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Skin Cancer Prevention Communication: A Global Bibliometric Analysis of the Literature from 2011 to 2021

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ABSTRACT

Growing evidence shows there is a spread of skin cancer as a global epidemic, making communication on prevention a public health priority. However, the reality contrasts with the high dispersion of literature. The main objective of this study was to gather and organise the literature to facilitate interdisciplinary research and future meta-studies. A bibliometric analysis of 53 research articles indexed in Web of Science (WoS) and Academic Search Complete (EBSCO) between 2011 and 2021 was conducted. The most prolific author was David B. Buller, connector of the two co-authorship networks identified, which had 2019 as the relay point. The United States was the country with the highest number of publications (67.9%), mostly applying the Health Belief Model (HBM). The sample population was largely adult, with a slight increase in interest in studying young people and university students from 2015 onwards. The most analysed topics were risk perception and media literacy, confirming the focus on prevention messages and public education. It is recommended that the authors define the lines of research, update the studies towards the analysis of social media and new media, and increase the focus on adolescents and young people, the target audience for skin cancer prevention messages.

Keywords: Skin Cancer, Health Communication, Prevention Communication, Bibliometric Analysis, Skin Cancer Prevention.

INTRODUCTION

Skin cancer is considered one of the expanding epidemics in the world. The incidence of both non-melanoma and melanoma skin cancers has been increasing over the past decades. In 2020, more than 1.5 million new cases of skin cancers were diagnosed worldwide, with an estimated 325.000 new cases of melanoma and 57,000 deaths (Arnold et al., 2022). It is estimated as the most commonly diagnosed group of cancers worldwide and it is estimated to increase to 510,000 new cases and 96,000 deaths every year by 2040 (Arnold et al., 2022).

Skin cancer is considered the second most prevalent factor of mortality in industrialized countries and the third in economically developing countries (Leiter, Eigentler, & Garbe, 2014; Mahmoodabad, Sotoudeh, Vaezi, Fallahzadeh, & Noorbal, 2019). Due to their relative lack of skin pigmentation Caucasian populations generally have a much higher risk of getting non-melanoma or melanoma skin cancers than dark-skinned populations (WHO, 2017).

As stated by Wu, Zhu, Thompson, and Hannun (2018) “protection against skin cancer in the general population is a top public health priority”. A diverse focus on this issue has been developed from diverse disciplines of Health Sciences, in the fields of oncology, dermatology, psychology, epidemiology and public health. Nevertheless, the general lack of knowledge of the society about preventive methods and the potential risk of

using a first level method of prevention, justifies communication and interventions in the population. In spite of this need, the role of communication in cancer prevention has been scarcely studied.

Literature on skin cancer communication for prevention has an enormous dispersion and absolute lack of compilatory works that shed light on a dispersed and poorly integrated corpus. This situation falls behind the advance of the object of study, impeding the development of conclusive results and meta-studies. This paper proposes a first bibliometric analysis of the literature available to date in order to group, analyse and categorize it to advance the area of study.

In order to understand what has been researched to date in terms of communication for skin cancer prevention, a bibliometric analysis of the literature available to date has been carried out analysed through a bibliometric study, so that possible opportunities and needs in future research can be identified. It will also allow the international scientific community to order and categorize the literature on the object of study.

To achieve this goal, this paper focuses on a bibliometric study to answer research questions regarding the characteristics, affiliation and region of authors, the topic of studies and theoretical frameworks, methodologies and population samples, topics and types of messages.

THEORETICAL FRAMEWORK

Health communication is about improving health outcomes by encouraging behavioural modification and/or social change. It is increasingly considered an integral part of most public health interventions (National Center for Health Statistics, 2015; Bernhardt, 2004). Focusing on communication for skin cancer prevention, there is a lack of integration and a notable dispersion between studies carried out from diverse areas of communication and published in journals into and out of the discipline of health communication.

An important group of studies focus on media coverage of skin cancer (e.g. Kang & Walsh-Childers, 2014; Hong & Kim, 2020; Ballestero, 2018). Some of them use the methodology of content analysis, focused on mass media, which applies a journalism studies approach with attention to the sources of information. Regarding the type of media, in recent years the analysis of digital content and social media has been introduced as important channels of information and prevention (e.g. Merten, Roberts, King, & McKenzie, 2020; Stavrositu & Kim, 2015) for its great potential to increase public awareness about its prevention.

It is also observed that research is being carried out on the influence of media literacy and whether or not it translates into misconceptions about skin cancer (e.g. Mingoia, Hutchinson, Gleaves, & Wilson, 2019; Cho, Song, & Adams, 2020). Also on the influence of the social norm and the emotional effects (e.g. Ort, Reinhardt, Koch, & Rossmann, 2023; Lillie, Chernichky-Karcher, & Venetis, 2021; Nan, 2017).

On the other hand, there is a varied number of studies focused on the evaluation of skin cancer prevention campaigns, generally focused on population groups and/or countries (e.g. Doran et al., 2016; Y. Liu, Liu, Xiao, Cai, & Xu, 2010). Regarding population groups, it seems special attention has been placed on school-age children (e.g. Glanz et al., 2013; Kang & Walsh-Childers, 2014) and young adults (e.g. Trekels, Eggermont, Koppen, & Vandenbosch, 2018; Arnold & DeJong, 2015). These studies founded their interest in these specific age groups on skin cancer prevalence and higher risks of sun burning. Skin cancer communication campaigns have been mainly studied through advertising and behavioural intention models (e.g. Kang & Walsh-Childers, 2014).

The need for the prevention of the expanding epidemic of skin cancer and the proliferation of research in the field of communication makes it necessary to study to know what the situation of research in this field is through bibliometric analysis studies, such as the present bibliometric one. Bibliometric, bibliographic, and meta-studies in the field of health communications are particularly important in health communication research, as the recent on e-cigarette prevention by Noar et al. (2020).

The aim of this study is to put together and organize the literature on skin cancer communication in order to facilitate interdisciplinary research and future meta studies.

METHODOLOGY

With the objective of studying and analysing scientific activity in a certain field that allows us to know research trends, identify researchers and key research centres and their characteristics, bibliometric studies are "the application of mathematics and statistical methods to books and other media of communication" (Pritchard, 1969).

There is a substantial number of articles and evidence that demonstrate how health communication impacts people's knowledge, attitudes, assumptions and behaviours (e.g. Meijers et al., 2022; Duong, Van Nguyen, McFarlane, H. T. Nguyen, & Nguyen, 2023). However, the present bibliographic work sheds light on the specific works published in the last ten years (2011–2021) in the field of communication for the prevention of skin cancer.

A descriptive and bibliometric study has been carried out based on a literature search for articles related to skin cancer and its prevention in communication journals. The exploration was carried out between December 2021 and January 2022 in different computerized databases to locate the articles related to the subject, peer-reviewed.

A series of terms related to skin cancer prevention, including variations of the selected keywords, were listed from the results displayed. This keyword search was conducted in the communication and mass media collections. The list of terms was extensive to make it possible to capture all the work published in the established period of time, such as "sun prevention", "skin-cancer prevention", "skin cancer", "melanoma", "sun protection", also combined with each other.

The databases consulted were the Web of Science Core Collection (WAOS) and the Academic Search Complete Core Collection (EBSCO). Once the final corpus of articles to perform the review was identified, other references cited in those articles were searched to identify other possible articles to include.

The final inclusion criteria for papers as units of analysis was that should be published in journals with a focus on communication and be written in English (n=74 articles). Duplicate articles, those published in non-communication journals were excluded, as well as conference papers or book chapters. A total number of 53 articles were obtained. They were reviewed one by one, independently. PRISMA flow diagram describes the process (**Figure 1**).

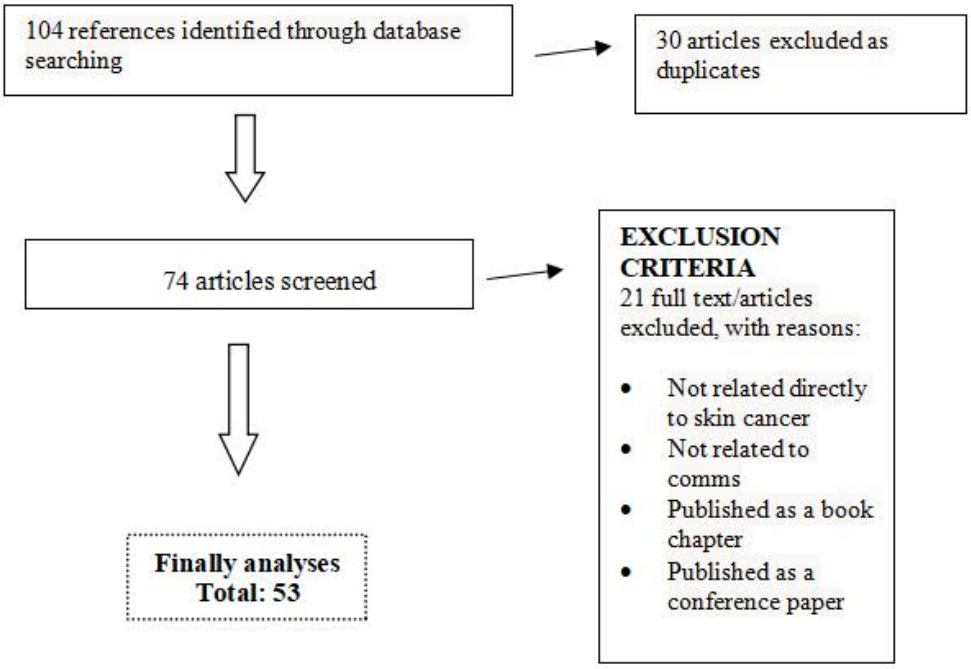

Figure 1. PRISMA Flow Diagram

Once the recent corpus of literature on the topic has been compiled, it is necessary to highlight first the limited scientific production and second its enormous dispersion through diverse areas of communications.

Article Coding

The coding has been carried out through a coding book divided into four sections: characteristics of the author, the study of the participants of the study and the area of study. The first section about the characteristics of the author takes into account sex, university of the main author, country and number of authors. The second section about the characteristics of the study focuses on the year of publication, country, theoretical application, differences, practical applications, study methodology and discipline. The third section on the characteristics of the participants of the study took into account the age groups, race/ethnicity and gender of the researched individuals and the fourth section focused on the areas of the studies, categorizing themes and types of messages researched.

Before coding, two coders were trained in the codebook. The reliability of the coding process was calculated on 11.32% (n = 6) of the entire sample (n = 53). Reliability was calculated using the Holsti Reliability Coefficient (C.R.) Holsti intercoder reliability was 1.0.

The data were analysed in IBM SPSS, in which the analysis of frequency distribution and bivariate contingency tables with Chi-square was carried out.

RESULTS

Characteristics of the Authors

The study took into account the sex of the main author, mostly women (67.9%, n = 36) and men (31.1%, n = 17). In relation to co-authorship and collaboration between researchers, analysis using VOSviewer software reveals that there were two main groups in the period (**Figure 2**). The central and common author was David B. Buller, who also shows a higher density of articles. From 2019 onwards, another co-authorship group emerges (on the right, in green). **Figure 2** shows the co-authorship network.

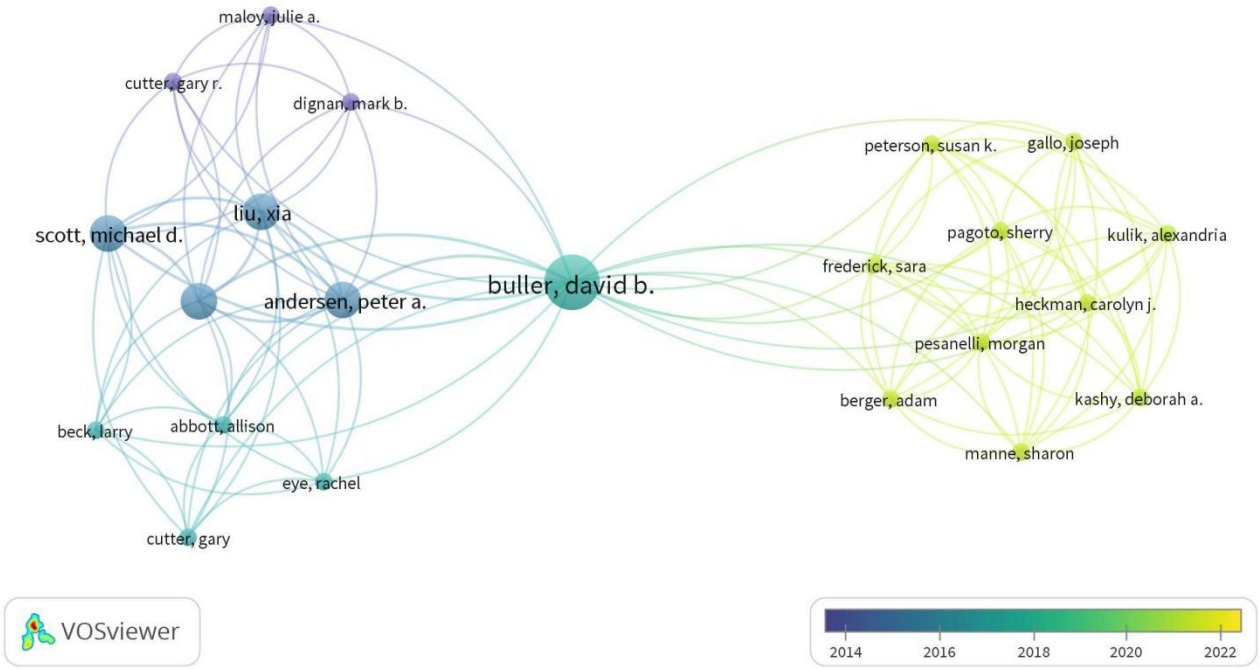

Figure 2. Co-authorship Network

The first insight shown regarding the institutional affiliation of authors is a huge dispersion. Although there are no institutions that have been noticed because of a long tradition of publishing on the topic (**Table 1** explains the university of the main author), the one that has published more articles was University of North Carolina at

Chapel Hill (5.7%, n = 3) and University of Miami, the Pennsylvania State University, The Ohio State University, University of Utah, Vanderbilt University Medical Centre, University of Waterloo, University of Georgia, and Memorial Sloan Kettering Cancer Centre (3.8%, n = 2, each of them).

Table 1. University of Main Author

	N	%
University of Florida	1	1.9%
University of Maryland	1	1.9%
University of Alabama	1	1.9%
University of Leuven	1	1.9%
San Diego State University	1	1.9%
Georgetown University	1	1.9%
University of New Mexico	1	1.9%
University of Kentucky	1	1.9%
The Ohio State University	2	3.8%
Chinese Culture University	1	1.9%
Universidad Carlos III	1	1.9%
Texas Tech University	1	1.9%
University of Washington	1	1.9%
Michigan State University	1	1.9%
University of Utah	2	3.8%
San Diego State University/ University of California	1	1.9%
Brigham Young University	1	1.9%
University of Miami	2	3.8%
University of North Florida	1	1.9%
Central Queensland University	1	1.9%
University of California	1	1.9%
Pennsylvania State University	2	3.8%
University of North Carolina at Chapel Hill	3	5.7%
Fourth Affiliated Hospital of Harbin Medical University	1	1.9%
University of Colorado	1	1.9%
Centre for Behavioural Research in Cancer	2	3.8%
Purdue University	1	1.9%
University of Portland	1	1.9%
University Jena	1	1.9%
Nanyang Technological University	2	3.8%
Vanderbilt University Medical Center	2	3.8%
University of Waterloo	2	3.8%
Klein Buendel	1	1.9%
University of Georgia	2	3.8%
Boston University School of Public Health	1	1.9%
Indiana University	1	1.9%
Memorial Sloan Kettering Cancer Centre	2	3.8%
University of South Australia	1	1.9%
University of Minnesota	1	1.9%
University of Guelph	1	1.9%

In regards to the country, three out of four papers were authorized by scholars from universities in the United States (73.6%, n = 39). Far beyond, the US is followed by Australia (7.5%, n = 4), Canada (5.7%, n = 3) China (3.8%, n = 2) and Belgium, Spain, Germany, Singapore and Poland (1.9%, n = 1, each of them). **Figure 3** shows the world map of geographically distributed papers.

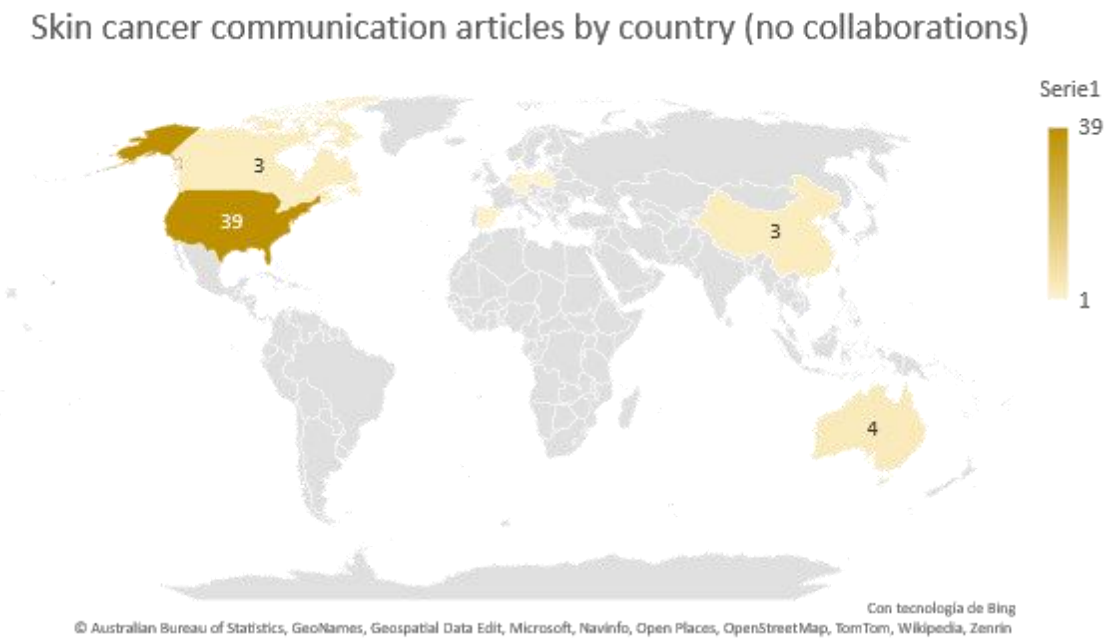

Figure 3. World Map of Geographically Distributed Papers

Articles were mostly signed by two authors (28.3%, n = 15), followed by more than five (18.9%, n = 10), five authors (17%, n = 9), one author and four authors (13.2%, n = 7) and three authors (9.4%, n = 5). Although most articles are signed by two authors, there is no clear trend in the number of researchers who sign the articles.

Study Characteristics

In the analysis, the year of publication of the article has been considered, since 2010 (5.7%, n = 3), 2013 (1.9%, n= 1), 2014 (7.5%, n = 4), 2015 (13.2%, n = 7), 2016 (15.1%, n = 8), 2017 (17%, n = 9), 2018 (9.4%, n = 5), 2019 (13.2%, n = 7), 2020 (7.5%, n = 4), 2021 (9.4%, n = 5). There was an increase in the number of articles published on the subject between the years 2015 and 2016 and reached its maximum in 2017, probably after echoing the rapid increase in the use of tanning booths by adolescents and young adults (e.g. Carcioppolo, Dunleavy, & Yang, 2016; Mays & Evans, 2017).

The country in which the research was carried out was mostly in the United States (67.9%, n = 36) which marks a clear difference with respect to other studies carried out in other countries. In addition, some studies were carried out with samples that combined the United States and Canada (3.8%, n = 2). The following are Australia (7.5%, n = 4), China (5.7%, n = 3), Canada (5.7%, n = 3), Belgium, Spain, Germany and Poland (1.9%, n = 1, each of them).

The Chi-square test revealed highly significant differences ($p < .001$) when relating the university-main author and the country where the research was carried out. Not surprisingly, it also determined a strong relationship between the country of the University and the country where the study was developed ($p < .001$). There is a strong relationship between the country where the University leading the research is located and the place where the data gathering of the studies was carried out.

Taking into account the theories, the Health Belief Model (HBM), together with Social Cognitive Theory (each one was applied in 9.4%, n = 5) of the corpus analysed and were the most used theories. Although it is true that the HBM was combined with others such as Health Behaviour Theory and planned behaviour (1.9%, n = 1), agenda setting (1.9%, n = 1) and Social Cognitive Theory (1.9%, n = 1). The use of Health behaviour theory (1.9%, n = 1), agenda-setting theory (3.8%, n = 2), health risk perceptions (5.7%, n = 3), objectification theory was also observed (1.9%, n = 1), innovations theory combined with transportation theory (1.9%, n = 1), theory-guided gain and loss and balanced-framed message (1.9%, n = 1) , influence of presumed media influence (IPI) hypothesis theory (1.9%, n = 1), metaphor modality (visual vs. verbal) (1.9%, n = 1), role transportation theory combined with protection motivation theory (1.9%, n = 1), exemplification theory combined with visual persuasion theory (1.9%, n = 1), stickiness messages in communications (1.9%, n = 1), foreshadowed death narratives (1.9%, n = 1), visual training methods (1.9%, n = 1) and visual training methods (1.9%, n = 1), Theory of normative social behaviour (TNSB) (3.8%, n= 2), appraisal theory (1.9%, n = 1), extended parallel process model (EPPM) (3.8%, n= 2), web-based Media Literacy Intervention (MLI) (1.9%, n = 1), Optimistic bias and narrative transportation (1.9%, n = 1), Theory of planned behaviour approach (3.8%, n= 2), Media and audience frames (framing effects) (1.9%, n = 1),

health literacy & learning styles principles (3.8%, n= 2), Visual Image Theory (1.9%, n = 1), Diffusion of Innovations Theory (1.9%, n = 1), News Literacy and inoculation theory. There were also articles which used more than two theories (3.8%, n = 2), and others that did not report a specific theory (13.2%, n = 7). These results indicate a very high dispersion of theories used, which makes it difficult to generate a corpus that allows consecutive meta-studies to be carried out.

The Chi-square test demonstrated a significant relationship between the university-main author and theoretical application variables ($p < .001$). This indicates that certain authors focus on certain theories, although taking into account the number of appearances of each theory, it is not possible to speak of such an extensive investigation over time. Likewise, statistically significant results were demonstrated between countries where the research was carried out and theoretical application ($p < .036$).

In this sense, there are countries more aligned with the theories that have been used more frequently. The theory that has been used most intensively by a country is the United States with Social cognitive theory (9.43%, n = 5). Likewise in the case of the United States with the Health Belief Model (5.77%, n = 3) and Canada (3.77%, n = 2). The articles from the United States also combined this theory with Health behaviour theory and planned behaviour (1.88%, n = 1) and with social cognitive theory (1.88%, n = 1). The other theory most used by a country, the United States, is Health risk perceptions (5.66%, n = 3). It is curious to note that the Agenda setting theory was not used in the United States, where the theory was actually invented (McCoombs & Shaw, 1972) although it was the main theory in articles from Australia and China (1.88%, n = 1, respectively). In the case of Australia, the second country with the highest number of articles, a majority of the articles did not use a single theory but a variety of them (5.66%, n = 3). **Table 2** explains the result of the cross table on variables, theories and country.

Table 2. Result of the Cross Table on Variables, Theories and Country

		The country where the research was carried out										Total
		United States	Australia	China	Canada	US + Canada	Belgium	Spain	Germany	Poland	Not reported	
Theoretical application	Health Belief Model (HBM)	5.66%	0%	0%	3.77%	0%	0%	0%	0%	0%	0%	9.43%
	HBM + Health behaviour theory + planned behaviour	1.88%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1.88%
	HBM + Agenda setting theory	0%	0%	0%	0%	0%	0%	0%	0%	0%	1.88%	1.88%
	HBM + Social Cognitive theory	1.88%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1.88%
	Health behaviour theory	1.88%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1.88%
	Agenda-setting theory	0%	1.88%	1.88%	0%	0%	0%	0%	0%	0%	0%	3.77%
	Social cognitive Theory	9.43%	0%	0%	0%	0%	0%	0%	0%	0%	0%	9.43%
	Health risk perceptions	5.66%	0%	0%	0%	0%	0%	0%	0%	0%	0%	5.66%
	Objectification theory	0%	0%	0%	0%	0%	1.88%	0%	0%	0%	0%	1.88%
	Innovations theory + Transportation theory	0%	0%	0%	0%	1.88%	0%	0%	0%	0%	0%	1.88%
	Theory-guided gain-, loss-+ balanced-framed message	1.88%	0%	0%	0%	0%	0 %	0%	0%	0%	0%	1.88%
	Influence of Presumed Media Influence (IPI) hypothesis theory	1.88%	0%	0%	0%		0%	0%	0%	0%	0%	1.88%
	Metaphor modality (visual vs. verbal)	1.88%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1.88%
	Role Transportation theory + Protection Motivation Theory	0%	0%	1.88%	0%	0%	0%	0%	0%	0%	0%	1.88%
	Exemplification Theory + Visual Persuasion Theory	1.88%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1.88%
	Stickiness Messages in Communications	1.88%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1.88%
	Forshadowed Death Narratives	1.88%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1.88%
	Visual Training methods	1.88%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1.88%
	Theory of normative social behaviour (TNSB)	3.77%	0%	0%	0%	0%	0%	0%	0%	0%	0%	3.77%
	Appraisal theory	1.88%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1.88%
	Extended Parallel Process Model (EPPM)	1.88%	0%	1.88%	0%	0%	0%	0%	0%	0%	0%	3.77%
	Web-based Media Literacy Intervention (MLI)	1.88%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1.88%
	Optimistic bias and narrative	1.88%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1.88%

		The country where the research was carried out										Total
		United States	Australia	China	Canada	US + Canada	Belgium	Spain	Germany	Poland	Not reported	
	transportation											
	Theory of planned behaviour approach	3.77%	0%	0%	0%	0%	0%	0%	0%	0%	0%	3.77%
	Media and audience frames (framing effects)	0%	0%	0%	0%	0%	0%	0%	1.88%	0%	0%	1.88%
	Health Literacy & Learning styles principles	3.77%	0%	0%	0	0%	0%	0%	0%	0%	0%	3.77%
	Visual Image Theory	0%	0%	0%	1.88%	0%	0%	0%	0%	0%	0%	1.88%
	Diffusion of Innovations Theory	0%	0%	0%	0%	1.88%	0%	0%	0%	0%	0%	1.88%
	News Literacy and inoculation theory	1.88%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1.88%
	Use of various theories	3.77%	0%	0%	0%	0%	0%	0%	0%	0%	0%	3.77%
	Not reported	3.77%	5.66%	0	0%	0%	0%	1.88%	0%	1.88%	0%	13.20%
Total		67.92%	7.54%	5.66%	5.66%	3.77%	1.88%	1.88%	1.88%	1.88%	1.88%	100%

Considering the contributions of the studies, in a slight majority of the cases they provided refutation of previous ideas and theories (52.8%, n = 28) and news contributions and insights (47.2%, n = 25). This analysis has also considered practical applications and the results showed that the vast majority derived from implications for effective health campaigns (71.7%, n = 38), and to a lesser extent contributed to methods (20.8%, n = 11) or tips (7.5%, n = 4).

Regarding the type of methodological study applied, the majority application of quantitative methods is observed, more specifically online surveys (22.6%, n = 12) followed by cross-sectional studies (20.8%, n = 11). There were which used pair matched group-randomized pretest-post-test (11.3%, n = 6), content analysis (9.4%, n = 5), experiments (3.8%, n = 2), content analysis combined with cross-sectional study (5.7%, n = 3), survey (1.9%, n = 1), pretest-post-test with content analysis (1.9%, n = 1), post qualitative methodologies, non-experimental surveys (1.9%, n = 1), qualitative focus groups/interviews (7.5%, n = 4) and qualitative content analysis (5.7%, n = 3) were used. There were also studies that used content analysis with methodological triangulation, or mixed or varied methods (3.8%, n = 2). Nevertheless, the study methodology and the country of the university are strongly related ($p < .001$).

Participant Characteristics

In this study, the characteristics of the population samples that were investigated in the different studies have been considered. The vast majority of the articles have investigated groups in adulthood (41.51%, n = 22) followed by university students (30.19%, n = 16), young adults (11.3%, n = 6), parents (3 .8%, n = 2) and adults over 45 (1.9%, n = 1). There were studies that did not report the age group of the sample (11.3%, n = 6).

Pearson's chi-square test finds that there is a strong relationship between the age group variable and the year of publication ($p < .019$). **Table 3** explains the result of the cross table on variables, age groups and year of publication. It is observed that the articles focus on the adult population group over the years, although there is special interest in the group of parents in the years 2013 and 2014 (1.88%, n = 1 in both years) and a special interest in the young population and university students starting in 2015, with the highest number in 2017 in the case of university students (7.54%, n = 4) and young adults (3.77%, n = 2).

Table 3. Result of the Cross Table on Variables, Age Groups and Year of Publication

		Age groups						Total
		Parents	University students	Young adults	Adults	Adults (+45)	Not reported	
Year of publication	2010	0%	1.88%	0%	0%	0%	3.77%	5.66%
	2013	1.88%	0%	0%	0%	0%	0%	1.88%
	2014	1.88%	0%	0%	3.77%	0%	1.88%	7.54%
	2015	0%	5.66%	1.88%	5.66%	0%	0%	13.20%
	2016	0%	3.77%	1.88%	7.54%	0%	1.88%	15.09%
	2017	0%	7.54%	3.77%	5.66%	0%	0%	16.98%
	2018	0%	5.66%	0%	3.77%	0%	0%	9.43%
	2019	0%	0%	1.88%	7.54%	1.88%	1.88%	13.20%
	2020	0%	3.77%	1.88%	0%	0%	1.88%	7.54%
	2021	0%	1.88%	0%	7.54%	0%	0%	9.43%
Total		3.77%	30.18%	11.32%	41.50%	1.88%	11.32%	100%

Regarding the study of samples of people based on race or ethnicity, the vast majority of studies choose heterogeneous samples of white/Caucasian, black/African American, Hispanic/Latino, Asian/pacific islanders, American Indian (69.8%, n = 37) although there are some studies that focus exclusively on the study of white/Caucasian people (5.7%, n = 13). There were studies that did not report race or ethnicity (24.5%, n = 13). The Chi-square test determined that there was a strong relationship between country where the research was carried out and race/ethnicity ($p < .001$).

Regarding the gender of the participants, a large majority studied men and women (67.9%, n = 36), although some focused on analysing women exclusively (17%, n = 9), something that may be a consequence of melanoma being one of the most common cancers in young adults, especially in young women, according to the American Cancer Society). There were some studies that did not report the gender to which they directed their studies (15.1%, n = 8).

When crossing the gender variable with age groups, the chi-square test showed its significance ($p < .001$). **Table 4** explains the result of the cross table on variables gender of the participants and age groups. There was

also a significant relationship between gender and race/ethnicity (p < .001), specifically in articles that studied white/Caucasian women (3.7%, n = 2).

Table 4. Result of the Cross Table on Variables Gender of the Participants and Age Groups

		Gender of the participants			Total
		Women	Mixed	Not reported	
Age groups	Parents	0%	1.88%	1.88%	3.77%
	University students	15.09%	15.09%	0%	30.18%
	Young adults	1.88%	9.43%	0%	11.32%
	Adults	0%	39.62%	1.88%	41.50%
	Adults (+45)	0%	1.88%	0%	1.88%
Total	Not reported	0%	0%	11.32%	11.32%
		16.98%	67.96%	15.09%	100%

*Sig. < .05

The highest percentage of articles has been given taking into consideration adults and both sexes (39.62%, n = 21). The results show that there is a high percentage of the total that focuses on university women (15.09%, n = 8), which is equal in frequency to studies that focus on university students of both sexes (15.09%, n = 8).

Areas of Study

The main issues related to communication in the field of health and skin cancer have been analysed. Once the corpus has been analysed, the topics have been organized according to the main topic of analysis of each of the articles for the prevention of skin cancer and, in turn, subcategories have been created to help identify more specific topics in the Available bibliography: *campaigns* (13.32%, n = 6), *risk perceptions* (35.89%, n = 19), *social media and digital media* (11.32%, n = 6), *media literacy* (20.75%, n = 11), *messages* (9.43%, n = 5), *visual images* (5.66%, n = 3), *others* (5.66%, n = 3). **Figure 4** shows the tree map of the study themes.

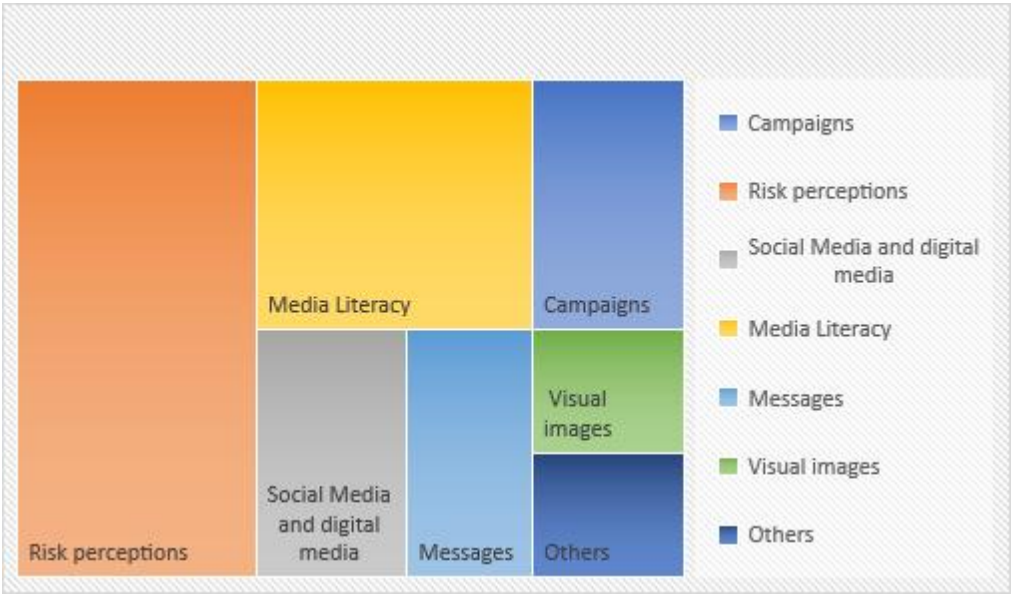

Figure 4. Tree Map of the Study Themes

Regarding frequencies, the most researched topic was risk perceptions and more specifically, within this group, the perception of risks related to indoor tanning (20.75%, n = 11 of the total). **Table 5** explains the areas of study.

Table 5. Areas of Study

Dimension	N	%
Campaigns	6	13.32%
Sun-care advertisements/campaigns	5	9.43%
Promote sun protection	1	1.88%
Risk perceptions	19	35.84%
Indoor Tanning	11	20.75%
Health risk perception	5	9.43%
Health check-ups	1	1.88%
Melanoma risks perception	2	3.77%
Social media and digital media	6	11.32%
Social Media- Pinterest	2	3.77%
Health blogs, websites	2	3.77%
Social Media- YouTube	1	1.88%
Social networking sites (social media)	1	1.88%
Media literacy	11	20.75%
Influence of media	2	3.77%
Reality TV exposure	1	1.88%
Mass media	2	3.77%
Health media	1	1.88%
Effects of media frames on attitudes and behavior	2	3.77%
Health Literacy- Genetic Literacy	2	3.77%
Video misinformation- news literacy video, real time	1	1.88%
Messages	5	9.43%
Messages promoting early melanoma detection	2	3.77%
Persuasiveness of stickiness messages	1	1.88%
Persuasive- fear appeal messages	2	3.77%
Visual images	3	5.66%
Pattern-focused visuals- Visual communication	1	1.88%
Visual images	1	1.88%
Health Warning Labels in Indoor Tanning	1	1.88%
Others	3	5.66%
Improving patient-provider relationships	1	1.88%
Tailored communications on family to change cancer prevention	1	1.88%
Packaging/labelling of sunscreen preparations	1	1.88%

Table 6. Result of the Cross Table on Variables Country of the University and Areas of Study

		Country of the university									**Total**
		United States	Belgium	China	Spain	Australia	Germany	Singapour	Canada	Poland	
Areas of study	Campaigns										
	Sun-care advertisements/campaigns	5.66%	0%	0%	0%	3.77%	0%	0%	0%	0%	9.43%
	Promote sun protection	1.88%	0%	0%	0%	0%	0%	0%	0%	0%	1.88%
	Risk perceptions										
	Indoor Tanning	20.75 %	0%	0%	0%	0%	0%	0%	0%	0%	20.75 %
	Health risk perception	7.54%	0%	0%	0%	0%	0%	0%	1.88 %	0%	9.43%
	Health check-ups	0%	0%	1.88 %	0%	0%	0%	0%	0%	0%	1.88%
	Melanoma risks perceptions	3.77%	0%	0%	0%	0%	0%	0%	0%	0%	3.77%
	Social Media and Digital media										
	Social Media-	3.77%	0%	0%	0%	0%	0%	0%	0%	0%	3.77%

		Country of the university									Total
		United States	Belgium	China	Spain	Australia	Germany	Singapour	Canada	Poland	
	Pinterest										
	Health blogs, websites	3.77%	0%	0%	0%	0%	0%	0%	0%	0%	3.77%
	Social Media-Youtube	1.88%	0%	0%	0 %	0%	0%	0%	0%	0%	1.88%
	Social networking sites (social media)	0%	0%	0%	0%	1.88%	0%	0%	0%	0%	1.88%
	Media Literacy										
	Influence of Media	0%	0%	0%	1.88 %	1.88%	0%	0%	0%	0%	3.77%
	Reality TV exposure	0%	1.88%	0%	0%	0%	0%	0%	0%	0%	1.88%
	Mass media	1.88%	0%	1.88 %	0%	0%	0%	0%	0%	0%	3.77%
	Health media	1.88%	0%	0%	0%	0%	0%	0%	0%	0%	1.88%
	Effects of media frames on attitudes and behaviour	1.88%	0%	0%	0%	0%	1.88%	0%	0%	0%	3.77%
	Health Literacy-Genetic Literacy	3.77%	0%	0%	0%	0%	0%	0%	0%	0%	3.77%
	Video misinformation-news literacy video, real time	1.88%	0%	0%	0%	0%	0%	0%	0%	0%	1.88%
	Messages										
	Messages promoting early melanoma detection	3.77%	0%	0%	0%	0%	0%	0%	0%	0%	3.77%
	Persuasiveness of stickiness messages	1.88%	0%	0%	0%	0%	0%	0%	0%	0%	1.88%
	Persuasive- fear appeal messages	1.88%	0%	0%	0%	0%	0%	1.88%	0%	0%	3.77%
	Visual comunication										
	Pattern-focused visuals	1.88%	0%	0%	0%	0%	0%	0%	0%	0%	1.88%
	Visual images	0%	0%	0%	0%	0%	0%	0%	1.88 %	0%	1.88%
	Health Warning Labels in Indoor Tanning	0%	0%	0%	0%	0%	0%	0%	1.88 %	0%	1.88%
	Others										
	Improving patient-provider relationships	1.88%	0%	0%	0%	0%	0%	0%	0%	0%	1.88%
	Tailored communications on family to change cancer prevention	1.88%	0%	0%	0%	0%	0%	0%	0%	0%	1.88%
	Packaging/labelling of sunscreen preparations	0%	0%	0%	0%	0%	0%	0%	0%	1.88 %	1.88%
Total		73.58 %	1.88%	3.77 %	1.88 %	7.54%	1.88%	1.88%	5.66 %	1.88 %	100%

*Sig. < .05

The Chi-square test revealed highly significant differences ($p < .001$) when relating the university-main author and areas of study ($p < .001$). The University of North Carolina at Chapel Hill stands out, dedicating three articles to the topic of *risk perceptions-indoor tanning* (5.66%, n = 3), and the University of Miami on the same topic (3.77%, n = 2). Vanderbilt University Medical Centre dedicates two articles to the topic of *health literacy and genetic literacy* (3.77%, n = 2).

Following the results of the analysis, it is confirmed that the countries where the first author's universities are located are specialized in certain areas of study. **Table 6** explains the result of the cross table on variables country of the university and areas of study. There is great interest in the United States in topics related to *risk perceptions* and specifically in the topics of *indoor tanning* (20.75%, n = 11) and *health risk perceptions* (7.54%, n = 4), followed by studies focused on *sun-care advertisements and campaigns* (5.66%, n = 3). This same topic of *sun-care advertisements and campaigns* is the most discussed in the Australian literature (3.77%, n = 2).

When performing the chi-square test with the variable areas of study and theoretical application, its significance was evident ($p < .001$). When crossing these two variables, it is observed that the articles that have *indoor tanning* as their study area make greater use of *social cognitive theory* (5.66%, n = 3) and *health risk perceptions theory* (3.77%, n = 2).

The combination of variables country where the research was carried out and areas of study was also statistically significant ($p < .001$). The articles that focused on *risk perceptions- indoor tanning* conducted their research in the United States (20.75%, n = 11) and in Canada (1.88%, n = 1). Those who focused on campaigns and specifically on *sun-care advertisements/campaigns* developed their studies in Australia and the United States (3.77%, n = 2, respectively).

Reviewing the articles not only from the main topics related to the discipline of communication, but from the point of view of the messages analysed, they can be grouped into four large blocks: *skin cancer prevention* (56.6%, n = 30), *public education* (26.41%, n = 14), *beauty ideals* (9.43%, n = 5) and *communication with patients* (7.54%, n = 4). **Table 7** explains the message types.

Table 7. Message Types

Dimension	N	%
Skin cancer prevention	30	56.60%
Sunscreen	4	7.54%
Visual and verbal metaphors	2	3.77%
Media Literacy	3	5.66%
Prevention- family members	2	3.77%
Visual exemplification	2	3.77%
Effectiveness of messages	13	24.5%
Skin self-examination (SSE)	2	3.77%
Celebrities disclosure of skin cancer	1	1.88%
Risk perceptions	1	1.88%
Public education	14	26.41%
Attitude toward health behaviour	3	5.66%
Raise awareness through social media	2	3.77%
Public health education campaigns	5	9.43%
Public health education information	4	7.54%
Beauty ideals	5	9.43%
Tanned skin	4	7.54%
Normative motivations- perceived norms	1	1.88%
Communication with patients	4	7.54%
Emotions and communication during oncology interviews	1	1.88%
Health Literacy	2	3.77%
Survivor narratives	1	1.88%

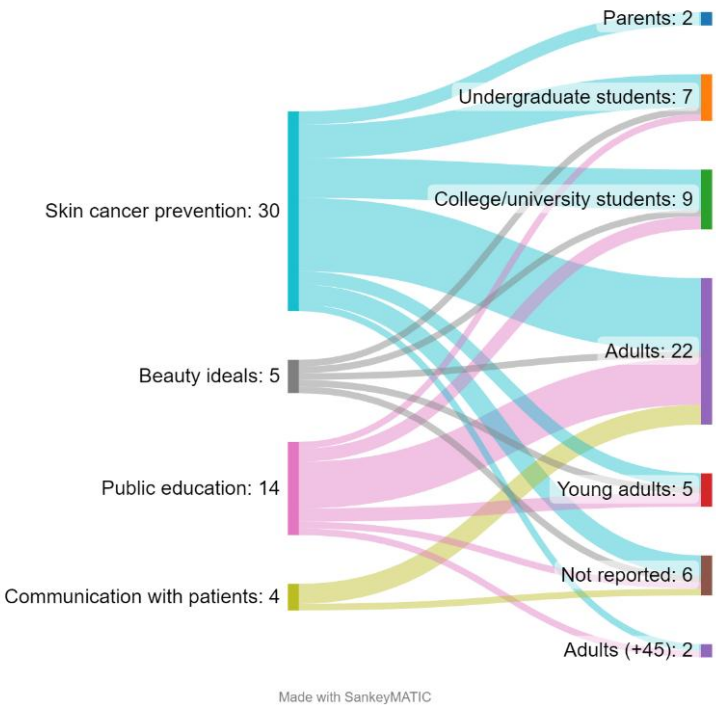

Figure 5. Sankey Diagram on the Study of Message Types in Age Groups

Sankey's flow diagram shows that most papers focus on *skin cancer prevention messages* and *public education* respect to the adult population. However, a lower presence of young adults as study participants is evident in all types of messages. Adults in their role as parents and those over 45 years of age are the least likely to be surveyed, especially on issues of *communication with patients*. **Figure 5** shows the Sankey diagram on the study of message types in age groups.

DISCUSSION

There has been an increase in the number of publications related to the role of communication in prevention of first level associated skin cancer (Wu et al., 2018, p. 1000) since 2015 and especially since 2017.

The vast majority of papers were published by female scholars in a wide variety of universities in the United States, followed far behind by countries such as Australia or Canada. Although this decision is explained by the preponderance of the language of scientific better positioned journals in JCR and Scopus, it may have limited the corpus of analysis.

The most used theoretical applications, alone or combined with other theories, were Health Belief Model (HBM) and Social Cognitive Theory. Contributions of new or less used theories related to the effectiveness of health campaigns and their messages, whether verbal or visual, are observed. However, none of these theories have stood out to become a trend, having observed an enormous dispersion in the use of theories. Furthermore, it was shown that there is a strong relationship between the theories used and the universities that lead the studies, as well as a strong relationship was observed between the country and theories used, and a tendency to use the social cognitive theory and health belief model in the United States.

In this sense, there are countries more aligned with the theories that have been used more frequently. The theory that has been used most intensively is Social cognitive theory, followed by the Health Belief Model in the United States. The articles from the United States also combined this second theory with Health behaviour theory and planned behaviour and with social cognitive theory. It is curious to note that the Agenda setting theory was not used in the United States, where was born, although it was the main theory in articles from Australia and China. In the case of Australia, the second country with the highest number of articles, a majority of the articles did not use a single theory but a variety of them applied mainly to campaigns.

It was observed that the articles analysed refuted previous ideas and theories and also provided new contributions and discoveries. However, most of them aim to demonstrate implications for effective health

campaigns. Along with diversity in theories, a greater diversity was found in methodological approaches. Different quantitative and qualitative methods were applied, although the majority application of quantitative methods is observed, more specifically online surveys and cross-sectional studies.

Although there are groups of studies that focuses only on young age groups and more specifically university students due to the evidence of their potential risk in the development of skin cancer (Tabbakh, Volkov, Wakefield, & Dobbinson, 2019) it is observed that the vast majority of articles have took their samples through adults populations, without discriminating by age.

As it is a type of cancer that has a very special influence depending on skin type, it is striking that only a few articles focused on white-skinned people have been published, although no articles focused on other skin types have been identified. Most research has been conducted among heterogeneous groups of skin types. The results of the research strongly linked the variables of the country where the studies were carried out and race/ethnicity. Similarly, regarding gender the vast majority of studies also conducted their investigations with mixed groups of men and women, with a small percentage focusing only on women. No references to the specific study of men were found, although some studies point to lower levels of prevention among men.

The selection of the study populations therefore tells us that in some aspects of the selection, the greater risk of that population can be taken into account (such as university students), but not in other aspects such as gender, perhaps due to assumptions, erroneous previous reports on prevalence and risk factors. These preferences allow us to find gaps in research on certain population sectors that should receive greater attention in future empirical research.

The study also confirms that there is a strong relationship between universities and the different areas of study to which they dedicate their efforts, as well as by country. There is an incipient specialization by countries and more specifically, by universities in different topics. Yet, the results of this study show the great diversity in the areas, focus and in the topics investigated. The preponderance of topics related to the analysis of risk perceptions, with special emphasis on indoor tanning, as it has been observed in the results, notices that there is room for improvement in the adjustment of communication and the effectiveness of messages to skin cancer prevention. It is striking that, taking into account that audiences in the last decade have shifted to digital platforms, it has not been a preferred topic (11.32%, n = 6).

There is a great diversity of communication messages studied in the different articles, although the majority focuses on skin cancer prevention, and on the effectiveness of communication campaigns or public education. Less common are those related to beauty ideals or those that focus on analysing the effectiveness of communication with patients.

CONCLUSION

This bibliometric study tries to carry out a review of the body of knowledge around communication for the prevention of skin cancer. Its objective is to improve the understanding of the research carried out so far and to find potential gaps in which to focus in the future. No previous bibliometric analysis had been identified on this object of study.

The existing literature in this discipline is extremely diverse and uses a wide variety of theoretical contributions, which promotes an evident search for effective tools, although applied to very different objectives. There is not one or certain clear and defined lines of research that focus the efforts of the research teams, but they end up dispersing, delaying the possibility of meta-studies that consolidate insights and advance the field. This article contributes to a review of the production of communication in the prevention of skin cancer and it could help identify areas of improvement, trends and also research opportunities.

The vast majority of studies published in the area have been produced in the United States, and there are different universities interested in the topic, especially female researchers. There is also a local and national scope of the empirical research, which invites us to think that future lines of transversal research could be carried out and with a corpus that aims for a more global than local scope. More studies that focus on different skin types, races or ethnicities also seem necessary, as well as studies focused particularly on men.

Changes in the type of media consumption by audiences in the last decade should also accompany the type of studies that are carried out, for example, oriented more towards the analysis of social media and new media. It is evident that efforts must be focused on a particular audience, that of adolescents and young adults as a priority objective. This age group also consumes information differently from other adult age groups, which requires special attention to the channels observed and criteria to be analysed in the future.

This study has several limitations on the scope of the corpus of analysis. In the first place, the articles published in collections of communication journals from the main databases have been taken into account, although, as I mentioned previously, they have been limited to the English language, which may have left research published in other languages out of the sample. By considering only articles with scope in the communication field, research that addresses close topic in other disciplines should be also researched. Although the focus of this study was communication for the prevention of skin cancer, future studies should address the study of other articles dispersed in journals of diverse health disciplines, oncology, dermatology and other related areas in order to have a more complete vision. Results of this study have shown the need for reducing the dispersion and producing more transnational, interdisciplinary research that is able to settle a consistent corpus on skin cancer communication.

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