

Review Article

Educational and Family Factors in Child Autism: A Systematic Literature Review

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Summary: The early detection of autism spectrum disorders is considered the best strategy for managing, controlling, and intervening with the patients before they reach adulthood. There is a consensus among medical professionals and research communities about the mismatching criteria, confusing symptoms, and inexhaustive nature of symptoms. Also, there are no established diagnostic factors to date due to many more non-deterministic factors like gender, race, age and region. In this study, a systematic literature review (SLR) was done on educational and family factors affecting child autism spectrum disorder at early stages. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines were adopted for selecting the forty-eight (48) items for the study. The results of this study revealed the educational and family factors for children with autism. This, in turn, will assist medical practitioners during the screening process, as well as help schools and specialised centres for autism plan effectively to meet the needs of integrated educational services for children with autism. This study also included a set of educational tools related to managing children with autism. This reveals some requirements in the field of assistive software, especially in the commencement of AI assistive tools for helping better and effective education in ASD kids. In addition to future research directions and areas of additional studies related to autism.

Keywords: Autism, Diagnosis, Children. Educational Factors, Family Factors, , Control, Management.

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INTRODUCTION

Autism spectrum disorder (ASD) is a combined phrase for a family of complex developmental disabilities, inclusive of "Autistic Disorder, Pervasive Developmental Disorder not Otherwise Specified (PDD-NOS), and Asperger's Disorder". "ASD is characterized not only by persistent impairments in reciprocal social communication and social interactions, but is also manifested by restricted, repetitive patterns of behaviour, interests, or activities" (Joon, Kumar and Parle, 2021; Edwards *et al.*, 2024). At the inception of the Century, the autism spectrum disorder ailment continues to spread unabated among children around the world. Consequently, there are more autism spectrum patients under 4 years of age seeking help with Pediatric health providers (James and Smith, 2020).

Autism is considered a serious health challenge in children. It is caused by heterogeneous etiologies, disrupted growths, poor signal flow among system parts, and distinct phenotypes in genetic makeups (complex interactions with genes and external factors). The condition negatively affects children's linguistic, neurological, adaptive, biological, social, and cognitive functions. Its symptoms and needs are complex and vary throughout their lives. There is understanding of hereditary predisposition, where a particular autism spectrum disorder gene may be absent

without a detectable medical marker when it is present (Hus and Segal, 2021).

Neurodevelopmental disorder sufferers show intellectual disability, speech impairment, motor deficits, sleep disturbances, gait alterations, and impairments in behaviour and psychological functioning. The symptoms of attention deficit hyperactivity disorder (ADHD), poor social skills, and communication difficulties are common in ASD, alongside hyperactivity and inattention. However, there are indications that seizures could decrease after 10 years. Still, the cognitive, gait, behavioural, and motor comorbidities tend to increase and persist throughout adulthood, requiring lifelong care (Strzelczyk *et al.*, 2023).

The adult population is increasingly being diagnosed with autism spectrum in the past decades, owing to factors like awareness, improvement in diagnostic procedures, and better clinicians. The key factors impacting the speedy and timely diagnosis of autism spectrum disorder include: co-occurring disability, autism subtype, and demography (that is, ethnic background and gender), developmental regression, and mental health. There are several inconsistencies in the literature about what factors predict the existence of autism spectrum disorders in children or younger adults. In particular, there are no interrelationships between high socioeconomic status (income, maternal

education, and urban residency), gender, ethnicity or nationality, and family history with screening of the autism spectrum disorder in people (Huang *et al.*, 2021; Hus and Segal, 2021).

Several determinants or factors have been recognized to impact the timing of autism spectrum disorder diagnosis. Studies have mentioned socioeconomic (ethnicity/race) and birth cohort variables in many cases. Children in order birth cohorts have better diagnoses much later against those in much early cohorts, which implies autism spectrum disorder age is diminishing as time passed. The children of non-colour at age 1 to 2 have lower chances of being positively diagnosed of autism spectrum than children of colour (Wiggins *et al.*, 2020). Several parents have explained their children's behavioural concern or medical issue to likely linked to autism spectrum disorder diagnosis, and not from the standpoint of developmental defects (Wiggins *et al.*, 2020).

Majority of research in autism in recent years were conducted in western countries having better income and living standard. Over 80% world's population are low-income countries, which informed the sparingly slow focus and extensive study in autism related subjects. There are quite wide gap and inequality on the knowledge and understanding of symptom and manifestation of the autism spectrum disorder, and the diagnosis and screening instruments. Moreso, there are seemingly a neglect of the population severally impacted by autism especially in the low-and-middle income nations, which implies shortages in access to diagnosis and evidence-motivated education and support (de Leeuw, Happé and Hoekstra, 2020).

The main problem in dealing with autism spectrum disorder in children is largely related to the relatively complex process of diagnosis. This requires that children be observed over a long period of time their behaviour and history of growth to determine whether the conditions are discovered. The similarity in the symptoms can be confusing as to the existence of autism spectrum disorder in children, including: maturational changes, co-occurring conditions, and many developing criteria. This has led to misdiagnosis at early stages of autism spectrum disorder in certain children, but much later than in others, regardless of possessing a comparable behavioural profile (Huang *et al.*, 2020).

On the part of clinicians, the standard methods [contained in the Diagnostic and Statistical Manual of Mental Disorders: Fifth Edition (DSM-5)] for screening autism spectrum cases are related to following: intellectual functioning, behavioural characteristics, co-occurring conditions, history of ailment in genealogy, and probability of suffering (de Leeuw, Happé and Hoekstra, 2020; Wiggins *et al.*, 2020). There are no effective diagnostic and biomarkers approaches are available for detecting autism in children at the earliest possible time (Hodges, Fealko and Soares, 2020). This renewed the calls for the most suitable autism diagnostic and screening tools matching the diverse cross-cultural and contextual inclinations (de Leeuw, Happé and Hoekstra, 2020). Studies have highlighted that the occurrence of comorbidities raises phenotype heterogeneity, though may alter or mask autism spectrum disorder symptoms (Elsabbagh, 2020). Therefore, children are highly probable to be misdiagnosed, delaying diagnosis. Also, children having medical or developmental or comorbidities

like anxiety, hearing impairment, and epilepsy could risk losing altogether their preliminary autism spectrum disorder diagnosis (Hus and Segal, 2021).

Joon, Kumar and Parle (2021) described autism or autism spectrum disorder as multi-factorial, heterogeneous, developmental disability that gives rise to abnormal pattern of growth at infancy and toddler periods. Considering the developmental disability, it refers to the chronic and severe condition of a person due to physical and mental impairments at the stage of growing up and beyond causing huge restriction in occupational, social, and everyday life activities. Autism is chief among developmental disorders in addition to others like learning difficulties, cerebral palsy, attention-deficit hyperactivity disorder, hearing/vision impairment, Asperger's disorder, Rett syndrome, and motor disorders. While the mental disorders cover the conditions limiting the process of thinking, behaviour, mood and feelings, which could be momentary or permanent. Specific cases of mental disorders have been identified as anxiety, personal disorder, depression, bipolar disorder, schizophrenia, dementia, and the lists are inexhaustible.

The standard procedure of diagnosing psychological and physical conditions of autism spectrum disorder relied largely on the documents that compared symptoms and diagnostic criteria for detecting availability or otherwise of the ailment. Two major standards autism diagnosis are available presently: (a) Diagnostic and Statistical Manual of Mental Disorders authored by the American Psychiatric Association as most common among clinicians in the Americas; (b) International Classification of Diseases distributed by the World Health Organization (WHO) and mostly accepted in the practice of clinicians in the European countries.

This paper conducted a systematic literature review on the educational factors and family factors affecting autism in children. The key contributions of the paper include:

- To understand the trends in children autism research.
- To identify the educational and family factors for the autistic child literacy.
- To identify the educational tools for the autistic children management.
- To present future research directions.

MATERIALS AND METHODS

The systematic study is to extract the factors that affect autism in children from the literature. The process of conducting the systematic study utilizes Kitchenham and Charters protocol (Kitchenham & Charters, 2007), the preferred reporting items for systematic review and meta-analysis, for developing the search mechanism as shown in Figure 1.

Research Questions: The mapping studies are required as input data realized from the following research questions including:

RQ1. What are trends in children autism research?

RQ2. What are the educational and family factors for the autistic children?

RQ3. What are educational tools for the autistic children management?

RQ4. What are the future research directions?

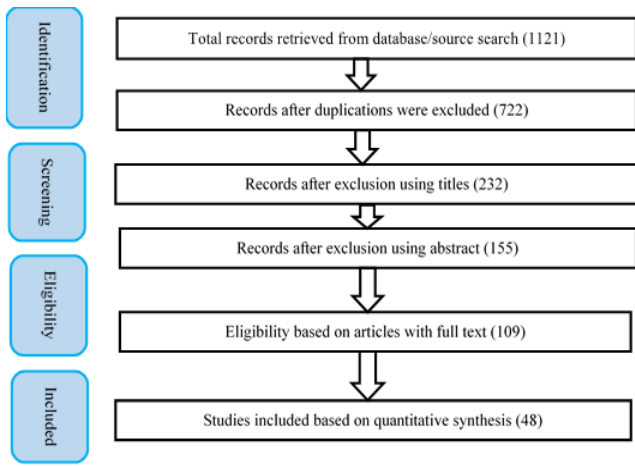


Figure 1. The SLR process using the PRISMA standard protocol

Search Mechanism: The following sets of strings and keywords were formulated matching the research questions to facilitate academic records retrieval including: “Autism, Child autism, Autism in children, Diagnosis of autism, Factors for the early detection of autism spectrum disorder, interventions of the child autism, educational tools for managing autism spectrum disorder problems in children, future research directions of child autism educational interventions”.

Data Extraction: The data was initially extracted from Google Scholar records (www.scholar.google.com), that is, the selected reputable and peer-reviewed studies on 27th June 2024 to 27th November 2024 for the period of 2018-2024 using these customised exclusion and inclusion criteria shown in Table 1.

From Table 1, the articles were screened using the title followed by abstract and conclusion. The selected articles as not conforming to the screening criteria were excluded. The selected articles as conforming to the screening criteria were accepted and included in this study.

Table 1. The study inclusion and exclusion criteria

S/N	Study inclusion	Study exclusion
1.	Article focuses on educational and family factors and educational tools for the autistic children.	Article does not focus on educational and family factors and educational tools for the autistic children.
2.	Article mode of communication is English.	Article mode of communication is not English.
3.	Article is published in reputable research society, and peer-reviewed.	Article is not published in reputable research society, and not peer-reviewed.
4.	Article is gotten from conferences or journals with high reputation.	Article is not gotten from conferences or journals without high reputation.
5.	Article discusses autism spectrum disorder current trends, educational factors, family factors for children.	Article does not discuss autism spectrum disorder current trends, educational factors, family factors for children.

Research System Dynamic Diagram: The taxonomy of the research in area of autistic children educational development is represented in Figure 2.

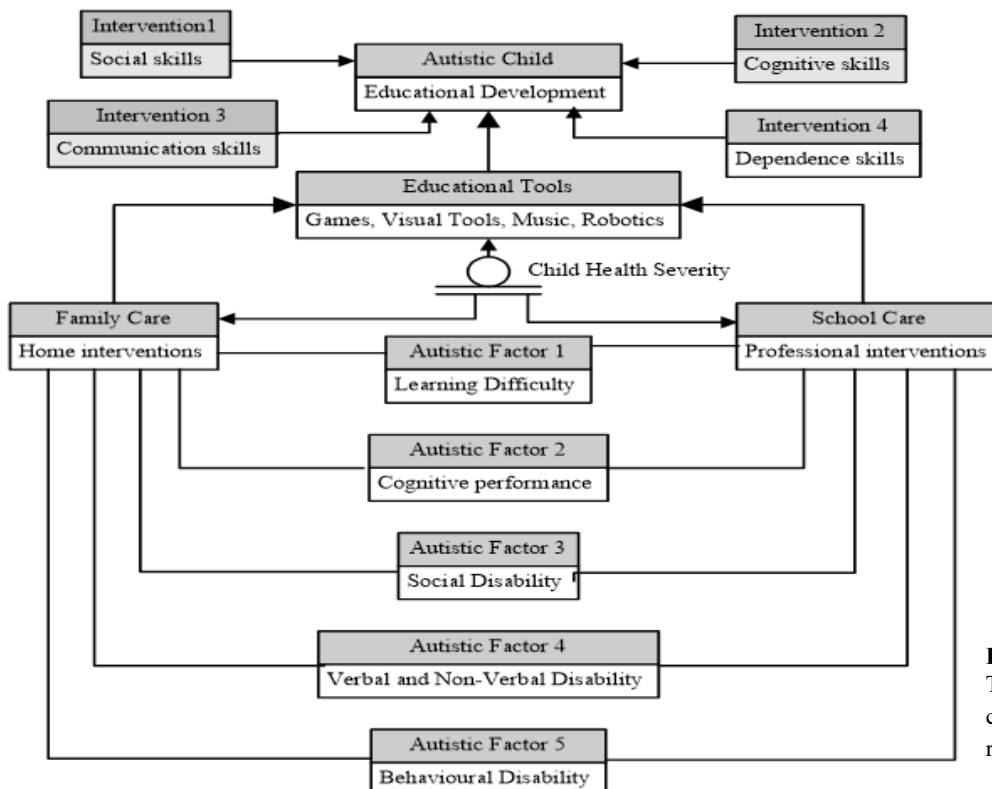


Figure 2. The taxonomy of the autistic children educational development research

From Figure 2, the literature reviewed from the included studies, child autism research is still an evolving field of endeavour, especially directed at improving educational development and appreciation. Several interventions are being planned for autistic children in areas of social skills, communication skills, cognitive skills and dependence skills. The concept of educational tools such as computer games, visual tools, music, robotics, and many other technologies to speed skills transfer and acquisition on the part of facilitators (family members and professionals) and the children suffering from autism spectrum disorders. More so, the child health severity is the main consideration at the root of all planning and implementation of educational activities to stimulate cognitive performance, learning

effectiveness, social development, verbal and non-verbal abilities, and behavioral stability. Most importantly, the included studies identified two environments for the effective educational development of child autism, which are the family homecare and school care.

Synthesis and Analysis of the Studies

Current Advances in Child Autism Research: The reviewers' analyses of each included study, focusing on the author(s), region of study, year of publication, publisher, and scope of the study, are shown in Table 2. These explain the recent and current advances in child autism research globally, stated as RQ1

Table 2.
The initial data extraction form

S/N	Author(S)	Authors' country	Year	Publisher	Scope
1.	(Zanuttini, 2023)	Australia	2023	Elsevier	Child autism
2.	(Purnama <i>et al.</i> , 2021)	Indonesia	2021	Elsevier	Child autism
3.	(Xinogalos and Tsikinas, 2019)	Greece	2019	Springer	Child autism
4.	(Mozolic-Staunton <i>et al.</i> , 2020)	Australia	2020	Elsevier	Child autism
5.	(Maddox <i>et al.</i> , 2020)	USA	2020	Routledge Taylor & Francis Group.	Child autism
6.	(Saleh, Hanapiah and Hashim, 2021)	Malaysia	2021	Taylor & Francis Group.	Autism
7.	(Syriopoulou-Delli and Gkiolnta, 2022)	Greece	2022	Taylor & Francis Group	Child autism.
8.	(Zilli, Parsons and Kovshoff, 2020)	UK	2020	The British Psychological Society	Child autism
9.	(Ke, Moon and Sokolikj, 2022)	USA	2022	SAGE	Child autism
10.	(Syrdal <i>et al.</i> , 2020)	UK	2020	DE GRUYTER	Child autism
11.	(Taheri <i>et al.</i> , 2021)	UK	2021	DE GRUYTER	Child autism
12.	(Hyman, Levy and Myers, 2020)	USA	2020	The American Academy of Pediatrics	Child autism
13.	(Chaidi <i>et al.</i> , 2021)	Greece	2021	Unknown	Child autism
14.	(Hussain, Mkpojiogu and Okoroafor, 2021)	Malaysia	2021	Unknown	Child autism
15.	(Fachantidis, Syriopoulou-Delli and Zygopoulou, 2020)	Greece	2020	Talyor & Francis Group	Child autism
16.	(Bamicha and Drigas, 2022)	Greece	2022	Unknown.	Child autism
17.	(Aloizou <i>et al.</i> , 2021)	Greece	2021	Routledge Taylor & Francis Group	Child autism
18.	(Galitskaya and Drigas, 2020)	Greece	2020	Unknown	Child autism
19.	(Chaidi and Drigas, 2020)	Greece	2020	Unknown	Child autism
20.	(Kirby <i>et al.</i> , 2022)	USA	2022	WILEY	Child autism
21.	(Baldassarri <i>et al.</i> , 2021)	Spain	2021	Springer	Child autism
22.	(Zhang <i>et al.</i> , 2022)	China	2022	MDPI	Child autism
23.	(Tareh <i>et al.</i> , 2020)	Malaysia.	2020	MDPI	Child autism
24.	(Carmona-Serrano <i>et al.</i> , 2020)	Spain	2020	MDPI	Child autism
25.	(Daulay, 2021)	Indonesia.	2021	Elsevier	Child autism
26.	(Bravou, Oikonomidou and Drigas, 2022)	Greece	2022	Unknown	Child autism
27.	(Singh <i>et al.</i> , 2023)	USA	2023	MDPI	Child autism
28.	(Elshahawy, Aboelnaga and Sharaf, 2020)	Egypt	2020	IEEE	Child autism
29.	(Davis, Fletcher-Watson and Digard, 2021)	UK	2021	Frontiers	Child autism
30.	(Blasco-Magrner <i>et al.</i> , 2021)	Spain	2021	MDPI	Child autism
31.	(Jackson and Hanline, 2020)	USA	2020	SAGE	Child autism
32.	(Sanromà-Giménez <i>et al.</i> , 2021)	Spain	2021	Unknown	Child autism
33.	(Harris <i>et al.</i> , 2021)	USA	2021	Unknown	Child autism
34.	(Pillay, Duncan and de Vries, 2021)	South Africa	2021	SAGE	Child autism
35.	(Gallardo-Montes, Caurcel Cara and Rodríguez Fuentes, 2022)	Spain	2022	Springer	Child autism
36.	(Bolourian <i>et al.</i> , 2021)	USA	2021	Springer	Child autism
37.	(Barbaro and Yaari, 2020)	Australia	2020	BMC	Child autism
38.	(O'Keefe and McNally, 2023)	Ireland	2023	Springer	Child autism

39.	(Khalil <i>et al.</i> , 2020)	Egypt	2020	Scholars Middle East Publishers	Child autism
40.	(Sweidan <i>et al.</i> , 2022)	Jordan	2022	Routledge Taylor & Francis Group	Child autism
41.	(Chinchay <i>et al.</i> , 2024)	Spain	2024	Taylor & Francis Group	Child autism
42.	(Fernández Cerero, Montenegro Rueda and López Meneses, 2024)	Spain	2024	MDPI	Child autism
43.	(Đorđević <i>et al.</i> , 2022)	Bosnia and Herzegovina	2022	The British Society of Developmental Disabilities	Child autism
44.	(McDevitt, 2021)	USA	2021	Elsevier	Child autism
45.	(Nisa, Zain and Rahmah, 2024)	Indonesia	2024	Faculty of Education and Teacher Training State Institute for Islamic Studies Batusangkar.	Child autism
46.	(Hermanto and Pamungkas, 2023)	Indonesia	2023	Unknown	Child autism
47.	(Yahya <i>et al.</i> , 2023)	Malaysia	2023	Unknown	Child autism
48.	(Kurniastuti, Evanjeli and Sari, 2023)	Indonesia	2023	Unknown	Child autism

RESULTS AND DISCUSSION

Table 2 presents the frequency of publications. The year 2021 had the highest turnover in terms of research outputs in the child autism spectrum disorder around the globe. The graphical representation of the published articles in the study for the period of seven years is shown in Figure 3. From Figure 3, the most active period of the research is year 2021 with 15 articles, followed by year 2020 at 14 articles, and year 2018 had no articles published.

Also, the distribution of the publishers of the included studies is shown in Table 4, which revealed that MDPI provided the most research works of 6, followed by Elsevier Inc. and Springer Inc., with 5 articles each on the child autism spectrum disorders and the relative factors from the educators' and parents' standpoints. Furthermore, the distribution of the regions of the included studies on the autism spectrum disorder in children, educational tools and interventions, educational and family factors are presented in Figure 4

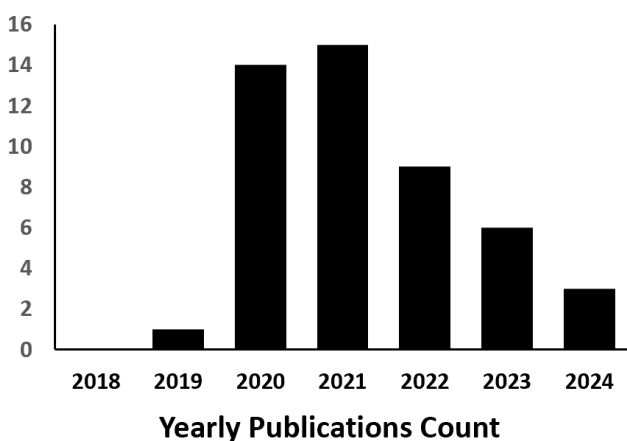


Figure 3: The distribution of published articles included in the study

From Figure 4, the most productive research regions on child autism and related investigations are the USA and Greece, at 9 authors each, closely followed by Spain at 7 authors, then, Bosnia and Herzegovina, China, Ireland, Jordan, South Africa produced 1 author each to be placed in the least productive regions. The reason can be attributed to early

knowledge and understanding of the ailment and high autistic populations with large clinical and academic studies towards its management and controls.

Educational and family factors for the autistic children: The answers to the research question two (RQ2), which are the most important educational and family factors of the child autism covered in included studies are presented in Table 4.

Table 3. The distribution of the publishers of the included studies

Article Publisher	Count
BMC	1
DE GRUYTER	2
Elsevier Inc	5
Faculty of Education and Teacher Training State Institute for Islamic Studies Batusangkar	1
Frontiers	1
IEEE	1
MDPI	6
Routledge Taylor & Francis Group	3
SAGE	3
Scholars Middle East Publishers	1
Springer	5
Taylor & Francis Group	4
The American Academy of Pediatrics	1
The British Psychological Society	1
The British Society of Developmental Disabilities	1
Unknown	11
WILEY	1
Elsevier Inc	5

From Table 4, the general factors adopted by educators, clinicians, and parents for identifying child autism spectrum disorder cases include:

Educational and family factors in child autism

- Socioeconomic factors: Race, ethnicity, socio-cultural, literacy levels of parents, living standards, environmental, social class, cultures and beliefs, demography.
- Biological factors: Birth cohorts, age, gender, co-occurring, facial dysmorphic traits, neurological signs, developmental disorders, genetic disorders, repetitive behaviours, comorbid concerns, neuropsychiatric disorders.
- Psychological and behavioural factors: Seizures, sensory impairment, hearing and vision difficulties, social functioning, intellectual disorders, communication changes, hyperactivity, intelligence quotient, cognitive ability, relationships, social, learning difficulty, mental health.
- Medical and healthcare factors: Expertise, synaptic dysfunction, medical co-occurring conditions, language skills, parental care, epilepsy, medical caregivers' experiences, and speech delays, attention deficit, nutrition, heavy metal exposure, perinatal, and risky lifestyles, presence of regression.
- Observatory factors: Physical activities, adaptive behaviours, non-verbal reasoning, social functioning, Asperger's syndrome, perspective development disorders, contextual and cultural factors, diagnostic criteria, behavioural analysis, knowledge and awareness of illness.

Educational factors matching different children autism during the early development stages including: Intellectual disability, learning difficulty, social, practical and intellectual functioning skills (Xinogalos and Tsikinas, 2019), verbal communication problems, cognitive performance (Mozolic-Staunton *et al.*, 2020), child

cognitive disability (Maddox *et al.*, 2020; Saleh, Hanapiah and Hashim, 2021; Ke, Moon and Sokolikj, 2022), mutual attention, imitation skills, verbal communication skills (Syriopoulou-Delli and Gkiolnta, 2022), Repetitive behaviour, severe and irritable behaviours, hyperactivity, inattention, distractibility (Hyman, Levy and Myers, 2020), Learning and communication disabilities (Yahya *et al.*, 2023), deficiencies in interaction skills, daily skills, domestic skills, learning skills (Hermanto and Pamungkas, 2023; Kurniastuti, Evanjeli and Sari, 2023), Academic performance, emotional disorders, lack of cultural and linguistic identity (Fernández Cerero, Montenegro Rueda and López Meneses, 2024), attention deficit, hyperactivity disorder, physical, mental and neurological challenges, communication deficiency, personality (Nisa, Zain and Rahmah, 2024).

Similarly, the family factors related to child autism detection including: persistent restricted, repetitive pattern interests or behaviours (Purnama *et al.*, 2021), speech/language, social developmental history, adaptive behaviour (Maddox *et al.*, 2020), Social and cognitive skills (Saleh, Hanapiah and Hashim, 2021; Syriopoulou-Delli and Gkiolnta, 2022), lack of social and collaborative play (Syrdal *et al.*, 2020), Disruptive activities at home, discomfort, and self-injurious behaviours and other co-occurring behavioural symptoms (Hyman, Levy and Myers, 2020), motor disorders, autism, speech delay, learning difficulties, speech impaired, slow learners, deaf, mentally retarded, blind, quadriplegic, unsociable (Kurniastuti, Evanjeli and Sari, 2023), communication, social interaction, offensive behaviours, stress (Fernández Cerero, Montenegro Rueda and López Meneses, 2024), self-development, cognition, and learning activities, behavioural and social defects (Nisa, Zain and Rahmah, 2024).

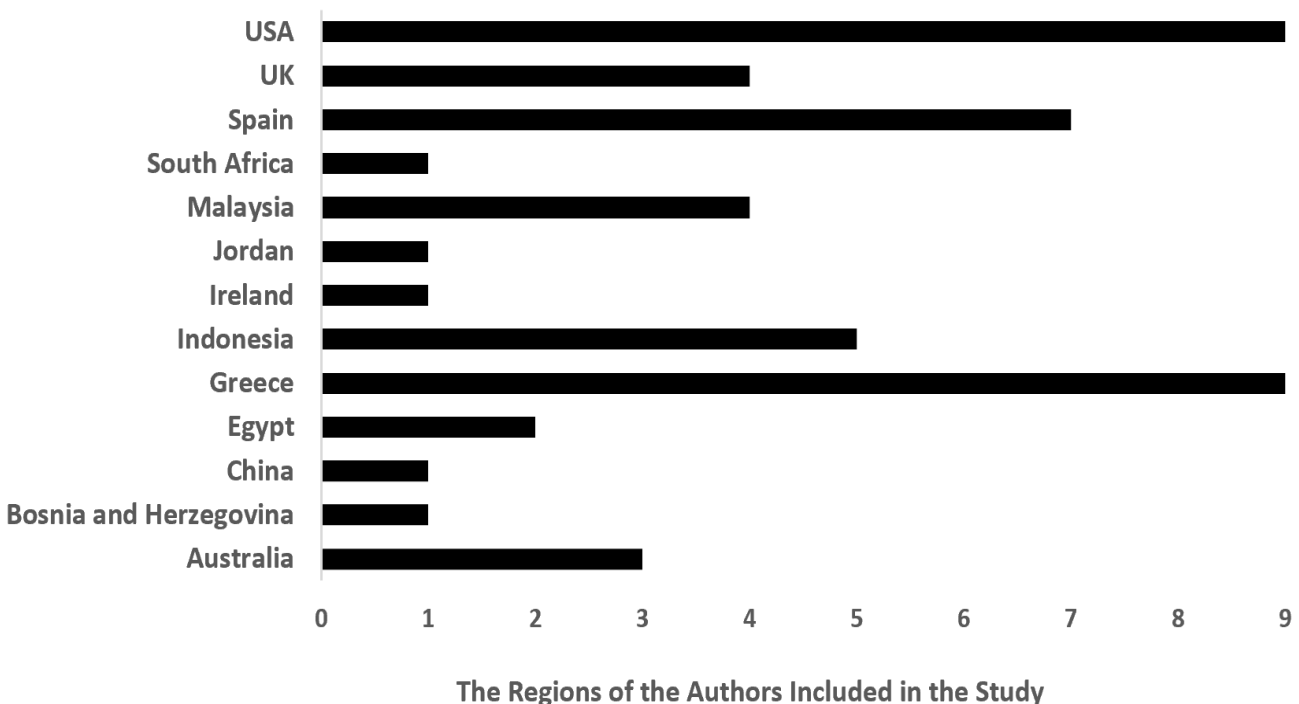


Figure 4.
The distribution of included studies by region of the authors

Table 4.
The educational and family factors of the child autism

No	Author(s)	Educational Factors	Family Factors
1	Zanuttini (2023)	Bullying, well-being, transition.	Uncovered.
2	Purnama <i>et al.</i> (2021)	Social interaction and communication. Cognition.	Persistent restricted, repetitive pattern interests or behaviours.
3	Xinogalos <i>et al.</i> (2020)	Intellectual disability, learning difficulty, social, practical and intellectual functioning skills.	Independent living skills
4	Mozolic-Staunton <i>et al.</i> (2020)	Verbal communication problems, cognitive performance.	Social and emotional developmental delays, stress.
5	Maddox <i>et al.</i> (2019)	Child cognitive disability.	Speech/ language, social developmental history, adaptive behaviour.
6	Saleh <i>et al.</i> (2020)	Severe intellectual disability, learning skills.	Social and cognitive skills.
7	Syriopoulous-Delli & Gkiolnta (2020)	Mutual attention, imitation skills, verbal communication skills.	Social skills.
8	Zilli <i>et al.</i> (2019)	Poor thinking skills, poor interest, social disconnection.	Unspecified.
9	Ke <i>et al.</i> (2022)	Social and communication skills.	Unspecified.
10	Syrdal <i>et al.</i> (2020)	Social and communication skills, narrow interests, repetitive and stereotypical behaviours.	Lack of social and collaborative play.
11	Taheri <i>et al.</i> (2021)	Stereotypical behaviours, cognitive defects.	High parenting stress levels.
12	Hyman <i>et al.</i> (2020)	Repetitive behaviour, severe and irritable behaviours, hyperactivity, inattention, distractibility.	Disruptive activities at home, discomfort, and self-injurious behaviours and other co-occurring behavioural symptoms.
13	Chaidi <i>et al.</i> (2021)	Learning difficulties.	Lack self-esteem, social interaction deficiency.
14	Hussain <i>et al.</i> (2021)	Language and communication skills.	Social interaction with verbal and non-verbal dimensions. Unusual response to stimulus.
15	Fachantidis <i>et al.</i> (2018)	Attention deficiency, social and communication problem, stereotypical behaviours.	Lack of autonomy and low quality of life.
16	Bamicha & Athanasios (2022)	Perception, social interaction, information processing, verbal and non-verbal communication, social and cognitive behaviour.	Social communication difficulty, uncontrollable repetitive behaviours, and interests.
17	Aloizou <i>et al.</i> (2021)	Communication, behavioural and cognitive deficiencies.	Communication and behavioural disorders.
18	Galitskaya & Drigas (2020)	Concentration and learning difficulties, intellectual disabilities, movement challenges.	Object recognition, movement difficulties.
19	Chaidi & Drigas (2020)	Communication and socio-emotional skills, attention disorders.	Communication skills, quality of life, behavioural disorders, difficulty in retaining knowledge, generalization problem, sleep disturbances,
20	Kirby <i>et al.</i> (2022)	Cognitive problems, adaptive behaviours, emotional instabilities, attention, and aggression.	Adaptive behaviour disorders, difficulty with sensory parts of the environment (extreme sensitivity, stress, sensitive to noise, over-responsiveness, excessive mouthing of objects).
21	Baldassarri <i>et al.</i> (2021)	Communication and attention disorders, cognition, concentration, contextualized challenges.	Emotional challenges (happiness, fears, disgust, surprise, sadness, neutral), social interactions and communication.
22	Zhang <i>et al.</i> (2022)	Cognitive skills, social and interaction skills, social communication (language and speech, emotion recognition, social functioning).	Atypical view patterns, irregular emotions, speech and language skills, social communication skills.
23	Taresh <i>et al.</i> (2020)	Behavioural disorders, learning difficulties, mental health issues, psychological disorders, emotional and physical disability.	Behavioral disorders, social and learning difficulty.

24	Carmona-Serrano <i>et al.</i> (2020)	Narrative skills, communication, participation, retention and assimilation of information.	Behavioural challenge, stress, dependence on daily life.
25	Daulay (2021)	Repetitive emotions, and behavioural patterns, communication, learning difficulty.	Burden of caregiving and negative emotions, socially delayed, inappropriate behaviours, poor adaptability.
26	Bravou <i>et al.</i> (2022)	Behavioural and learning difficulties, social and distracted problems.	Attention deficit, mental imagery disorders, information processing patterns, facial expressions, interpersonal skills.
27	Singh <i>et al.</i> (2023)	Non-verbal communication, seizures, learning difficulties, and verbal disorders.	Learning and social interaction problems.
28	Elshahawy <i>et al.</i> (2020)	Problem solving skills, language, social and communication skills, intellectual abilities.	Communication and behavioural deficiencies, social, restrictive, repetitive and stereotyped behaviours.
29	Davis <i>et al.</i> (2021)	Early language difficulty.	Early language and cognitive defects, low emotional processing.
30	Blasco-Magraner <i>et al.</i> (2021)	Learning and emotional difficulties. Psychological and deductive disorders.	Emotional intelligence, academic performance, and prosocial skills.
31	Jackson <i>et al.</i> (2020)	Learning disability, language and communication problem, and verbal disorders.	Social and learning disorders, verbal disorders.
32	Sanroma-Gimenez <i>et al.</i> (2021)	Learning difficulty, attention deficiency, lack of participation, interaction, commitment,	Low quality of life, learning disorders.
33	Harris <i>et al.</i> (2021)	Communication, play, and behaviour, learning difficulty, cognition and language functioning.	Social engagement, play, behaviour, and speech disorders.
34	Pilay <i>et al.</i> (2020)	Co-occurring intellectual disability, hyperactivity, language and speech disorders, attention-deficit.	Speech and language disorders, visual and hearing impairment, physical and intellectual disorders, hyperactivity/attention-deficit, behaviour and seizures.
35	Gallardo-Montes <i>et al.</i> (2022)	Language function, emotional disorders, entertainment.	Behaviours, verbal/ non-verbal impairments, and thinking, language and communication, interpersonal reciprocity.
36	Bolourian <i>et al.</i> (2022)	Social difficulties, fixed/focused interests, physical impairments, emotional and behavioural difficulties, inattention.	Communication skills and intellectual functioning, social communication and repetitive behaviours, and inappropriate behaviours.
37	Barbaro & Yaari (2020)	Social attention, communication and behavioural disorders.	Social attention, communication and behavioural disorders.
38	O'Keeffe & McNally (2021)	Social interaction disorders, communication, cognition.	Communication skills and social skills disorders.
39	Khalil <i>et al.</i> (2020)	Behavioural disorders, social interactions, communication deficit, intellectual disorders.	Behavior, social interaction, verbal and non-verbal communication, disorders.
40	Sweidan <i>et al.</i> (2019)	Social skills, language skills, inattention, learning difficulty, behavioural disorders.	Intellectual disabilities, personal development, social behavior and thinking deficiencies, speaking skills.
41	Chinchay <i>et al.</i> (2023)	Emotional instability, communication and social disorders.	Isolation, quarantine, physical and executive function disorders, language, cognition, memory deficiencies.
42	Cerero <i>et al.</i> (2024)	Academic performance, emotional disorders, lack of cultural and linguistic identity.	Communication, social interaction, offensive behaviours, stress.
43	Dordevic <i>et al.</i> (2022)	Mental health play, well-being, depression, relationship and communication problem.	Child behavioral difficulties, educational and learning deficiencies, developmental disabilities.
44	McDevitt (2021)	Socio-emotional instability.	Academic performance, social and communication issues,
45	Nisa <i>et al.</i> (2024)	Attention deficit, hyperactivity disorder, physical, mental and neurological challenges, communication deficiency, personality.	Self-development, cognition, and learning activities, behavioural and social defects.
46	Hermanto & Pamungkas (2023)	Learning disabilities, physical and developmental barriers, social and mobility deficiencies, cognitive skills defects, sight and hearing impairments, emotional and behavioural issues.	Learning difficulties, visual and hearing impairments, inattention,
47	Yahya <i>et al.</i> (2023)	Learning and communication disabilities.	Uncovered.
48	Kurniastuti <i>et al.</i> (2023)	Deficiencies in interaction skills, daily skills, domestic skills, learning skills.	Motor disorders, autism, speech delay, learning difficulties, speech impaired, slow learners, deaf, mentally retarded, blind, quadriplegic, unsociable.

Table 5.

The educational and assistive tools for autistic children management

S/N	Author(S)	Education/ Assistive Tools
1.	Purnama <i>et al.</i> (2021)	Sqizzy
2.	Xinogalos <i>et al.</i> (2020)	Computer-based serious games.
3.	Maddox <i>et al.</i> (2019)	Special education services.
4.	Saleh <i>et al.</i> (2020)	Robot applications
5.	Syriopoulous-Delli & Gkiolnta (2020)	Assistive technology.
6.	Ke <i>et al.</i> (2020)	Virtual reality
7.	Syrdal <i>et al.</i> (2020)	Kaspar Humanoid robot.
8.	Taheri <i>et al.</i> (2021)	Social robot for music lessons.
9.	Chaidi <i>et al.</i> (2021)	Educational robotics.
10.	Hussain <i>et al.</i> (2021)	Mobile applications.
11.	Fachantidis <i>et al.</i> (2018)	Assistive robotics.
12.	Bamicha & Athanasios (2022)	Computer assisted technology.
13.	Aloizou <i>et al.</i> (2021)	Tele-conferencing technologies.
14.	Galitskaya & Drigas (2020)	Digital and computer technologies. Assisted learning technologies.
15.	Chaidi & Drigas (2020)	Parent education and therapy. Family care and support packages.
16.	Kirby <i>et al.</i> (2022)	Autistic screening tools with sensory feature capabilities.
17.	Baldassarri <i>et al.</i> (2020)	Video games.
18.	Zhang <i>et al.</i> (2022)	Virtual reality technology.
19.	Taresh <i>et al.</i> (2020)	Teachers' education on the means to identify autistic children.
20.	Carmona-Serrano <i>et al.</i> (2020)	Technological interventions such videos, websites and gamified environment.
21.	Daulay (2021)	Online training of parents and teachers about coping with autistic children.
22.	Bravou <i>et al.</i> (2022)	Computer assistive tools such as role-playing games, interactive games.
23.	Singh <i>et al.</i> (2023)	Robotics.
24.	Elshahawy <i>et al.</i> (2020)	Computer-based solutions such as games
25.	Davis <i>et al.</i> (2021)	Bilingualism mobile app.
26.	Blasco-Magraner <i>et al.</i> (2021)	Music
27.	Jackson <i>et al.</i> (2019)	RECALL visual technology: Shared reading as an instructional context.
28.	Sanroma-Gimenez <i>et al.</i> (2021)	Educational mobile applications.
29.	Harris <i>et al.</i> (2021)	Electronic questionnaire for child autism screening during early literacy.
30.	Pilay <i>et al.</i> (2020)	Centralized education management information system for enrollment and tracking of children in school system.
31.	Gallardo-Montes <i>et al.</i> (2022)	Specialized Mobile applications and digital technologies.
32.	Bolourian <i>et al.</i> (2022)	Visual aids, learning module.
33.	Barbaro & Yaari (2020)	ASDetect Mobile applications for early detection of ASD by parents.
34.	O'Keeffe & McNally (2021)	Play-based interventions such as JASPER, ASAP, ENGAGE, SKILLS, FRIENDS.
35.	Khali <i>et al.</i> (2020)	Visual activity, verbal reinforcement, and telling social stories as most practical behavioral strategies.
36.	Sweidan <i>et al.</i> (2019)	Autistic innovative Assistant android smart phone application.
37.	Chinchay <i>et al.</i> (2023)	Assistive technologies such as desktop and mobile settings.
38.	Cerero <i>et al.</i> (2024)	Assistive technologies. Synergy between parents, educated and health professionals.
39.	Dordevic <i>et al.</i> (2021)	Parent-teacher interactions and collaboration for tending with autistic children.
40.	McDevitt (2021)	Parent education and training program for home-based interventions.
41.	Nisa <i>et al.</i> (2024)	Special assistant teachers.
42.	Hermanto & Pamungkas (2023)	Learning media, and resources such as textbooks, journals.
43.	Yahya <i>et al.</i> (2023)	Instruction digital model such as virtual and learning technologies, mobile apps, adaptive devices, augmented reality and virtual reality, social media and communication apps, virtual classroom, teletherapy.
44.	Kurniastuti <i>et al.</i> (2023)	Learning media and resources.

Educational tools for autistic child management: Research question three (RQ3) answers detail the educational and assistive tools used by teachers and parents for advancing and managing autistic children as presented in Table 5.

In Table 5, the major educational and assistive tools adapted by teachers and parents to meet the needs of autistic children include: Virtual reality and gaming technologies (Galitskaya and Drigas, 2020; Baldassarri *et al.*, 2021; Zhang *et al.*, 2022); Music

(Blasco-Magraner *et al.*, 2021); Gaming applications (Xinogalos and Tsikinas, 2019; Baldassarri *et al.*, 2021; O'Keeffe and McNally, 2023); Robot applications (Syrdal *et al.*, 2020; Chaidi *et al.*, 2021; Taheri *et al.*, 2021; Singh *et al.*, 2023); RECALL visual technology: Shared reading as an instructional context (Jackson and Hanline, 2020); Assistive technologies such as mobile and desktop applications (Galitskaya and Drigas, 2020; Bravou, Oikonomidou and Drigas, 2022; Gallardo-Montes, Caurcel Cara and

Rodríguez Fuentes, 2022; Chinchay *et al.*, 2024; Fernández Cerero, Montenegro Rueda and López Meneses, 2024); Learning media and resources (Hermanto and Pamungkas, 2023; Kurniastuti, Evanjeli and Sari, 2023)

Future research directions: The fourth research question (RQ4) answers provide the future research directions on the basis of the included studies, as shown in Table 6.

Table 6

Future research directions and area of further studies

S/N	Author(S)	Future Research Directions
1.	Zanuttini (2023)	Under-presented study areas around the globe.
2.	Purnama <i>et al.</i> (2021)	Design of assistive technologies could be more realistic.
3.	Xinogalos <i>et al.</i> (2020)	No user validation.
4.	Mozolic-Staunton <i>et al.</i> (2020)	No universal developmental surveillance for child autism.
5.	Maddox <i>et al.</i> (2019)	Educational autism classification utilizes ADOS-2 criteria in most advanced economies.
6.	Saleh <i>et al.</i> (2020)	To use robots to assess educational factors like rating of subjects' attention rate could be explored subsequently.
7.	Syriopoulous-Delli & Gkiolnta (2020)	Situating interventions to age, intellectual abilities of autistic children.
8.	Zilli <i>et al.</i> (2019)	Assistive communication solutions are probable.
9.	Ke <i>et al.</i> (2020)	Adapting non-natural solutions to users.
10.	Syrdal <i>et al.</i> (2020)	Evolving and complex research area.
11.	Taheri <i>et al.</i> (2021)	The use of educational tools had no significant improvements on the autistic child.
12.	Hyman <i>et al.</i> (2020)	Traditional screening approaches are less-effective.
13.	Chaidi <i>et al.</i> (2021)	Adaptive solutions to keep pace with learners' abilities.
14.	Hussain <i>et al.</i> (2021)	Effective usage of mobile apps to support ease of teaching and learning.
15.	Fachantidis <i>et al.</i> (2018)	Enhancing functionalities on the robotics solution.
16.	Bamicha & Athanasios (2022)	To adaptive digital interventions to specific educational needs of autistic children.
17.	Aloizou <i>et al.</i> (2021)	Ineffectiveness of digital interventions for severe and mobility difficult children.
18.	Galitskaya & Drigas (2020)	Limited to the geometric mathematics skills.
19.	Chaidi & Drigas (2020)	To evolve effective and early intervention for autistic children.
20.	Kirby <i>et al.</i> (2022)	Sociodemographic disparities impart on sensory features recognition and treatment.
21.	Baldassarri <i>et al.</i> (2020)	Inappropriate EEG devices for capturing data. Lack of analytical tools for explaining emotions of autistic children.
22.	Zhang <i>et al.</i> (2022)	Evolving technology little immersion. More functionalities expected,
23.	Taresh <i>et al.</i> (2020)	Preparing parents for early detection of child autism.
24.	Carmona-Serrano <i>et al.</i> (2020)	Continuous improvement of pedagogical interventions and tools for autistic children.
25.	Daulay (2021)	Poor knowledge on taking care of autistic children.
26.	Bravou <i>et al.</i> (2022)	The suitability of the gadgets for effective interactions.
27.	Singh <i>et al.</i> (2023)	The majority of child autism solutions are cost-ineffective.
28.	Elshahawy <i>et al.</i> (2020)	No usability studies were performed on available assistive technologies.
29.	Davis <i>et al.</i> (2021)	More cultural and social settings inclusion.
30.	Blasco-Magraner <i>et al.</i> (2021)	Evolving field of study in socio-emotional area.
31.	Jackson <i>et al.</i> (2019)	Limited to reading and comprehension skills in sciences.
32.	Sanroma-Gimenez <i>et al.</i> (2021)	Standardizing and Personalizing learning experiences for autistic children.
33.	Harris <i>et al.</i> (2021)	Impart of demographic information could be investigated.
34.	Pilay <i>et al.</i> (2020)	Lack policy documents on enrolment of autistic children into schools. Lack of appropriate tools for special educators in low-income nations.
35.	Gallardo-Montes <i>et al.</i> (2022)	Adaptability of technologies matching children with autism.
36.	Bolourian <i>et al.</i> (2022)	Focus to be on evidence-based tools for teachers in managing autistic children.
37.	Barbaro & Yaari (2020)	Parent literacy technologies could help child autism in low-income countries.
38.	O'Keeffe & McNally (2021)	Interventions are limited by interests and levels of development. Play-based curriculum is still evolving.
39.	Khali <i>et al.</i> (2020)	Professional standpoints on behavioural strategies for managing autistic children are expected.
40.	Sweidan <i>et al.</i> (2019)	Inclusion of artificial intelligence for a more personalized and adaptive experiences.
41.	Chinchay <i>et al.</i> (2023)	Ineffective due to large digital skills gaps of teachers, caregivers, and parents.
42.	Cerero <i>et al.</i> (2024)	Low availability of appropriate educational materials.
43.	Dordevic <i>et al.</i> (2021)	Scanty literature from developing countries.
44.	McDevitt (2021)	Lack of appropriate resources and professionals for schooling and services to autistic children. Educational tools could be situated to special needs of children.
45.	Nisa <i>et al.</i> (2024)	AI could be introduced in improving learning assistance of shadow teachers.
46.	Hermanto & Pamungkas (2023)	Strengthening of teacher-parent relation on improved education of autistic children. Artificial intelligence and expert systems could improve assistive learning.
47.	Yahya <i>et al.</i> (2023)	Low access to educational resources for autistic children.
48.	Kurniastuti <i>et al.</i> (2023)	More teacher training on care and teaching processes of autistic children.

From Table 6, the included studies revealed the highly pressing need for urgent attention in the child autism research. These include:

- The relevance of educational tools usage on autistic children cannot be ascertained in terms of significant improvements (Taheri *et al.*, 2021).
- The low-income countries are still underrepresented when compared to advanced countries in child autism research (Zanuttini, 2023).
- There are still no usability assessments performed on available assistive technologies, in which the effectiveness cannot be established (Elsabbagh, 2020).
- There is a need to standardize and personalize the learning experiences for the autistic children (Sanromà-Giménez *et al.*, 2021).
- The adoption of AI and machine learning algorithms to improve on autistic children management (Hermanto and Pamungkas, 2023; Nisa, Zain and Rahmah, 2024).
- There is a seemingly absence of appropriate resources and professionals for the schooling and services to autistic children, especially in low-income countries (McDevitt, 2021).
- Educational tools could be situated to special needs of children (Zhang *et al.*, 2022).
- There is a need to focus on evidence-based tools by teachers in the management of autistic children (Bolourian *et al.*, 2021).
- There is a consensus on the ineffectiveness of educational tools due to large digital skills gaps of teachers, caregivers, and parents (Chinchay *et al.*, 2024).

CONCLUSION

This study conducted an SLR to investigate educational and family factors of child autism spectrum disorder globally. The trends of research favour the more advanced and high-income countries, with sparse research contributions across low-income countries. The majority of research endeavours are more inclined to the diagnosis and the detection of autism disorders. The study identified factors associated with early, mild and severe symptoms of autism disorder among children from their teachers in schools, and parents and family members. There is little awareness about the educational and assistive tools capable of helping in the management of child autism cases in the high-income and low-income regions of the world. Though, majority of assistive tools are incorporating expert systems and AI for a more adaptive experiences of the available educational interventions on the part of family and educator.

The key patterns and factors exhibited by the children in the early autism spectrum disorder were established from the perceptible of the parents and teachers which could help the medical practitioners during the process of screening, and schools could effectively plan for different educational service needs. The various educational services and tools for addressing certain autistic children's problems were identified. This study provides the numerous areas of research requiring urgent attention in the future works section

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