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THE EVOLUTION OF AUTISM: A BIBLIOMETRIC ANALYSIS

OTİZMİN GELİŞİMİ: BİBLİYOMETRİK ANALİZ

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ABSTRACT

Objective: In parallel with the dramatic increase in the autism prevalence, a large number of articles has been published in recent years. The main aim of our study was to make descriptive and evaluative analysis of autism related publications using bibliometric mapping and provide better understanding of autism.

Methods: To make the bibliometric analysis of autism literature, all studies published from 1980 to 2020 on autism were selected from Web of Science. Density and network visualization maps according to certain bibliometric indicators (country, source, and keywords) were obtained with VOSviewer software.

Results: From 1980 to 2020, 59653 studies on autism were retrieved. The journal publishing the most studies on this subject is Journal of Autism and Developmental Disorders. The countries having the highest number of publications were USA (46.31%), England (11.39%) and Canada (6.02%). The top 3 organization that published most articles about autism were University of California System (3623), University of London (2671) and Harvard University (1663).

Conclusion: Studies on autism were on the rise worldwide, especially in the USA. They published in different fields and in many different sources. What needs to be done here is to increase cooperation in work with autism.

Keywords: Autism spectrum disorder, bibliometric analysis, VOSviewer

ÖZ

Amaç: Son yıllarda otizm prevalansındaki ciddi artışa paralel olarak, bu konuda çok sayıda çalışma yapılmıştır. Çalışmamızın temel amacı, bibliyometrik analizi kullanarak otizmle ilgili yayınların tanımlayıcı analizini yapmak ve otizm ile ilgili yapılan çalışmaların daha iyi anlaşılmasını sağlamaktır.

Yöntem: Otizm literatürünün bibliyometrik analizini yapabilmek için 1980-2020 yılları arasında otizm üzerine yayınlanmış tüm çalışmalar Web of Science'dan elde edilmiştir. VOSviewer yazılımı ile belirli bibliyometrik göstergelere (ülke, kaynak ve anahtar kelimeler) göre yoğunluk ve ağ görselleştirme haritaları elde edilmiştir.

Bulgular: 1980'den 2020'ye kadar otizmle ilgili 59653 çalışma alındı. Bu konuda en fazla çalışmayı yayınlayan dergi, Journal of Autism and Developmental Disorders'dır. En fazla yayına sahip ülkeler ABD (%46,31), İngiltere (%11,39) ve Kanada (%6,02) olmuştur. Otizm hakkında en çok makale yayınlayan ilk 3 kuruluş University of California System (3623), University of London (2671) ve Harvard University (1663) olmuştur.

Sonuç: Başta ABD olmak üzere tüm dünyada otizmle ilgili çalışmalar artış göstermektedir. Bu çalışmalar farklı alanlarda ve birçok farklı kaynakta yayımlanmıştırlar. Burada amaç otizmle ilgili çalışmalarda iş birliğini artırmaktır.

Anahtar Kelimeler: Otizm spektrum bozukluğu, bibliyometrik analiz, VOSviewer

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Introduction

Autism spectrum disorder (ASD) is a developmental problem with low interpersonal social interaction, repetitive movements and deficiencies in language development.¹⁻³ It was admitted as a comprehensible disorder by Kanner in 1943.⁴ While the reasons of ASD have not been determined exactly until now, it was considered that the genetics have a significant effect on it.^{5,6} Also the presence of toxins in utero insult during gestation was considered as another possible cause.⁶⁻⁹ In the past ASD prevalence was approximately 4 to 5 in 10000 children and it was considered a rare disorder, however, it becomes a common disorder now.¹⁰ ASD prevalence was 1 in 160 in 2019 according to the WHO's data. ASD was seen mostly in Hong Kong with 1 in 27, in South Korea with 1 in 38 and the USA with 1 in 45.¹¹ It is also seen 4 times higher in boys than girls.¹² Since the criteria for ASD diagnostics changed and awareness about ASD increased over time together with broadening of ASD, an increase was observed in ASD frequency.13 Although there were several risk factors identified in epidemiological studies, none of them has been proved to be a possible cause of ASD yet.¹⁴

Bibliometrics uses mathematical and statistical methods to make a quantitative evaluation of publication patterns.^{15,16} Therefore, it facilitates to understand the written communication process.^{16,17} It determines the effective researchers, countries, organizations and their connections and also make the comparisons of them.¹⁶

Bibliometric mapping provides researchers a powerful tool to study the structure and the dynamics of scientific fields and to understand their working field better.^{16, 18, 19, 20}

With this study, we aim to understand ASD better by conducting the bibliometric analysis of ASD related publications.

Methods

All articles published from 1980 to 2020 on ASD were selected from Web of Science (WoS, Core Collection database maintained by Clarivate Analytics) and analyzed using bibliometric methods. The search keywords were taken as "Autism", "Autistic", "Autism Spectrum Disorder", "ASD" and "Childhood Disintegrative Disorder". The keywords were chosen based on the commonly used definition of ASD. VOSviewer (version 1.6.16) package program was used for bibliometric network visualizations.²¹

The following bibliometric indicators were used in this study: $^{\rm 20}$

- Publication type
- Publication language
- Country and institutional affiliation
- Most productive authors
- Source and the name of the journal in which the document was published
- Most cited articles

According to the h index, the number of citations and publications and also the top ten places in terms of authors, institutions and journals were determined.

Results

Studies on autism have increased significantly in recent years. While approximately 150 studies were published annually in the early 80's, approximately 6000 studies were published in 2020.

In this study, a total of 59653 publications were retrieved, 63.69% of which were original articles. The remaining publications were reviews, meeting abstracts, editorial materials, proceedings paper and etc. The primary language was English (96.70%) for the retrieved articles. Other languages like Spanish, French, German, Portuguese, Russian, Turkish and etc. were also encountered.

Country

A total of 160 countries contributed to the advancement of autism research. The top 10 country that published the most articles about autism were USA (46.31%), England (11.39%), Canada (6.02%), Australia (5.23%), Italy (4.12%), France (3.51%), Japan (3.35%), China (3.34%), Netherlands (2.96%) and Germany (2.92%). Of these 160 countries, there were 60 countries that had at least 50 publications. Figure 1 demonstrated the international network visualization of these 60 world countries. The number of publications is given by the size of the circle, the strength of the relationship is indicated by the thickness of the lines and the clusters are shown by the colors.²²

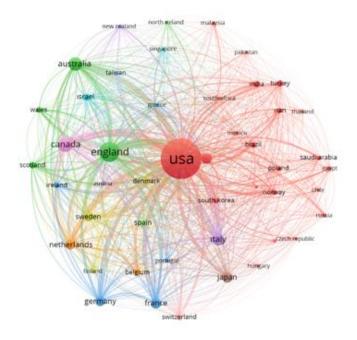


Figure 1. Network visualization map for international collaboration of worldwide countries during the period.

Research Areas

The top 10 research fields publishing the most articles about autism were psychology (36.41%), neurosciences neurology (22.59%), psychiatry (21.19%), rehabilitation (11.82%), educational research (11.38%), pediatrics (9.17%), genetic heredity (6.43%), behavioral sciences (4.95%), pharmacology (3.58%) and biochemistry molecular biology (2.80%).

Authors

The top 10 author that published the most articles about autism were Gillberg G. (417), Baron-Cohen (395), Lord L. (295), Matson JL. (294), Chairman T. (285), Dawson G.

(265), Zwaigenbaum L. (256), Szatmari P. (241), Bolte S. (233) and Happe F. (205). The number of publications, h-index, average citation per item and total citation were given in Table 1.

Density visualization map of co-authorship for autism research was given in Figure 2. Co-authorship refers to local and international collaborations. People who are away from the set have less co-authorship and collaboration than others. From yellow to blue, more collaborative authors are seen.

Moreover top 10 most cited articles according to number of citations per year on autism were given in Table 2.

Table 1. Top 10 author, source and organization publishing on autism (1980-2020)

		Number of publications	h-index	Average citation per item	Total citation
Author	Gillberg G.	417	84	65.26	27213
	Baron- Cohen S.	395	100	92.07	36369
	Lord L.	295	100	149.62	44138
	Matson JL.	294	50	30.10	8848
	Chairman T.	285	68	58.33	16625
	Dawson G.	265	82	102.93	27277
	Zwaigenbaum L.	256	64	66.58	17044
	Szatmari P.	241	67	73.21	17644
	Bolte S.	233	42	37.61	8763
	Happe F.	205	55	71.82	14724
Source	Journal of Autism and Developmental Disorders	5364	171	39.28	210691
	Research in Autism Spectrum Disorders	1461	69	18.91	27360
	Autism	1408	85	24.50	34490
	Autism Research	1184	63	18.46	21859
	Journal of the American Academy of Child and Adolescent Psychiatry	1013	95	28.06	28421
	Journal of Intellectual Disability Research	846	45	9.08	7684
	Biological Psychiatry	687	92	36.12	24813
	Research in Developmental Disabilities	561	63	28.15	15793
	Molecular Autism	512	54	24.75	12.674
	Journal of Applied Behavior Analyses	487	60	27.63	13457
Organization	University of California System	3623	198	51.98	188320
	University of London	2671	172	53.64	143272
	Harvard University	1663	132	40.52	67388
	King s College London	1434	137	61.73	88521
	University of North Carolina	1249	122	51.87	64787
	University of California Los Angeles	1197	134	60.78	72749
	University College London	1181	118	55.65	65727
	Pennsylvania Commonwealth System of Higher Education	1154	116	46.75	53947
	Yale University	1061	124	57.42	60925
	University of California Davis	1058	118	49.12	51972

Table 2. Top 10 most cited articles according to number of citations per year on autism

Author	Title	Year	Source	Number of Citations
Lord et al.	Autism Diagnostic Interview-Revise-A Revised Version of a Diagnostic Interview for Caregivers of Individuals with Possible Pervasive Developmental Disorders	1994	Journal of Autism and Developmental Disorders	5762
Lord et al.	The Autism Diagnostic Observation Schedule-Generic: A Standard Measure of Social and Communication Deficits Associated with The Spectrum of Autism	2000	Journal of Autism and Developmental Disorders	4625
Baroncohen et al.	Does the Autistic-Child have a Theory of Mind	1985	Cognition	3653
Baroncohen et al.	The Autism-Spectrum Quotient (AQ): Evidence from Asperger syndrome/high-functioning autism, males and females, scientists and mathematicians	2001	Journal of Autism and Developmental Disorders	2854
Baroncohen et al.	The "Reading the Mind in the Eyes" test revised version. A Study with Normal Adults, and Adults with Asperger Syndrome or High-Functioning Autism	2001	Journal of Child Psychology and Psychiatry	2830
Pennington and Ozomoff	Executive Functions and Developmental Psychopathology	1996	Journal of Child Psychology and Psychiatry	1895
Sebat et al.	Strong association of de novo copy number mutations with autism	2007	Science	1796
Baroncohen and Wheelwright	The Empathy Quotient: An Investigation of Adults with Asperger Syndrome or High Functioning Autism, and Normal Sex Differences	2004	Journal of Autism and Developmental Disorders	1756
Bailey et al.	Autism as a Strongly Genetic Disorder-Evidence from a British Twin Study	1995	Psychological Medicine	1588
Simonoff et al.	Psychiatric Disorders in Children with Autism Spectrum Disorders: Prevalence, Comorbidity, and Associated Factors in a Population-Derived Sample	2008	Journal of The American Academy of Child and Adolescent	1560

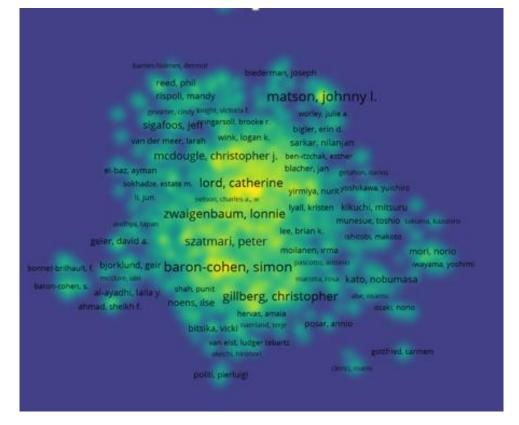


Figure 2. Density visualization map of co-authorship for autism research (1980-2020)

Source

The top 10 source that published the most articles about autism were Journal of Autism and Developmental Disorders (5364), Research in Autism Spectrum Disorders (1461), Autism (1408), Autism Research (1184), Journal of The American Academy of Child and Adolescent Psychiatry (1013), Journal of Intellectual Disability Research (846), Biological Psychiatry (687), Research in Developmental Disabilities (561), Molecular Autism (512) and Journal of Applied Behavior Analyses (487). Number of publications, h-index, average citation per item and total citation were given in Table 1. Network visualization map for citation analysis of source was given in Figure 3. The size of the circle shows the large number of citations. Looking at the sources with more than 50 citations, the Journal of Autism and Developmental Disorders is the most cited source.

Organization

The top 10 organization that published the most articles about autism were University of California System (3623), University of London (2671), Harvard University (1663), King S College London (1434), University of North Carolina (1249), University of California Los Angeles (1197). University of California Los Angeles (1181), Pennsylvania Commonwealth System of Higher Education (1154), Yale University (1061) and University of California Davis (1058). The number of publications, hindex, average citation per item and total citation were given in Table 1.

Keywords

Network map for trends based on keywords analysis on autism is given in Figure 4. The size of the circle shows the large number of keywords. The most used keywords are autism and autism spectrum disorder.

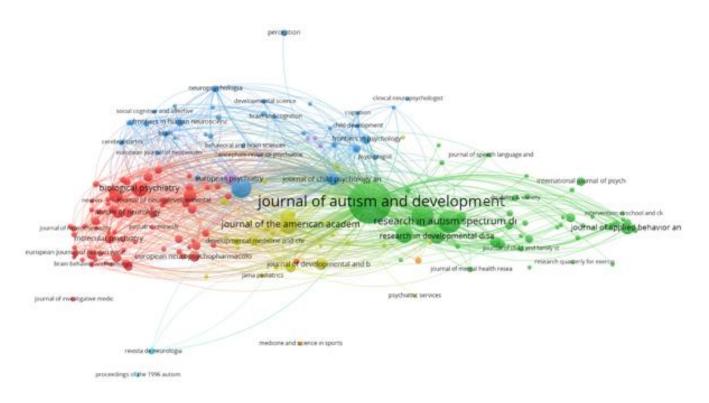


Figure 3. Network visualization map for citation analysis of source.

Discussion

In recent years, there has been a significant increase in the number of cases with autism, from 1 in 2500 cases to 1 in 160. Therefore, serious increases have been observed in the studies conducted in this area. While approximately 200 publications were made annually in the 80s, today this number has reached around 6000. These studies were especially concentrated in the USA. Also, USA is the third country with the most autism cases in the world.

In this study, we analyzed the studies on autism obtained from Web of Science between the years 1980-2020 using bibliometric analysis. Therefore, we aimed to determine the most effective researchers, organizations, countries, journals and their connections.

As a result, we found a statistically significant relationship between the number of publications in 10 countries publishing the most on autism and their economic income levels. While less article was done in low-income countries, more article was done in high-income countries. Likewise, Sweileh found a statistically significant relationship between the number of publications of 10 countries publishing the most on autism and the economic levels of them (r=0.948, p<0.01).¹⁵

Journals that contribute more to the literature in terms of number of publications were Journal of Autism and

Developmental Disorders, Research in Autism Spectrum Disorders and Autism. Journals that contribute more to the literature in terms of number of citations per article were Journal of Autism and Developmental Disorders, Biological Psychiatry and Research in Developmental Disabilities. Sweileh similarly found that the journals with the highest number of publications were Journal of Autism and Developmental Disorders, Research in Autism Spectrum Disorders and Autism. However, there was a difference in the number of citations per article. The journals highest number of citations per article in Sweileh's study were Journal of Child Psychology and Psychiatry and Allied Disciplines, Journal of the American Academy of Child and Adolescent Psychiatry and Journal of Autism and Developmental Disorders.

In our bibliometric study, we only received publications from the Web of Science. Similarly, there are other publications using only Web of Science as source in literature such as studies of Tao Li et al. and Banavent et al. Although web of science is frequently used, its use alone may be a limitation of our work. In addition, clear concepts about autism were used in the title and in the keyword part in order to receive only autism-related studies. Thus, we could not reach the studies on autism that do not have autism in the title or keywords. This may be considered as the second limitation of our study. As for the importance of this study, it provides a very largescale study on autism for researchers.

As a conclusion which sources, organizations and authors studied about autism were clearly revealed. The countries with the most studies on autism were USA, England and Canada. The most published authors in this field were Gillberg, Baron-Cohen and Lord. The most widely published sources were Journal of Autism and Developmental Disorders, Research in Autism Spectrum Disorders and Autism. University of California System, University of London and Harvard University were the most published organizations. In addition, approximately 96% of these studies were published in English. Moreover, autism studies were published in the fields of psychology, neurosciences neurology and psychiatry. Especially, studies on autism were carried out frequently in the USA on a country basis. The reasons behind this result may be the good economic development in the USA and the high rate of autism cases in USA. As a result, we consider that this bibliometric study can be an important tool to summarize the studies on autism in the literature for clinicians who want to study on autism.

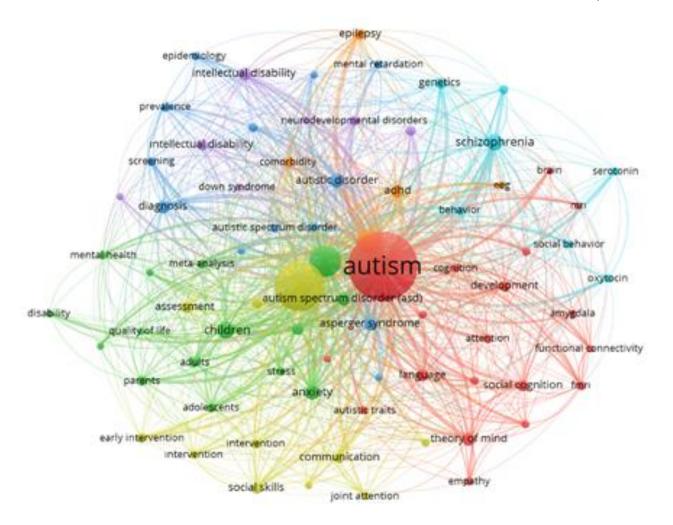


Figure 4. Network map for trends based on keywords analysis.

Compliance with Ethical Standards

Since this article is a bibliometric analysis, it does not contain any studies with human or animal subjects performed by any of the authors.

Conflict of Interest

The authors declare no conflicts of interest.

Author Contribution

Authors contributed equally to this work.

Financial Disclosure

None

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