INTERNATIONAL JOURNAL OF ACADEMIC RESEARCH IN BUSINESS & SOCIAL SCIENCES

Vol 14, Issue 9, (2024) E-ISSN: 2222-6990

Citation Obsolescence of Health Communication Research

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To Link this Article: http://dx.doi.org/10.6007/IJARBSS/v14-i9/22620 DOI:10.6007/IJARBSS/v14-i9/22620

Published Date: 13 September 2024

Abstract

Citation habits differ among research fields and that influences the obsolescence of their literature. This study's aim was to assess the degree of obsolescence in the field of health communication (HC) by conducting a synchronous citation analysis, using reference data of articles in the Web of Science published in 2020 to 2022. The half-life, Price Index, mean and median citation age, and maximum citation years were used to evaluate the aging trend of HC literature. Our results show that the aging of HC follows the negative exponential aging model. Moreover, citation aging has accelerated: The citation half-life decreased from 7.49 to 6.91, while the mean citation age changed from 9.21 to 9.09, with a median citation age of 7 to 6. Meanwhile, the Price Index rose from 0.33 to 0.38. Overall, these results suggest the HC discipline is undergoing rapid development. Since the measured maximum citation age was 4 to 3 years, but 3 on average, a 3-year assessment period is appropriate for evaluating the impact factor of HC journals.

Keywords: Citation Half-Life, Citation Aging Model, Health Communication, Literature Obsolescence, Literature Aging,Price Index.

Introduction

The aging of literature is a natural phenomenon in the development of any discipline and a key research topic in bibliometrics and scientometrics, referring to the literature's reduced frequency of use or citation, but not to its value as a source of knowledge (Dorta-González & Gómez-Déniz, 2022).

As early as 1943, Dr. Gosnell, based at New York University, conducted research on the aging of literature (Gosnell, 1943). Later, in 1958, the renowned scientist Bernal adopted the

term “half-life” from radiochemistry to study the aging rate of scientific literature, and put forward a negative exponential model of aging (Bernal, 1958). Soon after, Burton & Kebler (1960) formally defined the half-life of literature as “the time during which one-half of all the currently active literature was published” (p. 19), and devised and validated an aging model for scientific and technical literature. A decade later, the “Price Index” was introduced as a metric to quantify the speed at which literature ages (Price, 1970). Since then, many studies of new indicators and models of literature aging have been carried out (Dorta-González & Gómez-Déniz, 2022; Galiani & Gálvez, 2019; Gou et al., 2021; Lyu et al., 2023; Wang et al., 2019). Yet scholars predominantly utilize the citation analysis method for their research, deeming it the most robust approach (Lyu et al., 2023; Qiu, 2007). Furthermore, the current trajectory of a discipline’s development can be inferred by visualizing the patterns of its citation aging indicators (Yang et al., 2023).

The citation analysis method to investigate obsolescence entails two components: synchronic (retrospective) and diachronic (prospective). The synchronic analysis is based on the cited document, while the diachronic analysis is based on the citing literature. Actually, the validity of using either to explore the obsolescence of citations has long been disputed (Line & Sandison, 1974), but there is evidence does support the validity of synchronic analysis (Stinson & Lancaster, 1987). Moreover, in contrast to diachronic analysis, synchronic analysis is possible with a shorter time span for data acquisition and utilizes a simpler methodology. Hence there is a mounting preference for applying synchronic analysis (Yang et al., 2023).

As one of the most vibrant, complex, and significant areas of research and practice in today’s world (Harrington, 2015; Kreps, 2020), HC try to bridge the gap between the ever-expanding knowledge base of health sciences and the need to effectively convey this information to diverse populations, especially when faced with a public health crisis (de Las Heras-Pedrosa et al., 2022; OECD, 2020). As society continues to face evolving health challenges, the role of health communication in shaping the future of healthcare delivery and population health management becomes increasingly vital.

In the last decade or so, although some scholars have offered various definitions for HC (Ferreira et al., 2017; Harrington, 2015; Schiavo, 2013), the conceptualization presented by Rogers (1996) has garnered the most widespread acceptance within the academic community. He defined health communication in a broad sense, as “any type of human communication whose content is concerned with health” (p. 15). In fact, HC research has its own structure, developing within the overlapping realms of communication and health sciences (Ferreira et al., 2017). Thus, HC is a comprehensive discipline because it harbors many sub-fields, such as journalism and communication, public health, psychology, sociology, management, education, economics, and political science (Guenther et al., 2021; Kreps, 2020). In essence, HC comes from the synergistic creation of two isolated areas: communication and health, each with its principles and knowledge (Ferreira et al., 2017).

Obsolescence varies not only across different fields but also among their disparate subfields (Faber et al., 2023). Moreover, even within the same discipline, the rate of aging differs across its various developmental stages (Qiu, 2007). These patterns are usually attributed to different citation habits in research fields. Two main types of obsolescence occur

in relation to the citation process: In the first, there is a slower acceptance phase, leading to a gradual increase in citations. Subsequently, after reaching its peak, the citation starts to decline slowly. The other type undergoes an initial surge in citations until it peaks, followed by a sharp and rapid decline (Dorta-González & Gómez-Déniz, 2022). Accordingly, the question of which of those two patterns characterizes the obsolescence of the HC literature should be investigated thoroughly.

Our study objective was to measure the obsolescence of citations in HC area through a synchronic (retrospective) analysis. We empirically addressed two questions:

Q1. How is the health communication (HC) literature aging? And what's the negative exponential model of aging for HC citations?

Q2. What distinctions exist in the aging trend of the HC literature compares with the whole social sciences? Specifically, how does it differ from its related disciplines (e.g., communication, psychology, health sciences, education, management, economics, and political science)?

Our study of literature obsolescence in HC offers significant theoretical and practical implications. Theoretically, it advances the potential development of a new framework for transdisciplinary literature aging research in bibliometrics fields by testing the applicability of synchronous citation analysis in a transdisciplinary context. Additionally, this study reveals the dynamic changes in how HC knowledge is utilized over time, deepening our understanding of how transdisciplinary knowledge ages. Practically, this research informs library resource management, guiding collection development and journal subscription decisions pertaining to the HC discipline. Furthermore, it aids research evaluation by providing an empirical basis for determining appropriate assessment periods for HC research impact, crucial for funding agencies and policy makers; For social science journal editors and publishers, it offers valuable insights for content curation and impact factor calculations.

Literature Review

Decay of Social Science and Sub-Fields

The rate of citation aging is influenced by numerous factors, including linguistic variations, document typologies (journals/patents/reports/books/theses) (Hu et al., 2021), document content (theoretical or applied) (Gou et al., 2022), and changes in document volume, among others (Davis, 2014; Dorta-González & Gómez-Déniz, 2022). Table 1 lists the value of citation aging metrics in previous studies.

Table 1.
Obsolescence of citations in previous studies

Author	Publicationyear	Discipline	Half-life	Price Index	Mean citation age	Median citation age	Maximum citation age
Zhang & Glänzel (2017)	1992–2014	General, regional, and community issues		35.5%–26.0%	12.81–13.49	7–9	

		Economic and political Issues		37.4% – 24.6%	16.08– 17.68	7–10
		Education and information		39.9% – 27.0%	10.45– 12.05	6–8
		Psychology and behavioral sciences		29.2% – 25.2%	11.68– 12.46	8–9
Sangam & Mogali (2013)	2006–2010	Social science	9.04		13.04	
Davis & Cochran (2015)	1997–2013	Communication	8.80			
		Economics	8.69			
		Education and educational research	8.42			
		Social issues	7.51			
		Management	8.67			
		Political science	7.95			
		Psychology	8.47			
		Public, environmental and occupational health	7.20			
		Health care sciences and services	7.08			
		Health policy and services	6.67			
Faber,et al. (2023)	2012–2016	Healthcare and health policy			11.99	＞9
Wang (2013)	1980	Social sciences				6
		Health sciences				5
		Psychology				4
Johnston, et al. (2012)	1984–1988, 2004–2008	Economics				4

In recent years, several studies have found a trend suggesting that the aging of the social sciences literature is generally slowing down (Davis & Cochran, 2015; Zhang & Glänzel, 2017). This trend is manifested in the declining Price Index for every social science subfield, while their half-life, mean, and median citation ages are increasing. For the social sciences as a whole, the half-life exceeding 9 years (Sangam & Mogali, 2013). Yet in specific disciplines the situation differs, being characterized by wide variation in both the values and fluctuations of their aging indicators.

More recently, Faber et al (2023), performed a diachronous obsolescence study of 82 759 references from 2012 to 2016, covering 53 topics related to healthcare and health policy. They found considerable variability in the mean citation age and median citation age across different topics; the former ranged from 7 to 18.3 years (averaging 11.99), while the latter ranged from 4 to 17 years (averaging > 9 years), highlighting significant differences in aging rates among distinct sub-disciplines.

For the maximum citation age or citation peak age, Wang (2012), identified differences in the timing of citation peaks among various disciplines based on the literature published in 1980. Specifically, the citation peak age for social sciences is 6 years, while it is 5 years for health sciences and 4 years for psychology. In the same year, Johnston, et al. (2012) investigated papers published in the *American Economic Review* between 1984-1988 and 2004-2008. They found that citations for economics papers peak at around 4 years after publication.

From this literature overview, evidently the aging rate of social science literature has slowed in recent years, but the patterns of aging vary markedly across different sub-disciplines as well as time periods. Being a transdisciplinary field, we expected the HC literature's aging dynamics to diverge from those observed in other disciplines belonging to the social sciences.

Methodology

Data Collection

This study relied solely on the Core Collection in the Web of Science (WoS), because this database contains the most influential documents and constitutes a collection of trusted and reliable scientific research in the natural sciences, social sciences, arts, and humanities (Apriliyanti & Alon, 2017; Chu et al., 2022). Therein, "Social Sciences Citation Index (SSCI)" was chosen, since HC research is primarily done under the domain of social sciences.

The documents were drawn from a topic search that used the term "health" and "communication" (Hannawa et al., 2015; Lwin & Salmon, 2015; Mheidly & Fares, 2020a, 2020b) in conjunction with two prominent HC journals: *Health Communication* and *Journal of Health Communication.* On 25 January 2023, this search was run in the WoS database, with its results limited to publications from 2020 to 2022. The exported documents were restricted to articles published exclusively in English. Next, this dataset was de-duplicated and filtered, yielding a total of 17 499 articles.

We then applied Python 3.9 web-scraping software to these 17 499 articles, to gather bibliographic details of their references, such as the author name(s), title, and publication year. This yielded a total of 533 806 entries. Next, we eliminated those entries in which the reference was published after the citing article. In this way, our final dataset came to comprise 529 881 entries.

Indicators and Modeling of the Citation Obsolescence

The most prevalent indicators of citation aging are the half-life metric and Price Index (Yang et al., 2023). Along with those two, mean citation age is also commonly used for a synchronic analysis (Sotelo-Cruz et al., 2016). In addition, here we used both median citation age and maximum citation years, as supplementary metrics, to better understand the aging trend of the HC literature. For all five indicators, their corresponding definitions and calculation methods are presented in Table 2. For modeling purposes, we only applied the negative exponential function to depict the relationship between the age of citations and the quantity of citations, to discern and predict the trend in literature aging for HC. The age of each reference was determined as the difference between its publication year and the publication year of its corresponding citation.

Table 2
Citation aging indicators and negative exponential model

Indicators & model	Definition	Formula	Description
Half-life (1960)	How many years have elapsed since the newer half of all literature was used by the discipline.	$H = x + (0.5 - B_{citation}) / (A_{citation} - B_{citation})$	The integer part of H is x year; $A = x + 1$, $B = x$; $A_{citation}$ (≥50%) and $B_{citation}$ (≤50%) are the cumulative percentage of citations for the A and B year, respectively.
Price Index (1970)	The amount of cited literature published < 5 years divided by the total amount of cited literature.	$P = M/N$	M is the number of references not older than 5 years; N is total number of references in a given period.
Maximum citation age (2015)	The publication age of the reference that has been cited the most in the statistical year.		The time (years since publication) of citation peak.
Mean citation age	The mean age of citations counted by years.	$M = Y/X$	Y is the sum of citation ages; X is the total number of citations.
Median citation age	The median value of the age of citations.	M = value at $(N+1)/2$, N is odd; M = average values at $N/2$ and $(N/2)+1$, N is even.	Sort the ages of references in ascending order, where N is the total number of references in the statistical year.
Negative exponential model (Bernal, 1958)		$C(t) = Ke^{-at}$	Here t is the publication age of literature; $C(t)$ denotes the cited frequency of literature published t years ago; K is a constant, which varies across different disciplines; e is the base of the natural logarithm; a is the aging rate of literature.

The bibliometric indicators were calculated using MS Excel 2017. To visualize the data and fit the model of literature aging, Origin 8.5 software was used.

Results

Aging of the Health Communication (HC) Literature

1) Distribution of citations in HC

In the 2020–2022 period, the number of literature sources showed a trend of increasing, whose references reached a very high abundance (Table 3). The sudden, substantial increase in citations indicated that HC researchers could be diversifying their citation selections, pointing to a potential increase in collaboration across various disciplines and between academic and non-academic sectors.

Table 3
Yearly number of literature sources and references, and citation peak value

Year	Sourced literature	Number of references	Citation peak
2020	5033	153 564	12199
2021	6199	188 357	20677
2022	6267	187 960	21647
Total	17499	529 881	

A 100-year citation chronological distribution map was generated based on citation age and citation quantity (Figure 1). The ensuing citation distribution can effectively portray the aging patterns of documents. A key finding from Price's work was the significant similarity between the citation distribution curve and the aging curve of a discipline (Price, 1965, 1970). As seen in Figure 1, the citation distribution of HC conforms to a negative exponential curve in each year. After 2021, there is a notable sharpening of the peak and its leftward shift, suggesting an accelerated aging process.

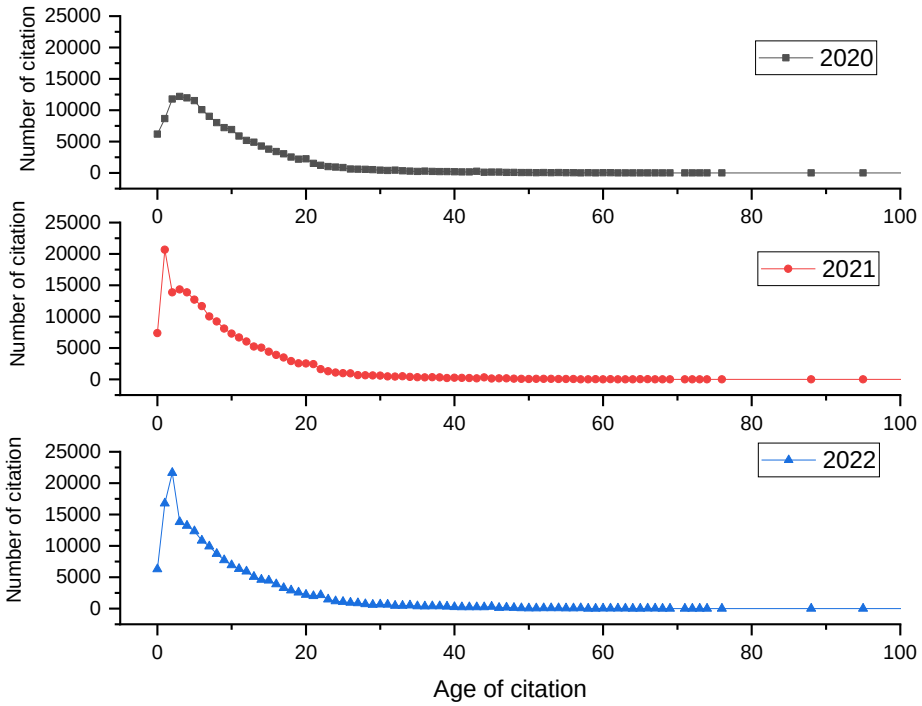

Fig. 1. Distribution of the citation age for HC literature from 2020 to 2022

In 2021 there was explosive growth in the maximum number of citations, increasing by 69.50% relative to 2020, while the increase in 2022 over 2021 was modest at 4.69%. The total number of citations in 2021 also surged by 22.66% when compared to 2020, but there was a slight 0.21% decline in 2022 vis-à-vis 2021. The growth rate of the citation maximum number between 2021 and 2022 slowed down relative to that for 2020 to 2021, accompanied by slightly less growth in the number of references. That could be due to the incomplete inclusion of papers published in 2022 in the SSCI during the literature collection process, leading to an underestimation of total citations as well as the citation peak. Overall though, when compared with 2020, for 2022 there was a significant increase in both its citation peak (up by 77.45% rise) and the number of cited papers (22.40% more).

Research on Literature Aging Indicators

Grand overview

In examining the variations in bibliometric indicators for the HC literature across different years (Table 4), evidently the differences in half-life between 2020–2021 and 2021–2022 were negative (–0.51, –0.06), which suggested its consistent annual decline Conversely, the Price Index showed positive differences (0.0414, 0.0096), indicating its continuous annual growth. Considering the maximum citation age, its highest point was in 2020 at 4 years, being lowest in 2021 at 2 years, followed by a modest increase in 2022 to 3 years.

Table 4
Indexes for the HC citation aging in 2020 to 2022, and their comparison

Year	Half-life	Price index	Half-life × Price index	Maximum citation age	Mean citation age	Median citation age
2020	7.49	0.330676461	2.48	4	9.21	7
2021	6.97	0.372091295	2.60	2	8.92	6
2022	6.91	0.381714195	2.64	3	9.09	6
Mean value	7.12	0.361493983	2.58	3	9.07	6
R_1	–0.51	0.041414834		–2	–0.29	–1
R_2	–0.06	0.009622900		1	0.17	0

*R_1, R_2 represent the differences in aging indicator values between 2021 and 2020, and likewise between 2022 and 2021, respectively.

Half-life analysis

In this study, the half-life of the HC literature was consistently under 7.5 years, decreasing yearly. This indicated the rate of citation aging for the HC field surpassed that for the overall social sciences, whose half-life was higher than 9 years (see Table 1) . Moreover, the aging rate of HC was accelerating over time.

Compared with other branches in the social sciences, HC's half-life value is lower than that of communication, economics, education, management, social issues, politics, and psychology, but comparable to health care sciences and services, health policy and services, as well as public, environmental, and occupational health (see Table 1). Moreover, HC's citation half-life shows a decreasing trend annually, which contrasts with the increasing trend observed in the citation half-lives of the disciplines (Davis & Cochran, 2015) mentioned above.

Price Index Analysis

Price (1970) called literature published < 5 years ago as "useful literature at present" and literature published > 5 years ago as "archival literature". When the Price Index ranges from 2% to 39%, this would signify a preponderance of citations from archival literature; however, when it is within the range of 75% to 80%, this would suggest the prevalence of citations from the literature emphasizing practicality and real-world applicability (Song et al., 2015). The Price Index of HC was distinguished by a consistent yearly increase. By 2022, at least 38% of the cited literature had been published within the past 5 years, demonstrating that archival literature remains predominant in HC research. Nevertheless, the citation proportion of archival literature has been steadily declining across years while the citation of practical literature has been rising.

The trend of the Price Index in HC is opposite to that in subfields of social sciences, whose Price Indices have fallen over the years (see Table 1). Besides, The Price Index of HC was on par with those of disciplines whose literature is published in 1992, like general, regional, and community issues; economic and political issues; and education and information.

Mean and Median Citation Age Analysis

The mean reference age was influenced more by extremes, it nonetheless remains valuable as an auxiliary tool for inference. Overall, the HC literature's mean citation age was ca. 9 years and on a downward trend. By contrast, the mean citation age of social science subfields, including education and information, psychology and behavioral sciences, is higher than 9 years and rising (see Table 1). For the healthcare and health policy domain, its literature has a mean citation age of 12 years, also surpassing that of HC (see Table 1).

The trend in median citation age mostly matches that observed for mean citation age. In 1992, while similar to that of general, regional and community issues; Economic and political issues; and education and information, the median citation age was lower for HC than for either psychology (Zhang & Glänzel, 2017)and healthcare and health policys (see Table 1).

Maximum Citation Age Analysis

The maximum citation age for social sciences is 6 years, while health sciences literature reaches its peak 5 years after publication. In addition, the peak citation age for both psychology and economics is 4 years (see Table 1). Our research findings indicate that only health communication (HC) literature published in 2020 has a maximum citation age of 4 years, on par with psychology and economics. However, for all other years examined, the peak citation age of HC literature is lower than that observed for social sciences, health sciences, psychology, and economics. Clearly, the citation peak occurs at different times for literature across various disciplines and publication years.

Relationships between the Half-Life and Price Index

Previous scholarly investigations (Chen et al., 2012) suggested an inverse correlation between half-life (H) and the Price Index (Pr), underpinned by a simple quantitative relationship: $Pr(H) \times H = C$, where C is a constant. Although the study subject was Chinese literature, Song et al. (2015) found that the C constant for diverse disciplines in the humanities

and social sciences fluctuated around a value of 2.6. Our results for HC also supported the veracity of those findings.

Research on the Aging Model

Typically, during the onset and early development of a discipline, its body literature undergoes exponential growth owing to a scarcity of original documents, and the aging of that literature follows a negative exponential function (Cunningham, 1995; Dorta-González & Gómez-Déniz, 2022). But our research revealed that the quantity of HC publications did not demonstrate exponential growth, though the aging pattern of this literature still obeyed Bernal's negative exponential model (Bernal, 1958). In Table 6, the R^2 values for regression equations modeling the distribution of HC's citation age for each year from 2020 to 2022 is around 0.9, with all *P* values below 0.0001. This evinced an exceptionally high goodness-of-fit, confirming the equations' robust significance and efficacy. From the fitted equations, we can see that as the "a" parameter increases in value, the aging rate of the HC literature accelerates.

Table 6
Fitted negative exponential aging model for HC citations, from 2020 to 2022

Year	R^2	*F*	*P*	Regression equation
2020	0.896	521.35	< 0.0001	C = 12 540.094 exp (–0.078*t*)
2021	0.902	482.62	< 0.0001	C = 16 771.525 exp (–0.088*t*)
2022	0.875	362.43	< 0.0001	C = 16 718.957 exp (–0.088*t*)

One study found that the share of citations for the HC literature decreasing yearly (Li et al., 2024). According to the analyzed citation patterns here, there was a potential upward trend in the proportion of cross-diciplinary citations, while the median citation age was expected to continue its decline.

Discussion

Distinctive Aging of HC Literature

Whether in the realms of the natural sciences, medicine, or social sciences, several studies indicating that scholars are increasingly relying on older literature, the pace of literature aging is decelerating (Larivière et al., 2008; Zhang & Glänzel, 2017). The results of our investigation into the aging of literature in health communication, a subfield within the social sciences, agrees with the common understanding that as scientific progress accelerates, the scientific literature becomes outdated more quickly (Wang et al., 2019).

Besides, the age at which a publication reaches its maximum number of citations is influenced by factors such as subject field, language, journal type, and article type. Therefore, studies conducted by scholars have yielded different peaking ages when investigating various academic fields, languages, and publication types (Abramo et al., 2019; Cai et al., 2023; Ding et al., 2022; Johnston et al., 2012; Song et al., 2014). Typically, papers reach their citation peak two, three, or even four years after publication (Li & Ye, 2014). In the course of the present study spanning 2020 to 2022, the maximum citation age for the HC literature precisely fluctuated within that 2–4 year-period, substantiating the typical conclusions.

As human society advances, the process of knowledge gain encompasses both accumulation and renewal. The ongoing renewal of knowledge underpins the metabolic nature of scientific literature. Research on the aging of scientific literature essentially probes into the speed by which scientific knowledge is corrected, which can be inferred via literature aging indicators (Qiu, 2007). Currently, the knowledge production in the field of HC is primarily through accumulation, as evidenced by its Price Index being below 39%. In terms of the cited half-life, HC literature ages more fast compared to the broader communication discipline, but at a rate comparable to the health sciences.

In general, from 2020 to 2022, the half-life of the HC literature has been decreasing whereas its Price Index has been increasing. In tandem, the maximum citation age exhibited a declining trend, which suggested an accelerating correction rate of knowledge in HC coupled with a diminishing utilization lifespan of its literature. The ongoing expansion of sourced literature within HC, along with the rapid growth in both total citations and the citation peak, together suggested a positive trend in research activities, one marked by the enrichment and deepening of knowledge.

After more than 50 years of development, HC has evolved into a relatively mature discipline, establishing its own theoretical framework, research methodologies, and a dedicated academic community. Obviously, HC's aging dynamics have their unique features, as reflected in the values of its aging indicators diverging from those of other subdisciplines in the social sciences. Our findings suggest that while classical or archival literature continues to dominate HC references, there is an emerging tendency for HC studies to incorporate more practical and applicable sources. This trend may indicate that the research topics and patterns in HC are shifting towards new directions, reflecting a growing emphasis on the pragmatic application of HC findings to real-world contexts.

Factors of HC Literature Aging

The timeframe of our research overlapped with the COVID-19 pandemic, this public health crisis likely spurred the ramped up production of papers, resulting in accelerated literature aging. On one hand, there is greater citation on literature related to the COVID-19 topic, leading to a pronounced rise in the centralization of citation distribution. On the other hand, that rapid proliferation of health-related literature has supplied more citation alternatives, resulting in reduced citations garnered by the older literature, thereby expediting the aging process of literature.

The term "transdisciplinary" encompasses both the diversity of different disciplinary communications and the participation of a varied group of non-academic participants in the research process. (Harrington, 2015; Tress et al., 2005). Concerning the diversity aspect, researchers consider three dimensions: variety (the number of disciplines), balance (the evenness of the distribution of disciplines), and disparity (the extent to which these disciplines are different) (Chen et al., 2022). Some research supports the notion that interdisciplinary approaches stimulate an increase in citations (Wang et al., 2022), facilitating the accelerated dissemination of knowledge and hastening the obsolescence of literature. However, there are also studies indicating that in many scientific fields the situation may be precisely the opposite (Chen et al., 2022; Wang et al., 2015; Yegros-Yegros et al., 2015). Regarding the involvement

of diverse non-academic participants, certain pockets of research literature may be directly applied to guide practice without generating substantial citations in the academic realm, leading to an apparent decrease in citation rates and an accelerated pace of literature aging. Hence, a more nuanced exploration is recommended to better understand the intricate impacts of variety, balance, and disparity within interdisciplinary frameworks, as well as the diversity emanating from non-academic sectors, upon citation and aging dynamics within transdisciplinary disciplinary domains.

As a major transdisciplinary area (Kreps, 2020), HC is innately different from an interdisciplinary field. More recently, some scholars have studied the citation aging patterns of interdisciplinary disciplines, for example, library and information science and chemistry, and analyzed the impact of interdisciplinarity on citation by using different diversity indices (Cai et al., 2023; Song et al., 2023; Yang et al., 2023). In reality, transdisciplinarity combines both “interdisciplinarity” and “non-academic participants”. When exploring how literature ages in transdisciplinary fields, it is imperative to consider not only interdisciplinarity’s influence but also the involvement of non-academic sectors, such as the quantity of non-academic sectors and the distribution of different types of entities among them, including commercial firms, government bodies, NGOs, independent think tanks, professional associations, and consumer groups. Since these factors may collectively impact the modes of knowledge exchange and dissemination in health communication, they warrant in-depth research investigation.

Limitations

1) The data for our study were extracted exclusively from the WoS database; consequently, the limitations inherent in this single-source data sampling approach inevitably lead to some loss of precision in the results.
2) A short research timeframe may hinder the thorough observation of citation patterns, which could prevent a comprehensive grasp of the literature aging process in the field of health communication.
3) Our analysis focused solely on computing an average trend, which fails to capture the obsolescence rate of specific literature. Certain classical publications might maintain a high citation frequency for a prolonged duration, demonstrating greater “longevity”.

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