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The research landscape of ferroptosis in cognitive function: A bibliometric and visualized analysis

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Abstract: *Ferroptosis, which is a new form of cell death distinct from apoptosis, necrosis and autophagy, is gradually gaining widespread attention in various research fields. There is now evidence from several studies that ferroptosis plays an important role in altered cognitive function. We used the Web of Science Core Collection (WoSCC) to search for "ferroptosis" and "cognitive function" as subject terms. A total of 37 published papers were included after filtering and deduplication were performed. CiteSpace (V6.1.R6) was used for bibliometric analysis and visualization to summarize the content and development process of the ferroptosis research in the field of cognitive function and to identify the current and possible future research hotspots and directions. The results show a rapidly increasing trend regarding studies related to cognitive function associated with ferroptosis. China is the world leader in terms of the number of studies and institutions publishing on related topics, with the United States at the center. There is less collaboration between researchers and institutions in this field. At present this research centers on the roles that oxidative stress, lipid peroxidation, and iron-related accumulation and regulation play in cognitive function, as well as their impacts, and these areas are likely to continue to be research hotspots in the future.*

Keywords: *ferroptosis; cognitive function; bibliometric; visualization, CiteSpace*

1. Introduction

In 2012, the concept of ferroptosis was introduced by Dixon SJ et al. Ferroptosis, as opposed to apoptosis, necrosis, and autophagy, is a novel form of cell death regulation in which intracellular iron causes lipid peroxides to accumulate to toxic levels [1]. It has been shown to be associated with pathological changes, including neurological changes and ischemia/reperfusion, in a variety of tissues and organs, including tumors [2]. Based on early molecular studies, most of the explanations and studies on the mechanism of ferroptosis have focused on cysteine and glutathione metabolism and the ability of phospholipid peroxidase to prevent peroxidation [3]. Ferroptosis has been shown to play an important role in Alzheimer's disease (AD) [4] and Parkinson's disease (PD) [5] in studies of cognitive function and neurological disorders. It is reasonable to assume that ferroptosis plays an important driving role in disorders related to bipolar disorder, cognitive schizophrenia and depression [6].

This study uses CiteSpace software for bibliometric analysis and visualization methods to explore not only the overall research content in the relevant field and its dynamic process over time but also to identify important research topics, researchers and important research results that have been published in the field in different time periods [7]. Therefore, the purpose of this study is to summarize and visualize the content and development of ferroptosis research in the field of cognitive function, to identify current and possible future research hotspots and directions and to provide suggestions for future research in this field.

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2. Methods

2.1 Data Source

All data were retrieved from the Web of Science Core Collection (WoSCC) on January 12, 2023. The literature search formula utilized was (Topic Search="cognitive function" AND Topic Search = "ferroptosis"). Only "Article" was selected as the type of literature, and the publication period was from 2014 to 2022. The titles and abstracts of the retrieved articles were examined to ensure that the included literature met the requirements, and a total of 37 articles were finally adopted.

The "full records and cited references" of the above literature were exported in "plain text file" format through WoSCC, and then filtered by using CiteSpace software with the "title" of the article as the basis for deduplication. Thirty-seven filtered papers were finally obtained and included in the subsequent analysis.

2.2 Data Analysis

The number of published papers and their trends over time were described and presented using Excel (2021). CiteSpace (V6.1.R6) was used to convert the format, deduplicate and filter the preliminary data, calculate the mediated centrality of authors, keywords, countries, institutions and cocited documents, draw author, institution, country and keyword co-occurrence maps, keyword clustering, Landscape View, and time-zone distribution maps and perform emergent analysis of keywords and cocited documents.

The number of CiteSpace Years per Slice function was set to “1 year” and different objects were selected. The mapping pruning algorithm was selected as the “Pathfinder” algorithm along with “Pruning slice networks.” Keyword clustering was conducted using the log-likelihood ratio (LLR) method. We selected the most representative keywords of this type of group as the label for this type of group. The sizes of the nodes in the graph reflects their counts relative to other nodes in the graph, and marking a nodes is marked with a purple circles indicates that that nodes has a high (not less than 0.1) centrality. The node linkage color corresponds to the time year shown in the legend above the map.

3. Results

3.1 Annual Publishing Trends

As determined by the search formula, the earliest article in WoSCC on ferroptosis and cognition-related topics was published in 2014, and no studies on related topics were published in the next two years. As determined by the search formula, the earliest article in WoSCC on ferroptosis and cognition-related topics was published in 2014, and no studies on related topics were published in the next two years. The publications stabilize at a smaller number during the period 2017-2020 period, during which time, with the greatest number of articles were published in 2019 (3 articles). However, there is significant research growth in 2021 and 2022, as the growth is 4 and 4.5 times higher than that in 2019, respectively. See Figure 1.

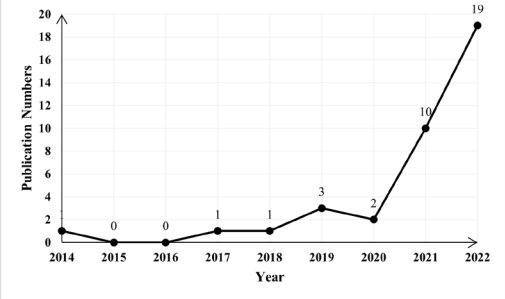

Figure 1: Annual publishing trends, 2014-2022

3.2 Publication of journals

Among the top five journals in terms of the number of articles published, we found that the five journals “CNS NEUROSCIENCE THERAPEUTICS”, “FREE RADICAL BIOLOGY AND

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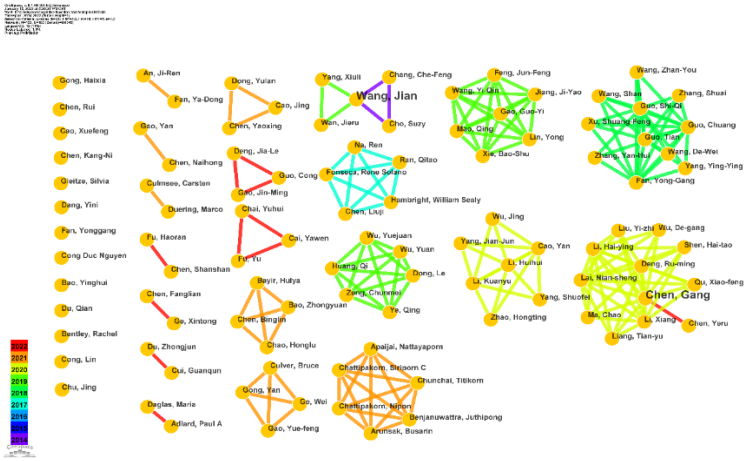
MEDICINE", "FRONTIERS IN AGING NEUROSCIENCE", "NEUROCHEMICAL RESEARCH", and "REDOX BIOLOGY" all published three articles on related topics. "JOURNAL OF NEUROINFLAMMATION" published two articles, and the remaining journals published one article each. "REDOX BIOLOGY" had the highest impact factor (IF: 8.101 (2021)). See Table 1.

Table 1: Publication of journals

Rank	Journal	Counts	IF(2021)	Research Areas
1	CNS NEUROSCIENCE THERAPEUTICS	3	7.035	Neurosciences & Neurology;Pharmacology & Pharmacy
2	FREE RADICAL BIOLOGY AND MEDICINE	3	8.101	Biochemistry & Molecular Biology;Endocrinology & Metabolism
3	FRONTIERS IN AGING NEUROSCIENCE	3	5.702	Geriatrics & Gerontology;Neurosciences & Neurology
4	NEUROCHEMICAL RESEARCH	3	4.414	Biochemistry & Molecular Biology;Neurosciences & Neurology
5	REDOX BIOLOGY	3	10.787	Biochemistry & Molecular Biology

3.3 Author Cooperation

Only two authors, Chen, Gang and Wang, Jian, cooperated with other scholars twice, while the remaining authors did not cooperate with other scholars multiple times. Chen, Gang showed a strong centrality among all scholars of related content studies (C=0.01). See Figure 2.



Note: The chart is arranged from left to right according to the number of times multiple scholar engaged in cooperative research.

Figure 2: Cooperation between authors

3.4 Country Cooperation

By counting the countries of the authors of the articles, it was found that scholars from only ten countries published relevant articles, with the largest number of nodes in China (29). Publications from China far exceeded the second place country, i.e., United States (6); additionally, China showed a strong centrality among all countries (C=0.06) and was the earliest (2014) to publish findings related to ferroptosis and cognitive function. See Table 2.

Table 2: Cooperation between Countries

Rank	Country	count	centrality	year	Rank	Country	count	centrality	year
1	PEOPLES R CHINA	29	0	2018	**6**	BELGIUM	1	0	2021
2	USA	6	0.06	2014	**7**	RUSSIA	1	0	2021
3	THAILAND	1	0	2021	**8**	SOUTH KOREA	1	0	2022
4	AUSTRALIA	1	0	2022	**9**	SWITZERLAND	1	0	2021
5	GERMANY	1	0	2021	**10**	CHILE	1	0	2021

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3.5 Institutional Cooperation

Both Nanjing Medical University and Shanghai Jiao Tong University appeared three times, and Nanjing Med University had strong centrality (0.01) and was at the core of research institutions in this field. Cooperation between Tianjin Medical University General Hospital, China Agricultural University, Northeastern University, Johns Hopkins University, Jilin University, and Nanchang University occurred twice, with the remaining occurrences of cooperation between different countries occurring only once and with low correlation. See Figure 3.

Note: The chart is arranged from left to right according to the number of cooperation instances.

Figure 3: Cooperation between Institutions

3.6 Subject Category Information

A statistical analysis of the subject category areas covered by the published literature shows that the greatest number (14) of articles were in the field of NEUROSCIENCES, with BIOCHEMISTRY & MOLECULAR BIOLOGY and PHARMACOLOGY & PHARMACY ranking second (13) and third (10), respectively, in terms of the subject areas, far exceeding the others. In addition to the three mentioned above, the disciplines in which research on this topic is central include MEDICINE, RESEARCH & EXPERIMENTAL, CHEMISTRY, MEDICINAL and FOOD SCIENCE & TECHNOLOGY. The earliest relevant research was published in the fields of NEUROSCIENCES and CLINICAL NEUROLOGY (2014). See Table 3 and Figure 4.

Table 3: Subject Category Information

Rank	Institution	count	centrality	year
1	NEUROSCIENCES	14	0.69	2014
2	BIOCHEMISTRY & MOLECULAR BIOLOGY	13	0.7	2017
3	PHARMACOLOGY & PHARMACY	10	0.34	2019
4	MEDICINE, RESEARCH & EXPERIMENTAL	3	0.17	2019
5	CHEMISTRY, MEDICINAL	3	0.07	2021

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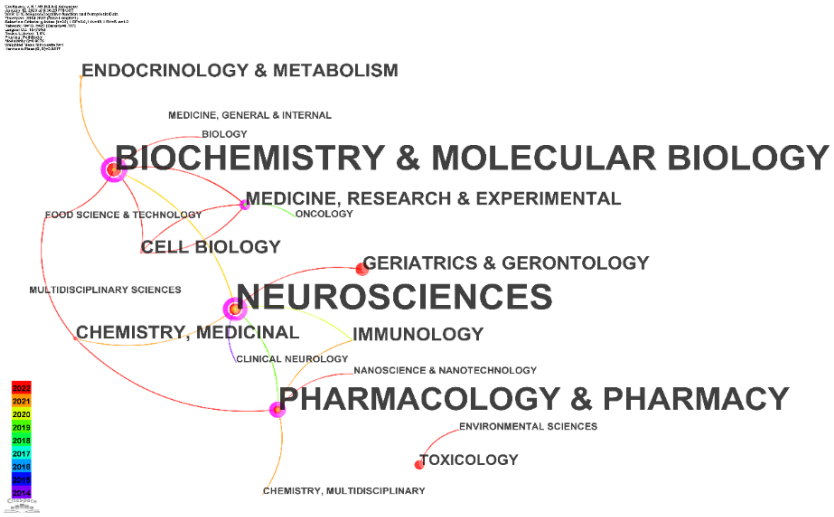

Figure 4: Subject area association

3.7 Subject Category Information

After excluding "ferroptosis" and "cognitive impairment", the most frequently occurring keyword was " oxidative stress" (16 times), and the keywords that appeared together in the article included "apoptosis", "neuroinflammation", "memory", "lipid", "cognitive impairment", "memory", "lipid peroxidation", "inflammation", "glutathione peroxidase 4", "Alzheimer's disease", "neuron", " amyloid precursor protein", "alpha-lipoic acid", "death" and "peroxidation". The next most frequently used keyword was "Alzheimer's disease" (12 times), and the keywords it co-occurred with were "central nervous system", "central nervous system", "central nervous system", "microglia", "ferroptosis inhibitor", "lipid peroxidation", "transgenic mice", "glutathione peroxidase 4", "cell death", "cell", "amyloid precursor protein", "calcium release channel", "treatment option", "alpha-lipoic acid"、 "brain", "neuronal loss", "iron", "neurofibrillary tangle", "mouse model", "blood brain barrier" and "alpha synuclein aggregation". The rest of the keywords appeared less than 10 times. Sixty-one (49.6%) of all keyword occurrences had a centrality ≥ 0.01, showing a high research status and strong relevance. See Table 4.

The keyword co-occurrence map shows that today (2022), the co-occurrence of the keywords "oxidative stress"-"glutathione peroxidase 4", "iron " - "dysfunction" - "accumulation" - "cognitive impairment " and "mechanism"-"impairment" were the three "critical paths" of keyword co-occurrence. See Figure 5.

Table 4: Top ten keyword co-occurrences

Rank	Keyword	Count	Centrality	Year
1	oxidative stress	16	0.22	2018
2	alzheimers disease	12	0.17	2017
3	ferroptosis	9	0.09	2020
4	cognitive impairment	9	0.35	2017
5	iron	8	0.26	2014
6	impairment	8	0.11	2020
7	expression	7	0.09	2019
8	cell death	7	0.38	2017
9	brain	6	0.04	2018
10	lipid peroxidation	6	0.07	2018

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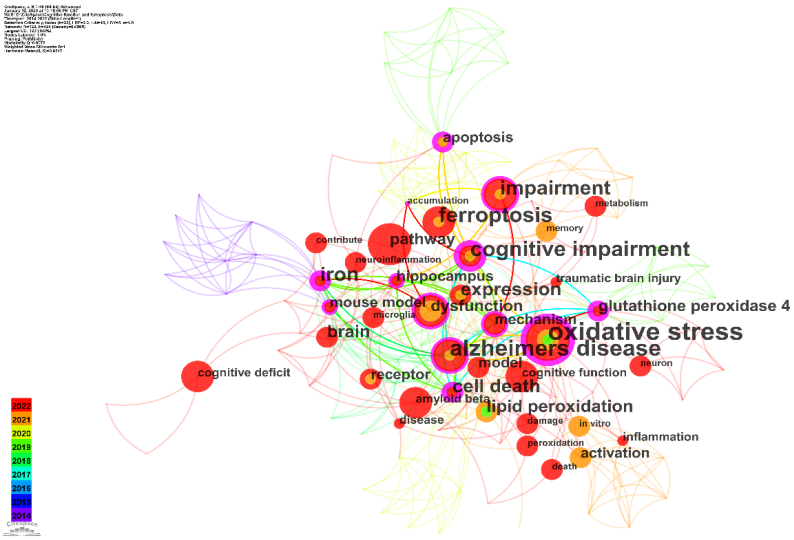

Note: The paths composed of keywords with darker and obvious connecting lines in the figure are critical paths, highlighting the connections between nodes with higher centrality.

Figure 5: Keyword co-occurrence and critical path situation

3.8 Keyword Clustering

A total of 9 clusters were obtained by keyword clustering calculation, and the silhouette values were all >0.7, which indicated a good clustering effect. The largest number of keywords is #0, which represents the keyword "neurodegeneration" and contains 25 main keywords. The class groups with the closest mean year to the present day (2022) are #5 and #6, whose class groups are represented by the words "neuron" and "deferiprone", respectively. See Table 5.

The keyword clustering landscape view showed an increasing trend compared to 2021, with class clusters numbered #1, #3, #4, #6 and #7, whose class clusters represented the words "lipid peroxidation", "cognitive function ", "stroke incidence", "deferiprone", and "lipid ros accumulation ". See Figure 6.

Table 5: Clustering of keywords

cluster ID	Size	Silhouette	Mean (year)	Representative terms(LLR)	Keywords
#0	25	0.929	2019	neurodegeneration	neurodegeneration; cognitive impairment; alpha-lipoic acid; aging brain; acyl-
#1	16	0.799	2020	lipid peroxidation	lipid peroxidation; glutathione peroxidase; amyloid beta; transient forebrain ischemia; cell death recommendation
#2	16	0.954	2020	cluster	cluster; immune characteristics; drosophila ortholog; nomogram; acsl4
#3	15	0.79	2019	cognitive function	cognitive function; liproxstatin-1; kainic acid; temporal lobe epilepsy-rats; gpx4
#4	14	0.941	2016	green tea catechin	green tea catechin; heme oxygenase 1; stroke incidence; 5xfad mice; caspase activation
#5	10	0.862	2021	neuron	neuron; anesthesia; chronic posttraumatic brain damage; pocd; mib2
#6	10	0.797	2021	deferiprone	deferiprone; chelator; astrogliosis; neuropathology; behavioural deficits
#7	9	0.943	2019	lipid ros accumulation	lipid ros accumulation; traumatic brain injury (tbi); iron accumulation; alzheimers disease; ferroptosis
#8	8	0.807	2020	liraglutide	liraglutide; diabetic cognitive impairment; inflammation; iron overload; tsg

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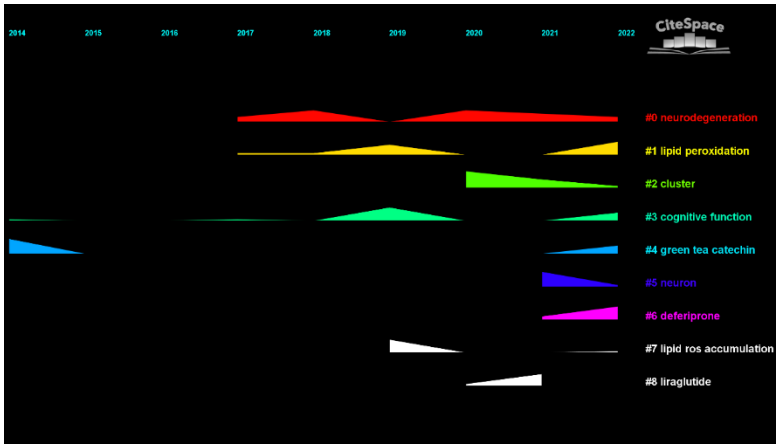

Figure 6: Landscape view of clusters

3.9 Keyword time-zone map

The largest number of keywords (32) was found to appear for the first time in 2022 in the published literature exploring ferroptosis and cognitive impairment. In 2014, the keywords "iron" and "mouse model" appeared more frequently than other keywords for the first time. In 2017, "Alzheimer's disease", "cognitive impairment", "cell death" and "glutathione peroxidase 4" were the first and most frequently used keywords. In 2018, "oxidative stress" and "lipid peroxidation" appeared for the first time and with high frequently. The keywords that appeared for the first time and with high frequency in 2019 were "expression", "apoptosis", "hippocampus", "model", "mechanism" and "traumatic brain injury". The keywords that appeared for the first time and were most prominent in 2020 were "impairment", "autophagy", "accumulation", "disruption" and "deferoxamine". In 2021, with "dysfunction", "activation", "receptor", "inflammation", "disease", "memory", "blood brain barrier" and "in vitro" were the keywords appearing for the first time and with high frequency. The keywords appearing with high relative frequency for the first time in 2022 are "pathway", "cognitive deficit", "cognitive function " and "amyloid beta". See Figure 7.

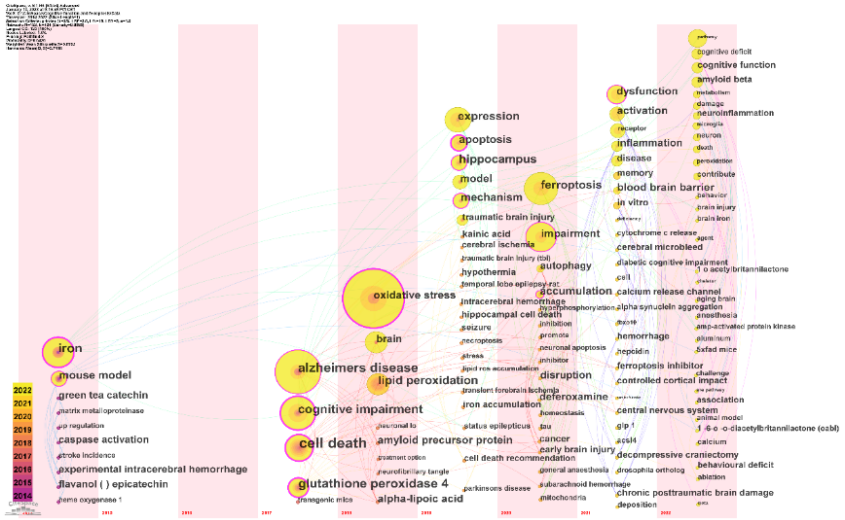

Figure 7: Keyword time-zone map

3.10 Keyword Bursting

The keyword burst analysis revealed that the research keywords with the longest sustained bursts were "mouse model" and "iron" (2014-2018). However, research on "lipid peroxidation" has remained in a research burst since 2018. See Figure 8.

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Figure 8: Burst situation of Keywords

3.11 Cocited and Burst of Reference

An analysis of cocited references revealed that "Ablation of the iron sagging regulator glutathione peroxidase 4 in forebrain neurons promotes cognitive impairment and neurodegeneration", which was published in the journal “Redox biology”, had the highest number of cocitations in this research area, with 13 citations. “Ablation of the Ferroptosis Inhibitor Glutathione Peroxidase 4 in Neurons Results in Rapid Motor Neuron Degeneration and Paralysis” published in the “JOURNAL OF BIOLOGICAL CHEMISTRY” in 2015 had the highest centrality (C=0.47). See Table 6.

The analysis of cocited reference bursts shows that there are currently three papers in a cocited literature burst, and the paper in a burst thus far from 2019 is "Ferroptosis: A Regulated Cell Death Nexus Linking Metabolism, Redox Biology, and Disease", which was published in the journal of “CELL”. The papers that have been in blast status since 2020 to date are "Ischemia-induced ACSL4 activation contributes to ferroptosis-mediated tissue injury in intestinal ischemia/reperfusion" and "Ferroptosis: past, present and future" published in “CELL DEATH AND DIFFERENTIATION” and “CELL DEATH & DISEASE” in 2020. See Figure 9.

Table 6: Top five cocited references

Rank	Title	Frequency	Centrality	Year	Source Journal
1	Ablation of ferroptosis regulator glutathione peroxidase 4 in forebrain neurons promotes cognitive impairment and neurodegeneration	13	0.2	2017	REDOX BIOLOGY
2	Ferroptosis: A Regulated Cell Death Nexus Linking Metabolism, Redox Biology, and Disease	8	0	2017	CELL
3	ACSL4 dictates ferroptosis sensitivity by shaping cellular lipid composition	8	0.28	2017	NATURE CHEMICAL BIOLOGY
4	Inhibition of neuronal ferroptosis protects hemorrhagic brain	7	0.18	2017	JCI INSIGHT
5	Inhibition of ferroptosis attenuates tissue damage and improves long-term outcomes after traumatic brain injury in mice	6	0.03	2019	CNS NEUROSCIENCE & THERAPEUTICS

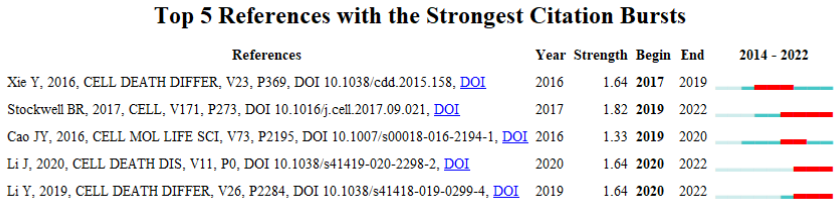

Figure 9: Cocited references breaking out

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4. Discussion

According to the annual publication trends, although there are fewer studies related to cognitive function when the concept of ferroptosis was first introduced, with the development of the concept and its study in multidisciplinary fields and according to the publication trends over the last two years, it can be expected that the number of studies related to ferroptosis in cognitive function will continue to increase in 2023 compared to the number of publications in 2022. The research disciplines involved continue to focus on neuroscience, biochemistry and molecular biology, and pharmacology, and the academic results on these related topics are published more in journals and on online platforms.

4.1 Author co-occurrence analysis

In a study published in 2021, Chen, Gang of the Department of Neurosurgery, Soochow University Hospital and the Laboratory of Brain and Neurological Research, Soochow University, First Affiliated Hospital, Suzhou, China, who is among the two prominent authors engaging in collaborative study, demonstrated that acyl coenzyme A synthase long-chain family member 4 can exacerbate early brain injury-induced subarachnoid hemorrhage by mediating ferroptosis through the establishment of a rat model of subarachnoid hemorrhage [8]. In a subsequent study, sevoflurane administration was shown to cause cognitive impairment due to mitochondrial dysfunction and dysregulation of iron homeostasis as assessed by chromosomal function, mitochondrial lipid peroxidation and ferroptosis in adult mice after sevoflurane inhalation and after deferiprone treatment. Protection of mitochondrial function and chelation of neurotoxic iron can effectively reverse these pathological processes [9].

Wang, Jian of Hopkins University School of Medicine, USA, constructed a mouse model of cerebral hemorrhage, which was presented in an article published in 2014. He demonstrated that catechins protect against cerebral hemorrhage by reducing ferroptosis and other related gene expression through a Nrf2 nondependent pathway [10]. An article published in 2020 summarizes the mechanism and role of ferritin in different brain diseases for subsequent prevention and treatment [11].

4.2 Country and Institution Analysis

Although the number of nodes in the U.S. is much lower than that of China, which is the country with the highest number of publications, the centrality (C=0.06) of the U.S. is much higher than that of all the remaining countries and is in the center of the field. China is the country with the highest number of publications in this research area, and the co-occurrence analysis of research institutions shows that 9 of the top 10 institutions are located in China (the other institution is Johns Hopkins University in the United States), showing that China has high coverage in this area.

In the institutional release, Nanjing Medical University has a central position in the field of research. In their 2021 publication, Bao, ZY et al. demonstrated that prokineticin-2 mediates neuronal cell death through ferroptosis in traumatic brain injury [12]. In 2022, by constructing a mouse model of Alzheimer's disease that in the presence of Salidroside (Sal), Cai, YW et al. demonstrated that NLRP3 inflammatory vesicles can benefit AD by inhibiting cell scorching [13]. In the same year, Dang Y et al. found that ferroptosis was activated in novel glial cells by single-cell RNA sequencing, providing clues to explain the physiological process of AD at the cellular level [14].

4.3 Keyword Analysis

4.3.1 Co-occurrence analysis

The co-occurrence analysis of the keywords showed that "oxidative stress" was the keyword most frequently co-occurring with other keywords. Ferroptosis is triggered by the accumulation of large amounts of reactive oxygen species (ROS) and lipid peroxides as the mechanism of action, resulting in cell death by iron deposition [1]. Therefore, its mitigation and treatment for ferroptosis still revolves around oxidative stress. It has been demonstrated that ferrostatin-1 (Fer-1) [15, 16], α-lipoic acid (LA) [17], liraglutide(LIRA) [18], tetrahydroxy stilbene glycoside (TSG) [19], eriodictyol [20], 1,6-O,O-diacetylbritannilactone (OABL) [21], tetrandrine [22], quercetin [23], insamgobonhwan [24], acetaminophen (APAP) [25], avenanthramide-C [26] and mesenchymal stromal cells (MSCs) [27] can delay and inhibit ferroptosis by affecting oxidative stress-related pathways.

As the population ages, the incidence of AD, the most common type of dementia, has increased exponentially [28, 29]. Iron and its accumulation play an important role in oxidative stress and lipid

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peroxidation, which is an important factor in increasing neurodegenerative alterations diseases, including AD, and its mechanism of action has been widely validated [2, 30].

4.3.2 Critical Path Analysis

The critical path shows the keyword co-occurrence in the keyword analysis of a total of three critical paths during 2022. In addition to the critical pathway of oxidative stress summarized above, in the second critical pathway of "iron"-"dysfunction"-"accumulation"-"cognitive impairment", Wu, J et al. found that general anesthesia (GA) disturbed iron stabilization in hippocampal neuron cultures in vitro and in vivo and caused ferroptosis in a GA model induced by inhalation of sevoflurane and injection of ketamine and suggested that the cognitive dysfunction caused by this approach is likely to be caused by ferroptosis [31]. In 2022, He YJ et al. concluded from the analysis of 10 hub genes obtained by two machine algorithms that type A is significantly more immune infiltrated than type B, demonstrating that type A may be at the peak of AD neuroinflammation. This study provides new insights into the role of ferroptosis-related molecular patterns and immune mechanisms in AD [32].

Regarding ferroptosis-related mechanism study in the third critical path, Ye Q et al. identified ferroptosis as the pathogenesis of temporal lobe epilepsy (TLE) [15]. Cai, YW et al. suggested that NLRP3 inflammatory response-mediated ferroptosis plays an important role in AD [13]. Zhang, P et al. showed that sevoflurane administration led to mitochondrial dysfunction and iron homeostasis, ultimately leading to cognitive impairment, and that protection of mitochondrial function and chelation of neurotoxic iron effectively reversed these pathological processes [9]. Xie Z et al. showed that activation of ferroptosis in hippocampal neurons leads to cognitive impairment in HFD-STZ mice. In addition, p-AMP-activated protein kinase (AMPK) activation may reduce ferroptosis processes in the hippocampus, thereby improving cognitive performance in diabetic mice [33].

4.3.3 Cluster Analysis

The keyword clustering peak plots revealed that except for the cognitive function-and oxidative stress-related clusters, the clusters including green tea catechins showed an increasing trend in 2021-2022. Chang, CF et al. concluded that catechins significantly reduced injury volume, improved neurological deficits, and reduced cell death and neuronal degeneration in the hematoma area in male and female intracerebral hemorrhage (ICH) mice after oral administration of catechins in a mouse model of ICH. It was also noted that the decrease in caspase-3 activity and high mobility histone B1 (HMGB-1) levels was associated with catechins and that oxidative damage was attenuated. Catechins also reduce brain iron deposition through a nondependent pathway of NF-E2-related factors and decrease the expression of patch-dependent cell death and ferritin-dependent related genes [10].

4.3.4 Time-zone and burst analysis

According to the keyword time-zone distribution and burst results, lipid peroxidation appeared as a keyword for the first time in 2018 and is currently at the core of and is a hotspot in the ferroptosis research on cognitive function. It has been suggested that alpha-lipoic acid (LA), acyl-CoA synthetase long chain family member 4 (ACSL4), ferritin inhibitor-1, mitochondrial aldehyde dehydrogenase (ALDH2) and aberrant Ca2+ signaling pathways caused by repairing ferroptosis are associated with the mitigation of lipid peroxidation. Phenotype involves brain injury caused by subarachnoid hemorrhage, temporal lobe epilepsy, AD and other related diseases [8, 15, 17, 34, 35]. Moreover, lipid peroxidation can induce apoptosis through different signaling pathways such as the NF-κB protein family, mitogen-activated protein kinase (MAPK) and protein kinase C (PKC) [36]. Therefore, future studies may focus on the role and association of lipid peroxidation with ferroptosis in cognitive function.

4.4 Cocited reference analysis

The cocited references reflect, to some extent, the best references and sources for scholars targeting the field of ferroptosis and recognition function research and may have an important role currently and in the future. In the burst of citations, Stockwell, BR et al. reviewed the potential mechanisms of ferroptosis and highlighted their connections in the fields of biology and medicine [37]. Li, J et al. provided a systematic account of recent advances in ferroptosis research, mechanisms of action and the role of ferroptosis in the development of related diseases, providing a reference for the proposal of new targets for the treatment of related diseases [38]. Li Y et al. found that the key transcription factor special protein 1 (Sp1) increases the transcription of ACSL4 and affects ferroptosis in ischemia/reperfusion by binding to the promoter [39].

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5. Conclusion

Research related to ferroptosis in cognitive function is currently rising rapidly. China is the world leader in terms of the number of studies and institutions publishing on related topics, while the United States is at the center. There is less collaboration among researchers and institutions in this field. Currently and for some time to come, the field is likely to center on the roles played by and the impacts of oxidative stress, lipid peroxidation, and iron-related accumulation and regulation in cognitive function as the hotspots and center of the research in this field.

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