ISSN 2580-5703 (CETAK)
ISSN 2775-7242 (ONLINE)

AUTISM SPECTRUM DISORDER (ASD) TOPIC TRENDS: BIBLIOMETRIC ANALYSIS USING BIBLIOSHINY

Gusti Fawwaz Setyo[1], Afandi[2*], Eko Sri Wahyuni[3]
Universitas Tanjungpura[123]
afandi@fkip.untan.ac.id[1]

Abstrct: Bibliometric analysis, a scientific study that uses mathematical and statistical methods to analyze literature, was employed to examine the trends in research on Autism Spectrum Disorder (ASD). The main objective of this study was to identify the development, focus areas, and emerging themes in ASD research over the past decade. The present study utilized data from the Scopus database, which included articles and conference papers published between 2014 and 2023. The study aimed to map and analyze the research direction on ASD. The analysis of 3,879 documents revealed several key findings. Firstly, the topic of ASD exhibited an increasing trend each year. Secondly, certain words such as "autism," "male," and "female" were frequently cited and continued to grow, suggesting emerging research themes. These results provide a comprehensive understanding of the evolving nature of the topic and serve as a valuable foundation for future research and collaboration in health and education. Furthermore, it was observed that research on ASD will continue to expand with diverse research focuses.

Keywords: Autism Spectrum Disorder (ASD), Bibliometric Analysis, Biblioshiny

PENDAHULUAN

Children with Special Needs (CSN) is a term used to refer to children who have different characteristics compared to normal children. According to (Yumni & Ramadhani, 2023), CSNs are children with special characteristics that are not much different from normal children in general but always show one or more mental, emotional, or physical disabilities and deficiencies. A child with special needs is said to be so because they experience obstacles and deficiencies in emotional control, mental retardation, or physical limitations. An example of a child who is classified as CSN is a child with Autism. Autism Spectrum Disorder (ASD) is a developmental disorder characterized by challenges in social interaction, communication, and a limited range of interests or activities (Baio et al., 2018). Autism spectrum disorder is a neurological developmental condition marked by notable difficulties in social communication and interaction, along with patterns of restricted and repetitive behaviors (Hodges et al., 2020).

In general, ASD shows characteristics such as difficulty socializing with peers or other people and not being able to respond to an activity that is taking place around them (Irvan, 2017). Children with ASD usually begin to show symptoms at the age of 6 to 24 months, and some children will initially grow normally but exhibit degenerative changes and loss of language and social skills at the age of 24 to 36 months (Stilling et al., 2014). ASD children can be detected as early as 3 years of age because, at that age, ASD children do not show the development of communication and social interaction skills (Baas et al., 2020). Scientists do not yet know what exactly goes wrong in the brains of autistic individuals, but certainly, the cause is neurobiological, not interpersonal (Botha & Cage, 2022).

The prevalence of autism in the world is increasing. Global data from 2001 indicated that the prevalence of ASD rose from 0.7% to 1.0% since the 1990s, and

additional findings suggest that this rate has continued to increase steadily in recent years (Chakrabarti & Fombonne, 2001). According to data from the Centers for Disease Control and Prevention (CDC) in the United States, the number of ASD patients in 2012 increased by 23% compared to 2008. If in 2008, ASD patients experienced 1 in 100 children, then in 2012, the ratio rose to 1 in 88 children (Simatupang & Handayani, 2015). In 2013, CDC data showed that ASD patients increased again to 1:50 in the past year. Then, a study conducted by the CDC in 11 locations in 2018 showed 1 ASD patient in every 44 children aged 8 years (Maenner et al., 2023)

A recent systematic review of the global landscape of mental health disorders revealed that in 2019, the age-standardized worldwide prevalence of ASD was 369.4 cases per 100,000 individuals, with a notably higher rate among males (GBD 2019 Mental Disorders Collaborators, 2022). The increasing prevalence of ASD may be related to increased knowledge and awareness as well as changes in diagnostic criteria covering a wider range of diseases. In general, males outnumber females in ASD, and the ratio is approximately 3:1 to 4:1 (Loomes et al., 2017). The prevalence of children with autism in Indonesia, when assumed with that in Hong Kong, children with autism aged 5-19 years reach up to 66,000,805 people. It is estimated that there are more than 112 thousand children in Indonesia in the age range of 5-19 years with autism (Jiu & Rungreangkulkij, 2019). Based on these data, the number of individuals with autism is increasing both in Indonesia and around the world. To get a more complete review of the trend of ASD, a more in-depth review of the literature in recent years is needed to get more information about how far the ASD research has progressed. In order to find out the research's development, an analysis is needed to collect data that tends to be a lot of calculated manually, one of which is bibliometric analysis.

Bibliometric analysis is a quantitative method for analyzing bibliographic data in articles and journals (Donthu et al., 2021). Bibliometric analysis is used to determine how much research has developed from year to year (Hernandez-Torrano & Ibrayeva, 2020). Bibliometric analysis is a research trend that is in great demand because this research can provide opportunities and an overview for future research, so for a particular topic that has not been studied much, researchers will usually look for a literature review or bibliometric analysis first to find novelty or research opportunities (Cooper, 2015).

Based on the background exposure above, more in-depth research on ASD is necessary. Therefore, the researcher is interested in raising the research title Autism Spectrum Disorder (ASD) Topic Trends: Bibliometric Analysis Using Biblioshiny. This research is expected to determine the direction of research development and explain future research opportunities related to ASD topics using bibliometric analysis.

METODE PENELITIAN

This research uses descriptive quantitative methods with bibliometric analysis to map and analyze the development of related research. This research method is in the form of numbers and statistical results presented in diagrams. The sample used to collect the data comes from the Scopus database, which is often used in bibliometric studies to see the results of knowledge mapping in a study. Researchers also trust the Scopus database as a source of bibliometric data for large-scale analysis in research assessment. Sampling was conducted on November 13, 2024, through the Scopus database. The search was conducted by entering the keywords "(TITLE (asd) OR TITLE (autism AND spectrum AND disorder) OR TITLE (autism) AND TITLE-ABS-KEY (education)." The keywords in the Scopus

search were determined using Boolean Operators by combining the words AND, OR, and NOT.

Furthermore, the sample search was limited to 2014-2023, English language, scientific publications in journals and proceedings, and the file format of articles and conference papers. The results of the search obtained 3,879 documents. The file was downloaded and saved in CSV form and then analyzed using Bibliometrix R-Package (Biblioshiny) version 4.3.2 to be able to visualize and map Bibliometric network data. Bibliometrix R-Package (Biblioshiny) is part of R-Studio, which Massimo Aria and Corado Cuccurolo introduced in 2017. This application presents Bibliometric visualization results with statistics and graphics.

RESULTS AND DISCUSSION

1. Main Information

In bibliometric research, the first step is to identify key information. This section provides basic information about all articles on Autism Spectrum Disorder (ASD). Table 1 presents data on research development from data obtained through the Scopus database.

Table 1 above shows the data obtained in the 2014-2023 range containing 3879 documents, where the documents come from various sources, namely 3612 articles and 267 conference papers that Scopus has indexed. The average development of publications per year is 9.64%, with an average citation per document of 20.22. Furthermore, the main data also includes details regarding author contributions and international partnerships. The number of authors of scientific publications on ASD was 13565 authors involved, and 231 single authors produced 237 articles. This indicates a diversity in the authorship of the article. However, international collaboration among authors is relatively limited, accounting for only 16.04%, with an average of 4.99 authors per publication. In addition, 6903 author keywords (DE) and 138467 references match the topic of ASD.

Key information is one part of the Bibliometric analysis results. It only provides core information about the document's period, the number of articles, the number of issues, the type of document, the author, the document's content, and other information. Key information is beneficial for providing an initial overview of the analysis results.

2. Annual Scientific Production

The annual production of scientific articles in (**Figure 1)** shows that the most publications occurred in 2022, with 528 articles published or about 13.61% of the total articles published from 2014 to 2023. It is due to updates in diagnostic guidelines, such as DSM-5 and ICD-11, that affect how ASD is diagnosed and understood, and further research is encouraged to conform to the latest guidelines and understand their impact. ICD-11 (International Classification of Diseases, 11th Revision) is a classification system for diseases and health conditions published by the World Health Organization (WHO). This latest version replaces ICD-10, which has been widely used since 1992. ICD-11 officially takes effect on January 1, 2022, although some countries are starting the transition earlier.

Meanwhile, the fewest articles were shown in 2014, with 228 articles. In conclusion, the number of publications on ASD increased from 2014 to 2023, despite a slight decline in 2020, during which only 13 articles were published. One of the factors that caused the decrease in publications at that time was the COVID-19 outbreak that occurred at the end of 2019. Research on ASD can be said to be "slightly distracted" because researchers are focusing on research on the virus outbreak.

Table 1. Autism Spectrum Disorder (ASD) Topic Key Information

Main Information About Data	Description
Timespan	2014:2023
Sources (Journals, Books, etc)	1193
Documents	3879
Annual Growth Rate %	9,64
Document Average Age	4,74
Average citations per doc	20,22
References	138467
Document Contents	
Keywords Plus (ID)	8825
Author's Keywords (DE)	6903
Authors	
Authors	13565
Authors of single-authored docs	231
Authors Collaboration	
Single-authored docs	237
Co-Authors per Doc	4,99
International co-authorships %	16,04
Document Types	
Article	3612
Conference paper	267

3. Three Field Plot

The Three Field Plot, also known as the Sankey Diagram (**Figure 2**), is part of the dataset that results in interrelationships between 3 observed elements: sources, authors, and keywords. The Sankey Diagram is designed to illustrate and evaluate the connections among authors, sources, and keywords (Khan et al., 2023). The three components are represented by gray lines, illustrating their interconnections, starting from the source, followed by the author, and each author is then linked to a keyword. The size of each rectangle in the list represents the number of publications associated with that particular theme.

The first element (left) is the reference source. Nineteen reference sources presented in this three-field plot have published articles on the topic of ASD, and the top source that published the most articles on this topic is the Diagnostic and Statistical Manual of Mental Disorders (2013), which is depicted with a magenta-colored rectangle. The second element, centered, contains the author's name. Authors who have published articles in recognized journals are linked to reference sources and keywords. Based on the image author's research. In this study, among the above 20 authors who wrote above, 20 authors are listed in this element. The size of the bar chart shows how many publications as a result of each author's research. In this study, among the above 20 authors who wrote the most ASD-themed articles were Casari C, Trembath D, and Smith T. The last element, the third element, contains keywords related to the topics that appear most frequently in the articles. Each topic is associated

with the author who published the most on that topic. The twenty most "autism," indicated by the size of the green box dominating the other boxes. All of the listed authors also used the topic of ASD, which is in line with the frequently occurring keywords were "autism spectrum disorder" and focus of this research. In addition to ASD, this plot also displays other widely used keywords, such as "asd" and "intervention."

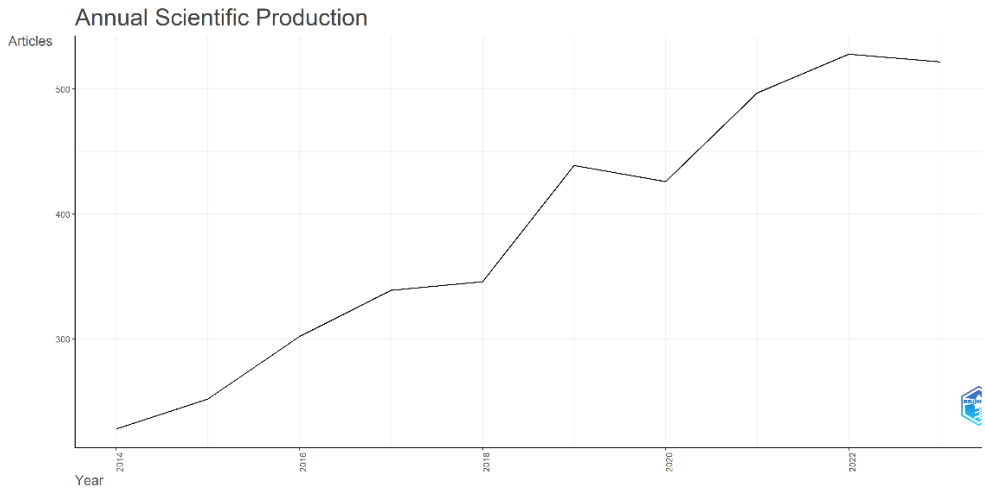

Figure 1. Annual Scientific Production

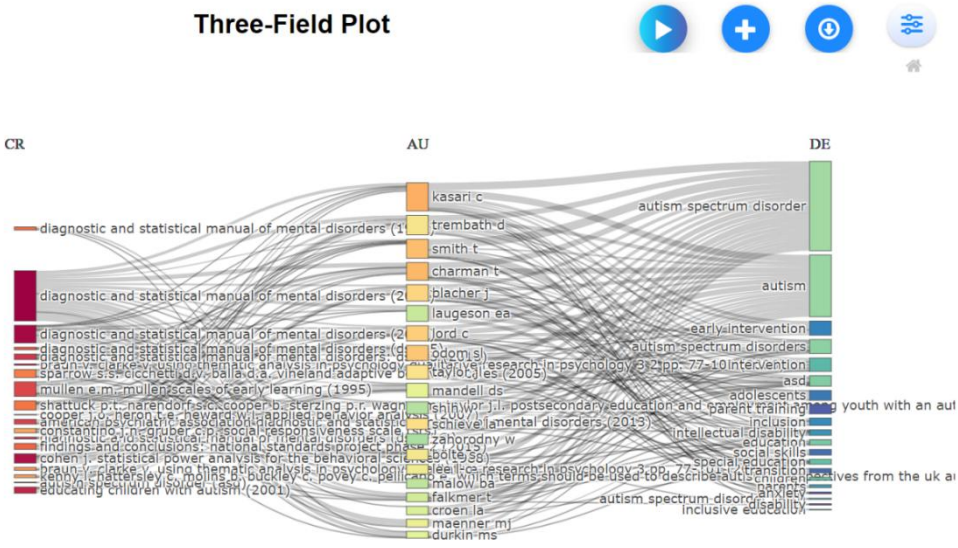

Figure 2. Three Field Plot

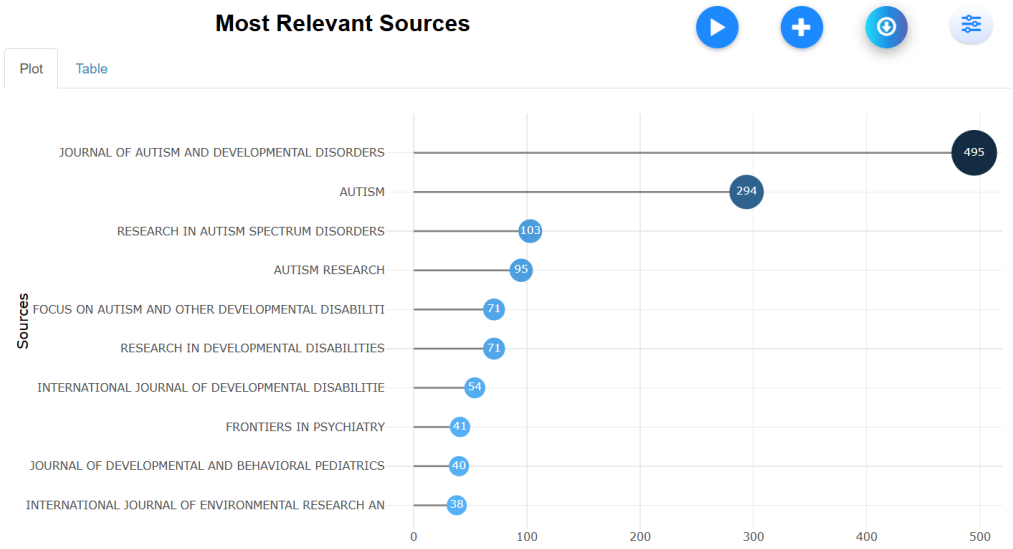

Figure 3. Most Relevant Source

4. Most Relevant Source

Based on the search results, the most relevant source (**Figure 3**) of the keywords mentioned is the Journal of Autism and Developmental Disorder (495 articles). In second place is the journal Autism (294 articles), followed by the third place is the journal Research in Autism Spectrum Disorders (103 articles). Next is Autism Research (95 articles), Focus on Autism and Other Developmental Disabilities (71 articles), Research in Developmental Disabilities (71 articles), International Journal of Developmental Disabilities (54 articles), Frontiers in Psychiatry (41 articles), Journal of Developmental and Behavioral Pediatrics (40 articles), and the journal with the lowest most relevant sources of the ten journals displayed is the International Journal of Environmental Research and Public Health (38 articles). The journal data above can make it easier for future researchers to find literacy sources or references when conducting research and data processing, especially regarding ASD.

5. Top Author Production Over Time

The given text discusses the top authors in the field of autism spectrum disorder (ASD) research and their publication trends over time. The author production over time section (**Figure 4**) shows the number of scientific articles produced by each author in each year. The dot size represents the author's publication output, while the red line indicates their initial activity in research until the year they published the research. Kasari C is identified as the author with the most publications from 2014 to 2023, with 35 publications represented by blue circles ranging in size. Charman T follows with 27 publications from 2015 to 2023, and Smith T with 23 publications from 2015 to 2021. The data reveals that research on ASD has been conducted since 2014, and various researchers have studied the topic over the period 2014-2023.

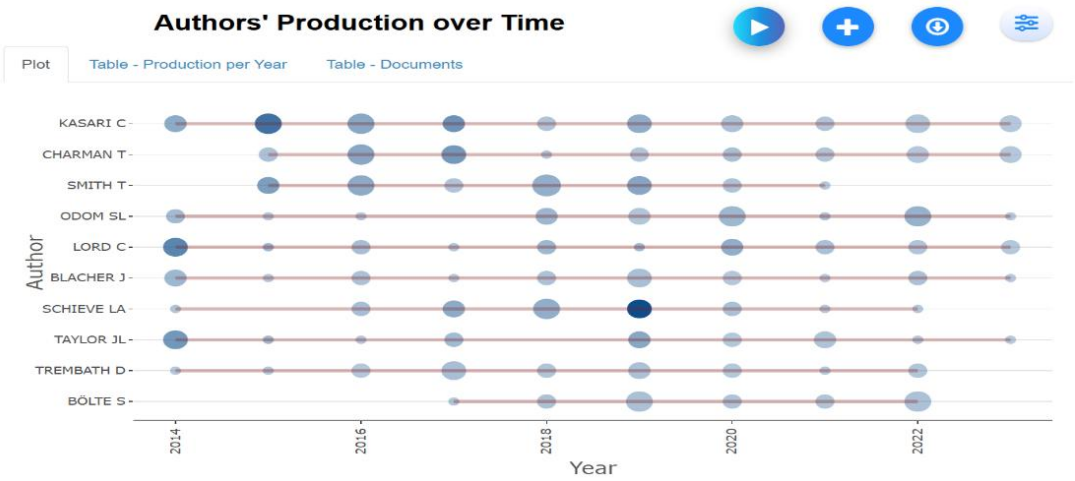

Figure 4. Author Production Over Time

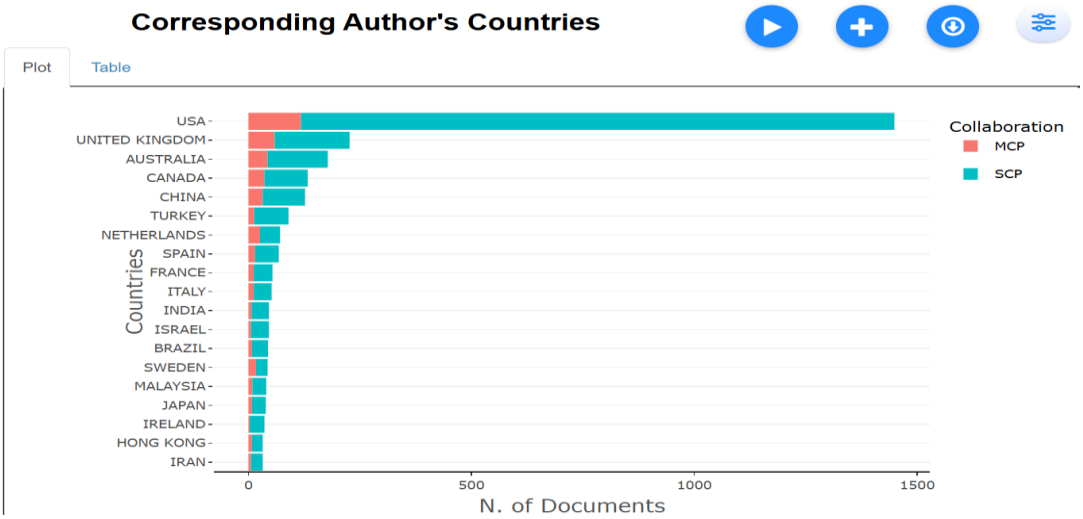

Figure 5. Corresponding Authors Countries

6. Corresponding Author Countries

The 'Corresponding Authors Countries' (**Figure 5**) presents data on the home country of each author. The calculation is derived from the total frequency of SCP (Single Country Collaboration) and MCP (Multiple Country Collaboration), which refer to collaborations within a single country and collaborations involving multiple countries, respectively. In this research, there are 10 top countries with an interval of the number of articles produced, namely between 0 to 1331 (SCP) and 0 to 118 (MCP) on the topic of Autism Spectrum Disorder (ASD). According to Figure 5, the USA has the highest author frequency (0.374) and has published 1331 SCP and 118 MCP articles, placing it in the first position. The United Kingdom is in second position with an author frequency of 0.059 and 168 SCP and 59 MCP articles. Australia ranks third with an author frequency of 0.046 and 135 SCP,

and 43 MCP articles. Canada is in fourth position with an author frequency of 0.034 and 133 articles successfully published. China ranks fifth with an author frequency of 0.033 and 127 articles published. Turkey, the Netherlands, Spain, France, and Italy follow in the sixth to tenth positions with varying author frequencies and numbers of articles published.

From the research data, it can be seen that the USA is the country that produces the most authors on the topic of ASD. The USA is one of the most developed countries in the world. The USA strongly supports institutions or authors in their country in the field of R&D (Research and Development). In addition, the USA is also very concerned about research in health sciences. It can be seen through the high funds given to research in the country, including many researchers in the US (Pena-Cristóbal et al., 2018). As the NSF (National Science Foundation) reported in 2021, the USA spent approximately 90 billion USD on R&D research (Nandiwardana et al., 2024).

7. Most Global Cited Documents

The 'Most Globally Cited Document' (**Figure 6**) is a dataset showcasing the most frequently cited documents in ASD research. Based on this, it displays the top 10 most cite cited documents in the study. The top position is Jhon Baio, published in 2018 in the journal MMWR SURVEILL SUM is the most cited document with 2775 citations entitled "Prevalence of Autism Spectrum Disorder Among Children Aged 8 Years - Autism and Developmental Disabilities Monitoring Network, 11 Sites, United States, 2014". The journal discusses that the number of 8-year-old ASD children in the USA was 16.8 per 1000 children, which means that 1 in 59 children had ASD in the USA in 2014.

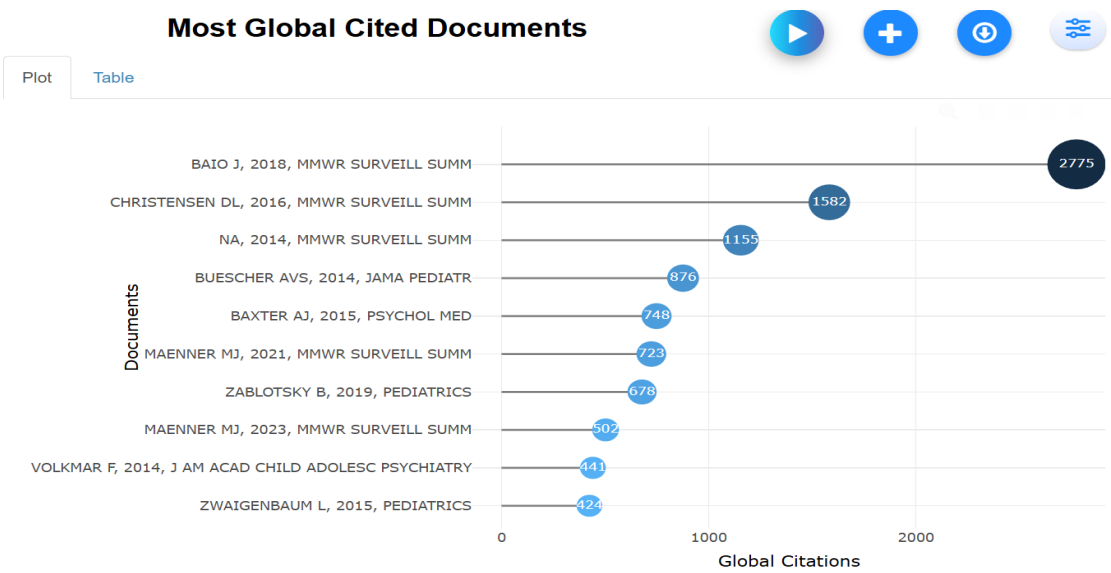

Figure 6. Most Global Cited Documents

8. Word Cloud

Word cloud (**Figure 7**) shows the word digest display. The word cloud visually represents words of varying sizes based on their frequency of occurrence. The more words, the larger the size of the words in the word cloud. The arrangement of words in the word cloud is generally random, but the most frequent word is usually placed at the center with a larger size for better visibility.

The emergence of popular words such as “male” and “female” occurs because the diagnosis of ASD mostly occurs in boys rather than girls, where the symptoms shown in boys and girls are also different. A recent comprehensive analysis of the global landscape of mental disorders revealed that, in 2019, the age-standardized worldwide prevalence of ASD was 369.4 cases per 100,000 individuals, with a notable predominance in males (GBD 2019 Mental Disorders Collaborators, 2022). The word "Autism" appears because it is the primary or core word of ASD itself, so it is the most used word in the ASD topic trend.

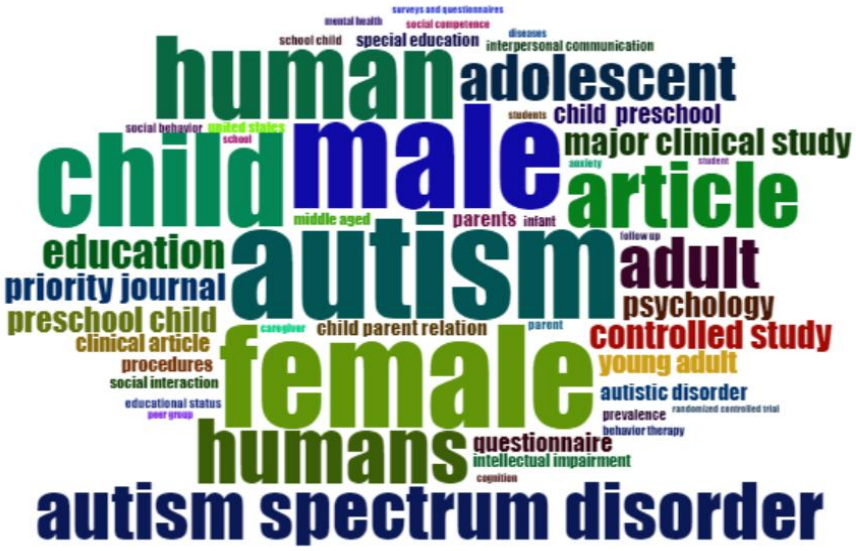

Figure 7. Word Cloud

9. Topic Trend

The 'Topic Trend' (**Figure 8**) in this study illustrates the evolution of a topic over the years. From the diagram, we can observe topics that have been prevalent for an extended period as well as those that have emerged more recently. The emerging topics also align with the frequency of word occurrences in ASD research. If more words are used, the circle will be larger; if newer words are used, it will be more to the right.

Based on this, the topic that is trending in ASD research at this time (in 2023) is the topic of attention deficit hyperactivity disorder (ADHD), with a frequency of 104. There are demographic topics with a frequency of 50 and sociodemographics with a

frequency of 22 in 2023. The emergence of these topics is because recent research about ASD examines the prevalence of ADHD based on validity issues, namely whether or not it is accurate in diagnosing children with ADHD; sociodemographics factors such as education level, employment status, family income, access to services and care received by individuals; and demographics factors such as age, gender, ethnicity, and socio-economics.

Meanwhile, the most discussed topic in ASD research in the last 10 years (2014 to 2023) is autism, with a frequency of 3261 and a research period from 2017 to 2021. Based on the above, the topics of attention deficit hyperactivity disorder (ADHD), demographics, and sociodemographics can be research opportunities in the future because of the minor frequency of research on ASD topics.

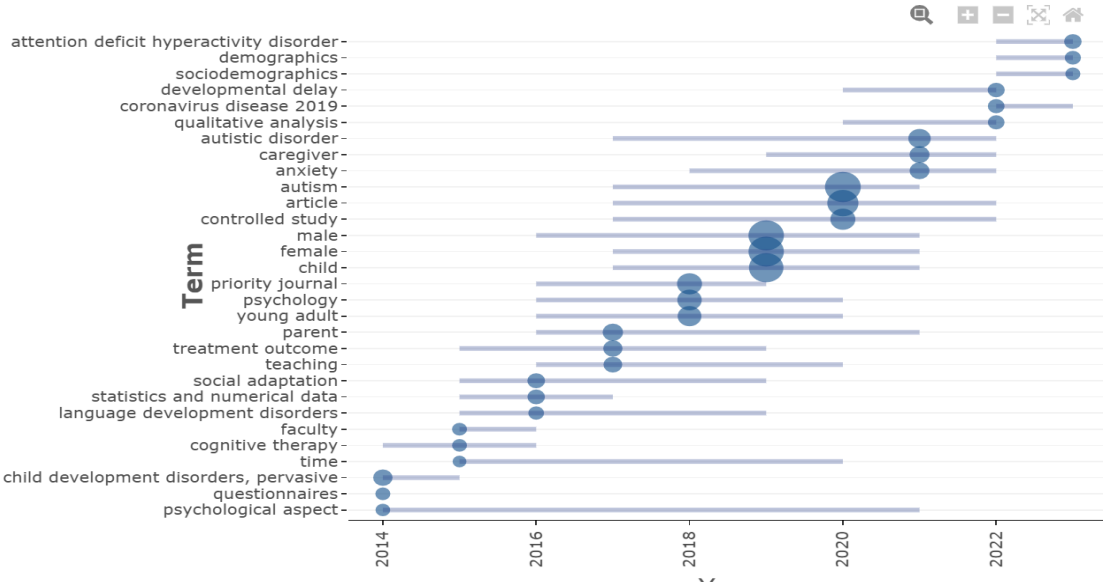

Figure 8. Topic Trend

10. Country Collaboration Map

The Country Collaboration Map (**Figure 9**) links research from different countries carrying out the same research, especially in this case on the topic of ASD. International collaboration examines how authors work together on research, share knowledge, and the relationships between countries in collaborative efforts (Gu et al., 2021). The dark blue color in the figure indicates that a country engages in extensive collaboration with other nations. Light blue indicates a lack of collaboration, and light gray indicates no collaboration or affiliation with other countries.

Based on the figure, there is extensive cooperation between the USA and Canada (frequency 51), the USA and United Kingdom (frequency 47), the UK and Australia (frequency 33), the USA and China (frequency 32), followed by USA and Austria (frequency 27) and Australia and Sweden (frequency 25). Meanwhile, other countries cooperate less, and some countries do not cooperate. The data shows that the countries collaborating a lot can be attributed to the complete literature on ASD. The USA is the country that

collaborates most with other countries because many research institutions that deal with ASD and ADHD issues come from the USA. In addition, many articles and authors who publish on ASD and ADHD topics also come from the USA (Lin et al., 2021).

With this bibliometric analysis research on ASD trends, it is hoped that interest in research on ASD topics will increase. Educators and health workers can use this research as one of the references that can be used to see sources, authors, documents, keywords, and which countries are active in writing about ASD topics. This research focuses solely on articles related to Autism Spectrum Disorder (ASD) and analyzes them using the Biblioshiny application with ten selected aspects. However, another aspect can be explored using the same application: average citations per year, clustering of most productive institutions, thematic maps, collaboration networks, and more. The sample used for this study was limited to articles published until 2023, which means that future developments and changes in the field of ASD may not be represented. The researchers suggest conducting a more comprehensive Bibliometric analysis in the future, exploring other aspects that have not been examined to obtain a more complete understanding of the topic.

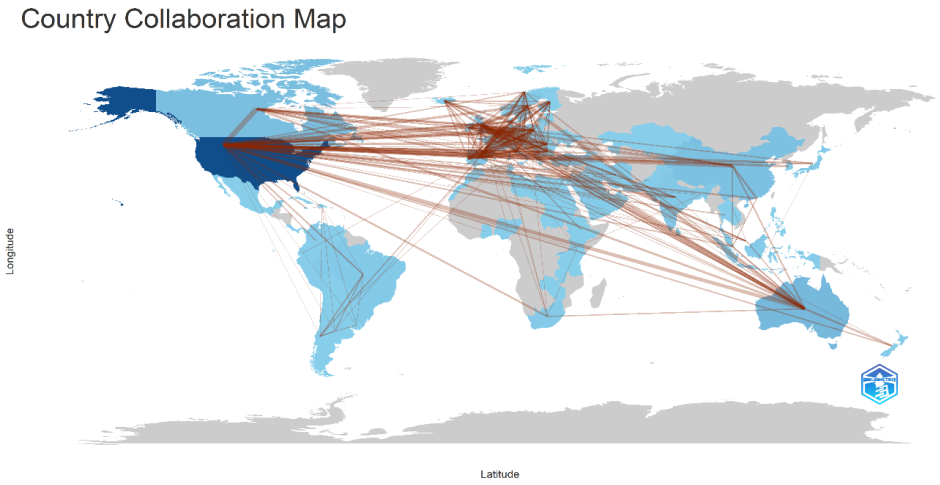

Figure 9. Country Collaboration Map

CONCLUSION

A bibliometric analysis based on the Scopus database with 3879 Autism Spectrum Disorder (ASD) topic documents has provided a comprehensive view of the domain's current status. The Annual Scientific Production results show an increase in the publication of ASD topics, which shows that this topic is still being researched and continues to develop today. In addition, the Most Relevant Source on the topic of ASD, namely the Journal of Autism and Developmental Disorder, can be used as a reference and the primary source of information regarding research on the topic of ASD. Meanwhile, the topics of attention deficit hyperactivity disorder (ADHD), demographics, and sociodemographics can be future research opportunities. The findings provide a comprehensive overview of how this topic evolves with a solid foundation for further research and collaboration.

ACKNOWLEDGEMENT

The author wishes to thank the lecturers for their guidance, advice, and support throughout the research process and

in the preparation of this paper. In addition, the author extends appreciation to all friends who have participated in this research and have been willing to share information about the focus of this research.

The authors affirm that there is no conflict of interest related to the publication of this article and confirm that the paper is original and free from plagiarism.

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