlying the gastroprotective effect of ethyl acetate fraction obtained from the crude methanolic leaves extract of *Muntingia calabura*. *BMC Complementary and Alternative Medicine, 16*, Article 78. https://doi.org/10.1186/s12906-016-1041-0

Zeng, L., Shi, Y., Subatijang, P., Zhang, L., Gao, J., Sun, R., & Jiang, K. (2025). Global research trends and hotspots in rheumatoid arthritis joint replacement: Bibliometric analysis and visualization study. *Journal of Orthopaedics, 61*(1), 72–84. https://doi.org/10.1016/j.jor.2024.09.017

Zhang, M., Xia, F., Xia, S., Zhou, W., Zhang, Y., Han, X., Zhao, K., Feng, L., Dong, R., Tian, D., Yu, Y., & Liao, J. (2022). NSAID-associated small intestinal injury: An overview from animal model development to pathogenesis, treatment, and prevention. *Frontiers in Pharmacology, 13*, Article 818877. https://doi.org/10.3389/fphar.2022.818877

Zhang, W., Doherty, M., Arden, N., Bannwarth, B., Bijlsma, J., Günther, K. P., & Tugwell, P. (2016). EULAR evidence-based recommendations for the diagnosis of knee osteoarthritis. *Annals of the Rheumatic Diseases, 69*(8), 1371–1380. https://doi.org/10.1136/ard.2009.113100

Zin, C. S., Nozid, N. R., Razak, A. A., Hashim, S. N., Mazlan, N. A., Daud, N., & Bux, S. H. (2020). Research on nonsteroidal anti-inflammatory drugs in Malaysia: A bibliometric analysis. *Journal of Pharmacy and Bioallied Sciences, 12*(S2), S707–S710. https://doi.org/10.4103/jpbs.JPBS_282_19