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# Decoding the Cognitive Footprint of Autism: Unveiling the Nexus between Autism Spectrum Disorder and Cognitive Abilities in Children with Special Needs

**Heni Dwi Windarwati,**[1]* **Retno Lestari,**[1] **Ridhoyanti Hidayah,**[1] **Haliza Hasan,**[2] **Mira Wahyu Kusumawati,**[3] **Niken Asih Laras Ati,**[4] **Irhamna Nias Selena,**[1] **Bergita Dumar,**[1] **Gemi Rahayu,**[1] **Asri Maharani**[5]

[1]Department of Mental Health Nursing, Faculty of Health Sciences, Universitas Brawijaya, Malang – Indonesia; [2]Department of Special Care Nursing, Kulliyyah of Nursing, International Islamic University Malaysia, Kuala Lumpur – Malaysia; [3]Department of Nursing, Faculty of Health Sciences, Universitas Kusuma Husada, Surakarta – Indonesia; [4]Department of Mental Health Nursing, Faculty of Nursing, Universitas Jember, Jember – Indonesia; [5]Division of Nursing, Midwifery, and Social Work, University of Manchester, Manchester – United Kingdom

***Corresponding Author:**
email: henipsikfk@ub.ac.id - Puncak Dieng Eksklusif, Kabupaten Malang, Jawa Timur 65151, Indonesia

**Abstract:** Children with special needs experience disruptions in their physical, mental, and cognitive development and socialization, causing their daily activities to differ from other children. One classification of children with special needs was Autism Spectrum Disorder (ASD), in which the status and severity of ASD symptoms are related to cognitive abilities. This study aimed to determine the relationship between autism status in children with special needs and their cognitive abilities. This study employs a quantitative design with a cross-sectional method and involves 55 children with special needs in Malang City, East Java Province, Indonesia. The study was conducted on 55 children with special needs in Malang City in East Java Province, Indonesia. The Autism Spectrum Quotient (AQ-10) questionnaire was used to measure autism status, and cognitive abilities were measured using the Autism Treatment Evaluation Checklist (ATEC). This study showed that as many as 85.5% of children with special needs have characteristics that lead to autism. Most children lived with siblings (72.8%), and 21.8% had siblings with the same condition. The Spearman-Rho analysis indicated a significant relationship between autism status and cognitive abilities (coefficient: 0.425; p-value = 0.001). Our study found that children with special needs tend to have ASD status, so children with ASD need to get cognitive therapy according to their abilities. Therefore, parents and special needs schools must collaborate to enhance the cognitive abilities, quality of life, and overall health of special needs students through therapy focused on child's abilities to help them achieve independence and productivity.

**Keywords:** autism spectrum disorder; children with special needs; cognitive; disabilities

**Abstrak:** Anak berkebutuhan khusus mengalami gangguan pada perkembangan fisik, mental, dan kognitif serta sosialisasi sehingga menyebabkan perbedaan aktivitas sehari-hari dengan anak lainnya. Salah satu klasifikasi anak berkebutuhan khusus adalah *Autism Spectrum Disorders* (ASD), di mana status dan tingkat keparahan gejala ASD terkait dengan kemampuan kognitif. Penelitian ini bertujuan untuk mengetahui hubungan status autisme pada anak berkebutuhan khusus dengan kemampuan kognitifnya. Penelitian ini menggunakan metode penelitian kuantitatif dengan pendekatan crossectional dan melibatkan 55 anak berkebutuhan khusus di Kota Malang, Provinsi Jawa Timur, Indonesia. Kuesioner *Autism Spectrum Quotient* (AQ-10) di-

gunakan untuk mengukur status autisme, dan kemampuan kognitif diukur menggunakan *Autism Treatment Evaluation Checklist* (ATEC). Penelitian ini menunjukkan sebanyak 85,5% anak berkebutuhan khusus memiliki ciri-ciri yang mengarah pada autisme. Sebagian besar anak tinggal bersama saudara kandung (72,8%), dan 21,8% mempunyai saudara kandung dengan kondisi yang sama. Hasil analisis Spearman-Rho menunjukkan adanya hubungan yang signifikan antara status autisme dan kemampuan kognitif (koefisien: 0,425; p-value = 0,001). Penelitian ini menemukan bahwa anak berkebutuhan khusus cenderung berstatus ASD, sehingga anak ASD perlu mendapatkan terapi kognitif sesuai dengan kemampuannya. Oleh karena itu, orang tua dan sekolah harus berkolaborasi untuk meningkatkan kemampuan kognitif, kualitas hidup, dan kesehatan anak dengan kebutuhan khusus melalui terapi yang difokuskan pada kemampuan anak untuk membantu mereka mencapai kemandirian dan produktivitas.

**Kata Kunci:** *autism spectrum disorder*; anak berkebutuhan khusus; kognitif; disabilitas

## A. Introduction

Children with special needs are more likely to experience severe developmental disorders, such as physical, sensory, cognitive, developmental, learning, intellectual, emotional, and behavioral disorders.[1] Children with special needs are one of the main priorities in achieving the Sustainable Development Goals (SDGs), so early detection and treatment efforts should be prioritized.[2] Children with special needs also have problems in socializing skills with other people. One classification of children with special needs experiences physical, mental, and social disorders were children with Autism Spectrum Disorders (ASD).[3] Children with autism have a low quality of life, so they need support from parents and family in particular.[4] Common early signs and

[1] Ko Ling Chan et al., "Disability-Specific Associations with Child Health and Functioning," *International Journal of Environmental Research and Public Health* 16, no. 6 (2019): 1024, https://doi.org/10.3390/ijerph16061024.

[2] Nukhba Zia et al., "Understanding Child Disability: Factors Associated with Child Disability at the Iganga-Mayuge Health and Demographic Surveillance Site in Uganda," ed. Enamul Kabir, *Plos One* 17, no. 4 (2022): e0267182, https://doi.org/10.1371/journal.pone.0267182.

[3] Donald Maciver et al., "Participation of Children with Disabilities in School: A Realist Systematic Review of Psychosocial and Environmental Factors," ed. Tzipi Horowitz-Kraus, *Plos One* 14, no. 1 (2019): e0210511, https://doi.org/10.1371/journal.pone.0210511.

[4] Heni Dwi Windarwati et al., "Institutional and Family Support Impact on Health-related Quality of Life of Children with Autism Spectrum Disorders during the COVID-19 Pandemic," *Journal*

symptoms of ASD appear in children aged 2 years. They are characterized by no response to name when called, no or limited use of gestures in communication, and lack of imaginative play. The standard criteria for diagnosing ASD are carried out comprehensively by a medical team from various multidisciplinary sciences. They are based on the results of direct semi-structured observations of children's behavior. Identification is also carried out by interviewing caregivers using a semi-structured interview method that focuses on individual development and behavior according to standards.[5]

Autism Spectrum Disorder is a nervous disruption and developmental disorder that causes children to experience multisensory disorders in communication, cognition, and socialization.[6] Children with ASD have the characteristics of having difficulty focusing, getting bored quickly, and being unable to control motor movements that are not desirable.[7] These conditions make daily activities challenging and diminish the quality of life, especially for those who do not receive adequate support.[8] Children with ASD cannot carry out basic needs in everyday life, such as walking, playing, and interacting with the surrounding environment.[9] Children tend to behave differently from other children, such as enjoying playing alone and repeating it.[10] Cognitive

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*of Child and Adolescent Psychiatric Nursing* 37, no. 1 (2024): 12450, https://doi.org/10.1111/jcap.12450.

[5] Tomoya Hirota and Bryan H. King, "Autism Spectrum Disorder," *JAMA* 329, no. 2 (2023): 157, https://doi.org/10.1001/jama.2022.23661.

[6] Daniel Johnston, Hauke Egermann, and Gavin Kearney, "Innovative Computer Technology in Music-Based Interventions for Individuals with Autism Moving beyond Traditional Interactive Music Therapy Techniques," ed. Teppo Särkämö, *Cogent Psychology* 5, no. 1 (2018): 1554773, https://doi.org/10.1080/23311908.2018.1554773.

[7] Emma Sumner, Samuel B. Hutton, and Elisabeth L. Hill, "Subtle Oculomotor Difficulties and Their Relation to Motor Skill in Children with Autism Spectrum Disorder," *Advances in Neurodevelopmental Disorders* 5, no. 2 (2021): 144–55, https://doi.org/10.1007/s41252-020-00188-1.

[8] Yukihiko Shirayama et al., "Associations among Autistic Traits, Cognitive and Affective Empathy, and Personality Traits in Adults with Autism Spectrum Disorder and No Intellectual Disability," *Scientific Reports* 12, no. 1 (2022): 3125, https://doi.org/10.1038/s41598-022-07101-x; Windarwati et al., "Institutional and Family Support Impact on Health-related Quality of Life of Children with Autism Spectrum Disorders during the COVID-19 Pandemic."

[9] Brittany G. Travers et al., "Biofeedback-Based, Videogame Balance Training in Autism," *Journal of Autism and Developmental Disorders* 48, no. 1 (2018): 163–75, https://doi.org/10.1007/s10803-017-3310-2.

[10] Gray Atherton and Liam Cross, "The Use of Analog and Digital Games for Autism Interventions," *Frontiers in Psychology* 12 (2021), https://doi.org/10.3389/fpsyg.2021.669734.

abnormalities caused by brain structure and volume in people with ASD occur from childhood to adolescence.[11] The growth period towards adolescence will increase neural activity because it requires practical social skills that impact emotional regulation and increased social understanding. This condition involves cognitive abilities to adapt to physical changes and social knowledge to understand the actions and emotions of others.[12] Difficulty in controlling cognition is a condition of disorder that coincides with mental disorders in children with ASD.[13]

Children with ASD have damaging cognitive abilities, which then affect anxiety in children so that they refuse to socialize.[14] Cognitive disorders in children with ASD can vary and occur at the level of sensory perception, cognitive processing, learning, and memory.[15] The leading causes of cognitive disorders in ASD can be neurological, immune, and gastrointestinal dysfunction. Immune dysfunction can cause neuroinflammation, which affects neural connectivity, glutamate/gamma-aminobutyric acid (GABA) balance, and plasticity.[16] Cognitive abilities are needed to determine the success of children's learning and performance in everyday life. Cognitive abilities underlie planning abilities, flexibility, self-regulation, and behavior that aims to organize and coordinate information needed in everyday life. Cognitive functions coordinate high-level thinking processes, such as problem-solving abilities, to actions.

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[11] Lisa D. Yankowitz et al., "Evidence against the 'Normalization' Prediction of the Early Brain Overgrowth Hypothesis of Autism," *Molecular Autism* 11, no. 1 (2020): 51, https://doi.org/10.1186/s13229-020-00353-2.

[12] Angela Tseng et al., "Social Cognitive Interventions for Adolescents with Autism Spectrum Disorders: A Systematic Review," *Journal of Affective Disorders* 274 (2020): 199–204, https://doi.org/10.1016/j.jad.2020.05.134.

[13] Priscilla B. G. Godoy et al., "Brief Report: Associations between Cognitive Control Processes and Traits of Autism Spectrum Disorder (ASD), Attention-Deficit/Hyperactivity Disorder (ADHD) and Anxiety in Children at Elevated and Typical Familial Likelihood for ASD," *Journal of Autism and Developmental Disorders* 51, no. 8 (2021): 3001–13, https://doi.org/10.1007/s10803-020-04732-9.

[14] Xinyuan Wang et al., "Cognitive Behavioral Therapy for Autism Spectrum Disorders: A Systematic Review," *Pediatrics* 147, no. 5 (2021): 2020049880, https://doi.org/10.1542/peds.2020-049880.

[15] Yvonne M. Y. Han et al., "Neurophysiological and Behavioral Effects of Multisession Prefrontal TDCS and Concurrent Cognitive Remediation Training in Patients with Autism Spectrum Disorder (ASD): A Double-Blind, Randomized Controlled FNIRS Study," *Brain Stimulation* 15, no. 2 (2022): 414–25, https://doi.org/10.1016/j.brs.2022.02.004.

[16] Sarah H. Al-Mazidi, "The Physiology of Cognition in Autism Spectrum Disorder: Current and Future Challenges," *Cureus* 15, no. 10 (2023): 46581, https://doi.org/10.7759/cureus.46581.

Cognitive functions are essential in child growth and development because they are related to socio-behavioral functions, academic readiness, achievement, psychomotor skills, and the ability to receive information. Children with special needs with cognitive dysfunction will find it difficult to control impulsive behavior, regulate emotions, and inhibit their interest in class activities and academic achievement.[17]

The prevalence of ASD is increasing, with 1 in 54 children diagnosed each year at preschool age.[18] As many as 2% of the world's population is born with ASD.[8]World Health Organization estimates that for every 100 children, there is one child with ASD, with a prevalence of 1.70% in the USA, 2.64% in South Korea, and 0.23% in India.[19] As many as 95% of children with ASD experience hypersensitivity to several sensory systems. ASD occurs in 2.3% of children aged 8 years in the United States who experience cognitive, behavioral, and mental problems such as anxiety or aggression.[20] Autism is not a disease but a brain condition that works differently, so it is difficult to understand what other people think and feel. Expressing oneself with words, body movements, or facial expressions is difficult. The number of ASD in Indonesia continues to increase by 500 people every year, with 5,530 cases of children with developmental disorders, including autism, receiving services at health centers.[21] ASD occurs in 2.3% of children aged 8 years in the United States who experience cognitive, behavioral, and mental problems such as anxiety or aggression.[22] Autism is not a

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[17] Abbas Nesayan, Malahat Amani, and Roghayeh Asadi Gandomani, "A Study of the Cognitive Profile of Children and Its Relationship with Academic Performance," *Basic and Clinical Neuroscience Journal* 10, no. 2 (2018): 165–174, https://doi.org/10.32598/bcn.9.10.230.

[18] Tseng et al., "Social Cognitive Interventions for Adolescents with Autism Spectrum Disorders: A Systematic Review."

[19] World Health Organization, "Autism," World Health Organization, November 15, 2023, https://www.who.int/news-room/fact-sheets/detail/autism-spectrum-disorders?gad_source=1&gclid=Cj0KCQiAoJC-BhCSARIsAPhdfSg59efRgE8tVmwQ6hLmFXhgPHT4h2RjI1eQrKaCukc7YSlU5PXtV94aAvyZEALw_wcB; Surbhit Wagle et al., "Development and Testing of a Game-Based Digital Intervention for Working Memory Training in Autism Spectrum Disorder," *Scientific Reports* 11, no. 1 (2021): 13800, https://doi.org/10.1038/s41598-021-93258-w.

[20] Hirota and King, "Autism Spectrum Disorder."

[21] Kemenkes RI., "Autisme," Kementerian Kesehatan RI, Direktorat Jenderal Pelayanan Kesehatan, 2023, https://yankes.kemkes.go.id/view_artikel/1631/autisme.

[22] Andrew Dakopolos et al., "Developmental Associations between Cognition and Adaptive Behavior in Intellectual and Developmental Disability," Research Square, 2024, https://doi.org/10.21203/rs.3.rs-3684708/v1.

disease but a brain condition that works differently, so it is difficult to understand what other people think and feel. Hence, expressing oneself with words, body movements, or facial expressions is not easy. The number of ASD in Indonesia continues to increase by 500 people every year, with 5,530 cases of children with developmental disorders, including autism, receiving services at health centers.[26] These conditions force children with ASD to require therapy to enhance the quality of their mental health to adapt and perform their daily lives. Therefore, earlier treatment is needed for ASD to improve motor and cognitive skills.[23]

The impact that arises due to cognitive problems in children with autism is not being able to follow the same learning as their peers at school. Children sometimes have low motivation to excel at school due to a lack of attention, so they do not want to participate in class activities actively. This decrease in interest can lead to low academic achievement and low daily life skills.[24] Children with cognitive disorders are at greater risk of developing dementia as adults than the elderly.[25] The lower a person's cognitive function, the more appropriate and intensive stimulus and therapy are needed, so family support and involvement are needed.[26] Several therapies, such as using touch layers to robotics, exist for children with special needs such as autism.[27]

Children with ASD often experience speech delays because their cognitive ability to process information is delayed. Previous studies have suggested a relationship between the severity of ASD symptoms and cognitive skills.[28]

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[23] Íbis Ariana Peña de Moraes et al., "Motor Learning Characterization in People with Autism Spectrum Disorder: A Systematic Review," *Dementia & Neuropsychologia* 11, no. 3 (2017): 276–86, https://doi.org/10.1590/1980-57642016dn11-030010.

[24] In Young Sung et al., "The Effect of the 'Touch Screen-Based Cognitive Training' for Children with Severe Cognitive Impairment in Special Education," *Children* 8, no. 12 (2021): 1205, https://doi.org/10.3390/children8121205.

[25] Martin Lövdén et al., "Education and Cognitive Functioning Across the Life Span," *Psychological Science in the Public Interest* 21, no. 1 (2020): 6–41, https://doi.org/10.1177/1529100620920576.

[26] Ita Pursitasari, Allenidekania Allenidekania, and Nur Agustini, "Appreciation Family Support and the Abilities of Children with Special Needs to Maintain Personal Hygiene: An Indonesian Case Study," *Pediatric Reports* 12, no. 11 (2020): 8700, https://doi.org/10.4081/pr.2020.8700.

[27] Maria Chiara Di Lieto et al., "Improving Executive Functions at School in Children with Special Needs by Educational Robotics," *Frontiers in Psychology* 10, no. 2813 (2020), https://doi.org/10.3389/fpsyg.2019.02813.

[28] Camille N. Johnson et al., "Cognitive Correlates of Autism Spectrum Disorder Symptoms," *Autism Research* 14, no. 11 (2021): 2405–11, https://doi.org/10.1002/aur.2577.

However, other studies have shown no relationship between ASD severity and intelligence profile.[15] Therefore, further comprehensive studies are required to investigate the cognitive abilities of children with special needs, particularly in Indonesia. Understanding the status of ASD in children with special needs is essential to notice the development of children's abilities in a multisensory manner as they age. Screening on children's cognitive abilities can also be used as a standard of children's current abilities, and subsequent needs must be developed. This study aimed to determine the relationship between autism status in children with special needs and their cognitive abilities. This research could be used as a foundation for parents, health services, and educational services in developing children's cognitive abilities to maximise special needs children's capabilities.

## B. Method

This study used a quantitative cross-sectional method to determine the relationship between autism status in children with special needs and their cognitive abilities. The research was conducted in a school for children with special needs in Malang, East Java Province. This study was conducted in November 2022.

The population in this study were all children with special needs in the school for children with special needs in Malang, East Java. Researchers used a total sampling method to select respondents. The number of samples in this study was 55 children with special needs from special needs schools in the Malang area. The inclusion criteria for children were children aged six years and older; special needs children taking therapy, and special needs children experiencing more than one delay disorder. In addition, the parents also allow them to be involved in the study.

The instruments utilized in this study comprised three distinct sections: demographic and characteristic instruments, instruments designed to assess autism status, and tools for evaluating cognitive abilities in students with special needs. The initial stage involved a comprehensive demographic and characteristic questionnaire, which gathered crucial participant information. It included age, gender, number of siblings, presence of family members with similar developmental issues, specific disorders experienced, and the age at which a diagnosis was made for each special needs child.

Autism status was measured using the Autism Spectrum Quotient (AQ-10), and cognitive abilities were measured using the Autism Treatment Evaluation Checklist (ATEC). AQ-10 was a valid questionnaire used in health surveys to measure autism characteristics in various age respondents. A positive AQ score > 6 indicates leads to autism.[29] The Autism Spectrum Quotient (AQ-10) is highly recommended as a primary screening tool for identifying symptoms associated with autism spectrum disorders (ASD), which is crucial for achieving an accurate diagnosis.[30] This self-report questionnaire has been effectively utilized in both clinical settings and research studies to facilitate the diagnosis of autism spectrum disorders.[31]

ATEC is a questionnaire used to measure language/communication, socialization, sensory or cognitive awareness, and physical/behavioral abilities. Lower scores refer to mild autism, and higher scores refer to more severe autism. This questionnaire can be used according to the subscale based on the development of the ability to be measured.[32] This study used a subscale on sensory/cognitive awareness. Each subcategory of the ATEC scale is scored using a point scale of 0–3: 0 = did not have a problem, 1 = slightly problematic, 2 = moderately problematic, and 3 = very problematic, with a total score of 0-36. Lower scores refer to better cognitive abilities.

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[29] Heather Westwood et al., "Using the Autism-Spectrum Quotient to Measure Autistic Traits in Anorexia Nervosa: A Systematic Review and Meta-Analysis," *Journal of Autism and Developmental Disorders* 46, no. 3 (2016): 964–77, https://doi.org/10.1007/s10803-015-2641-0; Andreas Lundin, Kyriaki Kosidou, and Christina Dalman, "Measuring Autism Traits in the Adult General Population with the Brief Autism-Spectrum Quotient, AQ-10: Findings from the Stockholm Public Health Cohort," *Journal of Autism and Developmental Disorders* 49, no. 2 (2019): 773–80, https://doi.org/10.1007/s10803-018-3749-9.

[30] Elizabeth C. Kent, Gerald H. Burgess, and Elizabeth Kilbey, "Using the AQ-10 with Adults who Have a Borderline or Mild Intellectual Disability: Pilot Analysis of an Adapted AQ-10 (AQ-10-Intellectual Disability)," *Research in Autism Spectrum Disorders* 54, no. October (2018): 65–75, https://doi.org/10.1016/j.rasd.2018.06.010.

[31] Emily C. Taylor et al., "Psychometric Concerns with the 10-Item Autism-Spectrum Quotient (AQ10) as a Measure of Trait Autism in the General Population," ed. Christine Payne, *Experimental Results* 1 (2020): e3, https://doi.org/10.1017/exp.2019.3.

[32] Nouf Backer Al Backer, "Correlation between Autism Treatment Evaluation Checklist (ATEC) and Childhood Autism Rating Scale (CARS) in the Evaluation of Autism Spectrum Disorder.," *Sudanese Journal of Paediatrics* 16, no. 1 (2016): 17–22, http://www.ncbi.nlm.nih.gov/pubmed/27651549; Shreyas Mahapatra et al., "Autism Treatment Evaluation Checklist (ATEC) Norms: A 'Growth Chart' for ATEC Score Changes as a Function of Age," *Children* 5, no. 2 (2018): 25, https://doi.org/10.3390/children5020025.

The descriptive characteristics of the participants were summarized using mean and standard deviation for numerical variables and frequency and percentage for categorical variables. Age and the age at which the special needs children were diagnosed were reported as mean and standard deviation. In addition, the following categorical variables were presented using frequency and percentages: gender, whether the special needs children had siblings, whether those siblings also experienced special needs, and whether the children exhibited characteristics of Autism Spectrum Disorder (ASD) or had delays in speaking, learning, or multiple areas of delay development.

The Spearman-Rho analysis was employed to conduct a bivariate test examining the relationship between autism status and cognitive ability in children with special needs. In this study, autism status was the dependent variable, while cognitive abilities were the independent variable. A significance level, or p-value, was set at <0.05, indicating that results would be considered statistically significant if they fell below this threshold. Data was analyzed using the Statistical Package for the Social Sciences (SPSS) version 25. A p-value of less than 0.05 indicates a significant relationship between autism status and cognitive ability in children with special needs in the Malang area. The positive correlation between variables showed the lower children's lead to autism, the higher cognitive abilities among children in special needs schools. On the other hand, the negative correlation between variables showed that lower children lead to autism and lower cognitive abilities among children in special needs schools.

This research has obtained ethical clearance approval from the Health Research Ethics Committee Faculty of Nursing, Universitas Airlangga Number 2558-KEPK. Before data collection, the researcher explained the implementation of the research and the involvement of children as participants in the study, and informed consent was obtained from parents. Parents who consented to their child's participation in the research were asked to sign a voluntary informed consent.

Researchers adhered to key ethical principles while conducting their studies, including beneficence, justice, and respect for human dignity. The principle of beneficence guided them to prioritize the well-being of participants, ensuring that the benefits of the research outweighed any potential risks. Justice played a critical role in promoting fairness and equity, ensuring that the selection of participants was just and that the benefits and burdens of the

research were distributed fairly among all groups. Additionally, respecting human dignity involved acknowledging participants' autonomy, valuing their opinions, and safeguarding their privacy and rights throughout the research process. By integrating these ethical principles, researchers aimed to foster trust and uphold the integrity of their work while making meaningful contributions to their field.

## C. Results

The descriptive analysis of the respondents' characteristics is presented in Table 1. The data indicates that most children with special needs in this study are male, accounting for 81.8% of the participants. The study included special needs students aged between 6 to 18 years, with an average age of 9.7 years (SD = 3.83). The findings also reveal that, on average, these children were diagnosed with special needs at approximately 2.8 years old, or 32 months (SD = 15.09 months). A substantial portion of the participants, specifically 72.8%. Among those with siblings, the majority do not exhibit characteristics typical of special needs children. Of 55 participants, about 85.5% had characteristics that led to ASD.

The findings of this study indicated that among 55 respondents screened using the AQ-10, 85.5% of the children exhibited characteristics associated with Autism Spectrum Disorder (ASD) (see Table 1). The respondents demonstrated a range of cognitive abilities from lower to higher levels. Further analysis of cognitive abilities using the Autism Treatment Evaluation Checklist (ATEC) revealed that 27.27% of children in special needs schools had poor cognitive abilities. Half of the participants (50.91%) exhibited adequate cognitive abilities. Only 21.82% of children with special needs were found to have good cognitive abilities.

The results of the bivariate test analysis, which employed Spearman's Rho correlation, are detailed in Table 2. The findings indicate a significant correlation between these two variables, highlighting that autism status is associated with cognitive abilities. The analysis revealed a positive correlation with medium strength (coefficient: 0.425; p-value < 0.001), suggesting that as autism status increases, cognitive abilities tend to decrease among these students. In other words, special needs students with higher levels of autism status are likely to demonstrate lower cognitive functioning.

Table 1
The Demographic Characteristic of Participants (n = 55)

| Characteristics | n/mean | %/SD |
|---|---|---|
| Gender | | |
| Male | 45 | 81.8 |
| Female | 10 | 17.2 |
| Siblings | | |
| Did not have | 15 | 27.2 |
| Have a sibling | 40 | 72.8 |
| Have a sibling with special needs | | |
| Yes | 12 | 21.8 |
| No | 43 | 78.2 |
| Have characteristics of ASD | | |
| ASD | 47 | 85.5 |
| No | 8 | 14.5 |
| Delays | | |
| Speaking | 6 | 10.9 |
| Learning | 4 | 7.3 |
| Multiple delays | 45 | 81.8 |
| Age (years) | 9.7 | 3.83 |
| Age when diagnosed (Month) | 32 | 15.09 |

Table 2
The Spearman Rho Correlation Analysis on AQ-10 and Cognitive Status Variables

| | | Cognitive Status |
|---|---|---|
| AQ-10 | Correlation Coefficient | .425 |
| | Sig.(2-tailed) | .001 |
| | N | 55 |

## D. Discussion

Our study found that most of the children with special needs had characteristics that led to ASD. Based on the findings on children with special needs, the characteristics that lead to ASD were experiencing multiple delays: speaking, physical, learning, and mental. Children with ASD include one of the classification children with special needs who experience multiple sensory

disturbances at the early stages of development.[33] Multiple sensory disorders in children cause difficulties recognizing sensory stimuli from the constantly changing environment.[34] Delays in physical development often accompany mental and behavioral disorders that are rarely noticed.[35] ASD children tend to be sensitive to light and sound, which interferes with their concentration in understanding visual and audio images when learning. In addition, those with less sensory disturbances such as this sensitivity also cause inadequate learning interest.

This study indicated that most children with special needs have characteristics that lead to ASD. Based on previous research, parents' concerns about child development began with speech disorders in children.[36] Children with global developmental delays can often be diagnosed with autism spectrum disorders.[37] This study found that approximately 85.5% of the participants exhibited characteristics of ASD, which is significantly higher than the previous finding of 62.3% prevalence of ASD in children with developmental delays. The most commonly observed delays were in language ability and social activities.[38] Autism is a type of permanent disorder in special needs children's classification. Children with ASD are physically healthy but mentally and socially more aggressive and hyperactive. Children with special needs have limitations in one of their physical abilities, such as the blind and deaf, or limitations in psychological, such as ASD and ADHD. Children with ASD are psychologically

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[33] Taha Shabbir, "Autism Awareness in Parents in the Age of Digital Media (A Critical Study)," *Emergent: Journal Of Education DIscoveries And Lifelong Learning (EJEDL* 2, no. 5 (2021): 54–64, https://ejedl.academiascience.org/index.php/ejedl/article/view/49.

[34] Katy L. Unwin, Georgina Powell, and Catherine R. G. Jones, "The Use of Multi-Sensory Environments with Autistic Children: Exploring the Effect of Having Control of Sensory Changes," *Autism* 26, no. 6 (2022): 1379–94, https://doi.org/10.1177/13623613211050176.

[35] Aya Lotfy Zakarya Habbak and Laila Khodeir, "Multi-Sensory Interactive Interior Design for Enhancing Skills in Children with Autism," *Ain Shams Engineering Journal* 14, no. 8 (2023): 102039, https://doi.org/10.1016/j.asej.2022.102039.

[36] Nachum Sicherman et al., "Clinical Signs Associated with Earlier Diagnosis of Children with Autism Spectrum Disorder," *BMC Pediatrics* 21, no. 1 (2021): 96, https://doi.org/10.1186/s12887-021-02551-0.

[37] Ruziana Masiran and Mohamad Nizam Adha Ilias, "Child with Global Developmental Delay Presenting with Autistic Features," *BMJ Case Reports* 16, no. 9 (2023): e257293, https://doi.org/10.1136/bcr-2023-257293.

[38] Ling Shan et al., "Prevalence and Developmental Profiles of Autism Spectrum Disorders in Children with Global Developmental Delay," *Frontiers in Psychiatry* 12 (2022), https://doi.org/10.3389/fpsyt.2021.794238.

experiencing emotional and interactive disturbances. Physical disorders that may occur are similar to other disabilities, namely the ability to speak. So, children with special needs with psychological disorders can be suspected of leading ASD but require a further diagnosis from health professionals.

Children in this study were diagnosed with growth and development disorders for the first time on average at the age of 2.8 years. The results of previous studies showed that ASD was first diagnosed in children before the age of 3 years, even though the symptoms emerge at school age.[39] Research indicates that children with autism spectrum disorders (ASD) are typically diagnosed at an average age of 3.1 years. Various factors influence the age at which these diagnoses are made, including family income, place of residence, and family interactions with primary healthcare providers.[40] Improving early diagnosis in children is crucial, and family interaction plays a significant role in enhancing the quality of life for children with special needs, especially when compared to those with limited family support.[41] Children who demonstrate symptoms inconsistent with their growth and development under three years should be screened by a doctor and referred to a pediatric neurologist, child psychiatrist, and child psychologist to diagnose ASD.[42] When parents find developmental abnormalities at 18 to 24 months, they should seek help from a health practitioner because the earliest diagnosis of ASD can be made in primary care at 18 months.[43]

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[39] Peter Szatmari et al., "Prospective Longitudinal Studies of Infant Siblings of Children with Autism: Lessons Learned and Future Directions," *Journal of the American Academy of Child & Adolescent Psychiatry* 55, no. 3 (2016): 179–87, https://doi.org/10.1016/j.jaac.2015.12.014; Noor B. Almandil et al., "Environmental and Genetic Factors in Autism Spectrum Disorders: Special Emphasis on Data from Arabian Studies," *International Journal of Environmental Research and Public Health* 16, no. 4 (2019): 658, https://doi.org/10.3390/ijerph16040658.

[40] David S. Mandell, Maytali M. Novak, and Cynthia D. Zubritsky, "Factors Associated with Age of Diagnosis Among Children with Autism Spectrum Disorders," *Pediatrics* 116, no. 6 (2005): 1480–86, https://doi.org/10.1542/peds.2005-0185.

[41] Windarwati et al., "Institutional and Family Support Impact on Health-related Quality of Life of Children with Autism Spectrum Disorders during the COVID-19 Pandemic."

[42] Antonio Napolitano et al., "Sex Differences in Autism Spectrum Disorder: Diagnostic, Neurobiological, and Behavioral Features," *Frontiers in Psychiatry* 13 (2022), https://doi.org/10.3389/fpsyt.2022.889636.

[43] Luther G. Kalb et al., "Parental Relationship Status and Age at Autism Spectrum Disorder Diagnosis of Their Child," *Autism* 25, no. 8 (2021): 2189–98, https://doi.org/10.1177/13623613211013683.

Early diagnosis of autism spectrum disorders presents significant benefits, including the chance for early intervention that can enhance a child's development and adaptive skills.[44] Additionally, these interventions can be tailored to meet the unique needs of each child experienced with autism spectrum disorders.[45] As a result, this approach can improve the child's skills and abilities, leading to better behavior and overall enhanced quality of life for children with autism spectrum disorders.[46] Early diagnosis can be aided by information from parents;[47] the earlier the parents find a disorder and carry out an examination by the medical team, the better it will be for the child's growth and development. A critical examination is conducted to determine the child's physical, neurological, cognitive, language, and adaptive functions, detect any disturbance and provide early therapy. Interviews with parents also supported the examination to assess the child's history from conception to the present, including the mother's and child's psychosocial environment. In children over three years of age, screening can be carried out at schools to direct them to schools for special needs children, which a medical diagnosis can validate.

Most of the participants were males aged nine years who were school-aged children. The prevalence of ASD is higher in males, 70%, than in females.[48] Research indicates that autism spectrum disorders are four times more common in boys than in girls.[49] Biologically, the incidence of ASD in several

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[44] Bonati Maurizio, Massimo Cartabia, and Antonio Clavenna, "Still Too Much Delay in Recognition of Autism Spectrum Disorder," *Epidemiology and Psychiatric Sciences* 31, no. January (2022): e1, https://doi.org/10.1017/S2045796021000822.

[45] Okoye et al., "Early Diagnosis of Autism Spectrum Disorder: A Review and Analysis of the Risks and Benefits."

[46] Stephen Bent et al., "Quality of Life Among School-Age Children with Autism: The Oak Hill School Outcomes Study," *Seminars in Pediatric Neurology* 34, no. July (2020): 100808, https://doi.org/10.1016/j.spen.2020.100808.

[47] Elahe Arabameri and Mohammad Saber Sotoodeh, "Early Developmental Delay in Children with Autism: A Study from a Developing Country," *Infant Behavior and Development* 39, no. May (2015): 118–23, https://doi.org/10.1016/j.infbeh.2015.02.017.

[48] Napolitano et al., "Sex Differences in Autism Spectrum Disorder: Diagnostic, Neurobiological, and Behavioral Features."

[49] Rachel Loomes, Laura Hull, and William Polmear Locke Mandy, "What Is the Male-to-Female Ratio in Autism Spectrum Disorder? A Systematic Review and Meta-Analysis," *Journal of the American Academy of Child & Adolescent Psychiatry* 56, no. 6 (2017): 466–74, https://doi.org/10.1016/j.jaac.2017.03.013.

previous studies is mostly from childhood to adolescence.[50] Genetically, the protective effect of the X chromosome and hormones reduces the risk of ASD in females.[51] The development of baby boys and girls at conception is also influenced by sociocultural factors that impact brain development. Women and men have different brain development, so the ability to express ASD characteristics intrapersonally, family, and socially is also different.

Most children with special needs have siblings, so they have friends to play with at home. As many as 12% of children have siblings with disabilities. The etiology of ASD is not known clearly, but the most significant are genetics and the environment.[52] Genetic, epigenetic, and environmental factors are declared to cause multifactorial disorders in children with ASD.[53] Families with ASD have a 25-times risk of having ASD in their next child compared to the general population.[54] A family history of ASD has a 50-90% risk of being passed on to the next generation.[55] In this study, only a small proportion had siblings with disabilities, which may be because most of it could be caused by unhealthy lifestyles, polluted environment, lack of support, high stressors, and parents' physical condition. Stress from oneself or the environment can affect the hormones of pregnant women, and consuming alcohol and drugs during pregnancy can cause unhealthy fetal development and the risk of experiencing congenital disabilities, although this requires further research. The challenges faced by children with autism spectrum disorder (ASD) can profoundly affect

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[50] Concetta de Giambattista et al., "Sex Differences in Autism Spectrum Disorder: Focus on High Functioning Children and Adolescents," *Frontiers in Psychiatry* 12 (2021), https://doi.org/10.3389/fpsyt.2021.539835.

[51] Adriana Cherskov et al., "Polycystic Ovary Syndrome and Autism: A Test of the Prenatal Sex Steroid Theory," *Translational Psychiatry* 8, no. 1 (2018): 136, https://doi.org/10.1038/s41398-018-0186-7.

[52] Almandil et al., "Environmental and Genetic Factors in Autism Spectrum Disorders: Special Emphasis on Data from Arabian Studies."

[53] Habbak and Khodeir, "Multi-Sensory Interactive Interior Design for Enhancing Skills in Children with Autism."

[54] Almandil et al., "Environmental and Genetic Factors in Autism Spectrum Disorders: Special Emphasis on Data from Arabian Studies"; Daniel R. Morales et al., "Antidepressant Use during Pregnancy and Risk of Autism Spectrum Disorder and Attention Deficit Hyperactivity Disorder: Systematic Review of Observational Studies and Methodological Considerations," *BMC Medicine* 16, no. 1 (2018): 6, https://doi.org/10.1186/s12916-017-0993-3.

[55] Sherlly Xie et al., "The Familial Risk of Autism Spectrum Disorder with and without Intellectual Disability," *Autism Research* 13, no. 12 (2020): 2242–50, https://doi.org/10.1002/aur.2417.

their family members, particularly siblings. This study indicates that nearly three-quarters of children with ASD have siblings, and this relationship can significantly influence the siblings' self-identity, emotional development, and overall personal growth.[56] However, siblings also play a crucial role in fostering positive adaptive behaviors in the affected child.[57] The interactions between siblings can lead to increased social skills and emotional intelligence for both parties, emphasizing the importance of nurturing these relationships. Given the complexities of growing up alongside a sibling with autism, there is a pressing need for targeted support programs for these siblings.[58]

Children with special needs with characteristics that lead to ASD were significantly related to their cognitive abilities. This study indicated that more severe autism status in children with special needs is significantly associated with lower cognitive abilities. Children with ASD are usually followed by intellectual, sensory sensitivity, immunity, and mental disorders.[59] Some children have good language and intellectual abilities but can also be found with verbal speech disorders and intellectual disabilities, reaching 75% of the population.[60] Cognitive abilities in children with disabilities include planning, memory, initiation, delayed response, impulse control, action control, and mental management.[61] This condition has a social impact because children tend to be unable to socialize,

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[56] Lucy Watson, Paul Hanna, and Christina J. Jones, "A Systematic Review of the Experience of Being a Sibling of a Child with an Autism Spectrum Disorder," *Clinical Child Psychology and Psychiatry* 26, no. 3 (2021): 734–49, https://doi.org/10.1177/13591045211007921; Nicole E. Rosen, James B. McCauley, and Catherine Lord, "Influence of Siblings on Adaptive Behavior Trajectories in Autism Spectrum Disorder," *Autism* 26, no. 1 (2022): 135–45, https://doi.org/10.1177/13623613211024096.

[57] Alison Schmeer et al., "Through the Eyes of a Child: Sibling Perspectives on Having a Sibling Diagnosed with Autism," *Research in Developmental Disabilities* 119, no. December (2021): 104066, https://doi.org/10.1016/j.ridd.2021.104066.

[58] Naledi Mokoena and Anwynne Kern, "Experiences of Siblings to Children with Autism Spectrum Disorder," *Frontiers in Psychiatry* 13 (2022), https://doi.org/10.3389/fpsyt.2022.959117.

[59] Kristen Lyall et al., "The Changing Epidemiology of Autism Spectrum Disorders," *Annual Review of Public Health* 38, no. 1 (2017): 81–102, https://doi.org/10.1146/annurev-publhealth-031816-044318.

[60] Geraldine Leader et al., "Age of Autism Spectrum Disorder Diagnosis and Comorbidity in Children and Adolescents with Autism Spectrum Disorder," *Developmental Neurorehabilitation* 25, no. 1 (2022): 29–37, https://doi.org/10.1080/17518423.2021.1917717.

[61] Melek Hajri et al., "Cognitive Deficits in Children with Autism Spectrum Disorders: Toward an Integrative Approach Combining Social and Non-Social Cognition," *Frontiers in Psychiatry* 13 (2022), https://doi.org/10.3389/fpsyt.2022.917121.

reason, and solve problems, including expressing feelings verbally.[62] This study revealed that children have difficulty socializing, tend to be alone, and have learning disorders in line with previous research, which describes children with ASD have emotional and behavioral problems, especially deficits in social communication and interaction.[63] The socialization ability of children with ASD is influenced by intellectual disability and language.[64] Children with ASD also experience academic problems, such as specific learning disorders.[65] Therefore, creating an environment for playing together and guided learning is essential to improve their abilities. Serious games-based interventions for children with ASD can have a positive impact on social skills, behavioral skills, and emotional regulation.

Furthermore, a positive and ASD-friendly learning environment both at home and at school can support learning, complete complex needs, and the well-being of children with ASD.[66] An inappropriate school environment, like public schools, can present challenges for children with Autism Spectrum Disorder. These schools often have social settings that make it difficult for these children to establish relationships with their peers due to their unique characteristics.[67] This study emphasizes the importance of recognizing autism status in children with special needs. By identifying their cognitive abilities early on, we can provide appropriate interventions to support their development.

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[62] Hodges, Fealko, and Soares, "Autism Spectrum Disorder: Definition, Epidemiology, Causes, and Clinical Evaluation."

[63] Ching-Hong Tsai et al., "The Symptoms of Autism Including Social Communication Deficits and Repetitive and Restricted Behaviors Are Associated with Different Emotional and Behavioral Problems," *Scientific Reports* 10, no. 1 (2020): 20509, https://doi.org/10.1038/s41598-020-76292-y.

[64] Christine K. Syriopoulou-Delli, Ioannis Agaliotis, and Elpis Papaefstathiou, "Social Skills Characteristics of Students with Autism Spectrum Disorder," *International Journal of Developmental Disabilities* 64, no. 1 (2018): 35–44, https://doi.org/10.1080/20473869.2016.1219101.

[65] Izaida Ibrahim, "Specific Learning Disorder in Children with Autism Spectrum Disorder: Current Issues and Future Implications," *Advances in Neurodevelopmental Disorders* 4, no. 2 (2020): 103–12, https://doi.org/10.1007/s41252-019-00141-x.

[66] C. Hill, S. Keville, and A. K. Ludlow, "Inclusivity for Children with Autism Spectrum Disorders: Parents' Reflections of the School Learning Environment versus Home Learning during COVID-19," *International Journal of Developmental Disabilities* 69, no. 4 (2023): 546–54, https://doi.org/10.1080/20473869.2021.1975253.

[67] Shama El-Salahi, Zahra Khaki, and Reena Vohora, "Experiences of Inclusive School Settings for Children and Young People on the Autism Spectrum in the UK: A Systematic Review," *Review Journal of Autism and Developmental Disorders*, 2023, https://doi.org/10.1007/s40489-023-00405-2.

The limitation of this study was the minimum number of research participants. However, the study used a total sampling so that the results of this study may not be generalized broadly and were limited only to the research area. In addition, this research was a cross-sectional study, so it cannot see the relationship between variables.

## E. Conclusion

The findings of this study revealed that a significant number of children with special needs are diagnosed with autism, with approximately 85.5% exhibiting characteristics of Autism Spectrum Disorder. Additionally, around 50.91% of the participants demonstrated adequate cognitive abilities, while over one-fourth had poor cognitive skills. Most of the special needs students in this study were male (81.8%) and had an average age of 9.7 years. Most participants received their diagnosis before age three, specifically at around 32 months (2 years and 8 months). A notable percentage, 81.8%, experienced multiple delays that impacted their mental and social development. The primary finding indicated a positive and significant relationship between autism status and the cognitive abilities of children with special needs. Those with better cognitive skills found it easier to engage in learning and perform basic daily activities. Conversely, children with lower cognitive abilities were directed toward self-development initiatives. Therapy should be tailored to each child's abilities to help them achieve independence and productivity.

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## References

Almandil, Noor B., Deem N. Alkuroud, Sayed AbdulAzeez, Abdulla AlSulaiman, Abdelhamid Elaissari, and J. Francis Borgio. "Environmental and Genetic Factors in Autism Spectrum Disorders: Special Emphasis on Data from Arabian Studies." *International Journal of Environmental Research and Public Health* 16, no. 4 (2019): 658. https://doi.org/10.3390/ijerph16040658.

Atherton, Gray, and Liam Cross. "The Use of Analog and Digital Games for Autism Interventions." *Frontiers in Psychology* 12 (2021). https://doi.org/10.3389/fpsyg.2021.669734.

Backer, Nouf Backer Al. "Correlation between Autism Treatment Evaluation Checklist (ATEC) and Childhood Autism Rating Scale (CARS) in the Evaluation of Autism Spectrum Disorder." *Sudanese Journal of Paediatrics* 16, no. 1 (2016): 17–22. http://www.ncbi.nlm.nih.gov/pubmed/27651549.

Bent, Stephen, Jessica Wahlberg, Yingtong Chen, Felicia Widjaja, Michael G. McDonald, and Robert L. Hendren. "Quality of Life Among School-Age Children with Autism: The Oak Hill School Outcomes Study." *Seminars in Pediatric Neurology* 34, no. July (2020): 100808. https://doi.org/10.1016/j.spen.2020.100808.

Carneiro, Tânia, António Carvalho, Sónia Frota, and Marisa G. Filipe. "Serious Games for Developing Social Skills in Children and Adolescents with Autism Spectrum Disorder: A Systematic Review." *Healthcare* 12, no. 5 (2024): 508. https://doi.org/10.3390/healthcare12050508.

Chan, Ko Ling, Camilla K. M. Lo, Frederick K. Ho, and Patrick Ip. "Disability-Specific Associations with Child Health and Functioning." *International Journal of Environmental Research and Public Health* 16, no. 6 (2019): 1024. https://doi.org/10.3390/ijerph16061024.

Cherskov, Adriana, Alexa Pohl, Carrie Allison, Heping Zhang, Rupert A. Payne, and Simon Baron-Cohen. "Polycystic Ovary Syndrome and Autism: A Test of the Prenatal Sex Steroid Theory." *Translational Psychiatry* 8, no. 1 (2018): 136. https://doi.org/10.1038/s41398-018-0186-7.

Dakopolos, Andrew, Emma Condy, Elizabeth Smith, Danielle Harvey, Aaron J. Kaat, Jeanine Coleman, Karen Riley, Elizabeth Berry-Kravis, and David Hessl. "Developmental Associations between Cognition and Adaptive Behavior in Intellectual and Developmental Disability." Research Square, 2024. https://doi.org/10.21203/rs.3.rs-3684708/v1.

Giambattista, Concetta de, Patrizia Ventura, Paolo Trerotoli, Francesco Margari, and Lucia Margari. "Sex Differences in Autism Spectrum Disorder: Focus on High Functioning Children and Adolescents." *Frontiers in Psychiatry* 12 (2021). https://doi.org/10.3389/fpsyt.2021.539835.

Godoy, Priscilla B. G., Elizabeth Shephard, Bosiljka Milosavljevic, Mark H. Johnson, Tony Charman, Simon Baron-Cohen, Rachael Bedford, et al. "Brief Report: Associations between Cognitive Control Processes and Traits of Autism Spectrum Disorder (ASD), Attention-Deficit/Hyperactivity Disorder (ADHD) and Anxiety in Children at Elevated and Typical Familial Likelihood for ASD." *Journal of Autism and Developmental Disorders* 51, no. 8 (2021): 3001–13. https://doi.org/10.1007/s10803-020-04732-9.

Habbak, Aya Lotfy Zakarya, and Laila Khodeir. "Multisensory Interactive Interior Design for Enhancing Skills in Children with Autism." *Ain Shams Engineering Journal* 14, no. 8 (2023): 102039. https://doi.org/10.1016/j.asej.2022.102039.

Hajri, Melek, Zeineb Abbes, Houda Ben Yahia, Selima Jelili, Soumeyya Halayem, Ali Mrabet, and Asma Bouden. "Cognitive Deficits in Children with Autism Spectrum Disorders: Toward an Integrative Approach Combining Social and Non-Social Cognition." *Frontiers in Psychiatry* 13 (2022). https://doi.org/10.3389/fpsyt.2022.917121.

Han, Yvonne M. Y., Melody M. Y. Chan, Caroline K. S. Shea, Oscar Long-hin Lai, Karthikeyan Krishnamurthy, Mei-chun Cheung, and Agnes S. Chan. "Neurophysiological and Behavioral Effects of Multisession Prefrontal TDCS and Concurrent Cognitive Remediation Training in Patients with Autism Spectrum Disorder (ASD): A Double-Blind, Randomized Controlled FNIRS Study." *Brain Stimulation* 15, no. 2 (2022): 414–25. https://doi.org/10.1016/j.brs.2022.02.004.

Hill, C., S. Keville, and A. K. Ludlow. "Inclusivity for Children with Autism Spectrum Disorders: Parents' Reflections of the School Learning Environment versus Home Learning during COVID-19." *International Journal of Developmental Disabilities* 69, no. 4 (2023): 546–54. https://doi.org/10.1080/20473869.2021.1975253.

Hirota, Tomoya, and Bryan H. King. "Autism Spectrum Disorder." *JAMA* 329, no. 2 (2023): 157. https://doi.org/10.1001/jama.2022.23661.

Hodges, Holly, Casey Fealko, and Neelkamal Soares. "Autism Spectrum Disorder: Definition, Epidemiology, Causes, and Clinical Evaluation." *Translational Pediatrics* 9, no. S1 (2020): S55–65. https://doi.org/10.21037/tp.2019.09.09.

Ibrahim, Izaida. "Specific Learning Disorder in Children with Autism Spectrum Disorder: Current Issues and Future Implications." *Advances in Neurodevelopmental Disorders* 4, no. 2 (2020): 103–12. https://doi.org/10.1007/s41252-019-00141-x.

Johnson, Camille N., Bruce Ramphal, Emily Koe, Amarelis Raudales, Jeff Goldsmith, and Amy E. Margolis. "Cognitive Correlates of Autism Spectrum Disorder Symptoms." *Autism Research* 14, no. 11 (2021): 2405–11. https://doi.org/10.1002/aur.2577.

Johnston, Daniel, Hauke Egermann, and Gavin Kearney. "Innovative Computer Technology in Music-Based Interventions for Individuals with Autism Moving beyond Traditional Interactive Music Therapy Techniques." Edited by Teppo Särkämö. *Cogent Psychology* 5, no. 1 (2018): 1554773. https://doi.org/10.1080/23311908.2018.1554773.

Kalb, Luther G., Calliope Holingue, Danika Pfeiffer, Rachel Reetzke, Emily Dillon, Gazi Azad, Brian Freedman, and Rebecca Landa. "Parental Relationship Status and Age at Autism Spectrum Disorder Diagnosis of Their Child." *Autism* 25, no. 8 (2021): 2189–98. https://doi.org/10.1177/13623613211013683.

Kemenkes RI. "Autisme." Kementerian Kesehatan RI, Direktorat Jenderal Pelayanan Kesehatan, 2023. https://yankes.kemkes.go.id/view_artikel/1631/autisme.

Kent, Elizabeth C., Gerald H. Burgess, and Elizabeth Kilbey. "Using the AQ-10 with Adults who Have a Borderline or Mild Intellectual Disability: Pilot Analysis of an Adapted AQ-10 (AQ-10-Intellectual Disability)." *Research in Autism Spectrum Disorders* 54, no. October (2018): 65–75. https://doi.org/10.1016/j.rasd.2018.06.010.

Leader, Geraldine, Amy Hogan, June L. Chen, Leanne Maher, Katie Naughton, Nathan O'Rourke, Mia Casburn, and Arlene Mannion. "Age of Autism Spectrum Disorder Diagnosis and Comorbidity in Children and Adolescents with Autism Spectrum Disorder." *Developmental Neurorehabilitation* 25, no. 1 (2022): 29–37. https://doi.org/10.1080/17518423.2021.1917717.

Lieto, Maria Chiara Di, Emanuela Castro, Chiara Pecini, Emanuela Inguaggiato, Francesca Cecchi, Paolo Dario, Giovanni Cioni, and Giuseppina Sgandurra. "Improving Executive Functions at School in Children with Special Needs by Educational Robotics." *Frontiers in Psychology* 10, no. 2813 (2020). https://doi.org/10.3389/fpsyg.2019.02813.

Loomes, Rachel, Laura Hull, and William Polmear Locke Mandy. "What Is the Male-to-Female Ratio in Autism Spectrum Disorder? A Systematic Review and Meta-Analysis." *Journal of the American Academy of Child & Adolescent Psychiatry* 56, no. 6 (2017): 466–74. https://doi.org/10.1016/j.jaac.2017.03.013.

Lövdén, Martin, Laura Fratiglioni, M. Maria Glymour, Ulman Lindenberger, and Elliot M. Tucker-Drob. "Education and Cognitive Functioning Across the Life Span." *Psychological Science in the Public Interest* 21, no. 1 (2020): 6–41. https://doi.org/10.1177/1529100620920576.

Lundin, Andreas, Kyriaki Kosidou, and Christina Dalman. "Measuring Autism Traits in the Adult General Population with the Brief Autism-Spectrum Quotient, AQ-10: Findings from the Stockholm Public Health Cohort." *Journal of Autism and Developmental Disorders* 49, no. 2 (2019): 773–80. https://doi.org/10.1007/s10803-018-3749-9.

Lyall, Kristen, Lisa Croen, Julie Daniels, M. Daniele Fallin, Christine Ladd-Acosta, Brian K. Lee, Bo Y. Park, et al. "The Changing Epidemiology of Autism Spectrum Disorders." *Annual Review of Public Health* 38, no. 1 (2017): 81–102. https://doi.org/10.1146/annurev-publhealth-031816-044318.

Maciver, Donald, Marion Rutherford, Stella Arakelyan, Jessica M. Kramer, Janet Richmond, Liliya Todorova, Dulce Romero-Ayuso, et al. "Participation of Children with Disabilities in School: A Realist Systematic Review of Psychosocial and Environmental Factors." Edited by Tzipi Horowitz-Kraus. *Plos One* 14, no. 1 (2019): e0210511. https://doi.org/10.1371/journal.pone.0210511.

Mahapatra, Shreyas, David Vyshedsky, Samantha Martinez, Benjamin Kannel, Julia Braverman, Stephen Edelson, and Andrey Vyshedskiy. "Autism Treatment Evaluation Checklist (ATEC) Norms: A 'Growth Chart' for ATEC Score Changes as a Function of Age." *Children* 5, no. 2 (2018): 25. https://doi.org/10.3390/children5020025.

Mandell, David S., Maytali M. Novak, and Cynthia D. Zubritsky. "Factors Associated with Age of Diagnosis Among Children with Autism Spectrum Disorders." *Pediatrics* 116, no. 6 (2005): 1480–86. https://doi.org/10.1542/peds.2005-0185.

Masiran, Ruziana, and Mohamad Nizam Adha Ilias. "Child with Global Developmental Delay Presenting with Autistic Features." *BMJ Case Reports* 16, no. 9 (2023): e257293. https://doi.org/10.1136/bcr-2023-257293.

Maurizio, Bonati, Massimo Cartabia, and Antonio Clavenna. "Still Too Much Delay in Recognition of Autism Spectrum Disorder." *Epidemiology and Psychiatric Sciences* 31, no. January (2022): e1. https://doi.org/10.1017/S2045796021000822.

al-Mazidi, Sarah H. "The Physiology of Cognition in Autism Spectrum Disorder: Current and Future Challenges." *Cureus* 15, no. 10 (2023): 46581. https://doi.org/10.7759/cureus.46581.

Moraes, Íbis Ariana Peña de, Thais Massetti, Tânia Brusque Crocetta, Talita Dias da Silva, Lilian Del Ciello de Menezes, Carlos Bandeira de Mello Monteiro, and Fernando Henrique Magalhães. "Motor Learning Characterization in People with Autism Spectrum Disorder: A Systematic Review." *Dementia & Neuropsychologia* 11, no. 3 (2017): 276–86. https://doi.org/10.1590/1980-57642016dn11-030010.

Napolitano, Antonio, Sara Schiavi, Piergiorgio La Rosa, Maria Camilla Rossi-Espagnet, Sara Petrillo, Francesca Bottino, Emanuela Tagliente, et al. "Sex Differences in Autism Spectrum Disorder: Diagnostic, Neurobiological, and Behavioral Features." *Frontiers in Psychiatry* 13 (2022). https://doi.org/10.3389/fpsyt.2022.889636.

Nesayan, Abbas, Malahat Amani, and Roghayeh Asadi Gandomani. "A Study of the Cognitive Profile of Children and Its Relationship with Academic Performance." *Basic and Clinical Neuroscience Journal* 10, no. 2 (2018): 165–174. https://doi.org/10.32598/bcn.9.10.230.

Okoye, Chiugo, Chidi M. Obialo-Ibeawuchi, Omobolanle A. Obajeun, Sarosh Sarwar, Christine Tawfik, Madeeha Subhan Waleed, Asad Ullah Wasim, Iman Mohamoud, Adebola Y. Afolayan, and Rheiner N. Mbaezue. "Early Diagnosis of Autism Spectrum Disorder: A Review and Analysis of the Risks and Benefits." *Cureus*, 2023. https://doi.org/10.7759/cureus.43226.

Pursitasari, Ita, Allenidekania Allenidekania, and Nur Agustini. "Appreciation Family Support and the Abilities of Children with Special Needs to Maintain Personal Hygiene: An Indonesian Case Study." *Pediatric Reports* 12, no. 11 (2020): 8700. https://doi.org/10.4081/pr.2020.8700.

Rosen, Nicole E., James B. McCauley, and Catherine Lord. "Influence of Siblings on Adaptive Behavior Trajectories in Autism Spectrum Disorder." *Autism* 26, no. 1 (2022): 135–45. https://doi.org/10.1177/13623613211024096.

Schmeer, Alison, Victor W. Harris, Larry Forthun, Greg Valcante, and Brian Visconti. "Through the Eyes of a Child: Sibling Perspectives on Having a Sibling Diagnosed with Autism." *Research in Developmental Disabilities* 119, no. December (2021): 104066. https://doi.org/10.1016/j.ridd.2021.104066.

Shan, Ling, Jun-Yan Feng, Tian-Tian Wang, Zhi-Da Xu, and Fei-Yong Jia. "Prevalence and Developmental Profiles of Autism Spectrum Disorders in Children with Global Developmental Delay." *Frontiers in Psychiatry* 12 (2022). https://doi.org/10.3389/fpsyt.2021.794238.

Shirayama, Yukihiko, Kazuki Matsumoto, Sayo Hamatani, Katsumasa Muneoka, Akihiro Okada, and Koichi Sato. "Associations among Autistic Traits, Cognitive and Affective Empathy, and Personality Traits in Adults with Autism Spectrum Disorder and No Intellectual Disability." *Scientific Reports* 12, no. 1 (2022): 3125. https://doi.org/10.1038/s41598-022-07101-x.

Sicherman, Nachum, Jimmy Charite, Gil Eyal, Magdalena Janecka, George Loewenstein, Kiely Law, Paul H. Lipkin, Alison R. Marvin, and Joseph D. Buxbaum. "Clinical Signs Associated with Earlier Diagnosis of Children with Autism Spectrum Disorder." *BMC Pediatrics* 21, no. 1 (2021): 96. https://doi.org/10.1186/s12887-021-02551-0.

Sumner, Emma, Samuel B. Hutton, and Elisabeth L. Hill. "Subtle Oculomotor Difficulties and Their Relation to Motor Skill in Children with Autism Spectrum Disorder." *Advances in Neurodevelopmental Disorders* 5, no. 2 (2021): 144–55. https://doi.org/10.1007/s41252-020-00188-1.

Sung, In Young, Jin Sook Yuk, Dae-Hyun Jang, Gijeong Yun, Chunye Kim, and Eun Jae Ko. "The Effect of the 'Touch Screen-Based Cognitive Training' for Children with Severe Cognitive Impairment in Special Education." *Children* 8, no. 12 (2021): 1205. https://doi.org/10.3390/children8121205.

Syriopoulou-Delli, Christine K., Ioannis Agaliotis, and Elpis Papaefstathiou. "Social Skills Characteristics of Students with Autism Spectrum Disorder." *International Journal of Developmental Disabilities* 64, no. 1 (2018): 35–44. https://doi.org/10.1080/20473869.2016.1219101.

Szatmari, Peter, Katarzyna Chawarska, Geraldine Dawson, Stelios Georgiades, Rebecca Landa, Catherine Lord, Daniel S. Messinger, Audrey Thurm, and Alycia Halladay. "Prospective Longitudinal Studies of Infant Siblings of Children with Autism: Lessons Learned and Future Directions." *Journal of the American Academy of Child & Adolescent Psychiatry* 55, no. 3 (2016): 179–87. https://doi.org/10.1016/j.jaac.2015.12.014.

Taylor, Emily C., Lucy A. Livingston, Rachel A. Clutterbuck, and Punit Shah. "Psychometric Concerns with the 10-Item Autism-Spectrum Quotient (AQ10) as a Measure of Trait Autism in the General Population." Edited by Christine Payne. *Experimental Results* 1 (2020): e3. https://doi.org/10.1017/exp.2019.3.

Travers, Brittany G., Andrea H. Mason, Leigh Ann Mrotek, Anthony Ellertson, Douglas C. Dean, Courtney Engel, Andres Gomez, Olga I. Dadalko, and Kristine

McLaughlin. "Biofeedback-Based, Videogame Balance Training in Autism." *Journal of Autism and Developmental Disorders* 48, no. 1 (2018): 163–75. https://doi.org/10.1007/s10803-017-3310-2.

Tsai, Ching-Hong, Kuan-Lin Chen, Hsing-Jung Li, Kuan-Hsu Chen, Chao-Wei Hsu, Chun-Hsiung Lu, Kuan-Ying Hsieh, and Chien-Yu Huang. "The Symptoms of Autism Including Social Communication Deficits and Repetitive and Restricted Behaviors Are Associated with Different Emotional and Behavioral Problems." *Scientific Reports* 10, no. 1 (2020): 20509. https://doi.org/10.1038/s41598-020-76292-y.

Tseng, Angela, Bruno Biagianti, Sunday M. Francis, Christine A. Conelea, and Suma Jacob. "Social Cognitive Interventions for Adolescents with Autism Spectrum Disorders: A Systematic Review." *Journal of Affective Disorders* 274 (2020): 199–204. https://doi.org/10.1016/j.jad.2020.05.134.

Wagle, Surbhit, Arka Ghosh, P. Karthic, Akriti Ghosh, Tarana Pervaiz, Rashmi Kapoor, Koumudi Patil, and Nitin Gupta. "Development and Testing of a Game-Based Digital Intervention for Working Memory Training in Autism Spectrum Disorder." *Scientific Reports* 11, no. 1 (2021): 13800. https://doi.org/10.1038/s41598-021-93258-w.

Wang, Xinyuan, Jinzhu Zhao, Shan Huang, Shuling Chen, Tuo Zhou, Qing Li, Xiaoping Luo, and Yan Hao. "Cognitive Behavioral Therapy for Autism Spectrum Disorders: A Systematic Review." *Pediatrics* 147, no. 5 (2021): 2020049880. https://doi.org/10.1542/peds.2020-049880.

Watson, Lucy, Paul Hanna, and Christina J. Jones. "A Systematic Review of the Experience of Being a Sibling of a Child with an Autism Spectrum Disorder." *Clinical Child Psychology and Psychiatry* 26, no. 3 (2021): 734–49. https://doi.org/10.1177/13591045211007921.

Westwood, Heather, Ivan Eisler, William Mandy, Jenni Leppanen, Janet Treasure, and Kate Tchanturia. "Using the Autism-Spectrum Quotient to Measure Autistic Traits in Anorexia Nervosa: A Systematic Review and Meta-Analysis." *Journal of Autism and Developmental Disorders* 46, no. 3 (2016): 964–77. https://doi.org/10.1007/s10803-015-2641-0.

Windarwati, Heni Dwi, Retno Lestari, Ridhoyanti Hidayah, Haliza Hasan, Niken A. L. Ati, Mira W. Kusumawati, Irhamna N. Selena, Bergita Dumar, and Gemi Rahayu. "Institutional and Family Support Impact on Health-related Quality of Life of Children with Autism Spectrum Disorders during the COVID-19 Pandemic." *Journal of Child and Adolescent Psychiatric Nursing* 37, no. 1 (2024): 12450. https://doi.org/10.1111/jcap.12450.

World Health Organization. "Autism." World Health Organization, November 15, 2023. https://www.who.int/news-room/fact-sheets/detail/autism-spectrum-disorders?gad_source=1&gclid=Cj0KCQiAoJC-

BhCSARIsAPhdfSg59efRgE8tVmwQ6hLmFXhgPHT4h2RjI1eQrKaCukc7YSlU5PXtV94aAvyZEALw_wcB.

Xie, Sherlly, Håkan Karlsson, Christina Dalman, Linnea Widman, Dheeraj Rai, Renee M. Gardner, Cecilia Magnusson, et al. "The Familial Risk of Autism Spectrum Disorder with and without Intellectual Disability." *Autism Research* 13, no. 12 (2020): 2242–50. https://doi.org/10.1002/aur.2417.

Yankowitz, Lisa D., John D. Herrington, Benjamin E. Yerys, Joseph A. Pereira, Juhi Pandey, and Robert T. Schultz. "Evidence against the 'Normalization' Prediction of the Early Brain Overgrowth Hypothesis of Autism." *Molecular Autism* 11, no. 1 (2020): 51. https://doi.org/10.1186/s13229-020-00353-2.

Zia, Nukhba, Abdulgafoor M. Bachani, Dan Kajungu, Edward Galiwango, Mitchell Loeb, Marie Diener-West, Stephen Wegener, George Pariyo, and Adnan A. Hyder. "Understanding Child Disability: Factors Associated with Child Disability at the Iganga-Mayuge Health and Demographic Surveillance Site in Uganda." Edited by Enamul Kabir. *Plos One* 17, no. 4 (2022): e0267182. https://doi.org/10.1371/journal.pone.0267182.

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