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Prevalence of autism spectrum disorder among children referred to special needs clinic in Giza

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Abstract

Background Little is known about the prevalence of autism spectrum disorder (ASD) among the population with disability in Egypt. Furthermore, the increasing prevalence of ASD and the variability of the ASD manifestations and severity highlight the importance of investigating the ASD comorbidities.

Aim of work This analysis was to compare the prevalence of autism with that of other disabilities among children visiting the clinic for special needs and to explore possible comorbid disorders in this sample of Egyptian ASD participants.

Methods The study included individuals who visited the clinic for special needs in Giza, affiliated to the National Research Centre, for nearly 4 years (2019 to 2022). They were subjected to full clinical evaluation. Autistic children were further subjected to scales for confirming diagnosis and severity evaluation.

Results The results revealed that a total of 3555 individuals were referred to the clinic. The percentage of children who were diagnosed as having ASD was 22.5% ($N=803$; age: 4.5 ± 2.4 years). The most common associated comorbidities with ASD were language and intellectual deficits (80.25%, 58.7%). Hearing impairment was the least common (0.75%). The scores of the childhood autism rating scale were higher in the groups with the comorbid disorders ($p=0.03$ or <0.0001).

Conclusion The prevalence of ASD among children with disability varied from other countries. Comorbid disorders have led to increasing the severity of ASD. We emphasize that accurate and early diagnosis of autism is the key for proper management of cases.

Keywords ASD, Prevalence, Comorbid disorders, Severity

Background

Individuals with autism spectrum disorder (ASD) manifest deficits in social communication and social reciprocity with the existence of restricted and/or repetitive behavioral patterns and sensory processing disorder. It is advised that the diagnosis of ASD incorporate data from various sources depending on the person's age. This was one of the key changes implemented with the introduction of the DSM-5: several distinct diagnoses were combined into one category, now known as ASD. Compared to the prior diagnostic standards, a number of

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adjustments have been implemented. ASD is characterized as a neurodevelopmental condition with symptoms in early childhood even though the disorder may first be diagnosed later in life. No focus was placed on language delay or age of onset. According to DSM-5, two domains, the social-communication domain and the behavioral domain, which includes fixated interests and repetitive behaviors, remain from the original three areas of impairment in ASD diagnostic criteria [1].

In the UK, the prevalence of ASD reached 3.8/1000 boys and 0.8/1000 girls in 2013, and it ranged from 1.81 to 2.6% in Asian countries [2]. In China, ASD prevalence reached 0.21% [3]. It has been reported in many countries to be rising over recent years. In the Arabian Gulf, it was determined to be 20.35 in 10,000 children in 2018. This was 15-fold more than what was reported in 2011 [4]. The male to female ratio was estimated to be 3:1 and reached 4:1 in some reports [5]. The data concerning the prevalence of ASD in developing countries, including Egypt, either among special-needs or the general population is limited, requiring more concern to this issue. The accretion of ASD cases can be explained by many factors. For example, the spread of new measures and tools used for screening and the young age at which children are first presented to health professionals, the rise in awareness about it, and the rising exposure to possible risk factors [3].

ASD is frequently associated with comorbid disorders. The developmental language delay in ASD toddlers has been reported to be very common. The linguistic disorders include pragmatic, phonological, and morphosyntactic deficits. Incapability in semantics and prosodic variations were also noticed in such individuals [6, 7]. The presence of hearing impairment influences language development and social interaction in children, especially those with autism. Presenting symptoms of hearing loss could mimic those of ASD. Thus, whenever ASD and hearing impairment coexist, diagnosing one problem would probably cause a delay in diagnosing the other. The lack of relevant screening and diagnostic tools tailored for the hearing-impaired population used to poses a challenge for clinicians to properly assess children who were both deaf and autistic, leading to a delay in identifying both [8]. This has been lately changed by implementing the programs of neonatal hearing screening in many countries which consequently allowed early detection of these cases. The prevalence of hearing loss in autistic children is an area of debate. Rosenhall et al. [9] stated that 3.5% of autistic children had coexisting profound sensorineural hearing loss, which is a prevalence rate higher than what was detected in the general population [9] whereas other studies stated that children with hearing impairment among ASD individuals were identified at a prevalence of 1.7%, which is the same as the general population [8]. Other comorbidities which were previously reported with ASD included epilepsy or electroencephalogram changes and attention-deficit hyperactivity disorder [10].

Developing countries, such as Egypt, are in major need of enhancing mental health for people with developmental disorders, especially ASD. The lack of parent and community awareness about ASD concerning recurrence risk, complicated variable phenotype, and coexisting problems can result in excess stress levels and inefficient strategies for coping for such children and their families. Consequently, the quality of life for autistic children and their families will be compromised. This will put a huge burden on the health system and the community. Furthermore, the severity of symptoms and the comorbidities diverge a lot in these individuals [11]. Thus, the aim of this study was to investigate the possible comorbid disorders among a sample of Egyptian children with ASD and their influence on the disorder's severity after specifying ASD prevalence among children visiting a multidisciplinary clinic for special-needs children.

Methods

This observational prospective study followed the checklist for STROBE. The participants were recruited from the special needs research clinic for children (a multidisciplinary team clinic). They visited the clinic in the years 2019 to August 2022. There were 3555 participants. Their complaints included language delay, learning problems, hyperactivity, social interaction deficits, behavioral problems, abnormal body movements or motor development, and abnormal facial features. Their ages ranged from 3 months to 8 years. Other diagnoses found among participants included developmental language disorder (either with or without intellectual disability), learning disorder, ADHD, Down syndrome, fragile X syndrome, Williams syndrome, myopathy, cerebral palsy (brain-damaged motor handicapped), and sensorineural hearing loss associated with delayed language development.

The inclusion criteria for the participants with ASD who were screened for comorbidities were as follows: a diagnosis of ASD and a chronological age that was less than 9 years. Exclusion of the children with autism was performed when they had dysmorphic features which may be suggestive of a syndrome or chromosomal aberration, microcephaly, the presence of gross motor delay, and the occurrence of neurological examination abnormalities. The criteria of the Diagnostic and Statistical Manual of Mental Disorders-the fifth edition in addition to the Autism Diagnostic Interview-Revised (ADIR) were used for confirming ASD diagnosis [1, 12]. Interviewing for a full medical history was performed together

with general examination, in addition to otorhinolaryngological examination, and neurological examination. The childhood autism rating scale was used to detect the severity of ASD [13]. Attention-deficit hyperactivity disorder was investigated with the guidance of DSM-5 [1]. To specify the intellectual performance of the autistic participants, Arabic version of the fifth edition of the Stanford Binet Intelligence Scales was used [14]. For those who were 2 years old or less, the Griffiths Developmental Scale was utilized [15]. The Arabic Preschool Language Scale [16] was used to obtain the language age of the children. The scale enables the examiner to obtain raw scores and scaled scores of receptive, expressive, and total language abilities to verify the presence of delays in language development. Furthermore, the total language age was determined. The test for Arabic Pragmatic Language was utilized to evaluate pragmatics performance of the participants [17]. Furthermore, audiological evaluation by tympanometry and click evoked auditory brainstem response (ABR) and 1-h electroencephalography (EEG) were performed. Informed consents were obtained from the parents of the participants.

Data were analyzed by the SPSS computer program with the version 19 for Windows. Results were presented in the form of a mean ± standard deviation and/or number and percentage. When p was less than 0.05, results were considered to be significant.

Results

The percentage of ASD children among those who visited the special needs clinic was 22.5% ($N=803$). Their age ranged from 1.5 to 8 (4.5 ± 2.4) years. The consanguinity between parents was positive in 29.3% ($N=236$). The percentages of males and females were75.8%, 24.1% ($N=609$ and 194). The male to female ratio was found to be 3:1. A history of autism in the family was detected in 7.5% ($N=61$). Other disorders reported in the families of participants were found in 44.8%of cases ($N=360$). These other disorders included intellectual disability, developmental language disorder, stuttering, learning disorder, cleft lip and palate, sensorineural hearing loss, epilepsy, hydrocephalus, anencephaly, sleep disorder, ADHD, schizophrenia, depression, diabetes, retinal degeneration, albinism, hemophilia, congenital heart disease, and achondroplasia.

The scores of CARS fell within the range of 29 to 46 (34.2 ± 3.8). The percentage of participants who had developmental language disorder (DLD) was 80.3 % ($N=645$). This makes it the most common comorbidity. Detected delays were in receptive, expressive, and pragmatic language performance. The receptive language age range in those with a language delay was from 1 to 6 years (2.7 ± 1.9). The age range of expressive language was from 6 months to 6.5 years (1.5 ± 0.8). The total language age range was from 8 months to 5.75 years (2.7 ± 2.1). All participants with DLD had below-normal scores concerning pragmatics development according to the test for Arabic Pragmatic Language (below 44). The percentage of children with intellectual disability was 58.7% ($N=472$). The ADHD was detected in 60.7% of ASD participants ($N=488$). Changes in EEG were detected in 17.4% of cases ($N=140$). The least common comorbidity was the presence of hearing impairment. It was detected in 6 participants. Conductive hearing loss was noticed in 2 participants due to otitis media with effusion with type B tympanograms. The other four participants had sensorineural hearing loss; two of them had bilateral mild-to- moderate sensorineural hearing loss and the others had bilateral severe-to-profound sensorineural hearing loss. They had a normal type A tympanogram. The EEG changes noticed in some children were generalized epileptic discharge, subcortical epileptic discharges, and focal temporal epileptogenic activity. Five of the autistic participants had previous attacks of tonic and clonic convulsions. These five were having medical treatment to control the convulsions. The other children were not on anti-epileptic drugs.

In the groups with comorbid disorders, the manifestations of autism were more severe when compared to those without the comorbid disorder. In Table 1, higher

Table 1 The influence of comorbidities on the childhood autism rating scale scores in autistic children with and without comorbidities

Items	Mean ± SD of CARS scores for the group with the comorbid disorder	Mean ± SD of CARS scores for the group without the comorbid disorder	*p* value
Developmental language disorder	35.7 ± 3.0	35.5 ± 2.5	0.03*
Intellectual disability	34.3 ± 3.7	32.4 ± 3.8	< 0.0001*
Attention-deficit hyperactivity disorder	35.8 ± 3.4	31.7 ± 2.6	< 0.0001*
Changes in EEG	35.8 ± 3.7	33.8 ± 3.6	< 0.0001*

CARS childhood autism rating scale

*Significant EEG electroencephalogram

CARS scores were found to be associated with the presence of concomitant DLD, intellectual disability, ADHD, and EEG abnormalities with a significant statistical difference.

Discussion

In developing countries, little is known about the prevalence of ASD among children with special needs. The prevalence of ASD in this study was more than that reported by Boat and Wu [18] which was 20.5% in the USA yet less than that reported by Bryson et al. [19] and Seif Eldin et al. [20] which was 28% in Canada and 33.6% in Arab countries, respectively. Moreover, identifying the prevalence of comorbid disorders in a population with ASD is essential for proper, accurate, and early diagnosis besides appropriate comprehensive management of such a disabling disorder [10]. A team including a geneticist, a pediatrician, a psychiatrist, a phoniatrician, an audio-vestibular medicine physician, and a psychologist should be involved in the process of evaluation and rehabilitation of such children. This is essential because ASD manifestations vary a lot among affected individuals.

ASD was reported to be more common among males. The male to female ratio in the present study was similar to other studies such as Posserud et al. [21]. This could suggest that sex hormonal levels and the sex chromosomes gene dosage can be involved in the ASD pathogenesis [22].

In this study, the percentage of positive family history for ASD is in agreement with the range which was previously reported in other studies (2–8%) [23]. The positive history of autism in the families of children with autism could be related to genetic alterations which could account for nearly 40% of cases with autism. Genetic variations which contribute to the development of autism could be de novo or inherited [24]. The presence of a familial history of other disorders could stem from genetic variations in the family members. Those could include copy number variant and single nucleotide polymorphisms. Such variations were found in conditions such as congenital cardiac anomalies, schizophrenia, and intellectual disability. Some of these genetic variations were also reported in ASD, which was detected in individuals who had some of these disorders. These disorders should be monitored and investigated in individuals with ASD considering that common biological determinants could exist [23].

Developmental language disorder (DLD) was detected in all participants, making it the most common comorbidity. This is in agreement with Sánchez Pérez [25]. They reported that the delay in language performance was common in autistic children. Furthermore, the delays in language development were reported to be among the most common presenting symptoms of ASD [26]. Altered development in receptive and/or expressive language abilities, including semantic, pragmatic, syntactic, and phonological components, and problems in social communication in individuals with ASD could be related to brain pathophysiological change. These changes include aberrant activation and/or disturbed connections between different areas that share in language development, such as Broca's area located in the left inferior frontal gyrus, and Wernicke's area located in the left superior temporal gyrus, left angular gyrus, fusiform gyrus, superior temporal sulcus, anterior cingulate cortex, amygdala, and striatum [27]. Furthermore, some genes were linked to both ASD and DLD, such as (CNTNAP 2) gene. There were common neurobiological etiologies that were found to be between intellectual disability and ASD [28]. These two disorders share mutations in some genes, such as ARX and DCX. Those genes were reported to be linked to changes in EEG that were detected in autism as well [29]. The EEG changes in autistic individuals could be related to local circuits' projection inhibitory deficit or alterations in the internal organization of cortical minicolumns [30]. In this study, the majority of ASD children exhibited attention deficit and hyperactivity disorder. This association can be explained by overlapping genetic influence. This data was proposed on the basis of molecular and twin studies which included children manifesting both disorders. Furthermore, similar basal ganglia neuroanatomical changes were detected in autism and ADHD [31].

The percentage of hearing impairment (HI) in this study was less than that reported in other populations with ASD [9]. The comorbidity of ASD and HI might be attributed to various reasons including positive consanguineous marriage or defective antenatal care in some rural areas in Egypt. Although this percentage is not adequate to perform analysis, it may assist in developing a diagnostic workup plan for co-occurring hearing loss with ASD. Proper audiological assessment can be challenging in autistic children. These children tend to obtain an ASD diagnosis in older age than those without HI. Moreover, they manifest more severe ASD symptoms than those without HI which leads to a delay in receiving proper rehabilitation. The lack of comprehensive interventional plans for ASD symptoms in hearing impaired children has detrimental effects on their development. A full audiological assessment is recommended for toddlers and children when ASD is suspected to ensure early diagnosis and proper intervention and to avoid misdiagnosis. Furthermore, reverting to objective assessment is essential for autistic children to verify the results of behavioral testing. Otoacoustic emission has been suggested by various studies as an adequate objective test for proper

assessment up to the level of the cochlea. It is a quick and noninvasive technique for such difficult-to- deal with children. It has been proven as a valuable component in the audiological test battery for ASD children. Moreover, tone-burst ABR is another beneficial objective test that should be included in the assessment battery for children with autism. It allows detection of frequency-specific hearing loss and gives the nearest thresholds to the behavioral audiogram [32].

The comorbidity between ASD and the developmental language disorder, intellectual disability, attention deficit and hyperactivity disorder, HI, and changes in EEG in this study was in agreement with Al-Beltagi [10], Ma [31], and Burns et al. [32]. The intellectual disability percentage in the current study exceeded that reported by Mutluer et al. [33] was less than that detected by Mpaka et al. [34]. However, the ADHD percentage reported by them was similar to the present study. There were similarities in ADHD percentage between this study and that of Al-Beltagi [10]. However, it exceeded what was reported in western countries, such as the study of Rong et al. [35]. The percentage of association between changes in EEG and ASD was consistent with previous studies such as Al-Beltagi [10]. The difference in the percentage of comorbidities with ASD highlights the genetic role and its interaction with environmental factors for a certain population and the uniqueness of each population. The parents of a few children with ASD reported complaints of sleep disorder and gastrointestinal manifestations. They were not listed in this study as no objective measures could verify these complaints. A comparison between the children with and without hearing impairment was not performed because there were too few. These factors could be considered limitations of this study. However, the authors preferred to include comorbid disorders that have certain diagnostic criteria or objective tools to be diagnosed and those that are common among ASD individuals to be able to compare the severity between the groups with and without these disorders.

The comorbid ADHD and changes in EEG in this study have led to statistically significant higher scores of CARS. This excess in ASD severity could be explained by attentional challenges, difficulties in communication, self-regulation, and living skills. These factors compromise the capacities of the autistic population for social information processing. Individuals with ASD were reported to show reduced alpha and theta power on quantitative EEG studies. This could have negatively impacted their cognitive and memory abilities, which would have hindered their adaptive performance and coping strategies. The maladaptive performance in such children could be related to a lack of facilities for early diagnosis and intervention for such cases, which underscores the importance of developing and spreading the proper screening tools for ASD and the commonly associated disorders in developing countries such as Egypt. The presence of comorbid disorders could impede the process of rehabilitation of these children [10, 36]. Thus, identifying such comorbid disorders as early as possible is crucial for the success of the intervention process targeting ASD children.

Conclusion

The percentage of comorbid disorders in this study differed from other studies which targeted other populations with ASD in other countries. Some comorbidities could have an influence on ASD severity. A high frequency of language deficits and intellectual disability (which are commonly the presenting symptoms) was revealed by our investigation. This can identify issues around the cultural and societal perceptions of the children's development. These comorbidities could complicate the process of rehabilitation of children with ASD. Clinicians are encouraged to investigate the presence of attention-deficit hyperactivity disorder and changes in EEG as they have a negative impact on the performance of ASD children. Early identification of ASD together with its comorbid disorders would help in proper and effective rehabilitation of such children and targeted intervention for all the possible constraints that can hinder the progress of the process of advancing their abilities.

Abbreviations

ASD	Autism spectrum disorder
ADHD	Attention deficit and hyperactivity disorder
ADIR	Autism Diagnostic Interview-Revised
ABR	Auditory brainstem response
EEG	Electroencephalography
DLD	Developmental language disorder
CARS	Childhood autism rating scale
HI	Hearing impairment

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Authors' contributions

The authors confirm contribution to the paper as follows: Prof. Dr. NM: study conception, study design, analysis and interpretation of results and manuscript preparation and revision. Dr. NHN: language assessment, analysis and interpretation of language results, and draft manuscript preparation. Dr. HG: audiological evaluation, analysis and interpretation of audiological results and draft manuscript preparation. Dr. HSH: neurological assessment and electroencephalography interpretation and draft manuscript preparation. Dr. GH: clinical examination, diagnosis of cases, collection of positive clinical data, and draft manuscript preparation. Dr. AE: clinical examination, diagnosis of cases, collection of positive clinical data, and draft manuscript preparation. All authors edited, reviewed, and approved the final draft of the manuscript.

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Availability of data and materials
The datasets generated and/or analyzed during the current study are available at the National Research Centre.

Declarations

Ethics approval and consent to participate
This study got approval from the Medical Research Ethics Committee at the National Research Centre (NRC). In addition, consent of participation was taken from the parent or caregiver of each child.

Consent for publication
Not applicable.

Competing interests
The authors declare that they have no competing interests.

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