

# Historical, descriptive and exploratory analysis of application of bibliometrics in nursing research

Peter Kokol, PhD<sup>a,\*</sup>, Helena Blažun Vošner, PhD<sup>b,c</sup>

<sup>a</sup>University of Maribor, Faculty of Electrical Engineering and Computer Science, 2000 Maribor, Slovenia

<sup>b</sup>Community Healthcare Centre Dr. Adolf Drolc Maribor, Maribor, Slovenia

<sup>c</sup>Faculty of Health and Social Sciences Slovenj Gradec, Slovenj Gradec, Slovenia

## ARTICLE INFO

### Article history:

Received 18 December 2018

Received in revised form

24 April 2019

Accepted 28 April 2019

Available online May 2, 2019.

### Keywords:

Bibliometrics

Nursing research

Papers as topics

Historical roots

Thematic analysis

## ABSTRACT

**Objective:** The aim of the study was to analyse the literature production on application of bibliometrics in nursing research.

**Methods:** Historical, descriptive, and exploratory bibliometrics analyses were used. The papers were harvested from the Scopus bibliographical database (Elsevier, Maribor, Netherlands), on November 18th, 2018, using the search string bibliometric\* in publication titles, abstracts, and keywords, limited to the subject of nursing, for the period 1970 to 2018.

**Findings:** The search resulted in 531 publications with 18 publications removed after manual inspection of publications abstracts. The literature production trend was positive. The nursing specific historical roots appeared only recently. The United States of America and Spain were the most productive countries, and most papers were published in *Nutricion Hospitalaria* and the *Journal of Advanced Nursing*. Descriptive analysis, research evaluation, content analysis, citation analyses, and trend analysis in nursing research were the most prolific themes.

**Conclusions:** Applications of bibliometric in nursing is comparable to bibliometrics use in general, however there are some gaps including the use of altmetrics and of Big Data analysis.

**Cite this article:** Kokol, P., Blažun Vošner, H., (2019, November/December). Historical, descriptive and exploratory analysis of application of bibliometrics in nursing research. *Nurs Outlook*, 67(6), 680–695. <https://doi.org/10.1016/j.outlook.2019.04.009>.

## Introduction

Explosive growth of the research literature production, makes the process to structurally examine its' content and context, even for a single research discipline or topic, a very challenging endeavour (Rodrigues, van Eck, Waltman, & Jansen, 2014). Bibliometrics provide investigators with the ability to enable macroscopic

and microscopic analyses of vast amounts of publications (i.e., research and review articles, conference papers, books, books chapters, notes, letters, errata, etc.), which can be extremely helpful. The bibliometric approach was defined by Pritchard (1969), as the application of mathematical and statistical methods to books and other media of communication. More than 30 years later, Hawkins (2001) defined bibliometrics as

**Declarations of interest:** none

\* Corresponding author: Peter Kokol, University of Maribor, Faculty of Electrical Engineering and Computer Science, Koroška cesta 46, 2000 Maribor, Slovenia.

E-mail address: [peter.kokol@um.si](mailto:peter.kokol@um.si) (P. Kokol).

0029-6554/\$ -see front matter © 2019 Elsevier Inc. All rights reserved.

<https://doi.org/10.1016/j.outlook.2019.04.009>

the quantitative analysis of the bibliographic features of a body of literature. Elements of bibliometric analysis can be books, monographs, reports, theses, conference papers. However, journal papers seem to be most frequently used in bibliometric studies. Bibliometric analysis can identify most prolific authors, institutions, countries, and journals within a scientific discipline or sub-disciplines, analyse dynamics of research literature production, patterns of communication and collaboration between authors, examination of the history and structure of a discipline, study the impact of journals, determine citation patterns, and identify research themes and future directions or hot topics (Bellis, 2009; Garfield, 2006; Kokol, Blažun Vošner, & Zeleznik, 2017; Kokol, Završnik, & Blažun Vošner, 2018). This method also enables the identification of current gaps in research disciplines or research topics (Hall et al., 2018). Bibliometrics can also play an important role in decision making regarding research output evaluation (González Alcaide & Gorraiz, 2018).

Domain independence makes bibliometrics applicable to almost any scientific field, hence application of bibliometrics has been spread to different research and knowledge domains (Tejasen, 2016). In health-related fields, bibliometrics has been successfully used in medicine (Thompson & Walker, 2015), nursing (Alfonzo, Sakraida, & Hastings-Tolsma, 2014; Smith & Watson, 2016), and dentistry (Delli, Livas, Spijkervet, & Vissink, 2017), among others. Nevertheless, to the best of our knowledge (Thompson & Walker, 2015) study seems to be the only one analysing the application of bibliometrics in health sciences from a general point of view. Based on key articles, authors illustrated basic bibliometric concepts and principles, briefly reviewed the history of bibliometrics and provided some examples of application of bibliometrics to medicine. However, they did not perform a more detailed content analysis. The aim of our study was to considerably extend their analysis, focusing on application of bibliometrics in nursing. We used historical bibliometrics (Herubel, 1999; Tejasen, 2016) to systemically analyse the historical roots, the history of literature production, and historical development of topics, descriptive bibliometrics (Diodato, Gellatly, & Gellatly, 2013; Zeleznik, Blažun Vošner, & Kokol, 2017) to analyse the most productive countries, institutions and source titles (journal names, book titles, conference proceeding titles and similar) and exploratory bibliometrics to identify the content, themes, collaboration patterns, and "hot" and emerging topics in the application of bibliometrics in nursing.

## Methods

### Data Source

The search was performed in Scopus (Elsevier, Marijbor, Netherlands). Scopus is the largest abstract and

citation database of peer-reviewed literature, which enabled us to harvest the largest amount of publications, related to application of bibliometrics in nursing. The corpus was formed on November 18th, 2018, using the search string *bibliometric\** in information source titles, abstracts, and keywords limited to *subject = nursing*. No other inclusion or exclusion criteria were used in the search. The publications were then assessed by both authors, in the manner that they were distributed equally between them, so that each publication was read by one author. The corpus publications belonging to categories unrelated to health, social or life sciences, and application of bibliometrics to nursing research were removed.

### Data Preparation and Analysis

Using some of the Scopus built in functions, we exported the publication titles, authors' affiliations' details, source title, publication type, abstracts, publishing years, references, and authors' keywords to MS Excel (Microsoft, Redmond, Washington, USA), VOS-Viewer and CitedReferenceExplorer (CRE), where they were further analysed. Using a customized VOSViewer thesaurus file, we excluded common terms like *study, baseline, control group, trend, method, significance, country and city names, time stamps* from the analysis and mapped synonyms into one entity (for example *bibliometric, bibliometrics and bibliometric analysis in bibliometric analysis*) from the bibliometric mapping analysis. The thesaurus file is consisting of two columns, first includes the synonym and second the term in which the synonym should be mapped (i.e., bibliometric analysis). To omit a term from the analysis, the second column entry was left empty.

Procedure: Please add a sentence or two or three introducing the reader to your procedures here and then go on to discuss what I think are the two primary procedures (methods)

Historical bibliometrics. Herubel (1999, p. 382) defined historical bibliometrics as "the bibliometric study of periodicals and books published in the framework of time and space." He proposed an approach combining bibliometrics and historical research methods, in the manner to gather biographical and sociological insight into the scholarly record. One of the tasks of historical bibliometrics is to identify the publications, which contributed most to the development of knowledge in specific scientific areas – so called historical roots (Marx, Bornmann, Barth, & Leydesdorff, 2014). Identification is based on the normative citation theory, which states that statistically more frequently cited scientific publications are more important for the advancement of knowledge (Merton, 1985). However; another factor to take into account is that the articles from the application of bibliometrics in nursing are also cited by articles from other fields. Additionally, historical roots may not be indexed in bibliographic databases, which are frequently the case for books, conference publications, or older publications.

Therefore, we analysed actual references appearing in publications from the field of the application of bibliometrics in nursing, and did not simply take the number of citations from a major bibliographic database. In that manner, we also employed specialized software tools such as the Reference Publication Year Spectroscopy (RPYS) (de Solla Price, 1963; Kostoff & Shlesinger, 2005; Marx et al., 2014). To perform RPYS we employed the CRE ([www.creexplorer.net](http://www.creexplorer.net)) software in our study. CRE analyses the references (in particular reference publication years) found in the publications from a bibliographic database, in our case Scopus (Elsevier).

Corpus is defined as a collection of articles selected for bibliometric analysis using inclusion and exclusion criteria. When aggregated over time and plotted along the time axis, “historical roots” become more pronounced, and form a spectrogram. Similar to the spectra in the natural sciences, where pronounced peaks represent certain phenomena, pronounced peaks in the CRE spectrogram represent historical roots – in our case important publications which contributed to the knowledge development in the application of bibliometrics in nursing.

Exploratory bibliometrics. For the exploratory bibliometrics we employed bibliometric mapping. Bibliometric mapping visualizes the content of papers and their metadata in form of bibliometric maps and landscapes (van Eck, Waltman, Noyons, & Buter, 2010) using text mining. It could be regarded as a form of “distant reading”, an approach to analyse large amounts of written materials in order to discover patterns (Moretti, 2013). In our bibliometric mapping analysis, we employed VOSViewer software version 1.9.6 (Leiden University, Leiden, Netherlands) (van Eck & Waltman, 2010), which is based on a mapping technique, called Visualisation of Similarities (VOS). The VOSViewer can visualize bibliometric maps (sometimes called landscapes) in different ways and consequently emphasise different aspects of a map (clusters, associations, timelines, citation density, publication density, citation networks, co-occurrence networks, etc.) In the basic analysis, VOSViewer software merges items of analysis (terms, keywords, source titles, countries, etc.) that are closely associated into clusters, denoted by the same cluster colour. The relation between items is expressed by their proximity on the map – closer items are more related. At the same time, more popular units are presented in a larger size.

Following bibliometric maps were used in the exploratory analysis in order to

- perform the thematic analysis. For this task we used the term cluster map as the data set for the thematic analysis (Vaismoradi, Turunen, & Bondas, 2013). Cluster terms were interpreted as codes and an appropriate theme was derived for each cluster;
- analyse the terms evolution through time. Two timeline maps were used, one for the incubation and initiation periods (1970–2014) and the other for the

Logarithmic growth period (2005–2018). In a timeline map the colours represent the average of publication years in which the specific terms occur;

- to analyse the level of inter-country cooperation, identify the most cited countries according to the references obtained from the corpus, and to identify countries with the average most recent publications. For this task the country co-authors timeline and citation density networks were employed;
- the journal citation, citation density, and co-citation networks to analyse inter journal citation patterns;
- identify hot topics. To perform this task the author’s keyword citation density network for the period 2015 to 2018 was used. The keywords occurring in at least two papers, which were cited in average more than two times, were identified as hot topics;
- identify emerging topics. Two author keyword networks, one for the period 2015 to 2016 and the second one for the period 2017 to 2018 were compared as described by Kokol et al., 2018.

### Findings

The search resulted in 531 publications. After manually removing publications not concerned with application of bibliometrics in nursing, 513 publications remained. According to the Scopus classification of publication types there were 349 (68.0%) articles (original research reports), 74 reviews /14.4%), 53 editorials (10.3%), 17 letters (3.3%), eight notes (1.6%), five short surveys (1.0%), four conference papers (0.8%), and three errata (0.6%) among the remaining 513 publications.

### Historical Bibliometric Analysis

The first publication related to bibliometrics application in nursing indexed in Scopus was published in 1970, by Sardin, Terrier, & Grouille, 1970. Authors presented a study using SIGAPS software in a bibliometric analysis of palliative medicine in France. The first publication with the term nursing in the title “Maternal-Newborn Nursing Research Published From 1977 to 1986” was published by Beck, 1989.

The dynamics of the literature production revealed three periods: 1) the incubation period (1970–1995), 2) the initiation period (1996–2004) and 3) the logarithmic growth period (2005–2018). During the incubation period, which lasted 26 years (1970–1995) publications were scarce, at most one paper was published per year. Altogether seven publications appeared in this period. The initiation period started with the first notable increase in the production in 1996 and reached its peak in 2001 with 22 publications. After that, the production exhibited a negative trend till 2005, when it starts to rise again, indicating the start of the Logarithmic growth period. Altogether, 90 publications were published in the initiation period and 416 in the Logarithmic growth period. Logarithmic growth period

reached its peak in 2017 with 38 papers. Looking at the cumulative number of publications we can observe that the popularity of bibliometrics application in nursing increased. It took 35 years (from 1970 until 2004 inclusive) to reach a total of 100 publications, and only 4 years to reach 200 publications (from 2005 until 2008 inclusive), and then 3 years to reach 300 publications (Figure 1).

### RPYS Analysis

The corpus contained 13,446 references. After removing duplicates, references without the publishing year or containing incomplete data, 11,895 references remained. RPYS analysis revealed that historical roots appeared in years 1955, 1963, 1969, 1972, 1978, 1987, 1990, 1992, 2002, 2006, 2010, and 2014 (Figure 2), however the oldest cited reference was from the year 1835, published by Belgian pioneer of statistics Quetelet on the study of man. It offers an extensive discussion of demographics and anthropometrics topics related to crime and suicide (Quetelet, 1842). The next oldest cited reference was also published by a pioneer, but this time in nursing, namely Nightingale, 1859. Her book was the first in introducing rules on how to care for wellbeing and recovery of patients at hospital and home.

The first historical root was the Garfield’s seminal paper in which he introduced a system of how to eliminate the “uncritical citation of fraudulent, incomplete or obsolete data” (Garfield, 1955), which later became the Science citation index. While his paper is not directly related to nursing, it was widely cited in nursing bibliometrics publications, especially in the Logarithmic growth period, as were the next three general bibliometric publications. Next, de Solla Price, 1963 proposed an approach of how to “use science to analyse science” and thus defined the beginnings of scientometrics. In 1969, Pritchard (1969), in attempt to disambiguate the term “statistical bibliography”, defined bibliometrics as the application of mathematics and statistical methods to books and other media. In his

1972 paper, Garfield (1972) introduced the idea of how frequency and impact of citation could be used to rank journals. In his paper, Garfield (1987) analysed the 100 most cited papers published in the Journal of the American Medical Association, with the aim to find a systematic method to select the landmark papers in a chosen scientific field. Campbell studied the citation patterns of US and UK based authors publishing in Lancet and the New England Journal of Medicine and found out that their citation practices are nationally biased (Campbell, 1990). In 1992, López Piñero, and Terrada discussed about the use and abuse of bibliometrics in medical sciences (López Piñero & Terrada, 1992). Ten years later in 2002, Callaham, Wears, and Weber (2002) analysed the Web of Science to identify characteristics of published research in the manner to predict further citation patterns. Hack, Crooks, Plohman, and Kepron (2010) paper was the only historical root from the nursing area. Authors showed that citation analysis can be useful to examine the research performance of academic researchers in nursing and identify leaders among them. The last historical root is the Van Eck and Waltman (2014) publication in which they provided an introduction to the topic of visualizing bibliometric networks. These historical roots show that knowledge development in application of bibliometric in nursing relied on publications outside of its own field, especially on work done by Garfield. Most historical roots were published in journals, but in the earlier periods also as books. The journals were mostly from the medical field. Thematically, publications were mostly concerned with citation analysis and evaluation of research.

### Evolution of Terms

The evolution of terms revealed six eras of application of bibliometrics in nursing (words in italics present terms from Figures 3 and 4):

- 1970 to 1998 (violet colour in Figure 3). Bibliometrics was used for the *assessment and evaluation of*

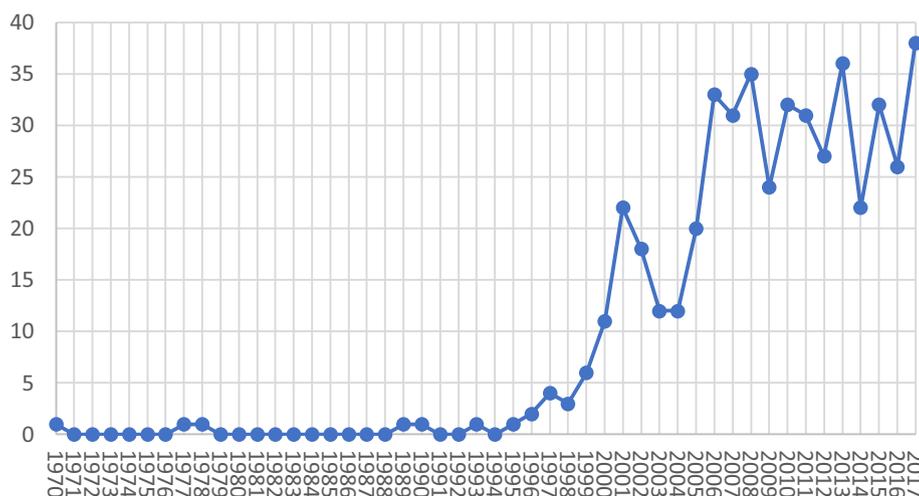
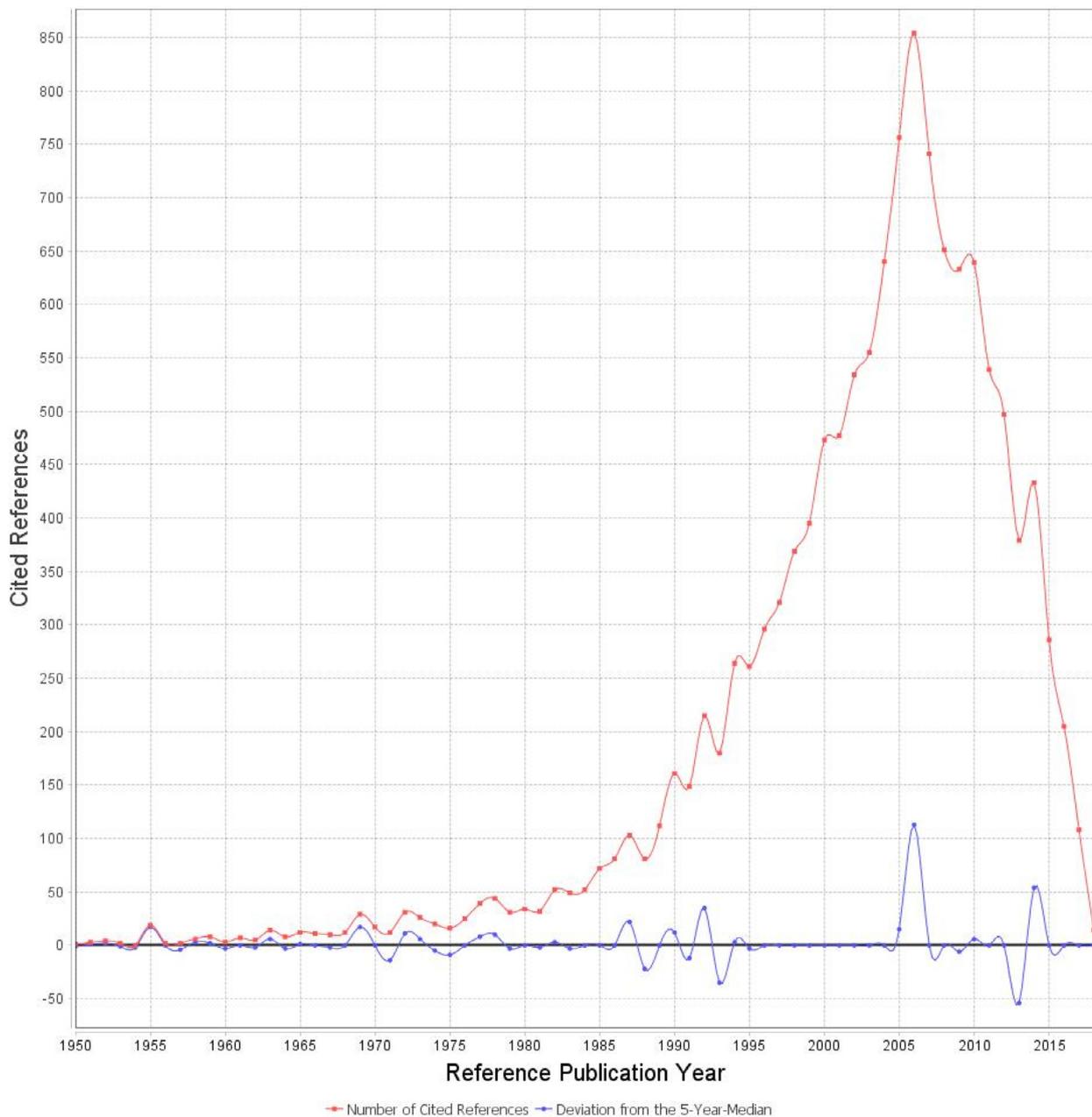


Figure 1 – The dynamics of literature production of application of bibliometrics in nursing.

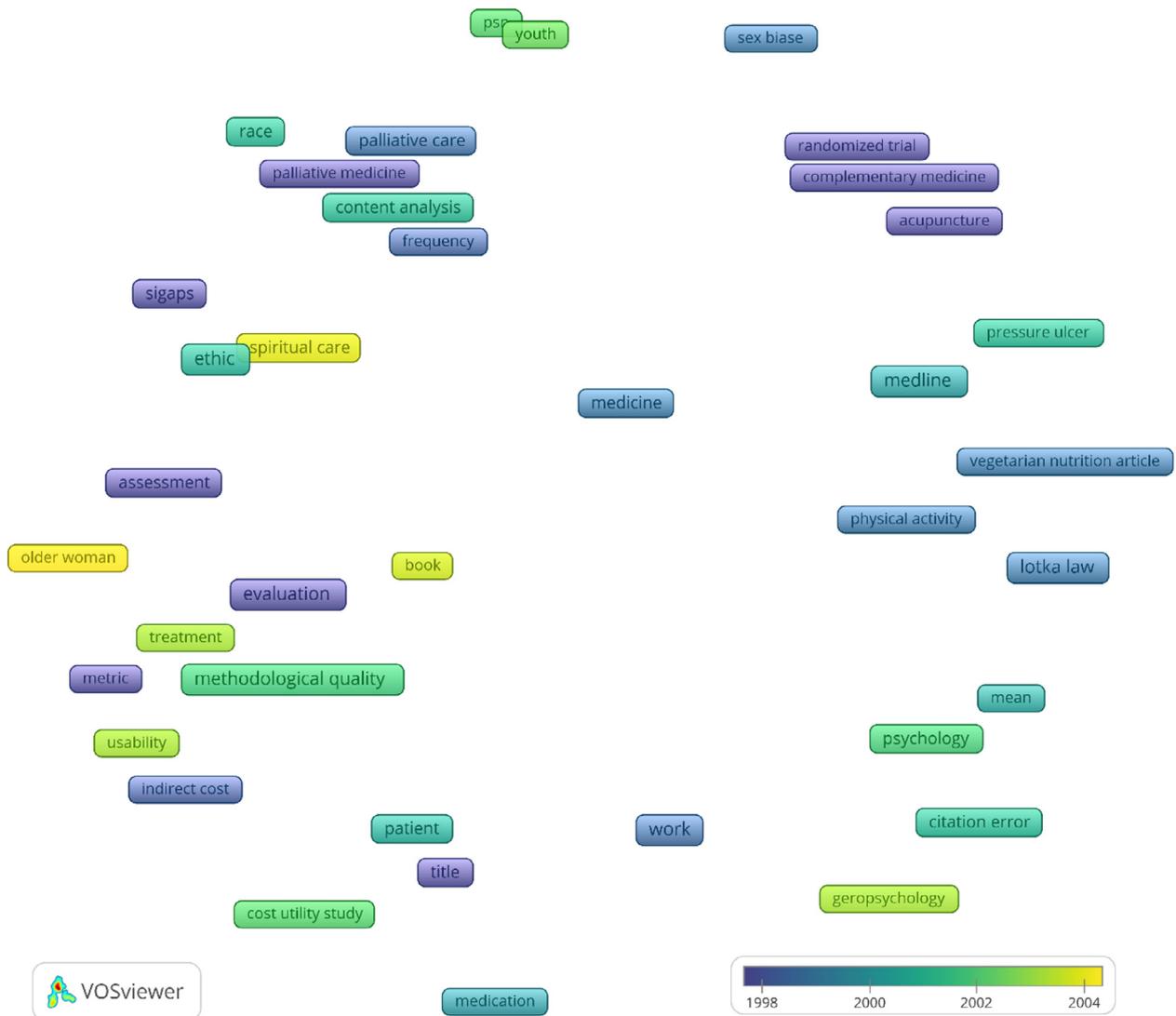


**Figure 2 – Reference Year Publication Spectrogram of historical roots of application of bibliometrics in nursing.**

research literature related to *palliative care* (Sardin et al., 1970), *randomized trials in complementary medicine* (Vickers, 1998) and *acupuncture* (Birch & Tsutani, 1996).

- 1999 to 2001 (blue colour in Figure 3). Bibliometric analysis was performed for analysis of research works related to *ethics* (Zahner, 2000), *vegetarian nutrition* (Sabaté, Duk, & Lee, 1999), *physical activity* (Lidor, Miller, & Rotstein, 1999), *pressure ulcer* (Halfens & Haalboom, 2001) and *medication* (Miasso & Cassiani, 2000). The prolific bibliometric approach used was the *content analysis* (Drevdahl, Taylor, & Phillips, 2001) and the prolific metrics used was *Lotka law* (Kawamura, Thomas, Kawaguchi, & Sasahara, 1999). MEDLINE was the preferred bibliographic database.

- 2002 to 2004 (green and yellow colours on Figure 3). Bibliometric studies were concerned with the *methodological quality* (Oermann, Mason, & Wilmes, 2002), *cost utility* (Greenberg & Pliskin, 2002), *treatment* (Burgers et al., 2002), *geropsychology* (Wahl & Krampen, 2003) and *spiritual care* (McEwen, 2004).
- 2005 to 2010 (violet colour in Figure 4), research seems to be focused on *quantitative research studies of open access journals related to health care* (Anderson et al., 2003), *social work* (Holden, Rosenberg, & Barker, 2005), *patients* (Gulmans, Vollenbroek-Hutten, van Gemert-Pijnen, & van Harten, 2007) and *clinical practice* (Oermann et al., 2008), *telemedicine* (Moser et al., 2004);



**Figure 3 – The evolution of terms for the period 1970 to 2004. (For interpretation of the references to colour in the text, the reader is referred to the web version of this article.)**

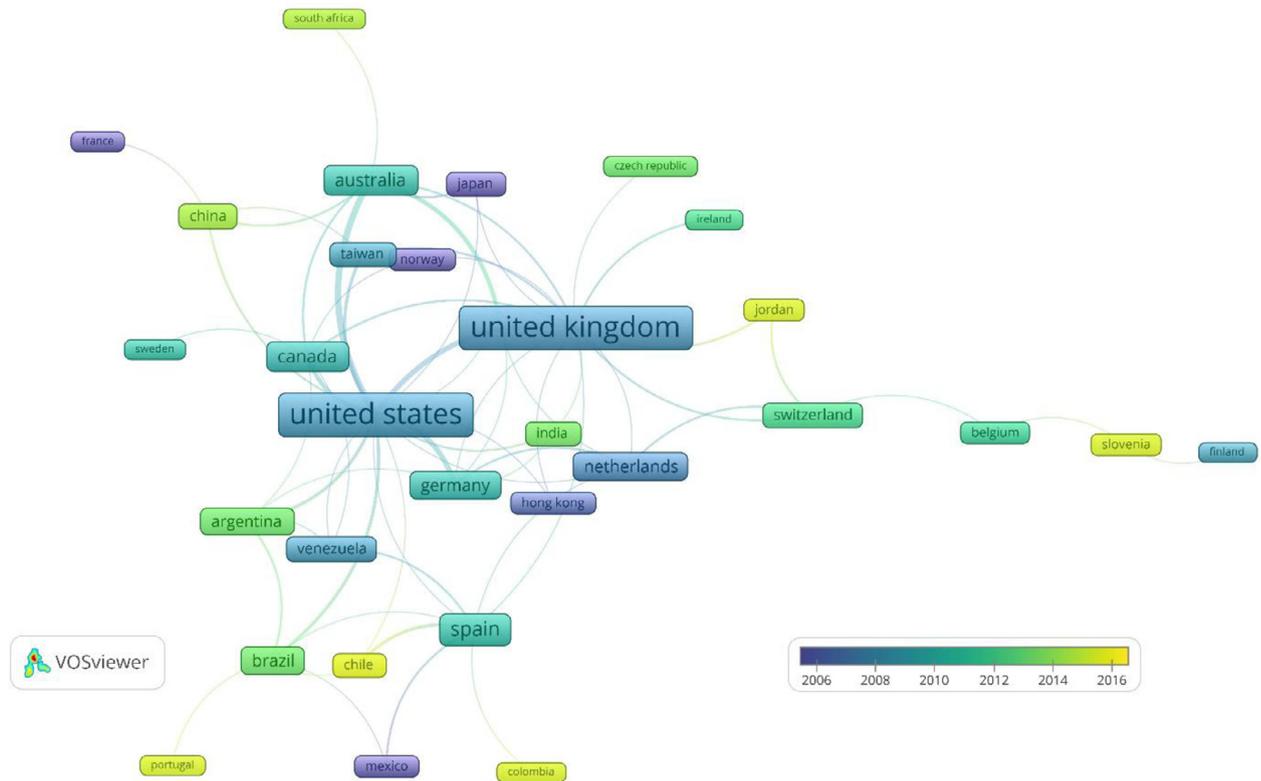
- 2011 to 2014 (blue colour on Figure 4). In this era focus shifted to *bibliometric studies* of nursing research published in *nursing journals* and dissertations related to *ethics*, *clinical nutrition* (Yu et al., 2013), *obesity* (Hilton, Patterson, & Teyhan, 2012), *nursing theory* (da Silva, Martini, & Becker, 2011) and *professionalism* (Smith & Hazelton, 2011) using *citation and descriptive analysis* (Baggio, Rodrigues, Erdmann, Figueiredo, & Vieira, 2014; Polit & Northam, 2011). The most frequently used bibliographic data base used were *Medline* (Smith & Hazelton, 2008), *LILACS* (Sanz-Valero, Gil, Wanden-Berghe, & Martínez de Victoria, 2012), and *CINAHL* (Ang, Chen, Siah, He, & Klainin-Yobas, 2013),
- 2015 to 2018 (green and yellow colours on Figure 4). In the most recent area, bibliometric studies were concerned with a broad range of nursing areas like *advanced nursing* (De Groote & Raszewski, 2012), *psychology*, *patient safety* (Gonçalves, Siqueira, & Caliri,

2017), *religion* (Cullen, 2016), *spirituality* (Şenel & Demir, 2018), *midwifery* (Iribarren et al., 2018), and *social medium* (Zyoud, Sweileh, Awang, & Al-Jabi, 2018). The most frequently used bibliographic data-base was Scopus (Morandi, Guido, & Tagliabue, 2015). The prolific bibliometric metric employed in this period was h-index (Avena & Barbosa, 2017).

#### **Geographical Distribution of the Research**

Papers presenting the application of bibliometrics in nursing research were published in 55 different countries. Among those 55 countries, 18 were from Europe, 14 from Asia, nine from South America, eight from Africa, four from Oceania, and two from North America. Nine countries produced more than 10 publications, 14 between five and nine, 15 between two and four publications, and 17 one publication. The 15 most productive countries were the United States of





**Figure 5 – The network of country cooperation based on co-authorship. The size of the circle represents the level of cooperation and the colour represents the average number of citations. Only countries publishing 2 or more publications are shown on the map.**

The countries with the largest number of international co-authored publications were the USA ( $n=40$ ), UK ( $n=26$ ), Australia ( $n=19$ ), Spain ( $n=12$ ), Germany ( $n=11$ ), Brazil ( $n=9$ ), and Argentina and Netherlands ( $n=8$ ). The strongest cooperation regarding the number of co-authored publications is between USA and UK ( $n=5$ ), Australia ( $n=6$ ), Germany ( $n=5$ ), Canada ( $n=4$ ), and Brazil and Argentina ( $n=3$ ); and Singapore and Australia ( $n=5$ ).

The most productive countries through the three periods identified in the beginning of the results section are depicted in Table 2. The number of active countries growth from 2 in the incubation period to 55 in the growth period. USA was the most productive country in all three periods, Spain and UK were among top three productive countries in both initiation and logarithmic growth periods. France was the top productive country in the initiation period, and Brazil and Australia become more productive countries in the Logarithmic growth period. Interestingly, the ratio of five most productive countries in overall production increased from 43.3% in the initiation period to 72.1% in the logarithmic growth period.

Top ten most productive institutions among 284 were University of Sao Paulo, Brazil ( $n=18$ ), University of Alicante, Spain ( $n=16$ ), University Miguel Hernandez the Elche, Spain ( $n=12$ ), University Cardenal Herrera, Spain ( $n=10$ ), University of North Carolina at Chapel Hill, USA ( $n=10$ ), Federal University of Santa

Catarina, Brazil and University of Sydney, Australia ( $n=9$ ), University of Maribor, Slovenia ( $n=8$ ), City University of New York, USA ( $n=7$ ) and Hittite University, Turkey ( $n=6$ ). Five institutions produced 10 or more publications, 69 institutions between three and five publications, 83 two publications, and 117 one publication. Most institutions were universities ( $n=259$ ), but there were also hospitals ( $n=16$ ) and medical or nursing research institutes/centres ( $n=9$ ).

#### Distribution by Source Titles

Application of bibliometrics in nursing was published in 197 different source titles, among them 72 from the nursing subject categories. Other journals were from social and health sciences, health care, nutrition, and medicine. Papers were published in five different journals (one nursing journal) in the incubation, 47 different journals (12 nursing journal) in the initiation and 160 different journals (63 nursing journal) in the growth period. The 10 most prolific journals are presented in the Table 1. The most productive journal was *Nutricion Hospitalaria* ( $n=26$ ) followed by *Journal of Advanced Nursing* ( $n=24$ ) and *Methods and Information in Medicine* ( $n=15$ ). Top 10 journals published 26.5% of publications.

In general, seven journals produced more than 10 publications, 24 between five and nine publications, 63 between two and four publications and 84 one

**Table 1 – Top 10 most productive journals**

Journal	Number of Publications	% of Publications
Nutricion Hospitalaria	26	5.1%
Journal of Advanced Nursing	24	4.7%
Methods of Information In Medicine	15	2.9%
International Journal of Nursing Studies	13	2.5%
Nursing Outlook	11	2.1%
Revista Latino Americana De Enfermagem	11	2.1%
Social Work in Health Care	11	2.1%
International Nursing Review	9	1.8%
Journal of Medical Ethics	8	1.6%
Obesity Surgery	8	1.6%
Total	136	26.5%

publication. The top 10 journals ranked from the 1956 rank (International Journal of Nursing Studies) to 12,325 rank (Revista Latino Americana De Enfermagem) out of 34,171 source titles indexed by Scopus and ranked by Scimago. Majority of the most productive journals belong to the Nursing miscellaneous subject category and represent some of the most prestigious journals in this category. Interestingly among top ten most productive journals there is none belonging to the Library and information sciences subject category, in which the majority of bibliometrics articles are normally published.

The journals with an average most cited articles (see Figure 6) were *Clinical Simulation in Nursing* ( $n = 3.15$ ), *Nursing Outlook* ( $n = 2.30$ ), *Nursing Research* ( $n = 1.89$ ), *Journal of Advanced Nursing* ( $n = 1.97$ ), and *Nursing and Health sciences* ( $n = 1.82$ ). Altogether 53 journals were linked by inter-journal citations by 235 links (Figure 3). The most linked journals are *Journal of Advanced Nursing*, linking with 24 other journals ( $n = 24$ ), *Nursing and Health Sciences* and *Nurse Education Today* ( $n = 18$ ), *International Journal of Nursing Studies* ( $n = 17$ ), and *Nursing Outlook* ( $n = 16$ ). Interestingly the *Obesity Surgery* journal which is among the top most prolific journals had no citation links with other journals.

Co-citation analysis showed that the *Journal of Advanced Nursing* is frequently cited together with the *International Journal of Nursing Studies* ( $n = 536$ ), *Nursing Research* ( $n = 506$ ), and *Journal of Clinical Nursing* ( $n = 373$ ). The journals most frequently cited together are the *Methods of Information in Medicine* and the

*Applied Clinical Information* ( $n = 1030$ ), which both belong to the IMIA group of journals. *Journal of Advance Nursing* and *Scientometrics* are the two most co-cited nursing and non-nursing journals ( $n = 116$ ).

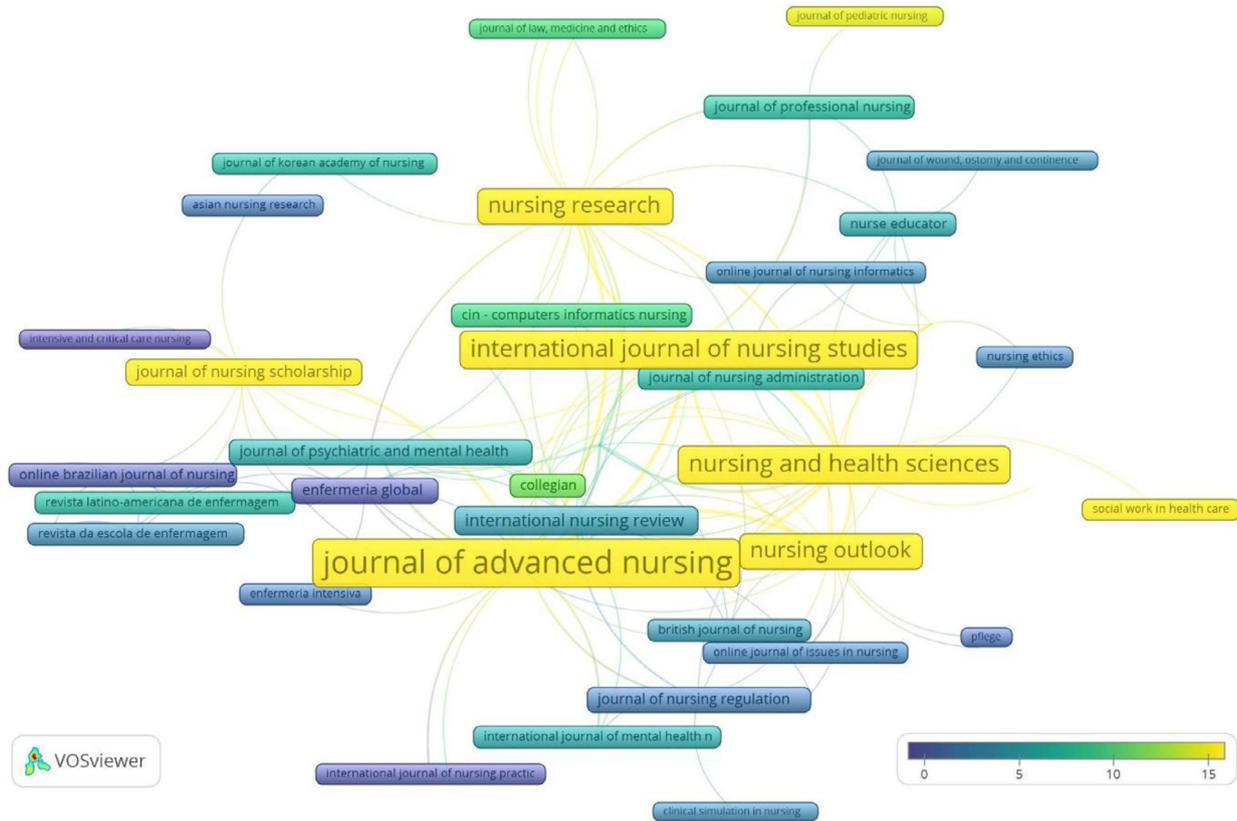
### Thematic Analysis

The thematic analysis of the term cluster map revealed six main themes (words in italics present terms from Figure 7):

- **Citation analysis of nursing research published in nursing journals** (green colour) is focusing on application of bibliometrics in nursing in the context of *clinical* (Smith et al., 2008) and *telemedicine research* (Carter-Templeton, Frazier, Wu, & Wyatt, 2018).
- **Research evaluation** (light blue colour) is related to assessment using bibliometric metrics like *h-index* (Avena & Barbosa, 2017) of research productivity in obesity (Hilton et al., 2012), *bariatric surgery* (Ahmad, Ahmad, Kohl, Ahmad, & Ahmed, 2015), and *psychology* (da Silva et al., 2011) research. The frequently used bibliographic databases were *Google Scholar* (Thompson & Clark, 2015) and *Scopus* (Morandi et al., 2015).
- **Descriptive bibliometrics of scholars in advanced nursing** (blue colour) is applied to *cancer treatment* and *social work* (Hui & Stickley, 2007) and *physical activity* (Guiller, Dupas, & Pettengill, 2007) research.
- **Descriptive bibliometrics of scientific publications regarding ethics** (yellow colour) is using descriptive

**Table 2 – The number of countries and most productive countries in three historical periods**

	Incubation Period		Initiation Period		Logarithmic Growth Period	
Number of all countries publishing bibliometrics in nursing studies	2		13		55	
Top productive countries	Country	% of production	Country	% of production	Country	% of production
	USA	85.7%	USA	17.8%	USA	30.3%
	France	14.3	UK	11.1%	Spain	12.5%
			Spain	7.8%	UK	10.8
			Australia, Israel, Japan, Netherlands	3.3%	Brazil	10.6%
					Australia	7.9%



**Figure 6 – The journal citation network.** The size of the circle represents the level of co-citation. The colour bar represents the number of citations. Only source titles publishing 25 or more documents are presented in the network.

measures like *frequency* and *ratio* to analyse manuscripts and abstracts in *ethics* (Levy-Malmberg & Eriksson, 2010), *bioethics* (Papavasiliou, Payne, Brearley, Brown, & Seymour, 2013), and *midwifery* (Davidson et al., 2014) research.

- **Bibliometric studies of nursing research published in medical journals** (red colour) measure “recognition” using measures like Lotka-law (Kawamura et al., 1999) in *medical informatics* (McCray et al., 2011), *patient safety* (Whipple, Dixon, & McGowan, 2013), *stroke* (Asplund, Eriksson, & Persson, 2012) and *food* (Hilton et al., 2012) by analysing original articles, The most frequently used bibliographic data base used was *Medline* (Smith & Hazelton, 2008).
- **Content and meta-analysis in nursing care and practice research** (violet colour) of bibliometric entities like *books* and *dissertations in religion* (Cullen, 2016), and *spirituality* (McEwen, 2004) research.

The citation density term network analysis revealed that publications containing terms *spirituality*, *religion*, *h-index*, *advance nursing*, *Goggle scholar*, *bariatric surgery*, *Scopus*, and *cancer* were cited in average more than two times. Contrary, publications containing terms *midwife*, *open access*, *older adult*, and *thesis* were cited less than 0.5 times in average.

### Hot Topics

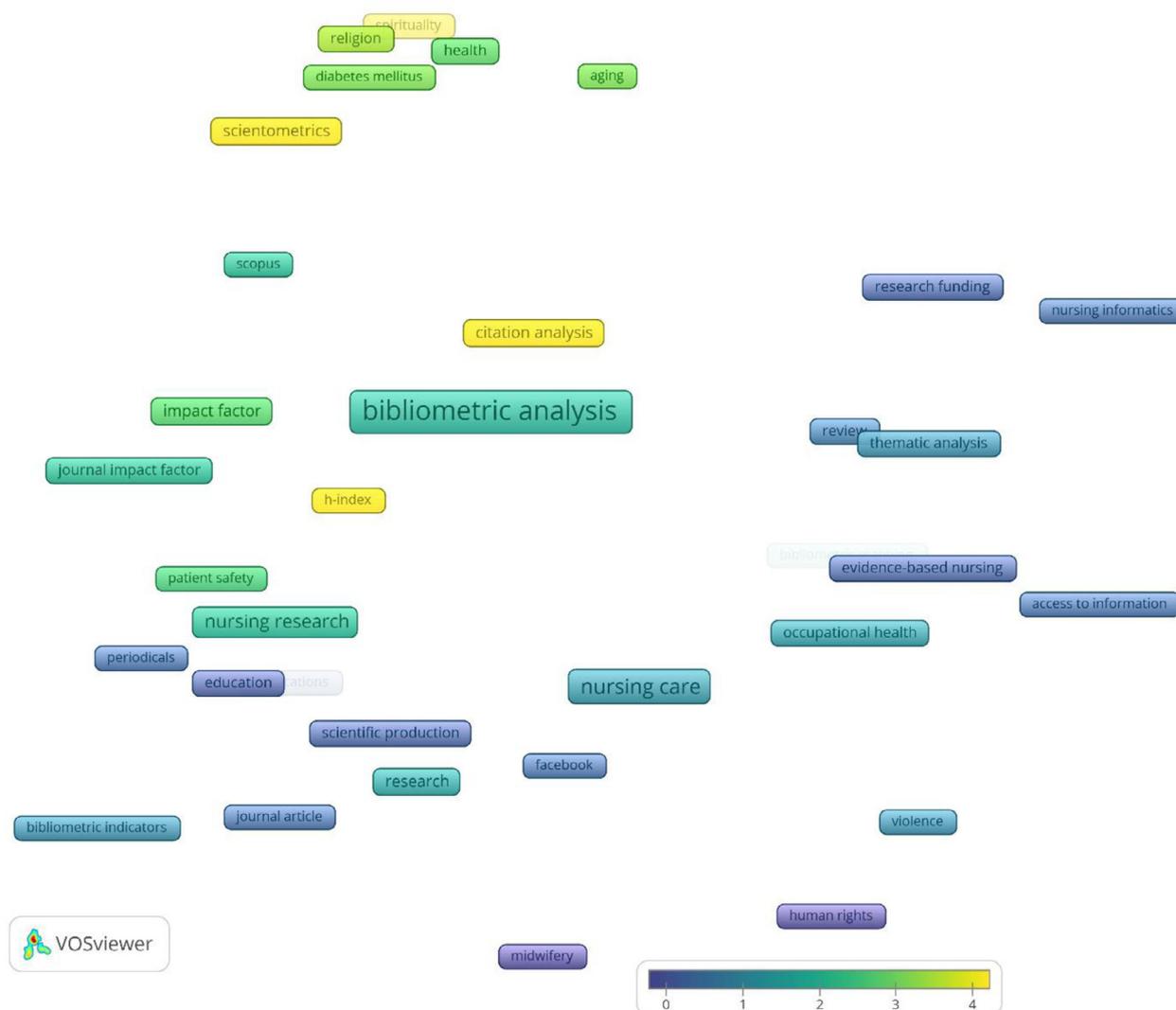
The author keyword co-occurrence network reveals that hot topics (green and yellow colours in Figure 8.) in the application of bibliometrics in nursing included:

- *Scientometrics and bibliometric analysis* of different health matters like *diabetes mellitus* (Oliveira, Costa, Ferreira, & Lima, 2017), *patient safety* (Gonçalves et al., 2017), *aging* (Cloyes, 2016), and *influence of religion and spirituality to health* (Şenel & Demir, 2018);
- *measurement of research recognition using h-index in citation analysis* (Santiago & Carlantonio, 2015; Smith & Watson, 2016);
- and *employing the impact-factor for comparing nursing journals* (Cáceres et al., 2017) or *bibliographic databases* (Powell & Peterson, 2017).

Based on the comparison of authors’ keyword co-occurrence networks for the period 2015 to 2016 and 2017 to 2018 trends in the application of bibliometrics in nursing research seems to be:

- the use of *citation analysis for research evaluation* (Ozsoy & Demir, 2018) and to identify sleeping papers (Kokol, Blažun Vošner, & Vermeulen, 2017);





**Figure 8 – The authors' keyword co-occurrence network for the period 2015 to 2018 and keywords occurring in more than one paper. The colour bar represents the number of citations. (For interpretation of the references to colour in the text, the reader is referred to the web version of this article.)**

publications, while the later historical roots are related to the use of application of bibliometrics in medicine. Only recently one “pure” nursing historical root emerged. Similar knowledge development patterns were also revealed by evaluation of terms.

Geographical distribution of literature production of bibliometric application in nursing is spread through all continents. On the other hand, regional concentration of literature production in G7 and countries with successful economies has also been observed. Namely, the five most productive countries contributed more than 65% to the literature production in application of bibliometric in nursing. A similar phenomenon was observed in scientometrics (Mooghali, Alijani, Karami, & Khasseh, 2011), dental research (Allareddy, Allareddy, Rampa, Nalliah, & Elangovan, 2015), and minimally invasive spine surgery (Fan, Han, Zhang, He, & Chen, 2017). Likewise as Adams and Gurney study (Adams & Gurney, 2018) in general, our study revealed intensive international collaboration among the top

productive countries. The reason might be, that internationally authored publications are more cited than publications written by authors from just one country, as shown by the Adams and Gurney study (Adams & Gurney, 2018) for the case of UK publications. USA, Spain, and UK were the three most productive countries in application of bibliometrics in nursing research. While USA and UK were first and second in both nursing and library and information sciences literature production, Spain ranked only eighth and seventh in above the two disciplines. However; this finding is in line with Ortiz-Repiso (Ortiz-Repiso, 2015) and Ardanuy and Urbano (Ardanuy & Urbano, 2015) studies where Spain was found as the third most productive country after USA and UK in Library and Information Sciences due to the comparable long tradition in Library and Information Sciences education, intensive research in bibliometric and scientometrics and the spread of Library and Information Sciences education from humanistic studies to Computer and Communication studies.

Thematic analysis showed that applications of bibliometrics in nursing include descriptive analysis, research evaluation, content analysis, citation analyses, and trend analysis. In that manner it covers most of the applications in which bibliometrics is used in general (Ball, 2018). However, there are also some gaps, which might be addressed in the future research, like altmetrics and use of Big Data analysis in bibliometrics. In addition to the major bibliographic databases which are used in bibliometrics in general, like Web of Science, Scopus and Goggle Scholar, MEDLINE is frequently used. That is quite logical due the health-oriented nature of publications indexed in MEDLINE, and the fact that MEDLINE is publicly available.

The strength of the present study is that it was the first holistic bibliometrics analysis of application of bibliometrics in nursing research. However, it has some limitations. One is that the analysis was limited to publications indexed in Scopus, thus the selection of another bibliographic database might lead to slightly different results. However, Scopus database has the largest coverage of publications, and thus its use enabled us the most comprehensive and accurate analysis. Additionally, the bibliometric mapping was performed on publication abstracts, titles, and author keywords only. It is possible that the results could have been different if the whole publications were available digitally and had been analysed. The thematic analysis is qualitative and, consequently subjective – other researchers might derive different themes interpreting the clusters.

## Supplementary materials

Supplementary material associated with this article can be found in the online version at <https://doi.org/10.1016/j.outlook.2019.04.009>.

## REFERENCES

- Adams, J., & Gurney, K. A. (2018). Bilateral and multilateral coauthorship and citation impact: Patterns in UK and US International Collaboration. *Frontiers in Research Metrics and Analytics*, 3. <https://doi.org/10.3389/frma.2018.00012>.
- Ahmad, S. S., Ahmad, S. S., Kohl, S., Ahmad, S., & Ahmed, A. R. (2015). The hundred most cited articles in bariatric surgery. *Obesity Surgery*, 25(5), 900–909. <https://doi.org/10.1007/s11695-014-1542-1>.
- Alfonzo, P. M., Sakraida, T. J., & Hastings-Tolsma, M. (2014). Bibliometrics: Visualizing the impact of nursing research. *Online Journal of Nursing Informatics*, 18(1), 3093.
- Allareddy, V., Allareddy, V., Rampa, S., Nalliah, R. P., & Elangovan, S. (2015). Global dental research productivity and its association with human development, gross national income, and political stability. *Journal of Evidence-Based Dental Practice*, 15(3), 90–96. <https://doi.org/10.1016/j.jebdp.2015.01.004>.
- Anderson, E., McDonald, D. D., Mikky, I., Brewer, T., Kosciwowski, C., LaCoursiere, S., . . . , Delaney, C. (2003). Health care implications and space allocation of research published in nursing journals. *Nursing Outlook*, 51(2), 70–83. [https://doi.org/10.1016/S0029-6554\(02\)05451-9](https://doi.org/10.1016/S0029-6554(02)05451-9).
- Andrew, S., & Halcomb, E. J. (2009). *Mixed methods research for nursing and the health sciences*. John Wiley & Sons.
- Ang, S. G. M., Chen, H.-C., Siah, R. J. C., He, H.-G., & Klainin-Yobas, P. (2013). Stressors relating to patient psychological health following stoma surgery: An integrated literature review. *Oncology Nursing Forum*, 40(6), 587–594. <https://doi.org/10.1188/13.ONF.587-594>.
- Ardanuy, J., & Urbano, C. (2015). Some research questions to frame a European Union overview on LIS research. Presented at the III International Seminar on LIS. Education and Research (LIS-ER). Retrieved from <https://www.semanticscholar.org/paper/Some-research-questions-to-frame-a-European-Union-Ardanuy/e361fdc8b4a1742d0a2dddfa0aaddb3503c673a2>.
- Asplund, K., Eriksson, M., & Persson, O. (2012). Country comparisons of human stroke research since 2001: A bibliometric study. *Stroke*, 43(3), 830–837. <https://doi.org/10.1161/STROKEAHA.111.637249>.
- Avena, M. J., & Barbosa, D. A. (2017). Bibliometric indicators of the nursing journals according to the index databases. *Revista Da Escola de Enfermagem*, 51. <https://doi.org/10.1590/S1980-220X2017014603262>.
- Baggio, M. A., Rodrigues, M. A., Erdmann, A. L., Figueiredo, M. C. A. B., & Vieira, M. M. S. (2014). Production of nursing thesis and dissertations in Portugal, 2000-2010: A bibliometric study. *Texto e Contexto Enfermagem*, 23(2), 250–260. <https://doi.org/10.1590/0104-07072014002190012>.
- Ball, R. (2018). *An Introduction to bibliometrics*. Amsterdam: Elsevier. <https://doi.org/10.1016/C2016-0-03695-1>.
- Beck, C. T. (1989). Maternal-Newborn nursing research published from 1977 to 1986. *Western Journal of Nursing Research*, 11(5), 621–626. <https://doi.org/10.1177/019394598901100513>.
- Bellis, N. D. (2009). *Bibliometrics and citation analysis: from the science citation index to cybermetrics*. Lanham, Md: Scarecrow Press.
- Benham-Hutchins, M. M., Brewer, B. B., Carley, K. M., Kowalchuk, M., & Effken, J. A. (2017). Design and implementation of a data collection system for social network analysis. *Online Journal of Nursing Informatics*, 21(2). <http://www.himss.org/ojni>.
- Birch, S., & Tsutani, K. (1996). A bibliometric study of English-language materials on acupuncture. *Complementary Therapies in Medicine*, 4(3), 172–177. [https://doi.org/10.1016/S0965-2299\(96\)80005-7](https://doi.org/10.1016/S0965-2299(96)80005-7).
- Bladek, M. (2014). Bibliometrics services and the academic library: Meeting the emerging needs of the campus community. *College & Undergraduate Libraries*, 21(3–4), 330–344. <https://doi.org/10.1080/10691316.2014.929066>.
- Burgers, J. S., Bailey, J. V., Klazinga, N. S., Van Der Bij, A. K., Grol, R., & Feder, G. (2002). Inside guidelines: Comparative analysis of recommendations and evidence in diabetes guidelines from 13 countries. *Diabetes Care*, 25(11), 1933–1939. <https://doi.org/10.2337/diacare.25.11.1933>.
- Cáceres, M. C., Guerrero-Martín, J., González-Morales, B., Pérez-Civantos, D. V., Carreto-Lemus, M. A., & Durán-Gómez, N. (2017). Impact factor evolution of nursing research journals: 2009 to 2014. *Nursing Outlook*, 65(5), 562–571. <https://doi.org/10.1016/j.outlook.2016.12.010>.

- Callaham, M., Wears, R. L., & Weber, E. (2002). Journal prestige, publication bias, and other characteristics associated with citation of published studies in peer-reviewed journals. *JAMA*, 287(21), 2847–2850.
- Campbell, F. M. (1990). National bias: A comparison of citation practices by health professionals. *Bulletin of the Medical Library Association*, 78(4), 376–382.
- Carter-Templeton, H., Frazier, R. M., Wu, L., & Wyatt, H. (2018). Robotics in nursing: A bibliometric analysis. *Journal of Nursing Scholarship*, 50(6), 582–589. <https://doi.org/10.1111/jnu.12399>.
- Cloyes, K. G. (2016). The silence of our science: Nursing research on LGBT older adult health. *Research in Gerontological Nursing*, 9(2), 92–104. <https://doi.org/10.3928/19404921-20151218-02>.
- Cullen, J. G. (2016). Nursing management, religion and spirituality: A bibliometric review, a research agenda and implications for practice. *Journal of Nursing Management*, 24(3), 291–299. <https://doi.org/10.1111/jonm.12340>.
- da Silva, A. M. F., Martini, J. G., & Becker, S. G. (2011). The social representation theory in graduate nursing dissertations and theses: A bibliometric profile. *Texto e Contexto Enfermagem*, 20(2), 294–300. <https://doi.org/10.1590/S0104-07072011000200011>.
- Davidson, P. M., Newton, P. J., Ferguson, C., Daly, J., Elliott, D., Homer, C., . . . Jackson, D. (2014). Rating and ranking the role of bibliometrics and webometrics in nursing and midwifery. *The Scientific World Journal*, 2014. <https://doi.org/10.1155/2014/135812>.
- De Groot, S. L., & Raszewski, R. (2012). Coverage of Google Scholar, Scopus, and Web of Science: A case study of the h-index in nursing. *Nursing Outlook*, 60(6), 391–400. <https://doi.org/10.1016/j.outlook.2012.04.007>.
- de Solla Price, D. (1963). *Little science, big science: 1963*. New York: Columbia Press.
- Delli, K., Livas, C., Spijkervet, F. K. L., & Vissink, A. (2017). Measuring the social impact of dental research: An insight into the most influential articles on the Web. *Oral Diseases*, 23(8), 1155–1161. <https://doi.org/10.1111/odi.12714>.
- Diodato, V. P., Gellatly, P., & Gellatly, P. (2013). *Dictionary of Bibliometrics*. Routledge. <https://doi.org/10.4324/9780203714133>.
- Dreval, D., Taylor, J. Y., & Phillips, D. A. (2001). Race and ethnicity as variables in nursing research, 1952–2000. *Nursing Research*, 50(5), 305–313. <https://doi.org/10.1097/00006199-200109000-00009>.
- Ebrahim, N. A. (2016, July 14). Research Tools: Software tools for bibliometrics | TIDSR: Toolkit for the Impact of Digitised Scholarly Resources. Retrieved December 15, 2018, from <http://researchtoolsbox.blogspot.com/2016/07/software-tools-for-bibliometrics-tidsr.html>
- Fan, G., Han, R., Zhang, H., He, S., & Chen, Z. (2017). Worldwide research productivity in the field of minimally invasive spine surgery. *Spine*, 42(22), 1717–1722. <https://doi.org/10.1097/BRS.0000000000001393>.
- Garfield, E. (1955). Citation indexes for science; a new dimension in documentation through association of ideas. *Science (New York, N.Y.)*, 122(3159), 108–111.
- Garfield, E. (1972). Citation analysis as a tool in journal evaluation: Journals can be ranked by frequency and impact of citations for science policy studies. *Science*, 178(4060), 471–479. <https://doi.org/10.1126/science.178.4060.471>.
- Garfield, E. (1987). 100 citation classics from the *Journal of the American Medical Association*. *Journal of the American Medical Association*, 257(1), 52–59.
- Garfield, E. (2006). The history and meaning of the journal impact factor. *JAMA*, 295(1), 90–93. <https://doi.org/10.1001/jama.295.1.90>.
- Gonçalves, N., Siqueira, L. D. C., & Caliri, M. H. L. (2017). Teaching patient safety in undergraduate courses: A bibliometric study. *Revista Enfermagem*, 25(1). <https://doi.org/10.12957/reuerj.2017.15460>.
- González Alcaide, G., & Gorraiz, J. I. (2018). Assessment of researchers through bibliometric indicators: The area of information and library science in Spain as a case study (2001–2015). *Frontiers in Research Metrics and Analytics*, 3. <https://doi.org/10.3389/frma.2018.00015>.
- Greenberg, D., & Pliskin, J. S. (2002). Preference-based outcome measures in cost-utility analyses: A 20-year overview. *International Journal of Technology Assessment in Health Care*, 18(3), 461–466.
- Guiller, C. A., Dupas, G., & Pettengill, M. A. M. (2007). Child with congenital abnormality: Bibliographical study about pediatric nursing publications. *ACTA Paulista de Enfermagem*, 20(1), 18–23.
- Gulmans, J., Vollenbroek-Hutten, M. M. R., van Gemert-Pijnen, J. E. W. C., & van Harten, W. H. (2007). Evaluating quality of patient care communication in integrated care settings: A mixed method approach. *International Journal for Quality in Health Care*, 19(5), 281–288. <https://doi.org/10.1093/intqhc/mzm029>.
- Hack, T. F., Crooks, D., Plohman, J., & Kepron, E. (2010). Research citation analysis of nursing academics in Canada: Identifying success indicators. *Journal of Advanced Nursing*, 66(11), 2542–2549. <https://doi.org/10.1111/j.1365-2648.2010.05429.x>.
- Halfens, R. J., & Haalboom, J. R. (2001). A historical overview of pressure ulcer literature of the past 35 years. *Ostomy/Wound Management*, 47(11), 36–43.
- Hall, K. L., Vogel, A. L., Huang, G. C., Serrano, K. J., Rice, E. L., Tsakraklides, S. P., & Fiore, S. M. (2018). The science of team science: A review of the empirical evidence and research gaps on collaboration in science. *American Psychologist*, 73(4), 532–548. <https://doi.org/10.1037/amp0000319>.
- Hawkins, D. T. (2001). Bibliometrics of electronic journals in information science. *Information Research: An International Electronic Journal*, 7(1), 120.
- Herubel, J. (1999). Historical bibliometrics: Its purpose and significance to the history of disciplines. *Libraries & Culture*, 34(4), 380–388.
- Hilton, S., Patterson, C., & Teyhan, A. (2012). Escalating coverage of obesity in UK newspapers: The evolution and framing of the obesity epidemic from 1996 to 2010. *Obesity*, 20(8), 1688–1695. <https://doi.org/10.1038/oby.2012.27>.
- Holden, G., Rosenberg, G., & Barker, K. (2005). Tracing thought through time and space: A selective review of bibliometrics in social work. *Social Work in Health Care*, 41(3–4), 1–34. [https://doi.org/10.1300/J010v41n03\\_01](https://doi.org/10.1300/J010v41n03_01).
- Hui, A., & Stickle, T. (2007). Mental health policy and mental health service user perspectives on involvement: A discourse analysis. *Journal of Advanced Nursing*, 59(4), 416–426. <https://doi.org/10.1111/j.1365-2648.2007.04341.x>.
- Iribarren, S., Stonbraker, S., Larsen, B., Santos, I., Faria, R., Góes, F. S. N., . . . Larson, E. (2018). Clinical nursing and midwifery research in Latin American and Caribbean countries: A scoping review. *International Journal of Nursing Practice*, 24(2). <https://doi.org/10.1111/ijn.12623>.
- Kawamura, M., Thomas, C. D. L., Kawaguchi, Y., & Sasahara, H. (1999). Lotka's law and the pattern of scientific productivity in the dental science literature.

- Informatics for Health and Social Care*, 24(4), 309–315. <https://doi.org/10.1080/146392399298320>.
- Kokol, P., Blažun Vošner, H., & Vermeulen, J. (2017). Exploring an unknown territory: “sleeping Beauties” in the Nursing Research Literature. *Nursing Research*, 66(5), 359–367. <https://doi.org/10.1097/NNR.0000000000000238>.
- Kokol, P., & Blažun Vošner, H. (2017). Nursing informatics research: A bibliometric analysis of funding patterns. *Online Journal of Nursing Informatics*, 21(2).
- Kokol, P., Blažun Vošner, H., & Železnik, D. (2017). Clinical simulation in nursing: a bibliometric analysis after its tenth anniversary. *Clinical Simulation In Nursing*, 13(4), 161–167. <https://doi.org/10.1016/j.ecns.2016.11.007>.
- Kokol, P., Završnik, J., & Blažun Vošner, H. (2018). Bibliographic-based identification of hot future research topics: An opportunity for hospital librarianship. *Journal of Hospital Librarianship*, 0(0), 1–8. <https://doi.org/10.1080/15323269.2018.1509193>.
- Kostoff, R. N., & Shlesinger, M. F. (2005). CAB: Citation-assisted background. *Scientometrics*, 62(2), 199–212. <https://doi.org/10.1007/s11192-005-0014-8>.
- Levy-Malmberg, R., & Eriksson, K. (2010). Legitimizing basic research by evaluating quality. *Nursing Ethics*, 17(1), 107–116. <https://doi.org/10.1177/0969733009349989>.
- Lidor, R., Miller, U., & Rotstein, A. (1999). Is research on aging and physical activity really increasing? A bibliometric analysis. *Journal of Aging and Physical Activity*, 7(2), 182–195. <https://doi.org/10.1123/japa.7.2.182>.
- López Piñero, J. M., & Terrada, M. L. (1992). [Bibliometric indicators and evaluation of the medical-scientific activity. I. Use and abuse of bibliometrics]. *Medicina Clínica*, 98(2), 64–68.
- Marx, W., Bornmann, L., Barth, A., & Leydesdorff, L. (2014). Detecting the historical roots of research fields by reference publication year spectroscopy (RPYS). *Journal of the Association for Information Science and Technology*, 65(4), 751–764. <https://doi.org/10.1002/asi.23089>.
- McCray, A. T., Gefeller, O., Aronsky, D., Leong, T. Y., Sarkar, I. N., Bergemann, D., . . . Haux, R. (2011). The birth and evolution of a discipline devoted to information in biomedicine and health care: As reflected in its longest running journal. *Methods of Information in Medicine*, 50(6), 491–507. <https://doi.org/10.3414/ME11-06-0001>.
- McEwen, M. (2004). Analysis of spirituality content in nursing textbooks. *Journal of Nursing Education*, 43(1), 20–30.
- Merton, R. (1985). *On the shoulders of giants: A Shandean postscript* (The Vicennial ed.). San Diego: Harcourt Brace Jovanovich. Retrieved from <https://onlinelibrary.wiley.com/doi/abs/10.1002/1520-6696%28198604%2922%3A2%3C178%3A%3AAID-JHBS2300220208%3E3.0.CO%3B2-M>.
- Miasso, A. I., & Cassiani, S. H. (2000). Errors in drug administration: Knowledge diffusion and identification of the patients as important aspects. *Revista Da Escola de Enfermagem Da U S P*, 34(1), 16–25.
- Mooghali, A., Alijani, R., Karami, N., & Khasseh, A. (2011). Scientometric analysis of the scientometric literature. *International Journal of Information Science & Management*, 9(1), 19–31.
- Morandi, G., Guido, D., & Tagliabue, A. (2015). A bibliometric study of scientific literature on the dietary therapies for epilepsy in Scopus. *Nutritional Neuroscience*, 18(5), 201–209. <https://doi.org/10.1179/1476830514Y.0000000118>.
- Moretti, F. (2013). *Distant reading*. London, New York: Verso.
- Moser, P. L., Haufler, H., Lorenz, I. H., Hager, M., Tiefenthaler, W., Lorenz, H. M., . . . Kolbitsch, C. (2004). Publication output in telemedicine during the period January 1964 to July 2003. *Journal of Telemedicine and Telecare*, 10(2), 72–77. <https://doi.org/10.1258/135763304773391495>.
- Nightingale, F. (1859). *Notes on nursing: What it is, and what it is not*: 1859 London: Harrison. Retrieved from <http://archive.org/details/notesnursingwhat00nigh>.
- Oermann, M. H., Mason, N. M., & Wilmes, N. A. (2002). Accuracy of references in general readership nursing journals. *Nurse Educator*, 27(6), 260–264. <https://doi.org/10.1097/00006223-200211000-00006>.
- Oermann, M. H., Nordstrom, C. K., Wilmes, N. A., Denison, D., Webb, S. A., Featherston, D. E., . . . Kowalewski, K. (2008). Dissemination of research in clinical nursing journals. *Journal of Clinical Nursing*, 17(2), 149–156. <https://doi.org/10.1111/j.1365-2702.2007.01975.x>.
- Oliveira, P. S., Costa, M. M. L., Ferreira, J. D. L., & Lima, C. L. J. (2017). Self care in diabetes mellitus: Bibliometric study. *Enfermeria Global*, 16(1), 670–688. <https://doi.org/10.6018/eglobal.16.1.249911>.
- Ortiz-Repiso, V. (2015). Rethinking library and information studies in Spain: Crossing the boundaries\*. *BiD: Textos Universitaris de Biblioteconomia i Documentació*, 35. <http://bid.ub.edu/en/35/ortiz.htm>. [Consulta: 23-05-2019].
- Ozsoy, Z., & Demir, E. (2018). The evolution of bariatric surgery publications and global productivity: A bibliometric analysis. *Obesity Surgery*, 28(4), 1117–1129. <https://doi.org/10.1007/s11695-017-2982-1>.
- Pan, R. K., Petersen, A. M., Pammolli, F., & Fortunato, S. (2018). The memory of science: Inflation, myopia, and the knowledge network. *Journal of Informetrics*, 12(3), 656–678. <https://doi.org/10.1016/j.joi.2018.06.005>.
- Papavasiliou, E., Payne, S., Brearley, S., Brown, J., & Seymour, J. (2013). Continuous sedation (CS) until death: Mapping the literature by bibliometric analysis. *Journal of Pain and Symptom Management*, 45(6), 1073–1082. <https://doi.org/10.1016/j.jpainsymman.2012.05.012>.
- Phethean, C., Simperl, E., Tiropanis, T., Tinati, R., & Hall, W. (2016). The role of data science in web science. *IEEE Intelligent Systems*, 31(3), 102–107. <https://doi.org/10.1109/MIS.2016.54>.
- Polit, D. F., & Northam, S. (2011). Impact factors in nursing journals. *Nursing Outlook*, 59(1), 18–28. <https://doi.org/10.1016/j.outlook.2010.11.001>.
- Powell, K. R., & Peterson, S. R. (2017). Coverage and quality: A comparison of Web of Science and Scopus databases for reporting faculty nursing publication metrics. *Nursing Outlook*, 65(5), 572–578. <https://doi.org/10.1016/j.outlook.2017.03.004>.
- Pritchard, A. (1969). Statistical bibliography or bibliometrics. *Journal of Documentation*, 25, 348–349.
- Quetelet, A. (1842). *A treatise on man and the development of his faculties*. Edinburgh: Chambers. Retrieved from <https://trove.nla.gov.au/version/9393096>.
- Rodrigues, S. P., van Eck, N. J., Waltman, L., & Jansen, F. W. (2014). Mapping patient safety: A large-scale literature review using bibliometric visualisation techniques. *BMJ Open*, 4(3). <https://doi.org/10.1136/bmjopen-2013-004468>.
- Sabaté, J., Duk, A., & Lee, C. L. (1999). Publication trends of vegetarian nutrition articles in biomedical literature, 1966-1995. *American Journal of Clinical Nutrition*, 70(3 Suppl.), 601S–607S.
- Santiago, L. C., & Carlantonio, L. F. M. (2015). The production of knowledge in nursing in the BRIC countries: A

- bibliometric study. *Texto e Contexto Enfermagem*, 24(2), 486–493. <https://doi.org/10.1590/0104-07072015001362014>.
- Sanz-Valero, J., Gil, Á., Wanden-Berghe, C., & Martínez de Victoria, E. (2012). Bibliometric and thematic analysis of the scientific literature about omega-3 fatty acids indexed in international databases on health sciences. *Nutricion Hospitalaria*, 27(Suppl. 2), 41–48. <https://doi.org/10.3305/nh.2012.27.sup2.6272>.
- Sardin, B., Terrier, G., & Grouille, D. (1970). SIGAPS, a French bibliometric score, and palliative medicine in France. *Medecine Palliative*, 11(6), 293–299. <https://doi.org/10.1016/j.medpal.2012.02.001>.
- Şenel, E., & Demir, E. (2018). Bibliometric and scientometric analysis of the articles published in the Journal of Religion and Health between 1975 and 2016. *Journal of Religion and Health*, 57(4), 1473–1482. <https://doi.org/10.1007/s10943-017-0539-1>.
- Smith, B. A., Lee, H.-J., Lee, J. H., Choi, M., Jones, D. E., Bausell, R. B., & Broome, M. E. (2008). Quality of reporting Randomized Controlled Trials (RCTs) in the nursing literature: Application of the Consolidated Standards of Reporting Trials (CONSORT). *Nursing Outlook*, 56(1), 31–37. <https://doi.org/10.1016/j.outlook.2007.09.002>.
- Smith, D. R., & Hazelton, M. (2008). Bibliometrics, citation indexing, and the journals of nursing. *Nursing and Health Sciences*, 10(4), 260–265. <https://doi.org/10.1111/j.1442-2018.2008.00414.x>.
- Smith, D. R., & Hazelton, M. (2011). Bibliometric awareness in nursing scholarship: Can we afford to ignore it any longer. *Nursing and Health Sciences*, 13(4), 384–387. <https://doi.org/10.1111/j.1442-2018.2011.00652.x>.
- Smith, D. R., & Watson, R. (2016). Career development tips for today's nursing academic: Bibliometrics, altmetrics and social media. *Journal of Advanced Nursing*, 72(11), 2654–2661. <https://doi.org/10.1111/jan.13067>.
- Taype-Rondan, A., Huapaya-Huertas, O., Bendezu-Quispe, G., Pacheco-Mendoza, J., & Bryce-Alberti, M. (2017). Scientific production in diabetes in Peru: A bibliometric study. *Revista Chilena de Nutricion*, 44(2), 153–160. <https://doi.org/10.4067/S0717-75182017000200006>.
- Tejasen, C. (2016). Historical bibliometric analysis: A case of the journal of the SIAM society, 1972–1976. *Proceedings of the Association for Information Science and Technology*, 53(1), 1–6. <https://doi.org/10.1002/pr2.2016.14505301108>.
- Thompson, D. F., & Walker, C. K. (2015). A descriptive and historical review of bibliometrics with applications to medical sciences. *Pharmacotherapy: The Journal of Human Pharmacology and Drug Therapy*, 35(6), 551–559. <https://doi.org/10.1002/phar.1586>.
- Thompson, D. R., & Clark, A. M. (2015). Measuring research success via bibliometrics: Where they fit and how they help and hinder. *Journal of Advanced Nursing*, 71(12), 2699–2701. <https://doi.org/10.1111/jan.12610>.
- Vaismoradi, M., Turunen, H., & Bondas, T. (2013). Content analysis and thematic analysis: Implications for conducting a qualitative descriptive study. *Nursing & Health Sciences*, 15(3), 398–405. <https://doi.org/10.1111/nhs.12048>.
- 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>.
- van Eck, N. J., & Waltman, L. (2014). Visualizing Bibliometric Networks. In Y. Ding, R. Rousseau, D. Wolfram (Eds.), *Measuring scholarly impact: methods and practice* (pp. 285–320). Cham: Springer International Publishing. [https://doi.org/10.1007/978-3-319-10377-8\\_13](https://doi.org/10.1007/978-3-319-10377-8_13).
- van Eck, N. J., Waltman, L., Noyons, E. C. M., & Buter, R. K. (2010). Automatic term identification for bibliometric mapping. *Scientometrics*, 82(3), 581–596. <https://doi.org/10.1007/s11192-010-0173-0>.
- Vickers, A. J. (1998). Bibliometric analysis of randomized trials in complementary medicine. *Complementary Therapies in Medicine*, 6(4), 185–189. [https://doi.org/10.1016/S0965-2299\(98\)80026-5](https://doi.org/10.1016/S0965-2299(98)80026-5).
- Wahl, H.-W., & Krampen, G. (2003). Geropsychology and psychology in the German-speaking and Anglo-American research community: A bibliometrical analysis. *Zeitschrift Fur Gerontopsychologie Und -Psychiatrie*, 16(1), 29–43. <https://doi.org/10.1024//1011-6877.16.1.29>.
- Whipple, E. C., Dixon, B. E., & McGowan, J. J. (2013). Linking health information technology to patient safety and quality outcomes: A bibliometric analysis and review. *Informatics for Health and Social Care*, 38(1), 1–14. <https://doi.org/10.3109/17538157.2012.678451>.
- Yu, Q.-H., Zhang, Y.-W., Li, Y.-Z., Bai, S.-P., Xiao, F.-X., & Li, Q.-H. (2013). Bibliometric analysis of advances in clinical nutrition in Chinese Journals. *Chinese Journal of Clinical Nutrition*, 21(1), 35–41. <https://doi.org/10.3760/cma.j.issn.1674-635X.2013.01.008>.
- Zahner, S. J. (2000). Ethics content in community health nursing textbooks. *Nurse Educator*, 25(4), 186–194. <https://doi.org/10.1097/00006223-200007000-00015>.
- Železnik, D., Blažun Vošner, H., & Kokol, P. (2017). A bibliometric analysis of the Journal of Advanced Nursing, 1976–2015. *Journal of Advanced Nursing*, 73(10), 2407–2419. <https://doi.org/10.1111/jan.13296>.
- Zyoud, S. H., Sweileh, W. M., Awang, R., & Al-Jabi, S. W. (2018). Global trends in research related to social media in psychology: Mapping and bibliometric analysis. *International Journal of Mental Health Systems*, 12(1). <https://doi.org/10.1186/s13033-018-0182-6>.