

# Research Trends and Hotspots of Acupuncture for Neurodegenerative Diseases: A Bibliometric Analysis

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**Keywords:** Acupuncture, Bibliometric, Neurodegenerative Diseases.

**Abstract:** Existing therapy of Neuro-degenerative Diseases (NDDs) is limited, hence acupuncture is needed. The aim of this research is to determine development trends and hotspots, and to predict potential research directions in this field by bibliometric analysis. By using the Scopus's electronic database, "Search document" within title article, abstract, and key functions, basic publication and citation information was collected. The timeframe was not set. The language was English. Complete bibliographic data were exported to the bibliometric software applications VOSviewer. To demonstrate the recurrent keywords and terms included in the titles and abstracts, visualization maps were created. A total of 2155 English articles on acupuncture and NDDs published until 2023 were obtained. From 1995 to 2015, annual publications showed a steady growing trend, and then grow up, especially in 2015–2022. China, Medicine United State, and Park HJ are the most prolific country, journal, and author, respectively. Network acupuncture and Parkinson's disease are the focal areas of current research. The primary areas of investigation in network acupuncture within the context of NDDs encompass the relationship between network acupuncture and Parkinson's disease. Recently, there has been significant study interest in the areas of network acupuncture and Parkinson's disease.

## 1 INTRODUCTION

Neurodegenerative Diseases (NDDs), characterized by the progressive degeneration and deterioration affecting both central and peripheral nervous system, pose a substantial and growing burden on global healthcare systems (Ayeni *et al.*, 2022; Li *et al.*, 2022). The current treatments primarily focus on symptom management, meanwhile a growing body of research suggests that acupuncture, a traditional Chinese medicine practice, may offer a promising avenue for addressing the underlying mechanism of these disorders. Acupuncture shows a potential role in the management and treatment as an alternative

supplementary medicine of some neurodegenerative diseases, including Alzheimer's disease, Parkinson's disease, and amyotrophic lateral sclerosis (Zeng, Salvage and Jenner, 2013; Guo and Ma, 2019; Wang *et al.*, 2023). Acupuncture's mechanisms of action, which include neuro-protection, anti-inflammatory effects, and modulation of neurotransmitters, offer a multifaceted approach to tackling the pathophysiological processes involved in these conditions (Joh *et al.*, 2010). Furthermore, acupuncture's relative safety and minimal side effects make it an attractive adjunct therapy for patients.

Published studies in terms of acupuncture has a growing merge in recent years. Previous studies

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stated that the the reporting quality of randomized controlled trials (RCTs) of acupuncture for mild cognitive impairment including dementia and Alzheimer's diseases is moderate to low (Deng and Wang, 2016; Zhou *et al.*, 2022). Most of the clinical trials have no allocation concealment and blinding mentioned, nor did strictly followed the Consolidated Standards for Reporting of Trials (CONSORT) statement and Standards for Reporting Interventions in Controlled Trials of Acupuncture (STRICTA) (Zhou *et al.*, 2022). Since there is a lack of systematic review of trends in this field, further studies are needed. Bibliometric visualization analysis could highlighted the quantitative characteristics of research articles in a certain and spesific fields to help researchers grasp the development point over time to get an important indicator for the following research in the future (Ellegaard and Wallin, 2015; Li *et al.*, 2020; Zhou *et al.*, 2022).

Bibliometric visualization analysis is a quantitative analysis method that combines mathematics and statistical methods, to analyze numerous published academic literatures. This study has advantages compared to other conventional research methods, such as study review, meta-analysis, and experimental or clinical research, which couldn't reach the same depth analysis results (Li *et al.*, 2022). Additional visualization applications used in bibiliometric study, such as CiteSpace and VOSviewer software to qualitatively and quantitatively explore the contribution of authors, countries/regions, institutions, and their cooperation relationship (Li *et al.*, 2020). VOSviewer software is a visual bibliometric network software developed by van Eck and Waltman in 2009 at Leiden University in the Netherlands (van Eck and Waltman, 2010; Yue *et al.*, 2022). Meanwhile, CiteSpace software is a visual information analysis software developed by Professor Chen Chaomei of Drexel University, which realizes multi-visual knowledge mapping in various research fields (Yue *et al.*, 2022) and help scholars fully understand the research status, hotspots, and trends.

Therefore, based on the Web of Science Core Collection (WOSCC) database, this bibliometric analysis investigated the research status, hotspots, and trends of acupuncture for neurodegenerative diseases using VOSviewer and CiteSpace to understand the cooperative network, and evaluates the research trends and frontiers.

## 2 METHODS

Library data is very important in bibliometric analysis. Accuracy, completeness and accessibility of data providers are some of the key factors for data processing. Bibliometric examination could obtained from five steps analysis (definition of search keywords, initial search results, refining of search results, gathering preliminary data statistic, and data analysis) to collect entire data and assesment studies of as shown in Figure 1(Handayani *et al.*, 2022). In this case the processing is done using VOSviewer and bibliometrix software, to analyzed and gained output in the form of links between authors, article links, etc. Scopus provides this format, being a published scientific research library database, which significantly simplifies the process of bibliometric analysis. This data set allows users to access all elements of authorship, such as citation information, bibliographic information, abstracts and keywords, financing details, and other information (references used, trade names, manufacturers, accession numbers, and chemicals). Downloaded samples in CSV and BibTeX formats can then be processed in VOSviewer (Nandiyanto and Al Husaeni, 2022).

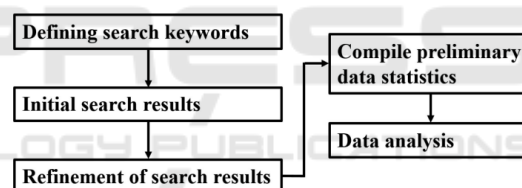


Figure 1: Five Phase of bibliometric analysis (Handayani *et al.*, 2022).

All data from the Scopus database is imported into VOSviewer v.1.6.16, which is typically used to analyze and visualize the relationship between authors, countries, shared citations and terms used in articles. Publications are systematically sorted and graded according to year of publication, research area, journal title, country, organizational affiliation, and author. Furthermore, the keyword frequency extracted from the articles is included in the network analysis. Different nodes represent different countries, institutions and keywords, while circle or font sizes reflect productivity. The strength of the links between nodes represents increased collaboration across countries, institutions, authors, and shared events (Fu, Lv and Li, 2023).

The Bibliometrix R software package (version R 4.2.2) provides a set of tools for quantitative research. It is developed in R language, an open-source environment, and in an ecosystem. Significant and

effective statistical algorithms, access to high-quality numerical routines, and the provision of integrated data visualization tools are among the strongest features of the software. Bibliometrix is an open-source tool for quantitative research in scientometrics and bibliometrics that includes all major bibliometric analysis methods (Kemeç and Altınay, 2023).

In this study, The data was obtained from the Scopus database with the keywords "Acupuncture" OR electroacupuncture OR "Neurodegenerative" OR "Neurologic Degenerative" OR "Nervous System Degenerative" OR "Neurodegenerative Disorder" OR "neurodegenerative diseases" OR "Neurologic Degenerative Condition" OR "Neurologic Degenerative" OR "Degenerative Neurologic Disorder" OR "Alzheimer Disease" OR "Cognitive dysfunction" OR "Alzheimer's disease" OR alzheimer OR "Parkinson's disease" OR pd OR "Huntington disease" OR "Huntington's disease" OR "Amyotrophic lateral sclerosis". Timeframe was not set, language preferences is English, resulting in a total of 2155 documents. Complete bibliographic data were exported to the bibliometric software applications VOSviewer for additional analysis. To demonstrate the recurrent keywords and terms included in the titles and abstracts, visualization maps were created.

### 3 RESULTS

#### 3.1 Annual Publication Trends

Total publications obtained are 2155 articles from every beginning of 1935. The number of global articles about acupuncture for neurodegenerative diseases has shown an increase in the last seven years (2015 – 2022). Between 2021 and 2022 there has been a rapid increase in literature published, 2022 counted as the highest published year with 255 articles in total (Fig 2).

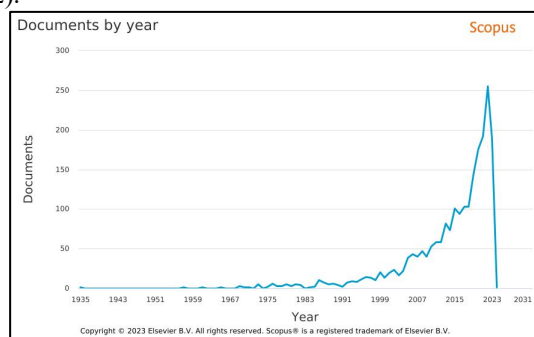


Figure 2: Number of annual publications on Acupuncture for Neurodegenerative diseases over the years from Scopus database

#### 3.2 Analysis of Authors

A total of 159 authors were involved in all articles related to acupuncture for neurodegenerative therapy. The top three authors are Park HJ (30), Li Z (21), Liu C.Z (19), Jia J (16), and Lim S (16). In addition, the top 15 authors published a total of 102 articles, accounting for 4.7% of the total articles (Fig. 2).

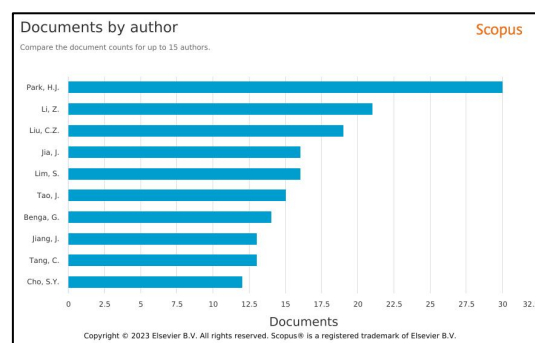


Figure 3: The top 10 authors with the most published articles on acupuncture for neurodegenerative disease

#### 3.3 Analysis of Country / Territory

In terms of number of publications, the top 10 countries/regions are China (840 articles), United States (424 articles), South Korea (179 articles), Japan (95), United Kingdom (88), Germany (76), Taiwan (69), Italy (66), India (55), Turkey (52) (Figure 3). China, where acupuncture originate, has most of the publications approximately 38,9% of all articles related.

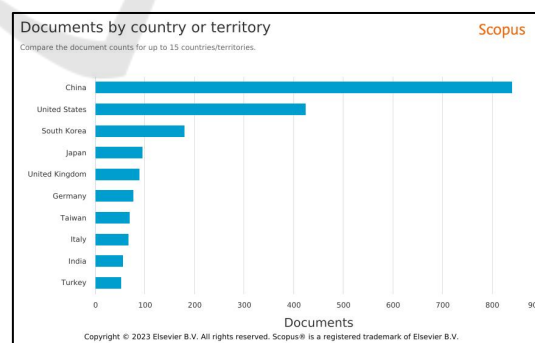


Figure 4: The top 10 regions with the most publications about acupuncture for neurodegenerative disease

#### 3.4 Analysis of Subject

Based on bibliometric analysis, acupuncture for neurodegenerative diseases involves in many research subject. The top five subject area are

Medicine in 1120 articles, Neuroscience in 414 articles, Biochemistry Genetics and Molecular Biology in 381 articles, Chemistry in 303 articles, and Physics Astronomy in 158 articles.

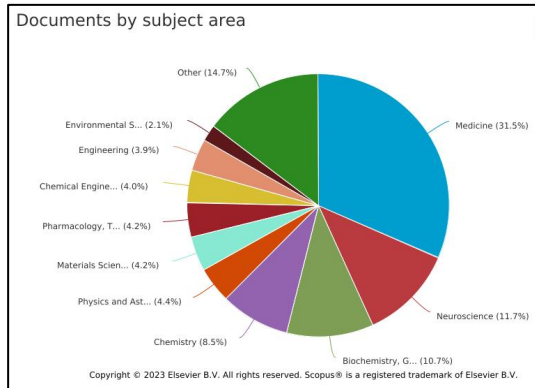


Figure 5: Subject area in acupuncture for neurodegenerative diseases articles published

### 3.5 Analysis of Sources

The results of analysis present that the highest publication year happened in 2022, along the highest publication rating comes from Evidence Based Complementary and Alternative Medicine with 75 (3,5%) papers published, followed by the second place from Medicine United States with 66 articles (2,06%).

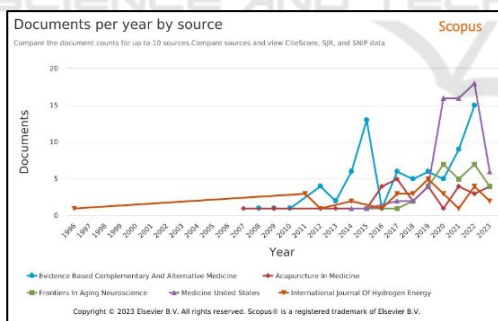


Figure 6. Source of articles with the most number of publications

### 3.6 Analysis of Affiliation

The university affiliation with the highest number of publications in terms of acupuncture for neurodegenerative diseases was Beijing University of Chinese Medicine with 79 publications, since China also counted as the most highest publication country. Moreover, Kyung Hee University ranked second with 77 publications, it is worth mentioning earlier we found that the most prolific author Park HJ who was

contributed 30 publications was affiliated with Kyung Hee University. The third and fourth rank was Ministry of Education of the People's Republic of China with 69 articles, and Guangzhou University of Chinese Medicine with 63 articles.

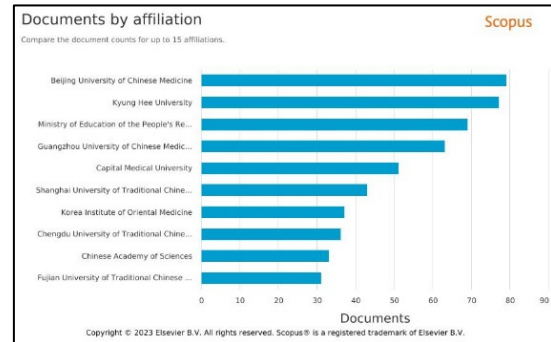


Figure 7: Top ten affiliation of acupuncture for neurodegenerative diseases

### 3.7 Analysis of the Keyword

Keywords, especially those used with high-frequency, usually represent research subject hotspots. In order to detect the most frequently used directions and topics in acupuncture for neurodegenerative diseases research field to aimed a better understanding in development trends. This analysis helps to quickly identify the topic and focus of the publication. The most frequently used keywords in this study are “acupuncture”, “parkinson’s disease”, and “electroacupuncture”. The top x number of keywords are used to create a cluster map of occurrences with keywords (Fig 7) from each time slice to obtain 5 clusters, As shown in Figure 8, the colors in the overlay visualization identify the average keyword publication year. The density visualization shows keywords according to their frequency of occurrence (Fig 9).

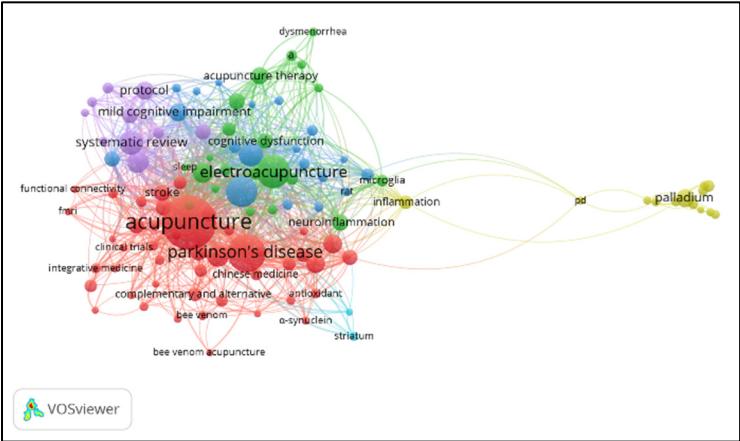


Figure 8: Keyword co-occurrence network map

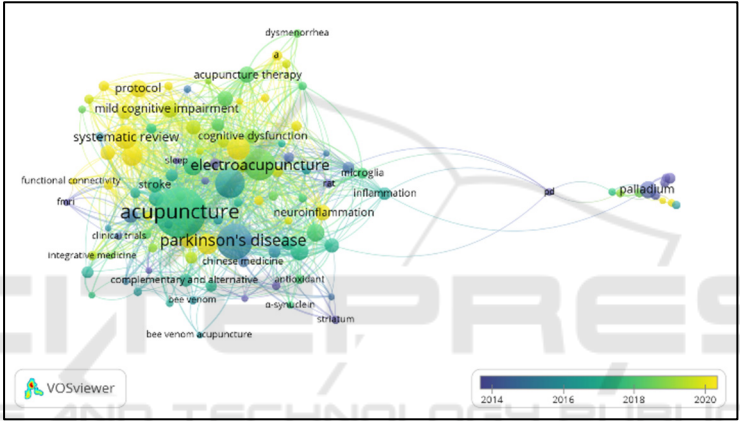


Figure 9. Keywords overlay visualization

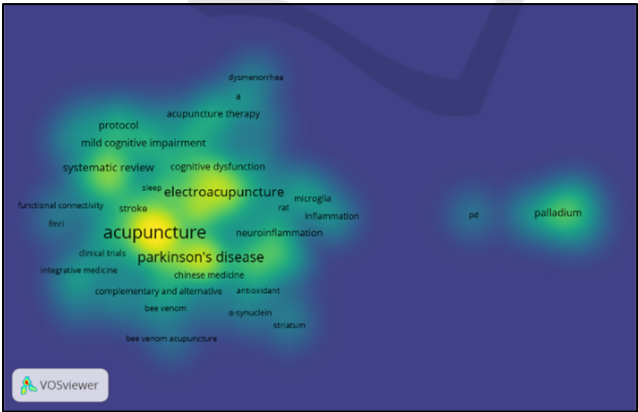


Figure 10. Keywords density visualization

Table 1: Top 20 most cited literatures

| Rank | Authors                                                                                                                                                                                                                                                                                             | Title                                                                                                                                                                 | Year | Source title                      | Citation | Reference                       |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-----------------------------------|----------|---------------------------------|
| 1    | Gorelick P.B.; Scuteri A.; Black S.E.; Decarli C.; Greenberg S.M.; Iadecola C.; Launer L.J.; Laurent S.; Lopez O.L.; Nyenhuis D.; Petersen R.C.; Schneider J.A.; Tzourio C.; Arnett D.K.; Bennett D.A.; Chui H.C.; Higashida R.T.; Lindquist R.; Nilsson P.M.; Roman G.C.; Sellke F.W.; Seshadri S. | Vascular contributions to cognitive impairment and dementia: A statement for healthcare professionals from the American Heart Association/American Stroke Association | 2011 | Stroke                            | 2662     | (Gorelick <i>et al.</i> , 2011) |
| 2    | Finniss D.G.; Kaptchuk T.J.; Miller F.; Benedetti F.                                                                                                                                                                                                                                                | Biological, clinical, and ethical advances of placebo effects                                                                                                         | 2010 | The Lancet                        | 931      | (Finniss <i>et al.</i> , 2010)  |
| 3    | Seppi K.; Ray Chaudhuri K.; Coelho M.; Fox S.H.; Katzenschlager R.; Perez Lloret S.; Weintraub D.; Sampaio C.; Chahine L.; Hametner E.-M.; Heim B.; Lim S.-Y.; Poewe W.; Djamshidian-Tehrani A.                                                                                                     | Update on treatments for nonmotor symptoms of Parkinson's disease—an evidence-based medicine review                                                                   | 2019 | Movement Disorders                | 541      | (Seppi <i>et al.</i> , 2019)    |
| 4    | Munro N.B.; Talmage S.S.; Griffin G.D.; Waters L.C.; Watson A.P.; King J.F.; Hauschild V.                                                                                                                                                                                                           | The sources, fate, and toxicity of chemical warfare agent degradation products                                                                                        | 1999 | Environmental Health Perspectives | 506      | (Munro <i>et al.</i> , 1999)    |
| 4    | Fox S.H.; Katzenschlager R.; Lim S.-Y.; Ravina B.; Seppi K.; Coelho M.; Poewe W.; Rascol O.; Goetz C.G.; Sampaio C.                                                                                                                                                                                 | The movement disorder society evidence-based medicine review update: Treatments for the motor symptoms of Parkinson's disease                                         | 2011 | Movement Disorders                | 493      | (Fox <i>et al.</i> , 2011)      |
| 5    | Hu Z.; Liu X.; Meng D.; Guo Y.; Guo Y.; Lu G.                                                                                                                                                                                                                                                       | Effect of Ceria Crystal Plane on the Physicochemical and Catalytic Properties of Pd/Ceria for CO and Propane Oxidation                                                | 2016 | ACS Catalysis                     | 473      | (Hu <i>et al.</i> , 2016)       |
| 6    | Réus G.Z.; Fries G.R.; Stertz L.; Badawy M.; Passos I.C.; Barichello T.; Kapczinski F.; Quevedo J.                                                                                                                                                                                                  | The role of inflammation and microglial activation in the pathophysiology of psychiatric disorders                                                                    | 2015 | Neuroscience                      | 438      | (Réus <i>et al.</i> , 2015)     |
| 7    | Wagner G.W.; Bartram P.W.; Koper O.; Klabunde K.J.                                                                                                                                                                                                                                                  | Reactions of VX, GD, and HD with nanosize MgO                                                                                                                         | 1999 | Journal of Physical Chemistry B   | 365      | Wagner <i>et al.</i> , 2022     |
| 8    | Lonergan P.; Tindall D.                                                                                                                                                                                                                                                                             | Androgen receptor signaling in prostate cancer development and progression                                                                                            | 2011 | Journal of Carcinogenesis         | 348      | Lonergan, <i>et al.</i> , 2011  |
| 9    | Hamblin M.R.                                                                                                                                                                                                                                                                                        | Shining light on the head: Photobiomodulation for brain disorders                                                                                                     | 2016 | BBA Clinical                      | 313      | (Hamblin, 2016)                 |

|    |                                                                                                                                                  |                                                                                                                                                                             |      |                                                                         |     |                                      |
|----|--------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------------------------------------------------------------------------|-----|--------------------------------------|
| 10 | Kuo M.-F.; Paulus W.; Nitsche M.A.                                                                                                               | Therapeutic effects of non-invasive brain stimulation with direct currents (tDCS) in neuropsychiatric diseases                                                              | 2014 | NeuroImage                                                              | 310 | (Kuo, Paulus and Nitsche, 2014)      |
| 11 | Benedetti F.; Carlino E.; Pollo A.                                                                                                               | How placebos change the Patient's brain                                                                                                                                     | 2011 | Neuropsychopharmacology                                                 | 303 | (Benedetti, Carlino and Pollo, 2011) |
| 12 | Seidel K.; Siswanto S.; Brunt E.R.P.; Den Dunnen W.; Korf H.-W.; Rüb U.                                                                          | Brain pathology of spinocerebellar ataxias                                                                                                                                  | 2012 | Acta Neuropathologica                                                   | 289 | (Seidel <i>et al.</i> , 2012)        |
| 13 | Seeram N.P.; Lee R.; Scheueller H.S.; Heber D.                                                                                                   | Identification of phenolic compounds in strawberries by liquid chromatography electrospray ionization mass spectroscopy                                                     | 2006 | Food Chemistry                                                          | 263 | Seeram, et al., 2006                 |
| 14 | Huang W.; Pach D.; Napadow V.; Park K.; Long X.; Neumann J.; Maeda Y.; Nierhaus T.; Liang F.; Witt C.M.                                          | Characterizing acupuncture stimuli using brain imaging with fMRI - a systematic review and meta-analysis of the literature                                                  | 2012 | PLoS ONE                                                                | 206 | Huang W et al., 2012                 |
| 15 | Xiong Z.; Zhao D.; Pan G.                                                                                                                        | Rapid and complete destruction of perchlorate in water and ion-exchange brine using stabilized zero-valent iron nanoparticles                                               | 2007 | Water Research                                                          | 201 | (Xiong, Zhao and Pan, 2007)          |
| 16 | Wang Y.; Liu G.; Hong D.; Chen F.; Ji X.; Cao G.                                                                                                 | White matter injury in ischemic stroke                                                                                                                                      | 2016 | Progress in Neurobiology                                                | 184 | (Wang <i>et al.</i> , 2016)          |
| 17 | Valincius G.; Heinrich F.; Budvytyte R.; Vanderah D.J.; McGillivray D.J.; Sokolov Y.; Hall J.E.; Lösche M.                                       | Soluble amyloid $\beta$ -oligomers affect dielectric membrane properties by bilayer insertion and domain formation: Implications for cell toxicity                          | 2008 | Biophysical Journal                                                     | 183 | (Valincius <i>et al.</i> , 2008)     |
| 18 | Sato H.; Toth R.S.                                                                                                                               | Effect of additional elements on the period of CuAu II and the origin of the long-period superlattice                                                                       | 1961 | Physical Review                                                         | 174 | (Tâm <i>et al.</i> , 2016)           |
| 19 | Gallagher D.A.; Schrag A.                                                                                                                        | Psychosis, apathy, depression and anxiety in Parkinson's disease                                                                                                            | 2012 | Neurobiology of Disease                                                 | 172 | (Callagher et al., 2012)             |
| 20 | Zhang H.; Ozbay F.; Lappalainen J.; Kranzler H.R.; Van Dyck C.H.; Charney D.S.; Price L.H.; Southwick S.; Yang B.-Z.; Rasmussen A.; Gelernter J. | Brain derived neurotrophic factor (BDNF) gene variants and Alzheimer's disease, affective disorders, posttraumatic stress disorder, schizophrenia, and substance dependence | 2006 | American Journal of Medical Genetics, Part B: Neuropsychiatric Genetics | 168 | (Zhang <i>et al.</i> , 2006)         |

### 3.8 Analysis of Document Type

Document type of the publications is also important to direct and re-direct prior studies and future research trends. Most of the publications related to acupuncture for neurodegenerative studies are in Articles type in total of 1546 publications (71,7%), followed by 394 review (18,3%), and 84 conference paper (3,9%). All of the document type shown in Fig 10, the others type are conference review and retracted.

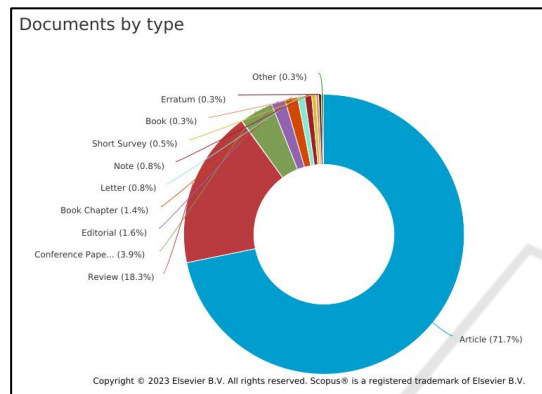


Figure 11: Document types of all the publications related to acupuncture for neurodegenerative diseases

### 3.9 Analysis of Funding Sponsor

Funding sponsor may also play a role in studies development. Bibliometric study allow us to looked up to the funding sponsor of the publications. The highest rank is National Natural Science Foundation of China in 340 total publications, followed by National Research Foundation of Korea in 64 publications (Fig 11). These funding sponsor also related to the top two Country / Nations with the highest publications (China and Korea).

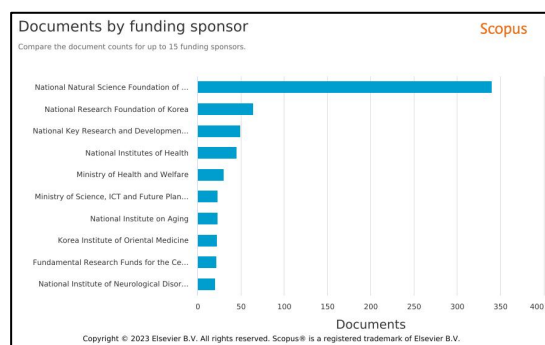


Figure 12: Top 10 of the funding sponsor in publications of acupuncture for neurodegenerative diseases

## 4 DISCUSSIONS

### 4.1 Literatures Publication Output

Based on search and analysis results, it shown that there has been a significant increase in acupuncture for neurodegenerative diseases mainly in last seven years (2015 – 2022). This trends related to how treatment plans nowadays focusing on minimally invasive treatment, as how acupuncture offers. A total of 2155 literatures from 80 countries within 160 institutes engaged with this topic.

### 4.2 Literature Publication Quality

Literatures distribution reflects the overall quality of studies about acupuncture for neurodegenerative studies. Among the top 20 cited articles, most of them discussed about acupuncture and its effect on movement disorder mainly Parkinson's diseases, and stroke. Molecular changes effect of acupuncture also shows a significant ammount on the top 20 cited articles, related to neuroscience, neuropharmacology, neurobiology, and neuropsychiatrics. Since judging research quality solely by journal distribution, it is necessary to assess the literature through the frequency of citations. Acupuncture counted as a nonpharmacological interventions on parkinson's diseases and the efficacy remains insufficient evidence, with acceptable risk without specialized monitoring, thereby there is a need for further research to investigate (Seppi *et al.*, 2019). Most cited studies stated acupuncture showed cognitive benefit in a rodent model of Vascular dementia, but still inconclusive which indicates that more studies are needed (Gorelick *et al.*, 2011).

### 4.3 Cooperation Status

This bibliometric study shows an uneven distribution of acupuncture for neurodegenerative diseases, most of the studies published from China, followed by United States and South Korea. Meanwhile, the most cited literatures comes from American Heart Association which talks about cognitive rehabilitation with acupuncture. Country collaboration and cooperation between United States and other countries is more than China collaboration.

### 4.4 Strength and Limitations

This bibilometric study focusing more into quantitative analysis than qualitative analysis. Selected literature

from a representative and high-quality SCOPUS database. We performed a visual analysis of the literature in terms of acupuncture for neurodegenerative diseases and the overall situation and general trends. Literatures included in this study has no time range, with English language selection only.

## 5 CONCLUSIONS

The primary areas of investigation in network acupuncture within the context of neurodegenerative diseases (NDDs) encompass the relationship between network acupuncture and Parkinson's disease. Recently, there has been significant study interest in the areas of network acupuncture and Parkinson's disease.

## ACKNOWLEDGEMENTS

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