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Chronic Pain Trends in Breast Cancer: A Comprehensive Bibliometric Analysis of a Psycho-Medical Factor

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Abstract

Introduction: Research in the field of chronic pain in breast cancer has increased during the past 50 years. However, no bibliometric research has been conducted in this regard. Thus, the present research was performed to determine chronic pain trends in breast cancer.
Method: This study focused on research about chronic pain in breast cancer, from 1971 to August 2022 from Scopus. For this purpose, 495 documents were selected through PRISMA protocol. Functional and network analysis were performed by R studio and vosviewer software, respectively.
Results: Based on findings of this study, the most effective article was Guh (2009), the most effective author was Kehlet, and the most impressive country, university, and journal were the United States, University of California, and Journal of Pain, respectively. Additionally, "breast cancer" and "chronic pain" were the most frequent keywords; and psychological keywords such as "quality of life", "anxiety" and "depression" were among the most frequent keywords, indicating the relationship between psychological factors with this field.
Conclusion: The results can pave the way for future researchers to choose appropriate keywords, appropriate journals to submit their research, collaborate with impressive researchers, universities and countries, and find important documents to read this field's literature.

Keywords: Bibliometric Analysis, Beast Cancer, Chronic Pain, Science Mapping Analysis

Introduction

Cancer is one of the main causes of global mortality and affects about 20 million people every year. Breast Cancer (BC) is known as the most common cancer having reported 7.8 million women suffer from BC in the last five years until the end of 2020, in whom 2.3 million new cases are related to 2020 [1]. However, more than 70% of new cases of BC can survive and the 5-year survival rate for non-metastatic and invasive BC is 99% and 90%, respectively. Because the life expectancy of BC patients has increased in recent years by the development and expansion of interventional methods such as surgery, chemotherapy and radiotherapy [2]. Despite the benefits of these treatments, they are associated with several side effects. Chronic pain is one of the most common side effects of BC [3]. Chronic pain relating to BC means pain having caused by cancer or cancer treatment and has lasted for at least three months [4]. It has been reported that 25-60% of BC patients suffer from chronic pain during treatment [5]; and approximately 35% of cancer survivors in the United States (US) suffer from chronic pain [6, 7].
Because of this, chronic pain can cause serious damage to the patients' physical and mental health [8]. In line with this, brain imaging studies have shown that chronic pain decreases the gray cortex of the brain, especially in pain perception or pain modulating regions, such as the thalamus and frontal cortex [9,10]. Other studies have shown that chronic pain in BC

patients is associated with low quality of life [7,11], high anxiety [11,12] and depression [12,13].

Furthermore, several review studies relating to this field have been conducted. In a review study, 60 research on chronic pain in BC patients from 1995 to 2010 was investigated and it was concluded that in most cases, chronic pain after BC was a physically and psychologically debilitating component [5]. Likewise, a bibliometric study by Wu et al. investigated the field of pain and cancer from 2010 to 2019 and revealed that 162 studies on pain and cancer were published in 2010, which increased to 9147 studies by 2019 [14] revealing the accumulated knowledge about this field during years. In their 2022 systematic review, Vincent Haenen et al. found that nearly 47% of cancer survivors report pain at least three months post-treatment. Analyzing 7300 articles and including 38 in their meta-analysis, they noted significant heterogeneity in pain prevalence, suggesting that many influencing factors remain unexplained and warrant further research [15]. Also, Wang et al. reviewed 177 articles and concluded that despite various techniques and treatments, chronic pain after BC is still a common and complex clinical problem causing physical and psychological damages [16].

However, this bibliometric was conducted for all cancers and all types of pain. Therefore, considering the prevalence of BC and its survivors among other cancers, unique characteristics of chronic pain in BC, and the lack of a new bibliometric study in this field, it is necessary to determine the recent development of science in this field. Additionally, highlighting the research trends of chronic pain in BC will be helpful for future researchers to choose appropriate keywords, journals, documents, universities and countries to conduct novel research and to read literature of this field. Thus, the current study aims to determine the most effective document, author, journal, country, the best organization and the most frequent keywords in this field. In addition, it aims to draw the co-citation network of authors, the citation network between documents and the coincidence of keywords.

Method

The present research followed its path through a positivist paradigm [17] and was based on a quantitative approach conducted in seven steps, including selecting the problem and the field of study, determining research objectives, search strategy, selecting software for analyzing, collecting, preprocessing and extracting data, limitation and discussion [18].

Based on search results in Google Scholar search engine in the publish or perish software on August 6, 2022 indicating the lack of bibliometric research in the field of chronic pain in BC, the present research conducted a bibliometric research to measure trends in this field.

The goals of the present research are followed in two parts: functional goals and network analysis goals, mentioned in the introduction section. In order to achieve the mentioned goals, a special search strategy was used.

In order to obtain documents related to chronic pain in BC research, Scopus was searched on August 6, 2022. The search strategy in the Scopus database in the present study is reported based on the main keywords and operators in Table 1.

Table 1. Search Strategy

Items	Description
Database	Scopus
Keywords	"chronic pain", "persistent pain", "major pain", "severe pain", "breast cancer"
Search scope in library	Title, Keyword, abstract
Search strategy	TITLE-ABS-KEY (("chronic pain" OR "persistent pain" OR "major pain" OR "severe pain") AND "breast cancer") AND (LIMIT-TO (DOCTYPE , "ar") OR LIMIT-TO (DOCTYPE , "re")) AND (LIMIT-TO (LANGUAGE , "English"))
Document type	Journal article and Review
Language	English
Duration of search	All years to 6 August 2022

In order to implement each stage of the present research, the following software was used:

- Publish or perish software version 8.2: to check the novelty of the subject and to find the research literature in the Google Scholar search engine.
- Excel software version 2013: to receive Comma Seperated Values (CSV) output from the citation data searched in the Scopus database, to check and filter the data and to enter the relevant file into the bibliometric analysis software.
- vosviewer software version 1.6.18: to perform network analysis.
- bibliometrix package from R studio plugin in R software version 4.2.0: to perform functional analysis.
- Mendeley software version 1.19.8: to cite inside and put references at the end of the text.

Based on the search strategy in Table 1, the entry criteria was determined. According to the entry criteria, 942 articles were obtained; and for considering the exit criteria, the PRISMA protocol [19] including five steps was used to screen the appropriate documents which can be seen in Figure 1. Finally, 495 articles were remained to be analyzed.

Based on the remaining 495 articles from the PRISMA protocol, firstly the results of functional analysis in R software, and secondly, the results of network analysis in vosviewer software have been presented in tables and figures.

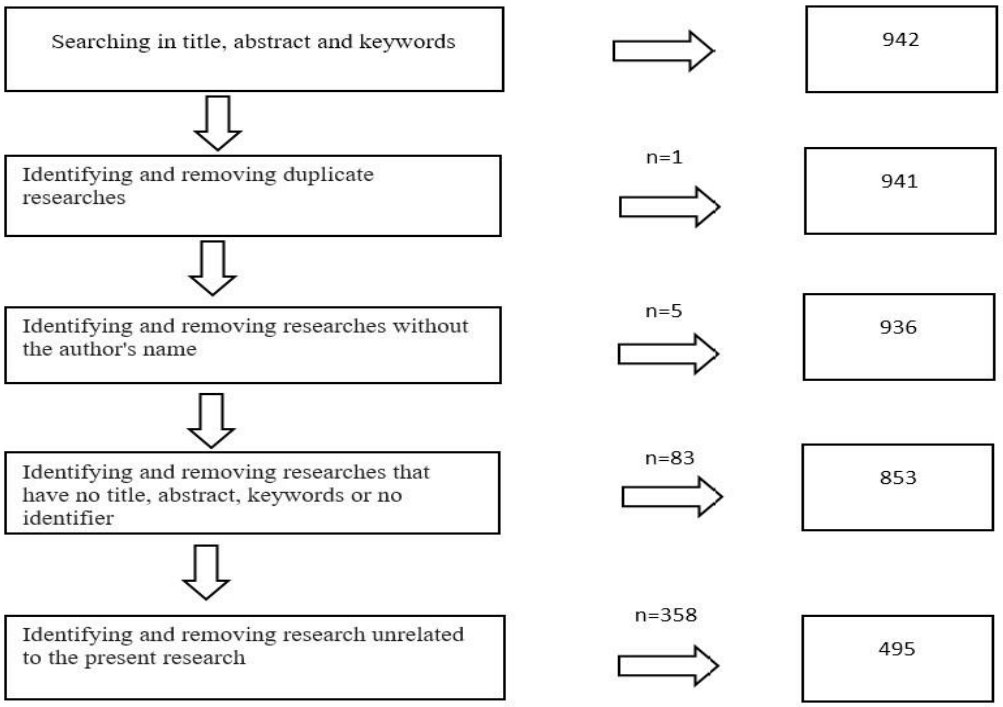

Figure 1. PRISMA protocol.

Results

According to the obtained results, 495 articles were related to the years 1971 to 2022, in which 417 were research articles and 78 were review papers. These articles were received from 244 sources. The annual growth of research in this field is estimated to be about 7.1% showing an increased trend. Furthermore, a total of 1003 keywords have been used by 2491 authors. In addition, there were 15 documents written by a single author; and 16.16% of documents were conducted by international cooperation. Furthermore, the research performed in the field of chronic pain in BC has increased from 1971 to 2021.

Based on Table 2, the highest cited article with 2242 Total Citation (TC) and 160.14 citations per year belongs to Guh et al. [20]. This article is a meta-analysis research about obesity-related issues and its relationship with a number of diseases, including types of cancer, such as BC and chronic back pain. It is logical that according to the analysis of the results of 89 studies in this meta-analysis, it has received attention of many researchers. A paper by Harstell et al. [21] is the second impressive article having received 616 TC. It focused on a trial of radiation therapy for palliative pain related to breast or prostate cancer, having widely been cited because of the aim for pain reduction in people who are suffering from these two types of cancer. The article by Gärtner et al. [22] has also been ranked third with 554 TC, relating to the prevalence of factors related to persistent pain in BC. This work was also interesting for researchers because of the nature of its epidemiology.

Based on Table 3, Kehlet has received 1632 citations by writing 18 papers in this field since 2009. Andersen also published 16 articles and received 880 citations; and Kalso wrote 22 articles and received 1364 citations, as the second and third best authors in this field. Although Kehlet has written fewer articles than Kalso, his articles have received the most TC among other authors, indicating that his articles are more effective comparing to other authors such as Kalso. Despite the higher number of Kalso articles compared to the first and second authors and his higher TC compared to the second author, Kalso has been ranked 3rd. His lower h index and m index than the first and second authors confirm this result.

In addition, "Journal of Pain" was ranked first, publishing 20 articles. This journal is related to the US and is among the Q1 journals. Its h-index is 146 with an impact factor =4 and citescore=7.9 in 2023 and SJR=1.36 in 2022. Thus, this journal is a reliable one with a background of the pain. This journal had 1820 citations and only 110 self-citations in 2020 indicating that this journal was noticed by articles from other journals, not itself. "Pain" is the second journal with 18 published articles. This American journal is also classified as a Q1 journal with an impact factor =7.92 and h-index =282. "Clinical Journal of Pain" is also the third productive journal in this field by publishing 13 articles, categorized among Q1 journals, and its impact factor is 2.9 and its hindex is 138. The articles in this journal are mainly related to the field of medicine. These information about this journal is retrived from Scimago journal ranking.Based on the growth of research data, five journals with the most research in this field were found. The research in all five journals has been upward, including "Breast Cancer Research and Treatment", "Clinical Journal of Pain, Journal of Pain", "Journal of Pain and Symptom Management", and "Pain". In addition, the highest research growth was related to "Pain" until around 2011, but "Journal of Pain" has surpassed this journal and has had the most growth compared to other journals since 2011.

Table 2. Most Global Cited Documents

Authors	year	title	Journal	Total Citations	TC per Year
Guh, Zhang, Bansback, Amarsi, Birmingham and Anis	2009	The incidence of co-morbidities related to obesity and overweight: A systematic review and meta-analysis	BMC Public Health	2242	160.14
Hartsell, Scott, Bruner, Scarantino, Ivker, Roach, Suh, Demas, Movsas, Petersen, Konski, Ceeland, Janjan and DeSilvio	2005	Randomized Trial of Short- Versus Long-Course Radiotherapy for Palliation of Painful Bone Metastases	Journal of the national cancer institute	616	34.22
Gartner, Jensen and Nielsen	2009	Prevalence of and Factors Associated With Persistent Pain Following Breast Cancer Surgery	Journal of American Medical Association	554	39.57
Poleshuk, Katz, Andrus, Jung, Kulick and Dworkin	2006	Risk Factors for Chronic Pain Following Breast Cancer Surgery: A Prospective Study	Journal of Pain	355	20.88
Gabriel, Woods, Ofallon, Beard, Kurland and Melton	1997	Complications Leading to Surgery after Breast Implantation	The New England Journal of Medicine	340	13.08
Andersen and Kehlet	2011	Persistent Pain After Breast Cancer Treatment: A Critical Review of Risk Factors and Strategies for Prevention	Journal of Pain	309	25.75
Fassoulaki, Patris, Sarantopoulos and Hogan	2002	The Analgesic Effect of Gabapentin and Mexiletine After Breast Surgery for Cancer	Anesthesia and Analgesia	264	12.57
Tasmuth, Smitten, Hietanen, Katajo and Kalso	1995	pain and other symptoms after different treatment modalities of breast cancer	annuals of Oncology	264	9.43
Katz, Poleshuk, Andrus, Hogan, Jung, Kulick and Dworkin	2005	Risk factors for acute pain and its persistence following breast cancer surgery	Pain	257	14.28
Andreae and Andreae	2013	Regional anaesthesia to prevent chronic pain after surgery: a Cochrane systematic review and meta-analysis	British journal of Anaesthesia	241	24.1

Table 3. Most Effective Authors and Most Productive Journals

10 Most effective authors						10 most productive journals	
Authors	h_index	g_index	m_index	TC	NP	PY_start	Journals	Articles
Kehlet H	15	18	1.071	1632	18	2009	Journal of pain	20
Andersen KG	13	16	1.083	880	16	2011	Pain	18
Kalso E	12	22	0.429	1364	22	1995	Clinical journal of pain	13
Kroman N	9	10	0.643	982	10	2009	Breast cancer research and treatment	11
Tasmuth T	9	9	0.321	1265	9	1995	Journal of pain and symptom management	11
Aouizerat BE	7	7	0.636	302	7	2012	Supportive care in cancer	10
Levine JD	7	9	0.636	315	9	2012	Breast	9
Miaskowski C	7	9	0.636	315	9	2012	Journal of pain research	8
Paul SM	7	9	0.636	315	9	2012	Journal of plastic, reconstructive and aesthetic surgery	8
Belfer I	6	6	0.6	416	6	2013	Pain practice	8

Table 4. Ten Most Productive Journals, Productive Countries and Cited Countries

10 most productive journals		10 most productive countries		10 most cited countries		
Affiliation	Articles	region	Freq	Country	TC	Average Article Citations
University of California	104	USA	826	USA	5805	49.62
Mcmaster University	37	China	206	Canada	2853	124.04
University of Helsinki	33	Canada	185	Denmark	2237	63.91
University of Toronto	32	France	175	Finland	1473	98.2
Harvard medical school	30	Denmark	161	United Kingdom	1265	50.6
University of Pittsburgh	28	UK	157	Greece	590	98.33
University of Michigan	27	Italy	113	France	467	21.23
University of Copenhagen	25	Belgium	106	Netherlands	448	34.46
University of Alcala	22	Japan	97	Germany	379	22.29
University of Sao Paulo	22	Germany	93	Ireland	353	44.13

Based on Table 4, The University of California is the most scientifically productive university in this field with 104 articles, having classified as a Q1 university. McMaster University and University of Helsinki are the second and third highest research production country in this field, respectively.

According to ‹Table 4, the US is the first country with 826 articles in this field. Considering the large population and the high prevalence of BC in the world population, China is the second country with the most research in this field, and Canada and France are in third and fourth place with 185 and 175 research, respectively.

Furthermore, the results report that most of the research were conducted without international cooperation. For example, the US has published 103 articles without international cooperation and only 14 articles with international cooperation. This rate is 28 versus 7 for Denmark and 30 versus 2 for China. However, a number of countries such as France, India, Japan, Turkey and Egypt have done all their research without international cooperation.

For analyzing the most frequent keywords, the 50 most frequently used keywords in research related to chronic pain in BC were found, among which the keywords “breast cancer” and “chronic pain” are the most frequent ones. According to the researchers' goal to find articles in the field of chronic pain in BC, this result seems logical. Among the keywords related to chronic pain, most researchers have used the term “chronic pain”, and the keyword “persistent pain” is the second most popular for authors. While the two keywords “major pain” and “severe pain” chosen by the researchers of the present study to select the articles, are not very common and are not in the list of 50 most used keywords.

Additionally, in 2018, the three keywords “breast cancer”, “chronic pain”, and “pain” were trends with frequencies of 139, 81, and 70, respectively. In 2019, the keywords “acute pain”, “breast reconstruction”, and “central sensitization” with a frequency of 13, 9, and 5, and in 2020, the keywords “chronic postsurgical pain”, “post-mastectomy pain syndrome”, and “analgesia” were trending with a frequency of 12, 9, and 9, respectively.

Figure 2 shows co-occurrence of authors’ keywords, the authors' co-citation network and the citation network between articles.

By setting the minimum number of documents for each author to five and the minimum citation for each author to 1, a network consisted of 14 authors in four clusters with 35 links was obtained (Figure 2). In cluster 1 highlighted with red, there is a co-citation between Kalso, as the cluster leader, with other authors including Tasmuth, Sipila and Lotsch. In the second cluster, marked with green, there is a co-citation network between authors including Kehlet, as the head of the cluster, and the other authors such as Andersen, Kroman and Gartner.

By setting the minimum number of citations of each document to 100, 34 articles in six clusters with a total of 128 links have been obtained (Figure 2). In cluster 1 shown with red, Andersen and Kehlet [5] has been cited by articles such as Macdonald et al. [23]; Poleshuck et al. [24] and Peuckmann et al. [25].

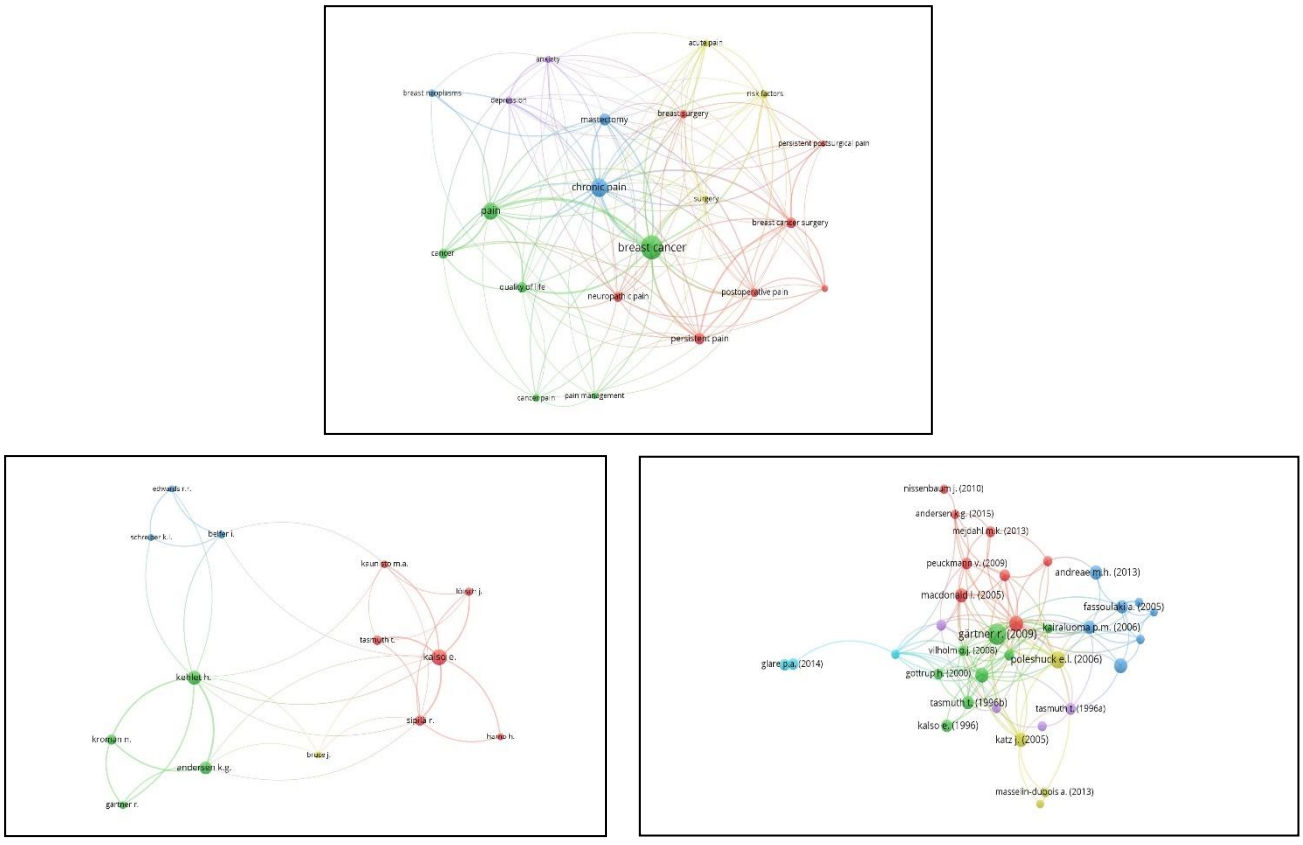

Figure 2. Co-occurrence of authors’ keywords, co-citation networks of authors and network of articles.

Finally, in order to draw the co-occurrence keyword network in Figure 2, the number of keyword co-occurrence was set to 10, and 5 clusters with 21 keywords and a total of 135 links were obtained based on this setting.

In cluster 1, shown with red, the co-occurrence of keywords such as “persistent pain” with “neuropathic pain”, “postoperative pain” and “breast cancer” can be observed in figure 2. In cluster 2, marked with green, there is a co-occurrence of keywords including “breast cancer”, as the head of the cluster, with “chronic pain”, “persistent pain”, “neuropathic pain” and “surgery”. The keyword “chronic pain”, as the head of the third cluster marked with blue, has co-occurrence with words such as “breast cancer”, “mastectomy”, and “pain”. In the cluster 4, displayed with yellow, there is also co-occurrence between keywords including “risk factors”, as the head of this cluster, with “acute pain”, “persistent postsurgical pain” and “breast surgery”; and in the cluster 5 drawn with purple, there is co-occurrence between words including “depression” with “anxiety”, “mastectomy”, “chronic pain” and “pain”.

Discussion

This bibliometric analysis provides a comprehensive overview of the scientific literature developments on chronic pain in BC patients over the past 50 years. The findings showed an increasing number of publications on chronic pain in BC patients since 1994. This can be due to the distinction between acute and chronic pain and the presentation of biopsychosocial models of pain [26]. In addition, the considerable increase in this field since 2003 may be due to the increasing number of patients, improvement in diagnosis and treatment [27]. In line with this, other bibliometric studies also reported that the 1990s was the period of the expansion of scientific literature in the field of pain [28].

Based on high cited articles among these research, the most popular topics were review articles, randomized controlled intervention trials, and epidemiological and etiology studies. These topics are in consistent with the trend observed in previous studies regarding the accumulated scientific literature in the field of pain and cancer [14, 28, 29]. However, the considerable point in the present study is that the most popular research topics have mainly investigated the prevalence of chronic pain and the risk factors of chronic pain in BC, in which the most important signs of danger are the treatment process such as surgery and radiotherapy [5, 19, 21].

According to the results, because the list of the top 10 articles belongs to 1997 to 2013, it seems that these articles have been cited for several years, indicating the important role of these ones in this field. These articles have pointed out that the line of research in the field of chronic pain and BC is still based on etiology and epidemiology in the recent years. Although this finding reveals that the research have noticed chronic pain in BC, it shows the relative lack of basic science about investigating alternative medicine intervention methods as well as psychological interventions in order to moderate and reduce chronic pain in them.

Therefore, more specific understanding and description of chronic pain in BC is required in future research. For example, animal studies can discover different interventions and different drugs and their relationship with chronic pain, as well as psychological interventions in different stages of diagnosis, before intervention and after treatment, which requires more communication and cooperation between specialists and medical centers.

On the other hand, network analysis based on keyword co-occurrence can provide information about the main content of an article and can also be useful to identify research trends in specific field. In the present research, "breast cancer" and "chronic pain" are the most frequent keywords. Additionally, the keywords like "pain", "mastectomy", "persistent pain" and "breast cancer surgery" are appropriate words for researchers to use in future research in this field according to their frequencies. Furthermore, the simultaneous use of keywords such as "breast cancer" with "chronic pain", "persistent pain", "neuropathic pain", and "surgery" and the simultaneous use of "depression" and "anxiety" with "chronic pain" shows that the study of these words in relation to each other were common in many research. Regarding the fact that these keywords have been used together at least 10 times in different studies, it is revealed that biological and psychological factors are related to chronic pain and BC. Therefore, future researchers can follow this factors in these patients.

In another result, it has been shown that the top three journals mainly publish articles in the medical field of pain. Likewise, the good metric of journals publishing research in this field shows that this field is considered as an important issue in the research literature. In addition, these findings showed that chronic pain articles in BC were constantly published by these journals which shows the importance of this field.

In line with other research [14,30], the findings of this study showed that the US is the top country in the literature, and the University of California is the most productive university in this field. Additionally, according to the 10 top country list, the field of chronic pain and BC is highly interesting for developed countries, which is in line with their budgets and scientific advances in the field of health. Another new and interesting point was that after the US and China, Canada was the largest producer of scientific literature and the second country with the most citations in this field. This finding could be the result of special cancer and pain programs (such as The Canadian Pain Task Force (CPTF)) in this country.

This study provides an overview of the path of science development in the past years and can also help those interested in this field and researchers to identify the path ahead of this field and challenging issues. Thus, a significant percentage of the articles having not reported enough details about chronic pain and its evaluation, were excluded from the analysis process. Probably, a part of this limitation can be because of the ambiguity in the exact definition of chronic pain and different scales for measuring pain. For this reason, new agendas such as

more precise classifications of chronic pain [31] and the pain research agenda in the 21st century [27] may reduce this ambiguity in future.

Conclusion

The present study provided a comprehensive review of existing research in the field of chronic pain and BC over the past 50 years. Analyzing 495 studies showed a significant growth of scientific literature in this field, especially in recent years. This study specified the state of existing knowledge and research guidelines in this field and paved the way for the study and implementation of research by future researchers. Therefore, the results presented in this research can be useful for researchers, funding agencies, and policy makers.

Conflict of Interest

There are no conflicts of interest.

Ethical Approval

As the present study was a review research, there are none to be declared.

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