

Comorbidity in Autism Spectrum Disorder, Prevalence and its Implication: What Speech Therapists Need to Know

Judy Muthoni and George Mathenge Wairungu (PHD).

Department of Early Childhood and Special Needs, Kenyatta University, Kenya

ABSTRACT

Alarming, multiple researches indicate that individuals with Autism Spectrum Disorder have a short lifespan. They die earlier than typical population not because of ASD symptoms but due to untreated or undiagnosed physical and mental health comorbidities. Comorbidity refers to secondary conditions that coexist with the more dominant primary condition. In this case, Autism Spectrum Disorder. Research indicates that 74% of individuals with Autism Spectrum Disorder exhibit at least one comorbidity. Comorbidities in ASD are common but difficult to diagnose because majority of individuals with ASD have challenges recognizing and communicating the symptoms. This is further complicated by commonly overlapping phenotypic symptomatology between ASD and some comorbidities. The etiology of ASD is not clear and neither is that of its comorbidities. The aim of this study is to qualitatively analyze literature on ASD comorbidities currently published in renowned peer reviewed journals. This is a qualitative desktop research assuming a descriptive research design. It is anchored in Lev Vygotsky's Social Constructivism theory of 1968. Comorbidities generally affect personalities, behavior and quality of life of individuals with ASD. One of the hall mark features of ASD is poor social communication skills. It requires a speech therapy intervention. It is important that speech therapists understand nature of comorbidities so that they can effectively manage them during therapy sessions. Further, speech therapy intervention is more effectively done through a multidisciplinary team approach. Speech therapists should be able to determine appropriately which professionals and support staff to collaborate with. Generally, attention, behavior problems, psychiatric and neurological disorders are the most common comorbidities in individuals with ASD.

Key words: Autism Spectrum Disorder, Comorbidity, Speech therapy, ADHD, Multidisciplinary team, Symptomatology

INTRODUCTION

Autism Spectrum Disorder (ASD) is a complex heterogeneous (Singer et al., 2021), neurodevelopmental disorder characterized by deficits in socio-communication skills, and presence of restricted interests and repetitive behaviors (Hodges et al., 2020). Typically, individuals with ASD exhibit repetitive behaviors and engage in stereotyped activities and interests (Marvin & Janice, 2003). A reasonable fraction of individuals with ASD also have a condition known as sensory processing disorder (Wairungu, 2020). Epidemiological studies further indicate that a reasonable number of individuals with ASD have a high prevalence of exhibiting aggression and emotional behavior problems. These include depression, anxiety and hyper activity (Mang'ombe & Wairungu, 2021). On the same note, more epidemiological studies show that males are 2 to 3 times more likely to be diagnosed with the condition than females (Zhang et al., 2017). Autism Spectrum Disorder is an early onset but lifelong neurodevelopmental disorder (Miot et al., 2019). In most cases, it is commonly diagnosed by third birthday (Ndiema & Wairungu, 2021). The Onset of ASD symptoms can be either early or regressive. In the former the child exhibits the symptoms in first year of life. The regressive one happens after a child has shown typical development but after second and third

year, the child begins to exhibit ASD symptoms. They also lose previously acquired social communication skills (Chen et al., 2021). Not much was known about autism until 1943 when Leo Kanner identified children described as having weird unusual antisocial features (Nyakundi & Wairungu, 2021).

It is Leo Kanner who wrote the first published article describing Autism condition in 1943. One year after, Asperger described children with similar characteristics (Campisi, et al. 2018). It is not clear what causes ASD but researchers postulate that it arises out of an interaction between environmental factors and genetics. Genes are thought to interact with elements in the environment affecting a child's development leading to ASD. While its etiology is not clear, some of the risk factors have been postulated to include low birth weight, having old parents, having a sibling with ASD and certain genetic conditions. Autism Spectrum Disorder is common in all races, ethnic groups, and economic classes. No particular population is more vulnerable than others. Today, the condition is in an unprecedented rate of increase (Hodges et al., 2019) throughout the world. Recent statistics indicate that one child for every thirty six children in United States of America is diagnosed with ASD (Guastello et al., 2023).

The process of diagnosing Autism Spectrum Disorder is complex requiring a multidisciplinary team approach (Wairungu, 2020). No biological marker or laboratory test exists to test the condition. The process entails considering the presence or absence of certain characteristic, behaviors as well as developmental delays. Introduction of Diagnostic Statistical Manual for mental disorders Edition five has significantly varied the diagnostic criteria. Unlike in DSMIV the term *spectrum* was introduced. This is because symptoms vary across individual ranging from mild to severe (Marvin & Janice, 2003). Precisely, no two children with ASD are exactly alike anywhere in the world. They however share the hallmark features of poor social communication skills and repetitive behaviors and restricted interests and activities (Bennet et al., 2022).

In DSMIV there existed five separate diagnoses classified under one umbrella term *pervasive developmental disorders*. These included childhood disintegration disorder, autistic disorder, Asperger Syndrome; pervasive development disorder not otherwise classified PDD-NOS and the *Rett* syndrome. In DSMV pervasive development disorder no longer appears. Further, Asperger syndrome, autistic disorder, and PDD-NOS were collapsed to form *Autism Spectrum Disorder*. In order for one to be diagnosed with ASD, he must exhibit difficulties in social emotional reciprocity, nonverbal communication and in developing and maintaining relationships. Further, an individual must portray two of the following characteristics (i)repetitive motor movements or stereotyped speech, (ii)rigid adherence to routine, ritualized patterns of behavior (either verbal or nonverbal), (iii)highly restricted interest and (iv) increased or decreased reactivity to sensory input .

Among the socio communication skills deficits in individuals with ASD include inability to form and maintain friendship, lack of ability to appreciate that other people have feelings (weak theory of mind), limited ability to *false play* with others or themselves, limited ability to understand and respond to verbal language, and limited ability in receptive and expressive communication. Before the introduction of DSMV social skills and communication skill deficits were considered to be two separate entities. It is DSMV that combined social skill deficits with communication skill deficits. This is because all communication has social intentions (Wairungu, 2020). Among the common restricted behavior patterns and interest in ASD include, a repertoire of activities that is restricted, and stereotyped and repetitive body movement. Individuals with ASD also exhibit restricted range of interests or narrow preoccupation with one interest. Unlike typically developing population individuals with ASD follow routines and structure to very fine details. Some may have persistent preoccupation with topics or objects (Marvin & Janice 2003). Further

research indicates that a good proportion of individuals with ASD have secondary conditions known as comorbidities. This forms the backbone of this research.

METHODOLOGY

This is a qualitative desktop research adopting descriptive research design. It is anchored in *Vygotsky* social constructive theory of 1968. Literature review on nature and proportions of existence of comorbidities was done by reading report on research findings published in renowned peer reviewed journals. A literature review is a systematic examination of existing scholarly research and publications related to a specific subject or area of inquiry. It allows information to be synthesized and analyzed from a wide range of sources. By critically reviewing the existing publications, this approach enables us to gain a comprehensive understanding of the current state of knowledge, identify key trends, patterns, and gaps in the literature, and inform evidence-based conclusions (Snyder, 2019). Furthermore literature review aligns well with the scope and objectives of this research, which aims to provide an overview and synthesis of the existing body of knowledge on comorbidities, rather than conducting new empirical investigations.

Database Selection: The literature search was conducted using several reputable databases. They included the Cochrane Library, Google Scholar, EBSCOhost, Francis and Taylor, JSTOR, and Wiley. These databases were chosen to ensure a comprehensive coverage of peer-reviewed articles related to the research topic (Yu et al., 2022). **Inclusion Criteria:** Studies included in this literature review are peer-reviewed articles published within the last nine years (2014-2023) that are relevant to the research topic. This timeframe was selected to ensure the review captures the most recent developments in the field (Yu et al., 2022).

Justification: Given the increasing global prevalence of ASD, coupled with the diverse range of associated comorbidities, there is an urgent need for a comprehensive understanding of the disorder and its comorbidities. Despite the increasing global prevalence of the condition, there remains a significant gap in our understanding of the full spectrum of comorbidities associated with the disorder. While the core symptoms of ASD are well-documented, the diverse range of associated comorbidities often goes unrecognized or is inadequately addressed. This oversight can lead to misdiagnoses, delayed treatments, and a diminished quality of life for individuals with ASD. Recognizing and addressing these comorbidities is crucial for improving the quality of life for individuals with ASD and guiding healthcare professionals in providing tailored care. A key a hall mark feature of ASD is challenges in social communication skills. An intervention against this is usually speech therapy. Speech therapists need an in-depth understanding of comorbidities for purposes of intervention.

Data Collection: Data for this study was collected by reviewing research findings reports and key information presented in the selected published research articles. The focus was on summarizing and synthesizing the relevant content from each source given the topic of research.

Quality Assessment: No formal quality assessment was conducted for the included studies. Instead, the review focused on providing a broad overview of the existing literature on the topic. **Ethical Considerations:** Ethical considerations primarily centered on proper citation practices and giving due credit to the original authors. Every effort was made to ensure that all sources were appropriately cited and referenced. **Scope and Limitations:** The scope of this study was defined by the selection criteria, database choices, and the chosen timeframe. Only information related to Autism Spectrum Disorder and its comorbidities was considered relevant. **Limitations** include the potential for publication bias, as well as the absence of a formal quality assessment, which may impact the overall comprehensiveness

and reliability of the review. By following this simplified methodological approach, the study maintains transparency and clarity while focusing on the essential aspects of the research process (Torres-Carrión et al., 2018).

RESULTS AND DISCUSSION

Etiology of Comorbidities Common in Autism Spectrum Disorder

To understand etiology of comorbidities, one must first understand the etiology of Autism Spectrum Disorder. As mentioned earlier, no one knows what exactly causes ASD. While there are several etiological theories, the origins and underlying causes of ASD remain a topic of intense research and debate. However, while precise etiological factors are elusive, evidence from family and sibling studies points towards a pronounced hereditary component, suggesting that genetics play a pivotal role in the onset of ASD (Houghton, 2021). In addition to genetic predispositions, recent research has ventured into the realm of *immune dysregulation* and *neuroinflammation*, proposing that these factors might be intricately linked to the pathophysiology of ASD. Such findings underscore the multifaceted nature of ASD's etiology and the potential interplay of genetic and environmental factors (Frye & Rossignol, 2016). The etiology of ASD and its comorbidities is therefore perceived to be multifaceted, involving both genetic and environmental factors. Sala et al. (2020) underscored the potential role of autoimmune phenomena in the pathogenesis of ASD. Additionally, the work by Doshi-Velez et al. (2014) utilized electronic health records to uncover distinct clinical trajectories of comorbidities, suggesting varied underlying causes for these health challenges in individuals with ASD.

Comorbidities Common in Individuals with Autism Spectrum Disorder

Autism Spectrum Disorder (ASD) has been recognized for the last few decades as a complex neurodevelopmental disorder. Historically, the focus was primarily on its hallmark social and behavioral skill challenges. Unlike DSM-IV, DSM-5 has given more emphasis to identification of subcategories including comorbidities in ASD (Romero et al., 2016). On the same note, as research advances there's been a growing recognition of the myriad of comorbidities associated with ASD. Studies, such as those by Mannix (2016) and Mbeya Mpaka et al., (2016), began to shed light on the diverse range of associated comorbidities, emphasizing the need for a more holistic understanding of the disorder. As defined earlier, comorbidity is the presence of one or more additional disease or disorder together with the primary diagnosis (disease, disorder or condition). This is more common in learners with Autism Spectrum Disorder than general population (Al-Beltagi, 2021). Several researches indicate that ASD commonly co-occur with several known developmental and psychiatric disorders. These co-occurring conditions, both medical and psychiatric, significantly influence the overall health and well-being of individuals with ASD.

Recent research has consistently highlighted the prevalence of varied comorbidities in individuals with ASD. For instance, Khachadourian et al. (2023) found that 74% of individuals with ASD live with at least one comorbidity. The challenges in diagnosing and treating these comorbidities are exacerbated by the inherent communication deficits associated with ASD. Further, Mannix (2016) opines that behaviors such as aggression or self-injury in individuals with ASD might sometimes be manifestations by underlying medical conditions, making their recognition challenging. Diagnoses and perception of ASD has a gender and cultural perspective.

The landscape of ASD diagnosis and its associated comorbidities varies considerably based on gender and cultural contexts. Studies consistently report a higher male-to-female ratio in ASD diagnoses, with some research indicating a ratio as high as 4.7:1 in certain

populations (Kreiser & White, 2013; Wang et al., 2018). Beyond gender, cultural nuances significantly influence the manifestation, recognition, and diagnosis of ASD and its comorbidities. A study that delved into cross-cultural differences in comorbid symptoms of children with ASD across Israel, South Korea, the UK, and the USA underscored the profound impact of cultural factors on how ASD symptoms are perceived and diagnosed (Cross-Cultural Differences, 2020). Among the most common comorbidities include, intellectual disorder, anxiety, language delay, ADHD, Tourette's syndrome and depression (Zhang et al., 2019).

Mental Health Conditions in Individuals with ASD

Research indicates that 85 % of individuals with ASD have some form of comorbid psychiatric diagnosis and 35 % are taking a minimum of a tablet to address the condition. Generally, individual with ASD have also been diagnosed with the following mental condition as per the corresponding percentage, ADHD 50 to 70 %, Depression 26%, Anxiety 30%, Bipolar 11% and Schizophrenia 7% (Bennet, 2022).

Attention Deficit Hyperactivity Disorder Comorbidity

More than half of children diagnosed with ASD have ADHD as well. On the centrally, only a quarter of individuals diagnosed with ASD also have ADHD. Scientific literature indicates that 50% to 70% of children diagnosed with ASD also present comorbidity of AD/HD. On the same, Mpaka et al., 2016 give an estimate of the comorbidity to be 20 to 85%. Significantly it is clear that Speech therapist must be able to address issues to do with ADHD as they provide their therapy. They need to collaborate closely with Behavior analysts and caregivers to manage the condition.

Anxiety and Autism Comorbidity

Anxiety is a common comorbidity in ASD (Godreau & Payne, 2019). It is diagnosed in more than 20% of adults with ASD as compared to only 8.7% of neuro-typical adults (Constance, 2020). More than 40 % of individuals with ASD also have comorbidity of anxiety. This can be challenging to speech therapists and other care givers. It amplifies behavior problems. It also further amplifies repetitive behaviors and social communication skill deficit (Zaboski & Storch, 2018). It is critical that Speech therapist understand nature and implications of Anxiety. It is equally important that in the multi-disciplinary team approach, psychiatrists and caregivers work closely with speech therapists.

Depression and Autism Comorbidity

Depressive syndrome represents a challenging condition in learners with Autism Spectrum Disorder. Ascertainment of its presence can be a challenge due to overlapping phenotypic features between the two conditions (Magnuson & Constantino, 2011). People with ASD have a higher likelihood of developing depression. They also have a higher likelihood of withdrawing from people and feeling hopeless (Kandola, 2023). Depression leads to increased rate of self-harm and possibly suicide (Psychiatry advisor, 2023). It is also expensive to manage especially with medication. Speech therapists need to work closely with psychiatrists, psychologists and medics to manage the condition as they provide speech therapy.

Obsessive Compulsive Disorder

OCD is relatively common in ASD and its symptoms can similarly present itself like the core features of ASD. It occurs in 2.3% of adults in USA. Its onset is below 15years in around 50% of the cases (Pazuniak & Pekrul, 2020). It is not a personality trait or a quirk or behavior that could simply be stopped if the individual really wanted to. It is instead a serious neuropsychiatric disorder (Hoffman & Hudak, 2022). Its key features include obsessions and compulsions. The former refers to unwanted intrusive recurrent thoughts or impulses usually associated with distress. The latter refer to unwanted excessive unrealistic repetitive behavior reinforced by escape from obsession related distress. The overlapping features are extremely

hard to disentangle (Guastella, 2023). The number of individuals who have ASD co-occurring with OCD are about 17% (Steensel et al., 2011). Equally it is critical that speech therapists understand the condition and collaborate effectively with psychiatrists, medics and related support professionals.

Other Comorbidities

Non-Mental Health Comorbidities

Apart from the above mental health comorbidities there are other common ones as well. Burns et al. (2023) reported that 29.0% of children diagnosed with ASD had one or more medical comorbidities, with neurological conditions being the most common. This aligns with findings from Mbeya Mpaka et al. (2016), who reported a significant prevalence of neurological conditions, particularly epilepsy, in children with ASD.

Epilepsy and Autism Comorbidity

Epilepsy is a prevalent neurological condition that affects a child's pattern of behavior as well as socio communication skills. There are few epidemiological studies that show a relationship between Autism Spectrum Disorder and Epilepsy (Zhang et al., 2019). Epilepsy is more common in individuals with ASD than in the general population. Approximately 20% of individuals with ASD also experience epilepsy (Besag, 2017). Other estimates range between 8% and 30%. Mpaka et al. (2016) give an estimate of the comorbidity to be 30%. It is also reported that more severe ASD is associated with epilepsy compared to the less severe one (Miot et al., 2019). Further research indicates that some of the risk factors for epilepsy include infections in CNS, difficult labor, and family history (Zhang et al., 2019). Significantly speech therapists need to understand epilepsy and how to manage it. Epilepsy can be life threatening if poorly managed. It is therefore critical that in the multidisciplinary collaboration, speech therapists work with families medics and related health care givers.

Intellectual Disability and Autism Spectrum Disorder

Intellectual disability is a group of conditions many of which genetic causes are known (Matson & Cervantes, 2013). Autism Spectrum Disorder is an early onset neurodevelopmental disorder often associated with intellectual disability (Miot et al., 2019). The two are the most common developmental disorders in human beings. Combined, they affect 3-5% of the population. They can also be found together in some individuals (Srivastaval & Schwartz, 2014). Both neurodevelopmental disorders have a high degree of overlap. Previously the co-occurrence was thought to be 70% but currently is believed to be 30% (Fodstad et al., 2020). Other estimates give the rate at between 50 and 80% (Mpaka et al., 2016). Speech therapist need to understand intellectual disabilities and their implications to speech therapy. Individuals vary in cognitive abilities and hence collaboration with family and other stake holders is critical.

Gastro Intestinal Disorders

Gastro intestinal disorders are a common medical condition comorbid with ASD. It has been linked to quite a number of issues in individuals with ASD. These include sleep patterns, behavior and psychiatric disorders (Madra et al., 2020). Children with ASD are six to eight times more likely to experience gastrointestinal symptoms as compared to typically developing peers. They include diarrhea, bloating, and constipation. Further children with GI are more likely to have more severe symptoms of ASD (Jeannette, 2022). The most prevalent is constipation which increases with greater social impairment. Prevalence of GI varies between 9 % and 91% among individuals with ASD (Madra et al., 2020). There is a bidirectional relationship between GI and internalized symptoms among children and adolescents diagnosed with ASD. Further, children with GI are more likely to have increased stress response and aggression (Consiglio, 2022). It is important that speech therapists understand this comorbidity and how it affects behavior. Discomforts significantly affect

quality of participation in the speech therapy. It is important therefore to collaborate with primary care givers medics and parents.

Sleep Pattern Challenges

Children with ASD have several comorbid medical conditions including sleep problems (Koo et al., 2021). Sleep is a basic need for everyone. It helps brains to remember memorize and analyze critical information (Bedfordship & Specialist, 2023). Sleep pattern challenges is reported to be higher in this population than any other group (Koo et al., 2021). Individuals with ASD have significant alteration in sleep architecture (Siriwat, 2018). This is evident as early as at age 2. It is one of the key hints that a child could potentially be having ASD. It persists throughout the lifespan (Adams et al., 2014). It leads to family stress and day time challenging behavior. Research indicates that prevalence of sleep disturbance in this population is between 64% and 93%. Insomnia is one of the most common sleep challenges. Characteristically, individuals are unable to initiate and maintain sleep (Singer et al., 2021). Other challenges include poor quality sleep, and waking up at night. It is important for speech therapists to understand the uneven sleep patterns which lead to family stress and challenging behaviors. They need to work closely with family primary health care providers and related support professional.

DISCUSSION AND IMPLICATION

The literature review on Autism Spectrum Disorders (ASD) paints a vivid picture of the evolving understanding of the disorder and its associated comorbidities. The field has transitioned from Kanner's early, broad descriptions in 1943 to the more nuanced, objective assessments of the 2000s. DSMV has encouraged consideration of subgroups among the broad ASD population. This shift not only reflects the maturation of research in ASD but also the recognition of its multifaceted nature. The prevalence of comorbidities, such as intellectual disability, epilepsy, and psychiatric disorders like ADHD and anxiety, underscores the intricate clinical landscape of ASD (Rao, 2020). These comorbidities, combined with the inherent and Hall mark features of poor socio-communication skills and behavioral challenges of ASD, emphasize the complexity of diagnosis and treatment. More challenging is the overlapping of symptomatology between ASD and a number of comorbidities (Magnuson, 2011).

Gender and cultural nuances further complicate the ASD landscape. The pronounced male-to-female diagnosis ratio and the influence of cultural factors on ASD manifestation and diagnosis highlight the need for more inclusive and culturally sensitive research and clinical approaches to interventions and diagnoses. Moreover, the etiological insights from the review suggest a blend of genetic, environmental, and potential immunological factors contributing to ASD. The emerging links between immune dysregulation, neuroinflammation, and ASD are particularly intriguing, suggesting new avenues for understanding and potentially treating the disorder and its comorbidities (An et al., 2019).

Despite the depth of understanding gleaned from the literature, there remain pronounced gaps in ASD research inclusive of its comorbidities. The call for long-term studies, a deeper exploration of less-studied comorbidities, and the development of accurate diagnostic tools emphasizes the challenges ahead (McPartland et al., 2021). The literature underscores the importance of a holistic approach, considering both the individual's unique needs and the broader societal and cultural context. As research continues, it is imperative to address these gaps to ensure comprehensive care and understanding for individuals with ASD and their associated comorbidities. Given the intricate nature of ASD and its associated comorbidities, there's a pressing need for a holistic, comprehensive, and individualized approach to both diagnosis and treatment.

Precisely, speech therapy intervention for socio communication disorder cannot achieve much if understanding of comorbidities remains as scanty as it is today. It is quite critical that interventions use a multidisciplinary approach but on the same note, managing behaviors and exceptional needs arising from comorbidities will remain a challenge given the current state of affairs. Finally research indicates that individuals with ASD have a short lifespan not because of ASD symptoms but because of poorly diagnosed or ignored comorbidities. This is alarming. It beckons for an urgent intervention locally and globally. This is not only to improve the quality of life of ASD population and as well give them more inclusive sense of belonging in the society.

REFERENCES

- Adams, H. L., Matson, J. L., Cervantes, P. E., & Goldin, R. L. (2014). The relationship between autism symptom severity and sleep problems: should bidirectionality be considered? *Research in Autism Spectrum Disorders*, 8(3), 193–199. <https://doi.org/10.1016/j.rasd.2013.11.008>
- Al-Beltagi M. (2021). Autism medical comorbidities. *World journal of clinical pediatrics*, 10(3), 15–28. <https://doi.org/10.5409/wjcp.v10.i3.15>
- An, J., Na, Y., & Zhang, P. (2019). How do parents of children with ASD use information grounds to seek for ASD-related information?. *Proceedings of the Association for Information Science and Technology*, 56(1), 10-20.
- Bennett, H. J., Jones, T., Valenzuela, K. A., & Haegele, J. A. (2022). Coordination variability during running in adolescents with autism spectrum disorder. *Autism: the international journal of research and practice*, 26(5), 1201–1215. <https://doi.org/10.1177/13623613211044395>
- Besag F. M. (2017). Epilepsy in patients with autism: links, risks and treatment challenges. *Neuropsychiatric disease and treatment*, 14, 1–10. <https://doi.org/10.2147/NDT.S120509>
- Brondino, N., Fusar-Poli, L., Miceli, E., Di Stefano, M., Damiani, S., Rocchetti, M., & Politi, P. (2019). Prevalence of medical comorbidities in adults with autism spectrum disorder. *Journal of general internal medicine*, 34, 1992-1994.
- Brookman-Frazer, L., Stadnick, N., Chlebowski, C., Baker-Ericzén, M., & Ganger, W. (2018). Characterizing psychiatric comorbidity in children with autism spectrum disorder receiving publicly funded mental health services. *Autism*, 22(8), 938-952.
- Burns, J., Phung, R., McNeill, S., Hanlon-Dearman, A., & Ricci, M. F. (2023). Comorbidities affecting children with autism spectrum disorder: A retrospective chart review. *Children*, 10(8), 1414.
- Campisi, L., Imran, N., Nazeer, A., Skokauskas, N., & Azeem, M. W. (2018). Autism spectrum disorder. *British Medical Bulletin*, 127(1), 91-100. <https://doi.org/10.1093/bmb/ldy026>
- Chandrasekhar, T., & Sikich, L. (2022). Challenges in the diagnosis and treatment of depression in autism spectrum disorders across the lifespan. *Dialogues in clinical neuroscience*, 17(2), 219-227.
- Chen, W. J., Zhang, Z., Wang, H., Tseng, T. S., Ma, P., & Chen, L. S. (2021). Perceptions of Autism Spectrum Disorder (ASD) Etiology among Parents of Children with ASD. *International journal of environmental research and public health*, 18(13), 6774. <https://doi.org/10.3390/ijerph18136774>
- Crane-Godreau & Payne, P. (2019). Addressing anxiety a comorbid of Autism Spectrum Disorder of Autism Spectrum Disorder: A case report using Qigong sensory training Methods. *Autism Open Access*, 9(3).

- Dizitzer, Y., Meiri, G., Flusser, H., Michaelovski, A., Dinstein, I., & Menashe, I. (2020). Comorbidity and health services' usage in children with autism spectrum disorder: A nested case-control study. *Epidemiology and psychiatric sciences*, 29, e95.
- Doshi-Velez, F., Ge, Y., & Kohane, I. (2014). Comorbidity clusters in autism spectrum disorders: an electronic health record time-series analysis. *Pediatrics*, 133(1), e54-e63.
- Fodstad, J. C., Elias, R., & Sarawgi, S. (2020). Intellectual Disability in Autism Spectrum Disorder. In S. W. White, B. B. Maddox, & C. A. Mazefsky (Eds.), *The Oxford Handbook of Autism and Co-Occurring Psychiatric Conditions*. Oxford Library of Psychology. <https://doi.org/10.1093/oxfordhb/9780190910761.013.10>.
- Frye, R. E., & Rossignol, D. A. (2016). Identification and treatment of pathophysiological comorbidities of autism spectrum disorder to achieve optimal outcomes. *Clinical Medicine Insights: Pediatrics*, 10, CMPed-S38337.
- Fulceri, F., Morelli, M., Santocchi, E., Cena, H., Del Bianco, T., Narzisi, A., ... & Muratori, F. (2016). Gastrointestinal symptoms and behavioral problems in preschoolers with Autism Spectrum Disorder. *Digestive and Liver disease*, 48(3), 248-254.
- Grzadzinski, R., Huerta, M., & Lord, C. (2013). DSM-5 and autism spectrum disorders (ASDs): an opportunity for identifying ASD subtypes. *Molecular autism*, 4(1), 1-6.
- Hodges, H., Fealko, C., & Soares, N. (2020). Autism spectrum disorder: definition, epidemiology, causes, and clinical evaluation. *Transl Pediatr.*, 9(Suppl 1), S55-S65. <https://doi.org/10.21037/tp.2019.09.09>
- Hoffman, J. & Hudak, R. (2022). Conceptualizing and Treating ObsessiveCompulsive Disorder in Adults with Autism Spectrum Disorder. *Journal of therapeutic schools and programs*, 14, 2689-2847.
- Hossain, M. M., Khan, N., Sultana, A., Ma, P., McKyer, E. L. J., Ahmed, H. U., & Purohit, N. (2020). Prevalence of comorbid psychiatric disorders among people with autism spectrum disorder: An umbrella review of systematic reviews and meta-analyses. *Psychiatry research*, 287, 112922.
- Houghton, R. (2021). *Utilisation and outcomes of treatment in Autism Spectrum Disorder*. [Doctoral Thesis, Maastricht University]. Gildeprint Drukkerijen. <https://doi.org/10.26481/dis.20210304rh>
- Hours, C., Recasens, C., & Baleyte, J. M. (2022). ASD and ADHD Comorbidity: What Are We Talking About? *Frontiers in psychiatry*, 13, 837424. <https://doi.org/10.3389/fpsy.2022.837424>
- Khachadourian, V., Ameis, S. H., Desarkar, P., Drmic, I. E., Lai, M. C., Lerch, J. P., & Anagnostou, E. (2023). Examining and comparing social perception abilities across childhood-onset neurodevelopmental disorders. *Journal of the American Academy of Child & Adolescent Psychiatry*.
- Khachadourian, V., Mahjani, B., Sandin, S., Kolevzon, A., Buxbaum, J. D., Reichenberg, A., & Janecka, M. (2023). Comorbidities in autism spectrum disorder and their etiologies. *Translational Psychiatry*, 13(1), 71.
- Koo, H. W., Ismail, J., Yang, W. W., & Syed Zakaria, S. Z. (2021). Sleep Disturbances in Children With Autism Spectrum Disorder at a Malaysian Tertiary Hospital. *Frontiers in pediatrics*, 8, 608242. <https://doi.org/10.3389/fped.2020.608242>
- Kreiser, N. L., & White, S. W. (2014). ASD in females: are we overstating the gender difference in diagnosis?. *Clinical child and family psychology review*, 17, 67-84.
- Madra, M., Ringel, R., & Margolis, K. G. (2020). Gastrointestinal Issues and Autism Spectrum Disorder. *Child and adolescent psychiatric clinics of North America*, 29(3), 501-513. <https://doi.org/10.1016/j.chc.2020.02.005>

- Magnuson, K. M., & Constantino, J. N. (2011). Characterization of depression in children with autism spectrum disorders. *Journal of developmental and behavioral pediatrics: JDBP*, 32(4), 332–340. <https://doi.org/10.1097/DBP.0b013e318213f56c>
- Mang'ombe, A.S. & Wairungu G.M. (2021). Autism Spectrum Disorder: A review of contemporary literature on common communication difficulties and recommended research based intervention strategies. *International Journal of Research and Scientific Innovation*, VII(IV). <https://www.researchgate.net/publication/361364936>
- Mannix, M. (2016). Medical comorbidities in autism spectrum disorder. *The Brown University Child and Adolescent Behavior Letter*, 32(2), 1-7.
- Matson, J. L., & Cervantes, P. E. (2013). Comorbidity among persons with intellectual disabilities. *Research in Autism Spectrum Disorders*, 7(11), 1318-1322.
- McPartland, J. C., Lerner, M. D., Bhat, A., Clarkson, T., Jack, A., Koohsari, S., ... & Trevisan, D. A. (2021). Looking back at the next 40 years of ASD neuroscience research. *Journal of Autism and Developmental Disorders*, 51(12), 4333-4353.
- Miot, S., Akbaraly, T., Michelon, C., Couderc, S., Crepiat, S., Loubersac, J., Picot, M. C., Pernon, É., Gonnier, V., Jeandel, C., Blain, H., & Baghdadli, A. (2019). Comorbidity Burden in Adults with Autism Spectrum Disorders and Intellectual Disabilities-A Report from the EFAAR (Frailty Assessment in Ageing Adults with Autism Spectrum and Intellectual Disabilities) Study. *Frontiers in psychiatry*, 10, 617. <https://doi.org/10.3389/fpsy.2019.00617>
- Mpaka, D. M., Okitundu, D. L. E. A., Ndjukendi, A. O., N'situ, A. M., Kinsala, S. Y., Mukau, J. E., ... & Steyaert, J. (2016). Prevalence and comorbidities of autism among children referred to the outpatient clinics for neurodevelopmental disorders. *The Pan African Medical Journal*, 25.
- Ndiema, D.C & Wairungu G.M. (2021). Learners with Autism Spectrum Disorder: What socio-communication difficulties entail and the recommended research based intervention strategies. *International Journal of Research and Innovation in Social Science (IJRISS)*, 5(12), 413-419. <https://ideas.repec.org/a/bcp/journal/v5y2021i12p413-419.html>
- Nimmo-Smith, V., Heuvelman, H., Dalman, C., Lundberg, M., Idring, S., Carpenter, P., Magnusson, C., & Rai, D. (2020). Anxiety Disorders in Adults with Autism Spectrum Disorder: A Population-Based Study. *Journal of autism and developmental disorders*, 50(1), 308–318. <https://doi.org/10.1007/s10803-019-04234-3>
- Nyakundi J.C & Wairungu G.M. (2021). Applied behaviour Analyses as an intervention strategy in learners with Autism Spectrum Disorder. *International Journal of Research and Innovation in Social Science (IJRISS)*, 5(7), 200-507. <https://api.semanticscholar.org/CorpusID:232165012>
- Pazuniak, M., & Pekrul, S. R. (2020). Obsessive-Compulsive Disorder in Autism Spectrum Disorder Across the Lifespan. *Child and adolescent psychiatric clinics of North America*, 29(2), 419–432. <https://doi.org/10.1016/j.chc.2019.12.003>
- Rao, P. S. (2020). *Pediatric Cardiology: How It Has Evolved over the Last 50 Years*. Cambridge Scholars Publishing.
- Romero, M., Aguilar, J. M., Del-Rey-Mejías, Á., Mayoral, F., Rapado, M., Peciña, M., Barbancho, M. Á., Ruiz-Veguilla, M., & Lara, J. P. (2016). Psychiatric comorbidities in autism spectrum disorder: A comparative study between DSM-IV-TR and DSM-5 diagnosis. *International journal of clinical and health psychology: IJCHP*, 16(3), 266–275. <https://doi.org/10.1016/j.ijchp.2016.03.001>
- Sala, R., Amet, L., Blagojevic-Stokic, N., Shattock, P., & Whiteley, P. (2020). Bridging the gap between physical health and autism spectrum disorder. *Neuropsychiatric Disease and Treatment*, 16, 1605-1618.

- Sauer, A. K., Stanton, J., Hans, S., & Grabrucker, A. (2021). Autism spectrum disorders: etiology and pathology. *Exon Publications*, 1-15.
- Segers, M., & Rawana, J. (2014). What do we know about suicidality in autism spectrum disorders? A systematic review. *Autism Research*, 7(4), 507-521.
- Singer, E. V., Niarchou, M., Maxwell-Horn, A., Hucks, D., Johnston, R., Sutcliffe, J. S., ... & Malow, B. A. (2022). Characterizing sleep disorders in an autism-specific collection of electronic health records. *Sleep Medicine*, 92, 88-95. <https://doi.org/10.1101/2021.10.29.21265659>
- Siriwat, R., Xu, Y., Hossain, M. M., & Simakajornboon, N. (2018). 0839 Sleep disorders in children with Autism Spectrum Disorder. *Sleep*, 41, A311. <https://doi.org/10.1093/sleep/zsy061.838>
- Snyder, H. (2019). Literature review as a research methodology: An overview and guidelines. *Journal of business research*, 104, 333-339.
- Srivastava, A. K., & Schwartz, C. E. (2014). Intellectual disability and autism spectrum disorders: causal genes and molecular mechanisms. *Neuroscience and biobehavioral reviews*, 46(Pt 2), 161–174. <https://doi.org/10.1016/j.neubiorev.2014.02.015>
- Torres-Carrión, P. V., González-González, C. S., Aciar, S., & Rodríguez-Morales, G. (2018, April). Methodology for systematic literature review applied to engineering and education. In *2018 IEEE Global engineering education conference (EDUCON)* (pp. 1364-1373). IEEE.
- van Steensel, F. J., Bögels, S. M., & Perrin, S. (2011). Anxiety disorders in children and adolescents with autistic spectrum disorders: a meta-analysis. *Clinical child and family psychology review*, 14(3), 302–317. <https://doi.org/10.1007/s10567-011-0097-0>
- Wairungu, G.M. (2020). Sensory processing disorder in individuals with Autism Spectrum Disorder. *International Journal of Research and Scientific Innovation (IJRSI)*, 5(6). <https://api.semanticscholar.org/CorpusID:232165012>
- Wang, K., Wang, C., Guo, D., van Wijngaarden, M., & Begeer, S. (2018). Children with autism spectrum disorder from China and the Netherlands: Age of diagnosis, gender and comorbidities. *Research in autism spectrum disorders*, 54, 76-82.
- Yu, J. X., Chang, L., & Qin, L. (2022). *Keyword search in databases*. Springer Nature.
- Zaboski, B. A., & Storch, E. A. (2018). Comorbid autism spectrum disorder and anxiety disorders: a brief review. *Future neurology*, 13(1), 31–37. <https://doi.org/10.2217/fnl-2017-0030>
- Zachor, D., Yang, J. W., Itzhak, E. B., Furniss, F., Pegg, E., Matson, J. L., ... & Jung, W. (2011). Cross-cultural differences in comorbid symptoms of children with autism spectrum disorders: an international examination between Israel, South Korea, the United Kingdom and the United States of America. *Developmental Neurorehabilitation*, 14(4), 215-220.
- Zhang, A., Li, J., Zhang, Y., Jin, X., & Ma, J. (2019). Epilepsy and Autism Spectrum Disorder: An Epidemiological Study in Shanghai, China. *Frontiers in psychiatry*, 10, 658. <https://doi.org/10.3389/fpsy.2019.00658>