

Bibliometric analysis of breast cancer-related lymphoedema research published from 2007–2016

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Key words

Bibliometric analysis, breast cancer, breast cancer-related lymphoedema, lymphoedema, publication trends

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Lymphoedema is a localised tissue swelling that results from fluid retention that occurs due to obstruction or disruption of the normal lymphatic system (Armer and Stewart, 2010; Cheville et al, 2003). Lymphoedema commonly occurs in the setting of breast cancer and is reported to occur in up to 25–89% of breast cancer patients (Kissin et al, 1986; Segerstrom et al, 1992). It is one of the leading complications of breast cancer, occurring due to lymphatic system injury during breast cancer treatment, particularly axillary lymph node dissection, surgery and radiation therapy (Kissin et al, 1986; Segerstrom et al, 1992; Heisig, 2016).

Although breast cancer-related lymphoedema (BCRL) is a major and common adverse event, significant research assessing BCRL education, risk factors, prevention and treatment has only become a focus within the last decade (DiSipio

Abstract

Background: Breast cancer-related lymphoedema (BCRL) has been a poorly-researched topic; however, research productivity related to BCRL has increased within the last decade. **Aims:** Conduct a bibliometric analysis to characterise recent BCRL research. **Methods:** A search for indexed English abstracts was performed in PubMed using search terms of (“lymphedema”[tiab] OR “lymphoedema”[tiab]) AND “breast cancer”[tiab]” from 2007–2016. Inclusion criteria were original research articles involving human subjects. **Results:** A total of 1,144 publications were identified, of which 570 met the inclusion criteria. The highest proportions of articles were published in 2015 and 2016. The breakdown of lymphoedema study purposes were as follows: diagnostic/educational (35.5%), treatment (30.2%), risk/risk factor (25.3%), prevention (9%). The USA (32.8%), Australia (9.6%), South Korea (6.7%), the United Kingdom (5.3%), China (3.7%) and Turkey (3.7%) produced the most BCRL research. Eight of the top 10 BCRL research institutions are in the USA, with the remaining two in Australia. **Conclusions:** Breast cancer-related lymphoedema research is predominantly being carried out in upper-middle- and high-income countries. In these developed countries, providers are beginning to focus on quality of life-impairing aspects of breast cancer. It is important to identify BCRL research to highlight the need for research support.

et al, 2013). The reasons for this are likely multifactorial, and include recent advancements in breast cancer treatment and the use of innovative surgical techniques for lymph node dissection (Stout, 2012; Fu, 2014). In addition, as breast cancer survival rates increase, healthcare providers are recognising that BCRL results in morbidity and impaired quality of life (Fu, 2014).

The management of BCRL can be challenging, as patients must cope with frequent healthcare visits, the rising economic burden of health care and the variable treatment response rates (Fu, 2014; Wanchai, 2016). Thus, research is pivotal to understanding BCRL and its burden, and to improving management of the condition. As BCRL research continues to grow, it is important to identify the research being performed and to analyse which countries, institutions and research groups are centres of BCRL research. To

Table 1. Top 10 countries for breast cancer-related lymphoedema research.

Country	Number of studies (%)
United States of America	187 (32.8)
Australia	55 (9.6)
South Korea	38 (6.7)
United Kingdom	30 (5.3)
China	21 (3.7)
Turkey	21 (3.7)
Brazil	19 (3.3)
Canada	17 (3)
Belgium	16 (2.8)
Japan	15 (2.6)
	419 (73.5) ^a

^aCumulative frequency and percentage of total articles

achieve this, we performed a bibliometric analysis to evaluate the publication trends regarding BCRL over the last decade. Evaluating these trends will help delineate and understand the scientific contributions being made in the field of BCRL research.

Materials and methods

PubMed was used to search for indexed English abstracts with available English full-text articles. The following search strategy was used to maximize sensitivity and specificity for obtaining BCRL citations: “(“lymphedema”[tiab] OR “lymphoedema”[tiab]) AND “breast cancer”[tiab]”. The publication limited to 2007–2016, as minimal published BCRL research existed before this time period.

The literature search was performed on November 27, 2016. Inclusion criteria were original research articles, clinical research, and involvement of human subjects only. Exclusion criteria were non-English articles; basic science or animal studies; non-original clinical research (i.e. commentary, editorial, letter to the editor, and review articles), and studies in which BCRL was not the primary focus.

Data were collected on the name(s) of the first and last author, journal of publication, impact factor (IF) of journal (according to Thomson Reuters Journal Citation Reports, 2014), publication year, country of author(s), income level of country, institution(s) of author(s) where

study was conducted, study type, and lymphoedema study purpose. The income level of the country was gathered using data from The World Bank (2016). If authors from multiple countries or institutions were involved, all participating countries and institutions were documented. The designated countries and institutions of these articles were primarily classified based on senior author and study location.

The study type was designated as a case report (one patient), brief report (two to four patients), case series (five or more patients), clinical trial, cohort, cross-sectional or meta-analysis/systematic review. Each study purpose was designated as a diagnostic/educational, risk/risk factor, prevention or treatment study.

Statistical examination using frequency analyses was performed using SPSS for Windows 2015, version 23.0.0.0 (SPSS, Chicago, Illinois). This study did not require submission of an Institutional Review Board (IRB) application, as there was no risk to human subjects. Data were gathered from a public domain using published literature.

Results

A total of 1,144 indexed articles were identified, of which 570 met inclusion criteria. The percentage of publications for each year is as follows: 2007 (5.6%), 2008 (5.4%), 2009 (7.7%), 2010 (7.7%), 2011 (9.6%), 2012 (11.2%), 2013 (11.2%), 2014

Table 3. Top first authors of breast cancer-related lymphoedema articles.

Author	Number of studies (%)
Fu MR	14 (2.5)
Ridner SH	13 (2.3)
Smoot B	6 (1.1)
Armer JM	5 (0.9)
Czerniec SA	5 (0.9)
Hayes SC	5 (0.9)
Vignes S	5 (0.9)
	53 (9.5) ^a

^aCumulative frequency and percentage of total articles

(11.1%), 2015 (14.2%) and 2016 (16.1%). The most common study type is cohort (31.1%), followed by cross-sectional (25.4%), clinical trial (18.5%), case series (6.7%), meta-analysis/systematic review (6%), case report (5.6%), case control (5.4%) and brief report (1.4%). The most common lymphoedema study purpose is diagnostic/educational (35.5%), followed by treatment (30.2%), risk/risk factor (25.3%) and prevention (9%).

There were authors from 39 countries in the included articles. The 10 countries with the most BCRL research publications are listed in *Table 1*. The 10 most common journals, as well as their respective impact factors, where BCRL research articles were published are listed in *Table 2*. The names of the most commonly occurring first and last authors are listed in *Tables 3* and *4*, respectively. The 10 most productive institutions doing BCRL research and consist of institutions from the USA and Australia only (*Table 5*).

Discussion

The study’s objective was to analyse the publication trends of BCRL research in order to characterize the conducted research and research productivity. This study shows that more BCRL research is being performed as time progresses, with 2015 and 2016 representing the most productive years of BCRL research. This data is in agreement with the literature supporting the theory that BCRL research has started to rise within the last few years (DiSipio et al, 2013).

Table 2. Top 10 journals publishing breast cancer-related lymphoedema articles.

Journal	Number of studies (%)	Impact factor ^a
<i>Lymphat Res Biol</i>	45 (7.9)	1.709
<i>Support Care Cancer</i>	35 (6.1)	2.364
<i>Breast Cancer Res Treat</i>	32 (5.6)	5.490
<i>Lymphology</i>	24 (4.2)	1.450
<i>Ann Surg Oncol</i>	23 (4)	3.930
<i>J Cancer Surviv</i>	12 (2.1)	3.303
<i>Breast</i>	11 (1.9)	2.381
<i>Plast Reconstr Surg</i>	11 (1.9)	2.993
<i>Int J Radiat Oncol Biol Phys</i>	10 (1.8)	4.258
<i>J Clin Oncol</i>	9 (1.6)	18.428
	212 (37.1) ^b	

^aThe impact factor was reported according to the 2014 Thomson Reuters Journal Citation Reports
^bCumulative frequency and percentage of total articles

This study shows that the USA is the primary country performing original BCRL research. This correlates with published data demonstrating the research prominence of the USA in breast cancer and related fields (Wang, 2016; Ha, 2014). This also aligns with the economic status and level of medical industrialization in the USA. Of the top 10 producing countries, all are either high-income or upper-middle-income countries (The World Bank, 2016). Eight of the top 10 productive institutions are located in the USA while the remaining two are located in Australia, the second most productive country. The prominence of these countries may also be due to the strength of certain research groups whose primary focus is lymphoedema. The lack of any low- or lower-middle-income countries in the top 10 is likely due to a combination of lack of research funding, and lack of diagnostic and therapeutic equipment, as well as a focus on the relatively more imperative management of breast cancer, factors that hold true in other fields (Adigun, 2008; Rohra, 2011; Mahawar et al, 2006). Research from these countries should be supported to fully understand the global effects and burden of BCRL. The 10 most common journals for publication are journals of oncology or lymphatics, with a median impact factor of 3.15. This is likely due to the research's narrow focus, which likely necessitates publication in specific lymphatic- or oncology-focused journals.

There are a number of novel findings made by this study. Mainly, this is one of the first studies to analyse publication trends of BCRL by characterizing both research and research productivity. Additionally, by

Table 4. Top last authors of breast cancer-related lymphoedema articles.

Author	Number of studies (%)
Taghian AG	15 (2.6)
Kilbreath SL	13 (2.3)
Schmitz KH	11 (1.9)
Armer JM	9 (1.6)
Dietrich MS	7 (1.2)
	55 (9.6) ^a

^aCumulative frequency and percentage of total articles

Table 5. Top 10 institutions conducting breast cancer-related lymphoedema research.

Institution	Number of studies (%)
University of Pennsylvania, Philadelphia, USA	20 (3.5)
University of Sydney, Sydney, Australia	19 (3.3)
Massachusetts General Hospital, Boston, USA	18 (3.2)
Vanderbilt University, Nashville, USA	14 (2.5)
New York University, New York, USA	13 (2.3)
University of Missouri-Columbia, Columbia, USA	11 (1.9)
Memorial Sloan Kettering Cancer Center, New York, USA	10 (1.8)
Queensland University of Technology, Queensland, Australia	10 (1.8)
University of Texas MD Anderson Cancer Center, Houston, USA	10 (1.8)
University of Pittsburgh, Pittsburgh, USA	8 (1.4)
	133 (23.5) ^a

^aCumulative frequency and percentage of total articles

targeting our search to the past 10 years, we captured the majority of published BCRL research. Limitations include limiting our search to PubMed, relevant articles missed as a result of our search terms, and not including non-published and non-English data. Our impression, however, is that there would not have been a significant rise in the number of results had we conducted these additional searches.

Conclusion

Historically, lymphoedema has been an under-researched topic, and funding for lymphoedema research is still limited (DiSipio et al, 2013). The publication of BCRL research has risen over the past few years and is being spearheaded by high- and upper-middle-income countries, primarily by institutions in the USA and Australia. As breast cancer diagnosis and treatment options improve in other nations, we will likely see an increase in survival rates in those countries and a corresponding rise in BCRL research. It is essential to continue capturing and characterising the BCRL research being conducted to highlight the need for continued research.

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