Pakistan Journal of Life and Social Sciences

www.pjlss.edu.pk

RESEARCH ARTICLE

Bibliometric Analysis of Research Trends on Micro-RNA In Autism Spectrum Disorder

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ARTICLE INFO	ABSTRACT
	Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder characterized by impairments in communication and social interaction, as well as restricted and repetitive behaviours. One of the pathogenic mechanisms of ASD involves the dysregulation of micro-RNA (miRNA). Several studies have explored the relationship between ASD and miRNA; however, no comprehensive mapping of research linking miRNA to ASD has been conducted. Therefore, a bibliometric analysis is necessary to understand the research landscape. This article presents a bibliometric analysis of studies conducted between 2013 and 2024. Data were collected using the Publish or Perish (Pop) application and analysed with VOS viewer. The findings indicate that research on ASD and miRNA saw a significant increase in 2020 and continues to persist in 2024. The United States and China are the leading contributors to research in this field. Emerging topics related to ASD and miRNA include biomarkers and pathways, which are gaining increasing attention in recent studies.

INTRODUCTION

Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder characterized by impairments in communication and social interaction, along with restricted and repetitive behaviours (Balantas've et al., 2023). The global prevalence of ASD is estimated to be 1.5% (Shrestha et al., 2020), while in Southeast Asia, it is approximately 0.6%, with a male-to-female ratio of 64.4% to 35.6%. The incidence of ASD is on the rise, warranting greater attention due to its lifelong nature, which significantly impacts an individual's ability to perform daily functional activities (Yon-Hernandez et al., 2023).

As a result, comprehensive management is crucial; however, treating ASD remains a challenge due to its complex etiopathology (Yokoyama et al., 2024). One contributing factor to ASD is microRNA (miRNA) dysregulation. miRNA is a type of short non-coding gene involved in post-transcriptional gene regulation. It binds to the 3' untranslated region (3'UTR) of mRNA, functioning as an RNA regulator to suppress gene expression (Lie et al., 2022).

The role of microRNA (miRNA) is crucial in regulating gene expression related to brain development and function. Since genetic factors are among the most significant contributors to ASD, targeting miRNA as a therapeutic approach may help regulate the expression of these genes (Hirsch et al., 2018). miRNA-based therapy includes two primary strategies: miRNA inhibitors, which function to silence specific miRNA targets, and miRNA mimics, which supplement or restore the function of certain miRNAs (Chakraborty et al., 2021).

Given the growing interest in the role of miRNA in ASD treatment, it is essential to analyse research trends in this area, one of which can be achieved through bibliometric analysis. Bibliometrics is a statistical analysis method used to evaluate the impact and trends of research based on scientific publications. Through bibliometric analysis, researchers can identify the most extensively studied topics, influential researchers, and global collaboration networks (Donath et al., 2021)

By applying bibliometric analysis, this study aims to explore research trends related to miRNA-based ASD, examine key terms to identify dominant concepts, and provide insights into the evolving landscape of research in this field.

METHODS

Data selected

The Scopus database, accessed through Publish or Perish (Pop), was selected as the primary data source due to its advanced features in indexing peer-reviewed scientific literature across multiple disciplines. The search strategy involved using the keywords "**Autism**" and "**miRNA**", applied to article titles, abstracts, and keywords to identify relevant literature. Through this approach, a total of 191 publications from 2013 to 2024 were retrieved.

To ensure the originality of findings and minimize bias, the document selection was restricted to original research articles and review papers, with no language limitations. After the screening process, 175 scientific publications were selected for further analysis. The extracted data included author names, article titles, publication years, affiliations, countries, citation counts, keywords, abstracts, and research fields. All collected data were then exported in CSV format for further analysis (Julia et al., 2020)
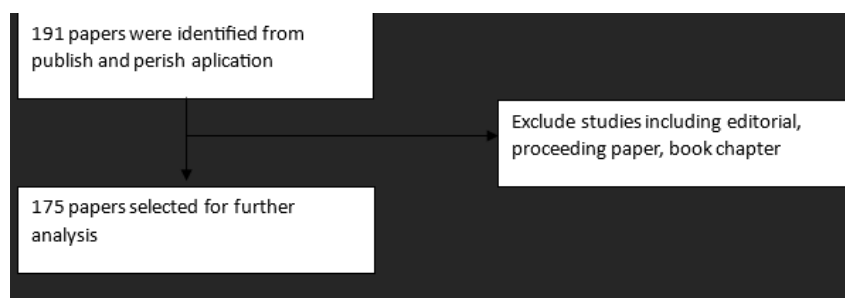

Figure 1. Literature Search Process.

Data Analysis

This analysis utilizes VOS viewer, a network visualization tool that enables the mapping of collaboration networks, co-authorship patterns, keyword relationships, and citation analysis (Rahimah, 2025).

To examine publication trends over time, the annual number of publications was collected to assess the progression of research related to autism and miRNA. The geographical distribution was evaluated by calculating the number of publications from each country. Additionally, the most productive authors and publishers were identified based on the number of publications and citations received. All data were presented in graphical patterns for better visualization (Ozturk et al.,2024).

VOS viewer was employed to conduct statistical analysis on scientific literature regarding miRNA studies in ASD and to convert the references into visual graphs. Network maps were generated, and an inter-variable relationship analysis was performed to gain a deeper understanding of the research landscape (Ullah et al., 2023)

RESULT AND DISCUSSION

Analysis of Quantity and Growth trend of Annual Publication

The quantity of annually published studies of miRNA for autism is increase 2018 and reach the peak in 2020 and relative stable in 2022 until 2024 but it's still persist, as shown in figure 2.
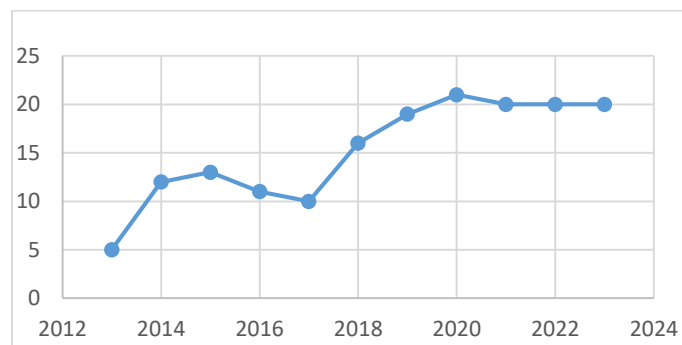
Figure 2. Research Trends on ASD and miRNA from 2013 to 2024.

Leading countries

Next, we analysed research activities related to miRNA and Autism across different countries. The collected literature included contributions from more than 22 countries. The number of publications originating from a particular country or region serves as an important indicator of research focus and scientific influence in this field. In this context, China had the highest number of studies, followed closely by the United States.

Figure 3. Distribution of Research on ASD and miRNA Across Different Countries.

Highly Cited Publications

Academic journals play a crucial role in sharing, distributing, and preserving scientific discoveries, making them essential in the advancement of knowledge. Based on our analysis, over 191 scientific journals have published research related to miRNA and ASD. Among them, five prominent journals were identified, including *Frontiers in Genetics, PLoS ONE, Frontiers in Neuroscience, Frontiers in Psychiatry*, and *Molecular Autism*. Additionally, the top 10 most productive journals are presented in Table 1.

Table 1. Top 10 Journals Publishing Research on ASD and miRNA.

Journals	Total Document	Quartile	H-index
Journal of Personalized Medicine	3	Q2	51
Molecular Psychiatry	4	Q1	250
Scientific Reports	4	Q1	315
Translational Psychiatry	5	Q1	125
International Journal of Molecular Sciences	6	Q1	269
Frontiers in Neuroscience	7	Q2	153
Frontiers in Psychiatry	7	Q1	114
Molecular Autism	7	Q1	79
PLoS ONE	8	Q1	435
Frontiers in Genetics	9	Q2	120

We obtained the impact factor, quartile ranking, and Web of Science categories of these journals from the JCR database. Among the top 10 journals, seven were classified under JCR quartile one (Q1), indicating their status as high-quality scientific publications according to the JCR evaluation system. Meanwhile, the remaining three journals were ranked in JCR quartile two (Q2).
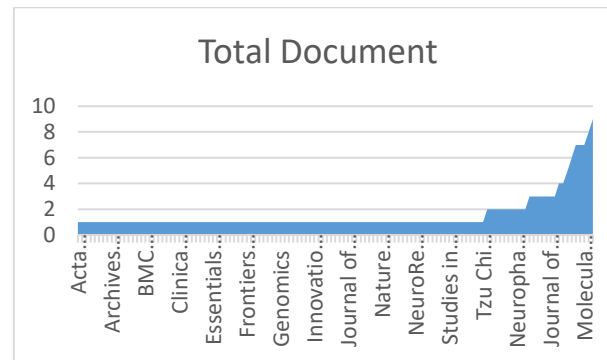

Figure 4. Journals Focused on Publishing Research Related to ASD and miRNA.

From Figure 4, it is evident that research on miRNA and Autism is predominantly published in Molecular Autism, Scientific Reports, and Epigenomics journals.

The network visualization map illustrates the co-occurrence of the keywords "Autism" and "miRNA" in research, offering insights into thematic clusters and interconnections within this field. The size of the nodes indicates the frequency of a keyword, while the colour and proximity between nodes represent thematic groupings. Based on the keyword "autism spectrum disorder," several related themes were identified, including "child," "disease," "miRNA," "microRNA expression," "dysregulation of miRNA," and "biomarker."

miRNA, as an epigenetic modulator, influences protein levels of target mRNAs without altering the gene sequence. Additionally, miRNA expression can be regulated through epigenetic modifications, highlighting the potential role of epigenetics in miRNA dysregulation (Torres et al., 2024)

Dysregulation in methylation and acetylation patterns of miRNA has been observed in the brains of individuals with ASD. Altered miRNA expression affects biological pathways and specific genes, leading to changes in gene expression levels. These modifications are highly relevant to the molecular mechanisms underlying autism (Torres et al., 2024)

The utilization of miRNA as a biomarker has the potential to support ASD diagnosis, especially considering that current ASD diagnosis relies solely on clinical assessments. Cell-free circulating miRNAs in biofluids are highly stable and are recognized as next-generation, non-invasive clinical biomarkers for various diseases, including ASD. Studies have shown that miRNA profiles in serum and saliva are dysregulated in individuals with ASD. However, existing research lacks consistency, which may be attributed to limited sample sizes in studies analysing miRNA in saliva. Therefore, a key research trend in miRNA and ASD is its potential role as a biomarker for diagnostic purposes (Salloum-Asfar., 2019).

Bibliometric analysis indicates that there is still no research trend focusing on miRNA as a therapeutic target or the use of synthetic miRNA for ASD treatment. The mechanism of miRNA-based therapy involves two primary approaches: miRNA inhibitors, which suppress overexpressed miRNAs, and miRNA mimics, which compensate for miRNAs with reduced expression levels.

Currently, no miRNA-based therapy for ASD has been developed. This is likely due to challenges in delivering miRNA to brain tissues, primarily caused by the blood-brain barrier, as well as uncertainties regarding the appropriate dosage and potential side effects. However, some miRNA-based therapies have been designed for cancer treatment and are currently being evaluated in clinical trials (Wu et al., 2020).
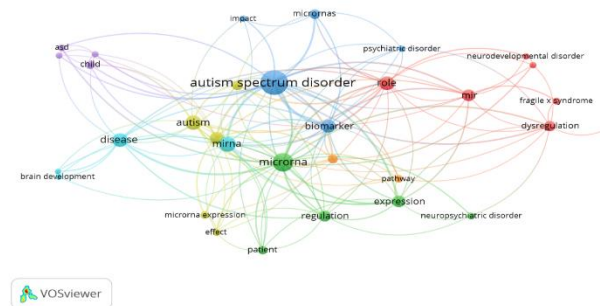
Figure 5. Network Visualization Mapping of Research Topics on ASD and miRNA.

Figure 5 illustrates eight distinct clusters in the network visualization of research on ASD and miRNA. The green cluster focuses on microRNA in relation to regulation, expression, patients, and biomarkers, showing a strong connection to autism spectrum disorder (ASD). The blue cluster highlights studies that explore the relationship between ASD, biomarkers, and the impact on miRNA. Another green cluster is associated with research on ASD in connection with gene regulation and expression. The purple cluster centres on studies examining ASD in children, although autism is known to persist into adulthood. The orange cluster covers studies that investigate pathways related to ASD. The red cluster focuses on research linking ASD to the role of miRNA and specific Mir molecules. The light blue cluster presents studies on the relationship between ASD, miRNA, disease, and brain development. Lastly, the light green cluster includes research examining the connection between ASD, miRNA, microRNA expression, and its effects.
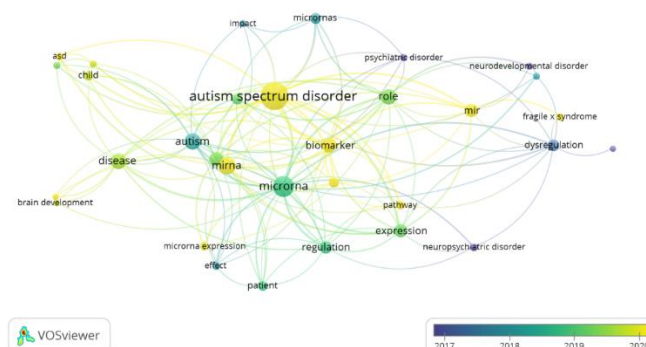

Figure 6. Network Visualization Mapping of Research Trend Topics on ASD and miRNA.

Figure 6 illustrates the evolution of research trends on autism spectrum disorder (ASD) and miRNA from 2017 to 2020, showcasing shifts in focus over time. In 2017, research primarily explored topics such as impact, neuropsychiatric disorders, and dysregulation. By 2018, the trend shifted towards studies on Autism, miRNA, regulation, and its effects. In 2019, research began focusing on the relationship between Autism, disease, brain development, and microRNA expression. In 2020, the dominant research themes revolved around ASD and miRNA, with an emphasis on biomarkers and pathways.

CONCLUSION

Research on Autism Spectrum Disorder (ASD) and miRNA has shown a significant increase since 2020 and continues to be actively explored through 2024. The topics commonly associated with ASD and miRNA include dysregulation, impact, regulatory effects, expression, and brain development. The most recent research trends in this field focus on biomarkers and pathways, highlighting their growing importance in understanding ASD at the molecular level.

Authors' Contributions

NYS: conceived the idea, design the project and wrote manuscript

ABS: Performed Publish and Perish and VOS Viewer analysis

DDS: Participated in the design and helped in writing the manuscript

AY: Participated in the design and helped in writing the manuscript

EW: Participated in the design and helped in writing the manuscript

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