

Global Risk Attitudes Research: From Climate Change to Vaccination

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Abstract: In recent years, risk challenges have become more intense with the globalization of the economy. As global risk attitudes have a considerable impact on various factors of global risk treatment, research on global risk attitudes has gradually increased in recent years, but there has been little bibliometric analysis, including co-citation analysis, hot topics, detection of unexpected events, and emerging trends. Therefore, this paper uses a combination of conventional bibliometrics and machine learning to address the above questions and to intuitively present hot topics and future research trends in global risk attitude research. It was found that major diseases, behavioral influences between men and women, climate change, experimental inquiry, vaccination, and sexual health were the most popular topics in global risk attitude research. Based on the current status of global risk attitude research, future research could be conducted on the topic of people's attitudes toward vaccination after COVID-19 infection to explore whether there are new changes in these people's attitudes toward vaccination. In addition, cluster analysis and burst detection of research themes revealed that vaccine hesitancy remains the most popular research direction in global risk attitude research at present. It is also very forward-looking to conduct research based on vaccine hesitancy as one of the top 10 health threats facing the world.

Keywords: Global Risk Attitudes; Climate Change; Vaccination; Machine Learning; Bibliometric Analysis

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1. Introduction

Global risks are present in all sectors. For example, extreme weather, climate change, and natural disasters are often at the top of the list of hot issues until 2019, and then the emergence of new coronaviruses in 2020, global risks continue to exacerbate the social divide between rich and poor, severely hampering economic development and geopolitical tensions. The most critical factor in the effective management of global risks is the participating actors, whose attitudes to risk influence every aspect of risk treatment, so understanding and managing these attitudes will improve the effectiveness of risk management. In recent years, a growing number of scholars have begun to examine how to enhance global risk management from the perspective of risk attitudes. It seeks to find ways to reduce and prevent global risks from different perspectives.

Global risk attitudes are a mindset chosen on the basis that there is positive or negative uncertainty about various global targets or how one chooses to respond to the perceived uncertainty of global importance, reflecting the compensatory requirements of economic agents for risk. A global risk attitude is also a descriptive label used to presume the shape of the underlying utility function chosen by a subject. A subject's risk attitude is used to describe the shape of his or her utility function. The assessment of global risk attitudes has two main components, traditional risk attitudes on the one hand and perceived risk attitudes on the

other.

Current areas of research on global risk attitudes cover five main categories: economic, ethical, health and safety, social and recreational. For example, in the field of agricultural economics, various risk attitude elicitation techniques were used to investigate whether measures of risk attitudes rooted in an expected utility framework were correlated with measures rooted in a multi-item scale framework, and the study showed that measures of the expected utility framework made the largest functional contribution to the structure of global risk attitudes. In the domain of intergenerational transmission (Sepahvand & Shahbazian, 2021)^[42], by using quantitative data from Burkina in 2014 to analysis three different self-reported risk questions, the findings suggested a strong intergenerational transmission of parents' attitudes towards their children. In the health domain (Robson & Samuelson, 2022)^[40], the evolutionary preference for choosing more aversion to overall risk over trait risk was analyzed through fertility thresholds. In the social domain (Liñeira & Henderson, 2021)^[25], the impact of risk attitudes on voting choice was analyzed by using panel survey data before and after the 2014 Scottish independence referendum, and a specific set of instruments measuring risk attitudes. In the field of entertainment (Liu & Trench, 2021)^{[26],} the role of risk attitudes in determining the optimality of a winner-take-all contest was examined by comparing a typical single-winner lottery contest with two alternatives. As research on global risk attitudes by different scholars intensifies, it is very relevant to summarize these studies and highlight their trends.

Scientometrics methods are well suited to doing research in this area and are described in this paper. Scientometrics is the quantitative analysis of the inputs, outputs, and processes of scientific activity using mathematical and statistical, and information technology methods. It aims to reveal quantitative regularities in scientific activity for decision-making purposes. Scientometrics techniques have produced many important results, such as the analysis of the Oropouche Global Study (Rios-González, 2017)^[39], the study of kosher meat and production issues (Della et al., 2021)^[11], and the analysis of the evolution of green finance and its contributing factors (Bhatnagar & Sharma, 2022)^[1], among others. These studies can help researchers focus on the missing information and identify future research directions. Another popular tool in Scientometrics is Citespace, which was developed by Professor Chen et al. (2004)^[7] at Drexel University, USA, and is mainly applied to scientific literature to identify and show new trends and developments in science. Citespace has several distinct advantages over other methods. For example, Citespace helps to identify intermediate centrality between key nodes in scientific articles, reflecting the importance of the nodes in the network. In addition, research frontier terminology can be provided to elucidate core concepts of co-citation clustering, thus gaining access to general knowledge areas and related networks. Finally, it is also possible to display publication times through time slices, presenting periods of citation bursts. Citespace has been widely used in recent years for electrochemiluminescent sensing technology (Liu et al., 2021)^[27], pediatric brain tumor research (Ozbek et al., 2022)^[13], blockchain research (Guo et al., 2021)^[19], and financial decision-making (Guo et al., 2022)^[18].

Finally, to enrich the exploration of the topic domain, potential Dirichlet allocation in machine learning is added to this paper. Latent Dirichlet Allocation (LDA), as a topic model based on Bayesian learning, is an extension of latent semantic analysis, probabilistic latent semantic analysis, and was introduced in 2003 by Blei et al^[3]. LDA is widely used in areas such as text data mining (Chen et al., 2019)^[7], image processing (Zhang et al., 2018)^[44] and bioinformatics processing (Kang et al., 2019)^[23]. The LDA model is a generative probabilistic model for text collections. Assuming that each text is represented by a polynomial distribution of topics and each topic is represented by a polynomial distribution of words, it is specifically assumed that the

prior distribution of the topic distribution of the text is a Dirichlet distribution and the prior distribution of the word distribution of the topic is also a Dirichlet distribution. The introduction of the prior distribution allows LDA to better cope with the overfitting phenomenon of topic model learning.

The contributions of this paper are mainly: (1) A quantitative analysis of the current state of global risk attitudes research, cocitation analysis, and outbreak detection, which provides scholars with a more comprehensive perspective on global risk attitudes research; (2) A visual presentation of the overall knowledge structure and emerging developments in global risk attitudes research, which helps scholars, especially beginners, to better understand this research area. To achieve these objectives, the paper is followed by the following: Section 2 presents the data collection, in which the sources of data and the corresponding operational processes and techniques are discussed. Section 3 focuses on the clustering of both cited literature and abstracts to analysis trends in global risk attitudes research. Section 4 uses Citespace to analysis the current state of global risk attitudes research by visualizing the number of issues, journals, authors, countries, institutions, and citations of global risk attitudes research in succession. Section 5 provides the main path analysis of global risk attitudes for burst detection and citations, providing information for potential research directions. Section 6 concludes, focusing on concluding the paper and an outlook for the future.

2. Data Collection and Processing

This sub-section first introduces the process of analyzing data using Citespace in terms of both data collection and research methodology, summarizing the process through an architectural diagram. This is followed by an introduction to the LDA text generation process and an understanding of how textual information can be used for topic clustering.

2.1 Analyzing Data with Citespace

Our primary source of data for this study is the Web of Science (WoS), a web-based multidisciplinary literature database created by Corevantage using the open internet environment, which includes SCIE (Science Citation Index Expanded), SSCI (Social Sciences Citation Index), A&HCI (Arts and Humanities Index), CPCI (Citation Index to Proceedings of Scientific Conferences) and other multi-seeded databases. Web of science is one of the most prestigious citation databases in the world, with a huge global reach and authority. A search for the research topic 'global risk attitudes research' brings up a total of 2160 articles. The data will be available for download from WoS on 1 November 2022. To make the process more intuitive, an architecture diagram is given in Figure 1 to show the details of the data analysis.

Figure 1 further supports the reasonableness of the results of the analysis by explaining some of the key terms and metrics to clarify how these techniques work. Below are specific explanations of some of the key indicators.

- Time slice: A method of dividing a period into a series of smaller windows.
- Threshold: Select the minimum or maximum value of the target during the visualization of the model.
- Top N: Select the top N articles that are highly cited.
- Top N%: Select the top N% of articles cited with high frequency.

- C, CC, CCV: Citations, co-citations, and cosine factors. CC(i, j) is the number of co-citations of reference i and reference j. C(i) and C(j) are their citation counts respectively. Assuming that the number of co-citations of reference i and reference j in a given period is 3, reference i is cited 5 times, and reference j is cited 6 times, then we have CCV =3/sqrt (5*6) \approx 0.548.
- Density: Ratio of actual relationships to maximum relationships in the network.

• Silhouette: A measure of homogeneity within clusters after clustering, the closer to 1, the better it reflects the clustering effect. Clustering results are efficient and reliable when the silhouette value is greater than 0.7, and the results are reasonable when their value is greater than 0.5.



Figure 1. Global risk attitudes research data analysis architecture diagram

2.2 Generating Text with LDA

To make the process of generating a collection of texts for LDA more intuitive, a flowchart is given in Figure 2 to illustrate it. The process can be divided into four steps: (1) Generate a random topic distribution for the text. (2) At each position in the text, generate a random topic based on the topic distribution for the text. (3) Generate a random word based on the word distribution for the topic at that position. (4) Generate the entire text up to the last position in the text. Repeat the above process for all texts.



Figure 2. LDA text generation process

3. Cluster Analysis of Cited Literature and Abstracts

This section mainly introduces the development trend of global risk attitudes research in terms of cited literature and abstract. This development trend can be analyzed more intuitively through the clustering map of co-cited literature constructed by Citespace and the LDA topic modeling of global risk attitude research abstracts.

3.1 Cluster Analysis of Literature Co-citation

This subsection illustrates the research focus and hot issues of global risk attitudes through cluster analysis of the cited literature. The location of clusters in the co-citation network and the associations between clusters show the structure of knowledge in scientific mapping, so it is easy to see the pulse of the whole mapping for more in-depth research on global risk attitude. Figure 3 shows the network of clusters in the global risk domain, which are labeled with index entries from their citers. Also, the different colored fields indicate when the co-citation connection for these fields first appeared, with the yellow fields being more forward than the red fields. In addition, a summary of the 10 largest clusters in the global risk attitudes study is shown in Table 1.

Table 1 shows the number of releases in the cluster, see Figure 3 for more details. for example, cluster (#0) has 71 members and it is the largest cluster in the global risk attitudes sector. The second cluster (#1) has 61 members and the third cluster (#2) has 47 members. On the other hand, Silhouette is a measure of the homogeneity of the clusters, and the higher the value of this

metric, the better the homogeneity. The log-Likelihood Ratio (LLR) is an algorithm that determines the maximum likelihood coefficient and finds the most likely words based on a probability density function. The size in Table 1 represents the average number of articles published per year for the cluster. As can be seen, categories 0, 1, and 2 are the main categories in the area of global risk attitude research, namely "public expectations", "controlled trials" and "hesitation in vaccination against novel coronavirus pneumonia". Overall, the clustering results are satisfactory based on the silhouette values in Table 1 and the color classification in Figure 3.



Figure 3. Clustering network of cited literature topics in global risk attitudes research

Cluster ID	Size	Silhouette	Label (LLR)	Mean (Year)
0	71	0.836	Public expectation	2011
1	61	0.912	Controlled trial	2013
2	47	0.953	Covid-19 vaccine hesitancy	2017
3	32	0.962	Hiv testing	2009
4	30	0.812	Extreme weather experience	2011
5	25	0.989	Warm weather	2000
6	21	0.963	Health care worker	2012
7	18	1.000	Urban Nigeria	2016
8	16	0.988	Pedestrian behavior	2015
9	15	0.952	Human health-what	2006

Table 1. Summary of the largest 10 clusters in global risk attitudes research

3.2 LDA Clustering and Visualization

In this subsection, the abstracts in each paper are further analyzed using the potential Dilley's allocation method for the themes of the global risk attitudes study. The main construction process of the LDA theme model for the global risk attitudes study is shown in Figure 4. the LDA-based theme modeling is a typical clustering technique, and to choose the optimal number of clusters, we make a judgment using a perplexity curve. In Figure 5, it can be seen that we are training different k values in the range of 1 to 15 clusters, and the perplexity reaches the optimum when the number of clusters is 6. Below we choose 6 clusters for analysis.



Figure 4. Flowchart of the LDA theme model for the global risk attitudes research



Figure 5. Confusion curves in global risk attitudes research

To visualize the top keywords for each cluster, we used LDAvis to describe the semantic distance maps between the seven clusters and their keywords. The trained LDA model was fed into LDAvis for keyword visualization. Figure 6 shows the results from LDAvis. There are two main parts of the results from LDAvis, the left part shows the semantic graphs on the clusters. It can be seen that the whole study can be divided into six themes: (1) major diseases; (2) behavioral influences between men and women; (3) climate change; (4) experimental investigations; (5) vaccination; and (6) sexual health. Firstly, the size of the circle corresponding to these six themes indicates the probability represented by this category, so that the theme with the highest heat is a serious illness, followed in order by behavioral impact between men and women, climate change, experimental inquiry, vaccination, and sexual health. Next, the distance between the circles corresponding to these six themes. The further the distance, the weaker the correlation, and the closer the distance, the stronger the correlation. This shows that behavioral influences between men and women are most strongly correlated with vaccination and

that there is an overlap. In addition, these two themes are also strongly associated with sexual health, experimental inquiry, and major diseases. According to Figure 6, it can also be seen that theme #3 climate change is more distant than the other five themes and therefore these five themes are less relevant to climate change.

The right-hand section shows the top 30 hottest keywords in each cluster after adjusting for l and the proportion of each

theme. l has a value between 0 and 1. When l is close to 1, it indicates that the words filtered for that topic are closer to the topics we trained on. Table 2 depicts the top 20 keywords in the six clusters with l = 1. As can be seen, the keywords corresponding to each theme have different relevance to each other, so we also further analyzed the themes according to the keywords corresponding to that theme, for example for the keywords "Woman", "Men" and "Sexual" under the influence of behavior between men and women in theme #2 with the keywords under theme #5 Vaccination Vaccine and the keyword HIV under theme #6 Sexual health have a strong correlation. To prevent HIV infection after sex between men and women, people would consider HIV vaccination. Since the development of an HIV vaccine is not yet mature, the willingness of sex between men and women and HIV vaccination will be influenced by risk attitudes, and the above analysis shows that the global risk attitudes study will intersect these major themes. In addition, the right-hand section shows the weight of each theme. For example, the first major theme, major diseases, accounts for 21.5% of the total themes.

The double cluster analysis of the co-cited literature and abstracts above gives us a more concrete picture of the hot themes in global risk attitude research, and in general, the main research directions fall into two categories, health, and climate, with health being the hotter. For scholars concerned with global risk attitudes, the health field could be used as an entry point for relevant research. Specifically, the impact between global risk attitudes and vaccines, sexual health, and influenza viruses, among others, could be examined to allow scholars to be more forward-looking in their research.



Figure 6. Thematic clustering map for global risk attitudes research

Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6
Patient	Woman	Change	Intervention	Vaccine	HIV
Community	Use	Climate	Patient	Among	Use
Knowledge	Gender	Global	Care	Child	Among
Method	Group	Research	Woman	Student	Testing
Food	Factor	Perception	Trial	Knowledge	Woman
Treatment	Men	Impact	Outcome	School	Prep
Disease	Age	Effect	Pregnancy	Vaccination	Participant
Practice	Behavior	Policy	One	Year	Men
Decision	Sexual	На	Method	Associated	Year
Need	Social	Environmental	Review	Reported	Sexual
Based	Among	Social	Use	Oral	Associated
Level	IPV	Factor	Low	Data	Partner
Cancer	Relationship	Public	Evidence	Participant	Test
Interview	Associated	Management	Group	Practice	Sex
Public	Used	Country	Participant	Parent	Stigma
Awareness	Violence	Human	Data	Smoking	Age
Survey	Model	Influence	Effect	Population	Related
Care	LA	Action	Included	Use	Reported
System	Based	Farmer	Clinical	Adult	Drug
Information	Adolescent	People	Healthcare	Age	Method

Table 2. Global risk attitudes study in the top 20 keywords in six clusters with l = 1

4. Visual Analysis of the Current Research Status of Global Risk Attitude

To clarify the current state of global risk research, this section combs the circulation, journal, author, country, institution, and cited literature of global risk attitude research. This research status is analyzed in detail by using Citespace to construct tables, visual network diagrams, and time diagrams.

4.1 Descriptive Analysis

To present the current status and development trend of global risk attitude research, this subsection mainly reviews the literature in this field. As can be seen from Figure 7, the topic of global risk attitudes is receiving increasing attention. The number of publications on global risk attitudes is increasing every year. It should be noted that there are still two months until the end of 2022, so the articles published in these two months are not available due to the retrieval delay, although it is expected that the number of articles published in 2022 will increase. More information is provided below.



Figure 7. Several publications of global risk attitudes research from 2003 to 2022

4.2 Visual Analysis of Journals and Authors in Global Risk Attitude Research

Table 3 and Figure 8 show that Plos One is the most prolific source, with 789 publications, representing 36.528% of the total number of publications. The scope of Plos One and the types of articles published include original research manuscripts in the natural sciences, medicine, engineering, and related social and humanities disciplines.

Sources	Number	The percentage of total
Plos One	789	36.528%
Lancet	737	34.120%
Bmc Public Health	585	27.083%
Soc Sci Med	467	21.620%
Am j Public Health	361	16.713%
Jama-j Am Med Assoc	350	16.204%
Bmj-brit Med j	319	14.769%
New Engl J Med	318	14.722%
Science	300	13.887%
Int J Env Res Pub He	257	11.898%

Table 3. Top 10 most productive sources in global risk attitudes research



Figure 8. Visual analysis of global risk attitudes research journals

Hundreds of scholars worldwide research global attitudes to risk. Table 4 shows the top ten most productive authors in the field. Catherine is the most prolific author. This author's main publication dates are 2018-2022. He focused on qualitative research on sexual health and bacterial infections, with a prominent contribution being the analysis of bacterial infection prevention from the standpoint of attitudes toward sexually transmitted infections. Figure 9 shows that the four authors Carl, Xuan, Cyrus, and Roger have collaborated more closely and that Catherine is the most prolific author, as can be seen by the largest circle, the outermost red color of which reflects the high number of articles published in recent years. The outermost red color of the circle reflects the high number of publications in recent years. According to Table 4, it is clear that Catherine is leading a new approach to the study of global risk attitudes today.

Authors	Publication number	The percentage of total
Catherine	13	0.602%
Rachel	12	0.556%
Roger	8	0.370%
Carl	8	0.370%
Cyrus	7	0.324%
Saad	6	0.278%
Anthony	6	0.278%
Xuan	6	0.278%
Susan	5	0.231%
Paula	5	0.231%

Table 4. Top 10 most productive authors in global risk attitudes research



Figure 9. Graph of the global risk attitudes research author collaboration network

4.3 Visual Analysis of Countries and Institutions in Global Risk Attitudes Research

The development of global risk attitudes research varies from country to country. Table 5 shows the top ten most productive countries in this study. The United States is the most productive country for global risk research, followed by the United Kingdom, Australia, China, Canada, South Africa, Germany, the Netherlands, Sweden, and Switzerland.

Countries	Number	The percentage of total	
USA	867	40.139%	
ENGLAND	421	19.491%	
AUSRALIA	278	12.870%	
PEOPLES R CHINA	186	8.611%	
CANADA	160	7.407%	
SOUTH AFRICA	128	5.926%	
GERMANY	108	5.000%	
NETHERLANDS	100	4.630%	
SWEDEN	98	4.537%	
SWITZERLAND	88	4 074%	

Table 5. Top 10 most productive countries in the global risk attitudes research



Figure 10. Graph of the global risk attitudes research country cooperation network

Figure 10 shows that the United States has been working more closely with the United Kingdom, the Netherlands, and South Africa in the study of global risk attitudes. The United States collaborates more closely with the United Kingdom, the Netherlands, and South Africa, and the largest circle for the United States also shows that it has published the most articles. China collaborates more with Australia, Sweden, and Japan, and the red color of the outermost circle for China is significant, which indicates that China has published more articles in recent years and is gradually paying more attention to this direction. As financial markets were established earlier in Western countries, economic development in these countries is more regulated and mature. Table 6 shows that North Carolina State University in the USA has the highest number of publications in global risk attitudes research with 88 publications. The second is the University of Melbourne in Australia and the third is the London School of Medicine in the UK. Of the top 10 institutions in Table 6, five are from the USA, three are from the UK as well as two are from Australia. However, China, Canada, South Africa, Germany, the Netherlands, Sweden, and Switzerland are the most productive countries in terms of global research on risk attitudes, but these countries do not have productive research institutions. This means that China should take more steps to develop a global risk attitudes institute, and it is essential to establish a special department for research on global risk attitudes.

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Countries	Number	The percentage of total	
North Carolina State University	88	4.074%	
University of Melbourne	80	3.703%	
The London School of Hygiene & Tropical Medicine	71	3.287%	
University College London	61	2.824%	
University of California, San Francisco	55	2.546%	
University of Oxford	47	5.926%	
University of Sydney	44	2.037%	
University of Washington	43	2.037%	
Duke University	35	1.620%	
Harvard University	35	1.620%	

Table 6. Top 10 most productive institutions in global risk attitudes research

4.4 Visual Analysis of the Cited Literature in Global Risk Attitude Research

Figure 11 shows the schedule of the top 10 cited articles in each year. This provides an intuitive and accurate way to understand the derivation path of each subfield. It can be learned that there are many significant achievements in global risk attitudes research from 2004 to 2020. These studies mainly explore the two themes of "climate change" and "vaccine". The discussion on climate change is carried out in the context of the accelerated melting of global glaciers due to global warming and frequent extreme weather in the 1990s. The representative papers mainly include, Dietz et al. (2005)^[12] introduced values into environmentally sustainable development for the first time, and proposed that values have an important impact on environmental issues. McCright & Dunlap (2011)^[30] studied the political polarization of the American public on the issue of climate change by analyzing data from 10 nationally representative Gallup polls between 2001 and 2010. Corner et al. (2014)^[9] extended Dietz's theory and further analyzed how values affect the public's participation in climate change. The discussion on vaccine was mainly conducted against the background of a survey on the causes of vaccine hesitation conducted by the World Health Organization (WHO) in 2014. It varies by time, place and vaccine. From the perspective of motivated reasoning (Hornsey et al., 2018)^[21], the psychological factors that may prompt people to reject the scientific consensus on vaccination have been studied, providing important data for identifying the root causes of vaccine skepticism. The outbreak of COVID-19 in 2020 posed a serious threat to people's lives around the world. Vaccination is the most direct and effective protective measure to achieve herd immunity. However, the use of vaccine by the public is affected by some wrong signals about the use of vaccine. Thus (Roozenbeek et al., 2020)^[41] proposed that there is a clear link between susceptibility to misinformation and vaccine hesitating and the reduced likelihood of compliance with health guidance measures. The analysis of the cited literature shows that scholars' research on risk attitudes has shifted from climate change to vaccine use, and they continue to deepen their research on it.



Figure 11. Schedule of the top 10 cited global risk attitudes research articles for each year

5. Burst Detection in Global Risk Attitudes Studies and the Co-occurrence Analysis

of Their Keywords

Burst detection allows articles that have received particular attention from the relevant scientific community at a certain time to be found quickly. Of interest is the fact that clusters of studies containing a certain number of articles with citation bursts can be considered a new research area. To reveal potential research directions, this subsection selects references and keywords with citation outbreaks and co-occurrence analysis of keywords to explain the focus of global risk attitudes research in different periods.

5.1 References and Keywords for Burst Detection

Table 7 shows the top 20 references with the strongest citation bursts. In the last column, the length of the line represents the period from 2003 to 2022, where the red line indicates the period of the citation burst. More bursts occur in the second half of the whole period. The top ranking in Table 7 is Kahan et al. $(2012)^{[22]}$ with an outbreak intensity of 5.0562, followed by McCright & Dunlap $(2011)^{[30]}$ with an outbreak intensity of 4.2784.

References Year	Strength	Begin	End	2003-2022
Kahan, 2012	5.0562	2015	2019	
McCright, 2011	4.2784	2013	2017	
Cohen, 2016	3.2835	2013	2015	
Bord, 1998	3.2098	2004	2006	
Lim, 2012	3.1922	2014	2017	

Table 7. The top 20 citation bursts with the strongest global attitudes risk research references.

Moher, 2009	3.1096	2014	2016	
Brulle, 2012	3.0213	2015	2019	
Spence, 2012	2.9796	2016	2018	
Lorenzoni, 2007	2.9403	2011	2015	
Higgins, 2012	2.8873	2015	2016	
Fishbein, 2010	2.8652	2016	2017	
Boykoff, 2004	2.8110	2006	2011	
Dohmen, 2011	2.7815	2017	2018	
Myers, 2012	2.6308	2015	2018	
McCright, 2011	2.5920	2013	2015	
O'Connor, 1999	2.5660	2004	2006	
Dunlap, 1998	2.5660	2004	2006	
Egan, 2012	2.5422	2014	2015	
Kellstedt, 2008	2.5193	2014	2016	
Lorenzoni, 2006	2.4460	2009	2011	

Both Tables 8 and 9 reflect the top 20 keywords that exploded, and they reflect the rapidly growing topic in global risk attitude research. Different burst keywords represent the corresponding characteristics of each time period. Table 8 is sorted by intensity, from which it can be seen that adherence ranks first with an outbreak intensity of 6.7209, followed by risk behavior with an outbreak intensity of 6.1728. The results show that the keywords "adherence" and "risk behavior" have great influence and are two very important indicators in the study of global risk attitudes, which are frequently used by relevant scholars. Table 9 is sorted by time. The hot keywords in the next few years were "Condom use", "HIV/aid", "Primary care" and "Outbreak", all of which corresponded to the same theme: Vaccines. Scholars initially discussed about the prevention of AIDS, and the corresponding hot keywords were "Condom use" and "HIV/aid". Then the global outbreak of COVID-19 shifted the discussion of vaccines to preventing infection. In this context, "Primary care" and "Outbreak" have become hot words in the new era, and vaccination has gradually become an important public health intervention measure recognized by the WHO.

Table 8	. Top	20	keyword	s for t	the expl	losion oj	f globc	ıl attitud	les risk	research	h
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Keywords	Strength	Begin	End	2003-2022
Adherence	6.7209	2011	2016	
Risk behavior	6.1728	2013	2016	
Outbreak	5.4646	2020	2022	
Adolescent	5.3577	2008	2012	
Randomized controlled trial	4.9205	2008	2017	
Primary care	4.8624	2017	2019	<mark></mark>
Condom use	4.7927	2005	2016	

Smoking	4.6462	2010	2012	
Reduction	4.5520	2019	2020	
Technology	4.5520	2019	2020	
HIV/aid	4.4926	2009	2017	
Exposure	4.4505	2010	2013	
Policy	4.2789	2010	2016	
Tanzania	4.2330	2016	2018	
Climate change	4.2112	2004	2009	
Uncertainty	4.0579	2011	2017	
Personality	3.9780	2020	2022	
Quality of life	3.9648	2011	2016	
Information	3.9369	2015	2018	
Social media	3.9191	2018	2020	

Table 9. Top 20 keywords for the explosion of global attitudes risk research

Keywords	Strength	Begin	End	2003-2022
Climate change	4.2112	2004	2009	
Condom use	4.7927	2005	2016	
Adolescent	5.3577	2008	2012	
Randomized controlled trial	4.9205	2008	2017	
HIV/aid	4.4926	2009	2017	
Smoking	4.6462	2010	2012	
Exposure	4.4505	2010	2013	
Policy	4.2789	2010	2016	
Adherence	6.7209	2011	2016	
Uncertainty	4.0579	2011	2017	
Quality of life	3.9648	2011	2016	
Risk behavior	6.1728	2013	2016	
Information	3.9369	2015	2018	
Tanzania	4.2330	2016	2018	
Primary care	4.8624	2017	2019	
Social media	3.9191	2018	2020	

Reduction	4.5520	2019	2020	
Technology	4.5520	2019	2020	
Outbreak	5.4646	2020	2022	
Personality	3.9780	2020	2022	

5.2 Main Path Analysis of Citations

Figure 12 shows a master path diagram of global risk attitudes research, with four papers appearing on the master path and being cited over 20 times in the WoS citation database. It follows the most original method of master pathway generation, demonstrating the diffusion of knowledge in global risk attitudes research and helping researchers to capture the backbone of knowledge and gain a comprehensive understanding of the dynamics of global risk attitudes research over the last 20 years. The generated master path does not show representative papers from the post-2019 period due to the short period since the novel coronavirus context, resulting in less impact. To make the research dynamics more complete, this paper will analyze the post-2019 research dynamics in conjunction with a timeline graph of keywords.



Figure 12. Master pathway map for global risk attitudes research

First, there are several branches of the main pathway's source, which represent some representative papers generated by the source and are analyzed specifically below. Palutikof et al. (2004)^[35] collected information on attitudes towards warm weather anomalies, the perceived risks and benefits of recent extreme weather, and the perceived and potential risks and benefits of such anomalies becoming more common in the future, examining the impacts of extreme weather from the perspective of public risk perception. Bickerstaff et al. (2004)^[2] conducted an innovative study in the area of public risk perception, looking at the public's experience of air pollution from a sociocultural perspective, revealing the degree of convergence between the findings obtained

in the areas of psychological and sociocultural risk perception, and evaluating the scientific and policy relevance of risk perception research to the management of risk assessment. Eiser et al. (2004)^[16] provided an overview of public risk perceptions in terms of attitudes, decision-making, learning and social influence, examined how people make judgements about possible future uncertain events and how they make decisions to achieve desired outcomes and avoid surprises. Palmgren et al. (2004)^[34] used two studies to assess public perceptions of proposals to avoid releasing carbon dioxide from power plants into the atmosphere and instead inject it into deep geological formations or the deep ocean. Poortinga & Pidgeon et al. (2004)^[36] used a questionnaire on genetically modified foods in the UK to suggest that the impact of self-reported trust varies depending on people's attitudes to the risks of the issue. The impact of self-reported trust varies. Poortinga et al. (2004)^[37] examined public attitudes to risk and management during the 2001 foot-and-mouth epidemic in the UK through a comparative study of two communities, suggested that differences in local experiences and the context of debates about the crisis in the two communities contributed to differences in trust and risk attitudes. Poortinga et al. (2019)^[38] used representative public surveys as a criterion in predicting the outcomes of complex design decisions, and used public attitudes towards risk as an important measurement objective.

Next, the papers on the main pathway are analyzed. Lorenzoni & Pidgeon (2006)^[28] situated public perceptions of climate change in the context of where people were located, such as in Europe and the US, and discussed them in terms of trust and responsibility for climate change action and risk communication to gain policy insights on how different populations respond to the dangers of climate change. Whitmarsh (2011)^[43] argued that political beliefs and values are more important than being influenced by education or knowledge in determining beliefs and skepticism about climate change. He also noted that different types of skepticism are interrelated and that climate skepticism is rooted in people's core values and worldviews. The fourth paper on the main pathway, Poortinga et al. (2019)^[38] provided a cross-sectional study of the impact of individual-level factors on climate change from the perspective of cross-national differences, suggested that the direction of the association between individual-level factors and climate change was roughly the same across countries, but the magnitude of the impact was inconsistent. An analysis of the above papers showed that prior research on global risk attitudes has focused mainly on climate change. The research on risk attitudes has evolved from a discussion of their importance to an examination of risk attitudes and perceptions from different perspectives, reflecting the increasing depth and innovation of research on global risk attitudes and climate change.

Finally, the research dynamics of global risk attitudes after 2019 are analyzed through the time plot of keywords. It can be seen from Figure 13 that before 2019, the research on the combination of global risk attitudes and vaccine mainly focused on HIV vaccine vaccination, and the corresponding keywords are "men" and "HIV injection". The hot topic after 2019 is COVID-19, which is consistent with our sudden detection results for the keywords above, which stemmed from the global outbreak of COVID-19. The keywords corresponding to this topic are mainly "COVID-19 vaccine", and the related ones are "death", "prognosis", "health behavior" and "health policy". The succession of these keywords shows that the research on the combination of global risk attitudes and COVID-19 has been deepened from some adverse symptoms caused by COVID-19 to death caused by COVID-19, from some health policies introduced to vaccination to prevent COVID-19 infection, which provides relevant research thoughts for later scholars.



Figure 13. Keyword timelines for the research of global risk attitudes

6. Conclusions

Based on the above LDA topic modeling of global risk attitude research and the Scientometrics review and main path analysis using Citespace, the following conclusions are drawn: (1)The US, UK, Australia and China are the four most productive countries. North Carolina State University, the University of Melbourne, Australia, and the London School of Medicine are among the most productive institutions in the global study of risk attitudes. Based on the above information, we can understand the development degree of global risk attitudes research in various regions. Catherine is the world's most prolific author in the field of risk attitudes. In the future, scholars studying this aspect can refer to some of Catherine's research methods, supplement and improve some conclusions obtained by Catherine, and obtain some innovative findings. (2) Critical diseases, behavioral influences between men and women, climate change, experimental inquiry, vaccination and sexual health are the most popular topics in global risk attitudes research. According to the current research status of global risk attitudes, future research can be conducted on the theme of people's attitudes toward vaccination after COVID-19 infection to explore whether there are new changes in these people's attitudes toward vaccination. (3) In the research on the theme of global risk attitude and vaccine, combining the keywords of "public expectation", "controlled trial", "COVID-19 vaccination hesitation", "pedestrian behavior" and "human health" obtained by clustering and burst detection, it can be found that vaccine hesitation is still the most popular research direction in the research on global risk attitude at present. In 2019, the WHO released a report indicating that vaccine hesitation is one of the top ten health threats facing global health, so it is very forward-looking to conduct research in this direction.

This article provides an overview of the current situation and future trends of global risk attitudes research from different perspectives of bibliometric analysis, offering the reader an overview of the hot dynamics of the past decades. The visual analysis and overview of global risk attitudes research articles, on the one hand, provides a direction for global risk attitude research in China and help to bring global risk research in China to maturity. On the other hand, it provides an insight into the

current state of research in various countries, and more attention should be paid to some countries that have not achieved much in global risk attitudes research.

Disclosure Statement

No potential conflict of interest was reported by the author(s).

Data Availability

All data included in this study are available upon request by contact with the corresponding author.

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