The European Journal of Psychiatry 37 (2023) 182—189

THE EUROPEAN JOURNAL OF PSYCHIATRY

www.elsevier.es/ejpsy

ORIGINAL ARTICLE

Psychosis in adults with autism spectrum disorder and attention deficit hyperactivity disorder at acute psychiatric wards

Hiromitsu Uno[a,b,*], Wakaho Hayashi[a,b,c], Akari Nakagawa[a,d], Takeshi Otowa[a,b], Hiroki Yamada[e], Akira Iwanami[a,b,d]

[a] *Department of Psychiatry, Showa University School of Medicine, 6-11-11 Kitakarasuyama, Setagaya-ku, Tokyo 157-8577, Japan*
[b] *Department of Psychiatry, Showa University Karasuyama Hospital, 6-11-11 Kitakarasuyama, Setagaya-ku, Tokyo 157-8577, Japan*
[c] *The Social, Genetic and Developmental Psychiatry Centre, Institute of Psychiatry, Psychology, and Neuroscience, King's College London, De Crespigny Park, London SE5 8 AF, United Kingdom*
[d] *Department of Psychiatry, Showa University East Hospital, 2-14-19 Nishinakanobu, Shinagawa-ku, Tokyo 142-0054, Japan*
[e] *Mental Care Center, Showa University Northern Yokohama Hospital, Chigasaki-chuo 35-1, Tsuzuki-ku, Yokohama-shi, Kanagawa 224-8503, Japan*

Received 17 October 2022; accepted 14 December 2022
Available online 10 January 2023

KEYWORDS
Autism spectrum disorder;
Attention deficit hyperactivity disorder;
Psychosis

Abstract
Background and objectives: Psychotic symptoms, such as delusions and hallucinations, in autism spectrum disorder (ASD) and attention deficit hyperactivity disorder (ADHD) have been increasingly reported in recent literature. In the present study, the prevalence and duration of psychotic symptoms, comorbid psychotic disorders, and clinical characteristics of adults with ASD and ADHD were retrospectively examined via a chart review.
Methods: The participants were 98 adults (mean age, 28.5 years; 72 men) who were admitted to the psychiatric emergency wards of Showa University Karasuyama Hospital, and who were diagnosed with ASD and/or ADHD according to the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision criteria.
Results: Among 69 individuals with ASD, 21 (30.4%) experienced psychotic symptoms, and among 29 individuals with ADHD, 5 (17.2%) exhibited psychosis. While all psychotic symptoms were classified as transient and none had comorbidity with schizophrenia and other psychotic disorders in adults with ADHD, 38.1% of psychosis was classified as prolonged and 10.3% had comorbidity with schizophrenia and other psychotic disorders in adults with ASD.

* Corresponding author at: Department of Psychiatry, Showa University School of Medicine, 6-11-11 Kitakarasuyama, Setagaya-ku, Tokyo 157-8577, Japan
E-mail addresses: unohir032@med.showa-u.ac.jp (H. Uno), wakahoh@med.showa-u.ac.jp (W. Hayashi), akari_lo_ve_pink@yahoo.co.jp (A. Nakagawa), otowa@med.showa-u.ac.jp (T. Otowa), yamada_showa_psy@yahoo.co.jp (H. Yamada), iwanami@med.showa-u.ac.jp (A. Iwanami).

https://doi.org/10.1016/j.ejpsy.2022.12.001

Conclusion: The results showed that a significant proportion of adults with ASD and ADHD experience psychosis during their course of illness, and provide evidence for the existence of a shared etiology between neurodevelopmental and psychotic disorders.

Introduction

Psychosis in neurodevelopmental disorders is increasingly being recognized in recent years, as a growing number of studies have suggested an association between psychotic symptoms or disorders and autism spectrum disorder (ASD) and attention deficit hyperactivity disorder (ADHD).[1—5] Although numerous studies have reported high comorbidity rates of ASD and ADHD with psychotic disorders such as schizophrenia and bipolar disorder with psychotic features,[3,6—9] evidence suggests that even with no such comorbid disorders, individuals with ASD and ADHD can exhibit psychotic symptoms such as hallucinations and delusions during the course of their illness.[10—13]

ASD is characterized by severely impaired social communication and repetitive behaviors, and its worldwide prevalence is approximately 1% in children and adults.[14,15] Historically, ASD was once considered a form of schizophrenia,[16—18] and numerous overlaps in clinical symptoms and genetic underpinnings have thereon been observed.[19—21] However, several significant differences, such as the onset time and the absence of ego disturbances in ASD, have led researchers to consider the current view that the two are likely to be separate disorders that can frequently co-occur.[9,22] The comorbidity rates of ASD and psychotic disorders, including schizophrenia and other psychotic disorders, have reportedly been as high as 34.8 —60%.[3,23] More importantly, even in the absence of comorbid psychotic disorders, such as schizophrenia, individuals with ASD have frequently reported experiencing psychotic symptoms, such as delusions and auditory hallucinations.[11,24,25] For instance, in a cohort study of 80 children with ASD, 23 (28.7%) had experienced psychotic symptoms such as delusions and hallucinations at age 12, and children with ASD were three times more likely (odds ratio 3.05) than controls to have a psychotic experience.[11] Moreover, ASD symptoms such as impaired social communication and restricted and repetitive behaviors were positively correlated with psychotic experiences. Similarly, in a large cohort study, Bevan Jones et al.[24] found that children with autistic traits were more likely to have psychotic experiences in early adolescence. Researchers have speculated that, regardless of the diagnostic threshold, the same etiology underlies psychotic symptoms in both ASD and psychotic disorders.[5,9] Moreover, recent evidence from genomic studies has put the historical concept in a new perspective that ASD and psychotic disorders may in fact lie on the same etiological and neurodevelopmental continuum.[26—28] Although detailed and longitudinal evaluation of psychosis in ASD would proceed to discussions on the association between ASD and psychotic disorders or experiences, few studies have examined psychotic symptoms systematically, especially in adults with ASD.

ADHD is another common neurodevelopmental disorder that presents with persistent symptoms of inattention, hyperactivity, and impulsivity.[14] The prevalence rates are reportedly 5—11.4% in children[29,30] and 3.4—4.4% in adults.[31,32] Although not as high as ASD, relatively high comorbidity rates with psychotic disorders and frequent occurrence of psychotic symptoms have been reported in individuals with ADHD.[2,33] For instance, Donev et al.[6] studied adults with schizophrenia and found 44.4% to be diagnosed with ADHD. Moreover, Kim-Cohen et al.[33] reported that 16% of adults diagnosed with schizophrenia spectrum disorders were diagnosed with ADHD during childhood. Hennig et al.[34] conducted a database study of 8247 children and found that 29.2% of those in the ADHD group (diagnosed with ADHD at the age of 7) in contrast to 11.2% in the control group, experienced psychotic symptoms such as delusions and hallucinations at the age of 12, with an odds ratio of 3.4. They also noted that psychotic experiences were particularly prevalent in the bullied group. In a study by Vitiello et al.[13] with 509 children with ADHD, the percentage of those who exhibited at least one psychotic symptom during the 10-year follow-up was 5.1% in the ADHD group, and 3.9% in the control group. Their results also showed that most psychotic symptoms observed in ADHD were transient. Although these studies suggest a possible link between ADHD and psychosis, only a handful of studies have examined psychotic disorders and symptoms in ADHD, especially in adults.

This study aimed to examine the clinical details of psychotic symptoms in adults with ASD and ADHD. We investigated the prevalence and length of psychotic symptoms experienced, the rate of comorbid psychotic disorders, and the demographic and clinical characteristics of adult inpatients with ASD and ADHD who were admitted to psychiatric emergency wards.

Methods

Participants

The Showa University Karasuyama Hospital, a psychiatric hospital located in central Tokyo, consists of 296 beds, among which 94 are for psychiatric emergency patients (two emergency wards). A retrospective chart review of patients admitted to two emergency wards between January 2010 and December 2016 was conducted. Only those with a final diagnosis of ADHD and/or ASD according to the DSM-IV-TR[35] criteria were included. No exclusion criteria were set except for those who did not consent to participate in the study. During the study period, 3217 patients (1404 men and 1813 women) were admitted and assessed for eligibility, and 98 (3.0%) were ultimately included in the study.

Assessment and diagnosis

Upon admission to the emergency ward, each patient underwent diagnostic assessment by at least two certified psychiatrists. This process included the evaluation of the current

medical condition by frequent medical examinations and the collection of detailed information on their developmental, medical, and past histories by interviewing the patients and their family members (including parents, siblings, and relatives) on several occasions. Demographic and social information (including years of education, employment status, family situations, and typical daily activities) was also obtained from the patients or their family members. Friends or acquaintances of the patients or social workers from the local government were called for information upon consent if no family member was available or reachable.

Final psychiatric diagnoses based on the DSM-IV-TR criteria were made upon discussion by the psychiatrists involved in the assessment processes. If the final diagnosis included either ADHD or ASD, two consultants specializing in neurodevelopmental disorders were referred for further assessment to verify the diagnosis (when discrepancies occurred, diagnoses made by the consultants were employed). For participants with ASD or ADHD, we re-examined the comorbidity of ASD and ADHD, since the DSM-5 now recognizes their co-occurrence. Further assessment included a detailed interview of the patients and their parents or siblings on their developmental history and a review of their maternity handbooks and school reports, if available. Magnetic resonance imaging and electroencephalography were performed, if necessary, to exclude organic diseases.

For those with both ADHD and ASD, the consultants decided on one of the two conditions as their primary diagnosis based on symptom dominance.

Data collection

For examining the psychotic symptoms and characteristics of patients with ADHD and ASD, we conducted a thorough chart review for the following information on the 98 individuals who had either ADHD or ASD or both, as their final diagnoses: (1) presence of psychotic symptoms at admission; (2) types of psychotic symptoms (transient or prolonged); (3) number of psychosis occurrences; (4) psychiatric comorbidity (other DSM-IV-TR diagnoses, if any); (5) present and past admission details (a period of current admission and a number of past psychiatric admissions); (6) demographic data (age, sex, and years of education); (7) employment and social functioning status (full, partial, or none); and (8) current or past attendance at special-needs school. Any form of hallucination or delusion was defined as psychotic symptoms. Delusions and/or hallucinations that lasted less than a month or subsided rapidly upon pharmacotherapy were defined as 'transient' and those that lasted more than a month or did not diminish upon pharmacotherapy were defined as 'prolonged' types. For employment and social functioning status, those who worked or attended school four or five days a week for a month prior to admission were categorized as having a 'fully functioning' status. This included housewives who could engage in housework or childcare activities for an equivalent amount of time. Participants who worked or attended school two or three days a week (housework or childcare for housewives), took irregular part-time work, were on sick leave, and had attended psychiatric rehabilitation services in the past month were categorized as having a 'partially functioning' status. Individuals with 'none' status stayed at home without performing any social function, including school and work, and did not engage in housework.

Statistical analysis

SPSS 22.0 J (IBM Corp., Tokyo, Japan) was used for all the statistical analyses. We divided the participants into ADHD and ASD groups according to their primary diagnosis. First, to characterize the study participants, descriptive analyses were performed by group for demographic (age, sex, years of education, employment, and social functioning status) and clinical data (psychosis, admission details, and comorbidity). Second, to examine the ADHD-ASD group differences in the demographic and clinical data, participants who had both ADHD and ASD diagnoses were excluded, and independent samples *t*-tests and chi-square tests were performed for between-group comparisons of continuous and categorical data, respectively. In addition, logistic regression analysis was carried out to examine the effects of demographic (age, sex, years of education, employment and social functioning status) and clinical (presence of psychiatric comorbidity) variables on the likelihood of developing psychosis (presence of psychotic symptoms) in the ADHD and ASD groups. The significance level was set at 0.05, and all tests were two-sided.

Results

Among the 98 participants (72 men and 26 women; mean age [SD], 28.5 [10.3] years), 69 were diagnosed with ASD (58 men and 11 women; mean age [SD], 28.1 [10.4] years), and 29 with ADHD (14 men and 15 women; mean age [SD], 29.7 [10.1] years). The demographic and clinical characteristics of patients are presented in Table 1. While the sex ratio was similar in individuals with ADHD (48.3% male), a male preponderance was observed in their ASD counterparts (84.1% male) and in the total participants (73.5% male). The average admission period was over 100 days for both the total (mean days [SD], 110.1 [175.2] days) and ASD participants (mean days [SD], 124.9 [188.8] days). Twenty-seven percent of the participants experienced psychotic symptoms, and the percentages were 30.4% and 17.2% for individuals with ASD and ADHD, respectively. While none of the psychotic symptoms were categorized as prolonged type in individuals with ADHD, 38.1% were classified as prolonged psychosis in those with ASD. Approximately one-third of participants had psychiatric comorbidities. Mood disorders (10.3%) and substance-related disorders (10.3%) were common comorbidities, whereas schizophrenia, other psychotic disorders (13.0%), and mental retardation (15.9%) were common co-occurring disorders in individuals with ASD. ASD-ADHD comorbidity was observed in two (6.9%) and four (5.8%) patients with ADHD and ASD, respectively. Among the nine participants with comorbid schizophrenia and other psychotic disorders, six were diagnosed with schizophrenia and three with schizophreniform disorder. All individuals with ASD who exhibited prolonged psychosis later received a comorbid diagnosis of 'schizophrenia or other psychotic disorder. On admission, almost all participants (95.9%) were prescribed psychotropic medication. In the ASD group, 1.4% were on methylphenidate, 2.9% were on atomoxetine, 76.8%

Table 1 Demographics and clinical characteristics of patients with ASD (n = 69) and ADHD (n = 29).

	ASD (n = 69) Mean (SD)	ADHD (n = 29) Mean (SD)	Total (n = 98) Mean (SD)
Demographics			
Age	28.1 (10.4)	29.7 (10.1)	28.5 (10.3)
Sex (men) N (%)	58 (84.1)	14 (48.3)	72 (73.5)
Years of Education	12.6 (2.2)	12.3 (2.6)	12.5 (2.3)
Admission History			
Current Number of Admission Days	124.9 (188.8)	74.7 (134.1)	110.1 (175.2)
Number of Admissions	2.3 (2.3)	3.0 (3.2)	2.5 (2.6)
Multiple Admissions N (%)	40 (58.0)	13 (44.8)	53 (54.1)
Employment and Social Functioning Status N (%)			
Fully Functioning	33 (47.8)	13 (44.8)	46 (46.9)
Partially Functioning	22 (31.9)	10 (34.5)	32 (32.7)
None	14 (20.3)	6 (20.7)	20 (20.4)
Special-needs school	20 (29.0)	2 (6.9)	22 (22.4)
Psychosis			
Number of Psychosis Occurrences	1.6 (0.9)	2.6 (2.5)	1.8 (1.4)
Presence of Psychotic Symptoms N (%)	21 (30.4)	5 (17.2)	26 (26.5)
Transient Psychotic Symptoms N (%)	13 (61.9)	5 (100)	18 (69.2)
Prolonged Psychotic Symptoms N (%)	8 (38.1)	0 (0.0)	8 (30.8)
Psychiatric Comorbidity N (%)			
Presence of Psychiatric Comorbidity	27 (39.1)	9 (31.0)	36 (36.7)
Schizophrenia and Other Psychotic Disorders	9 (13.0)	0 (0.0)	9 (9.2)
Mood Disorders	1 (1.4)	3 (10.3)	4 (4.1)
Anxiety, Somatoform, and Dissociative Disorders	2 (2.9)	0 (0.0)	2 (2.0)
Substance-Related Disorders	1 (1.4)	3 (10.3)	4 (4.1)
Pervasive Developmental Disorders	—	2 (6.9)	—
Attention-Deficit/Hyperactivity Disorders	4 (5.8)	—	—
Mental Retardation	11 (15.9)	2 (6.9)	13 (13.3)

The psychiatric diagnoses in this table are based on the DSM-IV-TR criteria.
The number of admissions includes current admission.
ASD, autism spectrum disorder; ADHD, attention deficit hyperactivity disorder; SD, standard deviation.

were on antipsychotics, 56.5% were on mood stabilizers, 23.2% were on antidepressants, 27.5% were on anxiolytics, and 49.3% were on hypnotics. In the ADHD group, 13.8% were on methylphenidate, 41.4% were on atomoxetine, 69.0% were on antipsychotics, 55.2% were on mood stabilizers, 34.5% were on antidepressants, 48.3% were on anxiolytics, and 75.9% were on hypnotics.

Table 2 presents the results of between-group comparisons. The ADHD group consisted of 27 participants (13 men and 14 women; mean age [SD], 29.7 [10.4] years) and the ASD group consisted of 65 patients (55 men and 10 women; mean age [SD], 28.1 [10.3] years). No group differences were found except for the sex ratio and attendance at special-needs schools, in which the ASD group had significantly more men than women (48.1% vs. 84.6%, χ^2 = 13.16, df = 1, $p < 0.001$) and was more likely to attend special-needs schools than the ADHD group (3.7% vs. 30.8%, χ^2 = 7.93, df = 1, p = 0.005).

The logistic regression analysis revealed that while individuals who attended special-needs schools were 8 times less likely to develop psychosis than those who did not (OR=0.13, 95%CI [0.02, 0.81]), those who had any co-occurring psychiatric disorders were 6 times more likely to have psychosis than comorbidity-free individuals (OR=6.40, 95%CI [1.34, 30.63]) in the ASD group (Table 3a). In contrast, no variables were found to be linked with psychotic symptoms in the ADHD group (Table 3b).

Discussion

This study examined psychotic symptoms and their associated clinical characteristics in adult inpatients with ASD and ADHD in psychiatric emergency wards. These results highlight the high prevalence of psychotic symptoms in both ASD and ADHD, as approximately one-third of individuals with ASD and nearly one-fifth of those with ADHD exhibited psychotic symptoms. While psychosis observed in ADHD was transient and resolved quickly, nearly 40% of psychosis in ASD was of the prolonged type, and all participants who later presented with prolonged psychosis received a comorbid diagnosis of a psychotic disorder.

Our results add further support to the previous findings that individuals with ASD experience high rates of psychotic symptoms throughout the course of their illness. In our clinical adult population with ASD, the rate of developing psychosis was 30.4%, which was similar to the 28.7% prevalence reported by Sullivan et al.,[11] who examined children with ASD. However, our percentage was three times higher than the 11.6% prevalence reported by Bevan Jones et al.,[24] who

Table 2 Between-group comparisons of demographic and clinical data (n = 92).

	ASD (n = 65)	ADHD (n = 27)	t/x	p
	Mean (SD)			
Demographics				
Age	28.1 (10.3)	29.7 (10.4)	−0.67	0.50
Sex (men) N (%)	55 (84.6)	13 (48.1)	13.16	**<0.001**
Years of Education	12.5 (2.3)	12.4 (2.7)	0.26	0.80
Admission History				
Current Number of Admission Days	129.7 (193.4)	78.6 (138.3)	1.43	0.16
Number of Admissions	2.4 (2.4)	2.7 (3.1)	−0.50	0.62
Multiple Admissions N (%)	39 (60.0)	11 (40.7)	2.85	0.11
Employment and Social Functioning Status N (%)				
Fully Functioning	32 (49.2)	12 (44.4)	0.18	0.82
Partially Functioning	20 (30.8)	9 (33.3)	0.06	0.81
None	13 (20.0)	6 (22.2)	0.06	0.79
Special-needs school	20 (30.8)	1 (3.7)	7.93	**<0.01**
Psychosis				
Number of Psychosis Occurrences	1.6 (0.9)	2.6 (2.5)	−0.86	0.44
Presence of Psychotic Symptoms N (%)	21 (32.3)	5 (18.5)	1.79	0.21
Transient Psychotic Symptoms N (%)	13 (61.9)	5 (100)	2.75	0.28
Prolonged Psychotic Symptoms N (%)	8 (38.1)	0 (0.0)	2.75	0.28
Psychiatric Comorbidity N (%)				
Presence of Psychiatric Comorbidity	23 (35.4)	7 (25.9)	0.78	0.47
Schizophrenia and Other Psychotic Disorders	9 (13.8)	0 (0.0)	4.14	0.05
Mood Disorders	1 (1.5)	3 (11.1)	4.20	0.07
Anxiety, Somatoform, and Dissociative Disorders	2 (3.1)	0 (0.0)	0.85	1.00
Substance-Related Disorders	1 (1.5)	3 (11.1)	4.20	0.07
Mental Retardation	11 (16.9)	1 (3.7)	2.94	0.10

The psychiatric diagnoses in this table are based on the DSM-IV-TR criteria.
Participants diagnosed with both ADHD and ASD were excluded.
Variables that showed significant differences (p<0.05) between the groups using chi-square tests or independent sample t-tests are in bold.
The number of admissions includes current admission.
ASD, autism spectrum disorder; ADHD, attention deficit hyperactivity disorder; SD, standard deviation.

included children with autistic traits. Although sampling differences may exist, these figures suggest that adults with ASD are more likely than, or at least as prone as, children with ASD to develop psychosis. In view of psychotic comorbidities, only 13.0% of our participants with ASD were diagnosed with schizophrenia or other psychotic disorders. While figures vary significantly among studies, our comorbidity rate was rather small compared to those previously reported (34.8% to 60%).[3,23] Given that we at best separated those presenting psychotic symptoms from those who were clearly diagnosed with psychotic disorders, psychosis observed in individuals with ASD may be more likely to be transient and

Table 3a Binary logistic regression model for the prediction of psychosis development in patients with ASD (n = 65).

Variables	Coefficient	SE	Wald test statistic	df	p-value	OR	95% CI
Age	0.001	0.033	0.001	1	0.970	1.00	0.94−1.07
Sex (women)	−1.271	0.953	1.777	1	0.182	0.28	0.04−1.82
Years of Education	−0.013	0.144	0.008	1	0.928	0.99	0.74−1.31
Employment and Social Functioning Status			0.548	2	0.760		
Partially Functioning	−0.008	0.693	0.000	1	0.990	0.99	0.26−3.85
None	−0.614	0.882	0.484	1	0.487	0.54	0.10−3.05
Special-needs school	−2.076	0.949	4.788	1	0.029	0.13	0.02−0.81
Presence of Psychiatric Comorbidity	1.857	0.799	5.408	1	0.020	6.40	1.34−30.63

OR, Odds Ratio; CI, Confidence Interval.

Table 3b Binary logistic regression model for the prediction of psychosis development in patients with ADHD (n = 27).

Variables	Coefficient	SE	Wald test statistic	df	p-value	OR	95% CI
Age	0.089	0.095	0.880	1	0.348	1.09	0.91−1.32
Sex (women)	−0.815	1.420	0.330	1	0.566	0.44	0.03−7.15
Years of Education	0.052	0.282	0.034	1	0.855	1.05	0.61−1.83
Employment and Social Functioning Status			0.000	2	1.000		
Partially Functioning	−20.929	12,822.532	0.000	1	0.999	0.00	0.00−-
None	−20.656	17,078.600	0.000	1	0.999	0.00	0.00−-
Special-needs school	44.209	43,670.967	0.000	1	0.999	1.58	0.00−-
Presence of Psychiatric Comorbidity	−0.697	1.744	0.160	1	0.690	0.50	0.02−15.21

OR, Odds Ratio; CI, Confidence Interval.

at a subthreshold level compared to meeting the full criteria for any comorbid psychotic disorder. In fact, 60% of psychosis exhibited by adults with ASD was typed as transient in our study and resolved quickly upon admission or treatment. This underlines the need for a more detailed evaluation of 'psychotic symptoms' in ASD and may explain the wide range of comorbidity rates reported in various studies. Nevertheless, it is clear that adults with ASD present a high risk of developing psychotic symptoms, regardless of whether they develop fully comorbid psychotic disorders and a shared etiology of ASD and psychotic disorders, as reported in several studies.[8,9,24] In addition, our regression results suggest that in contrast to the risk of having multiple psychiatric disorders, attendance at special-needs schools may act as a protective factor against psychosis in individuals with ASD. The environmental adjustment and scaffolding in early childhood may modify the course of neural development and decrease the risk of developing psychosis later in adulthood.

Although the rate was not as high as that observed for ASD, a significant proportion of adults with ADHD exhibit psychotic symptoms. Specifically, 17.2% of inpatients with ADHD in our study presented psychosis, which is comparable to a previous study in which 29.2% of children with ADHD experienced psychotic symptoms.[34] Since another study with children reported a much lower prevalence of developing psychotic symptoms (5.1%),[13] it is difficult to note the changes in the prevalence rates of psychosis throughout their lifetime. However, it is clear that both children and adults with ADHD experience psychotic symptoms to a significant degree. The fact that we only targeted inpatients at psychiatric emergency wards may have skewed our sample to rather severe cases, and psychosis in the general ADHD population may be lower, similar to the rate reported by Vitiello et al.[13] Importantly, in accordance with their results, all psychotic symptoms found in individuals with ADHD are transient and resolve rapidly upon admission and treatment. This suggests that, unlike the psychosis observed in ASD, psychotic symptoms in ADHD may be less severe and variable. In light of comorbidities, none of the studies in our study was found to have both ADHD and schizophrenia or other psychotic disorders, which sharply contrasts several studies reporting high comorbidity rates for ADHD and psychotic disorders.[6,33] It is possible that, similar to ASD, transient and sub-threshold levels of psychosis is more common and frequently observed than full-scale development of comorbid psychotic disorders in individuals with ADHD.

In terms of the ASD-ADHD comparison, we found no difference in demographic and clinical characteristics or in the prevalence and types of psychosis between the two groups, except that the participants with ASD showed more male preponderance and attended special needs schools than those with ADHD. While both ASD and ADHD frequently showed transient psychosis, only those with ASD had some cases of prolonged psychosis and comorbid psychotic disorders, such as schizophrenia and schizophreniform disorder. Although several studies have revealed shared genetic underpinnings between psychotic disorders and both ASD and ADHD,[4,19,21] ASD may be more akin to psychotic disorders than ADHD, and individuals with ASD may be more prone to developing severe psychosis or full-scale psychotic disorders than individuals with ADHD. Nonetheless, our results resonate with the concept of the neurodevelopmental continuum that neurodevelopmental disorders and psychotic disorders may emerge from shared abnormal genetic predispositions and neural development.[26−28]

The present study has several limitations. First, the participants comprised only those who were admitted to psychiatric emergency wards and may not be representative of the general ASD and ADHD population. Our sample may be skewed to those who present with severe symptoms or functional impairment as well as a higher frequency of psychosis. Second, this was a retrospective and cross-sectional study. Given that most psychosis observed was transient, prospective and longitudinal designs are necessary to determine the actual prevalence rate of psychotic occurrence. Third, the sample size was small (n = 98). The absence of a statistically significant difference between the ASD and ADHD groups may have been due to the underpowered statistics. Fourth, we excluded individuals who were on psychotropic medication or analyzed the data according to the type of psychotropic medication. In some cases, the pharmacological effects of psychotropic medications may have masked or fueled psychosis. Finally, the relationship between ASD/ADHD symptoms and psychosis has not yet been evaluated. Further studies with larger, wide-ranging clinical populations are necessary, with a more detailed evaluation of psychotic symptoms in relation to ASD/ADHD symptoms.

Conclusions

In summary, the present study demonstrated that adults with neurodevelopmental disorders present with psychotic symptoms to a significant degree, even in the absence of apparent comorbid psychotic disorders such as schizophrenia. This highlights the importance of the careful evaluation of psychotic symptoms in patients with ASD and ADHD. Healthcare providers should consider the possibility of transient delusions and hallucinations, differentiate them from comorbid psychotic disorders, and provide appropriate pharmacotherapy and psychosocial support.

Ethical Considerations

The study protocol was approved by the Research Ethical Committee of the Showa University School of Medicine (No. 22—019-A) and conformed to the provisions of the Declaration of Helsinki. All participants provided written consent to participate in the study after a full explanation of the study procedures.

Registry and Registration No. of the study: n/a. Animal Studies: n/a.

Disclosure

Data availability statement: The research data are not shared. This was because the participants did not consent to open data-sharing.

Author contributions

Data curation and Writing — original draft: HU. Conceptualization, Formal analysis, and Writing — review & editing: WH, TO, and AI. Investigation, Resources: AN and HY.

Funding

This study did not receive any specific grants from funding agencies in the public, commercial, or not-for-profit sectors.

Conflict of Interest

The authors declare no conflict of interest.

Acknowledgments

We thank the doctors in the Department of Psychiatry at Showa University for their helpful advice and support during this study. We would also like to thank Editage for the English language editing.

References

1. Arican I, Bass N, Neelam K, Wolfe K, McQuillin A, Giaroli G. Prevalence of attention deficit hyperactivity disorder symptoms in patients with schizophrenia. Acta Psychiatr Scand. 2019;139:89—96. https://doi.org/10.1111/acps.12948.
2. Dalsgaard S, Mortensen PB, Frydenberg M, Maibing CM, Nordentoft M, Thomsen PH. Association between Attention-Deficit Hyperactivity Disorder in childhood and schizophrenia later in adulthood. Eur Psychiatry. 2014;29:259—63. https://doi.org/10.1016/j.eurpsy.2013.06.004.
3. De Giorgi R, De Crescenzo F, D'Alò GL, Rizzo Pesci NR, Di Franco V, Sandini C, et al. Prevalence of non-affective psychoses in individuals with autism spectrum disorders: a systematic review. J Clin Med. 2019;8:1304. https://doi.org/10.3390/jcm8091304.
4. Pallanti S, Salerno L. Raising attention to attention deficit hyperactivity disorder in schizophrenia. World J Psychiatry. 2015;5:47—55. https://doi.org/10.5498/wjp.v5.i1.47.
5. Vaquerizo-Serrano J, Salazar de Pablo GS, Singh J, Santosh P. Autism spectrum disorder and clinical high risk for psychosis: a systematic review and meta-analysis. J Autism Dev Disord. 2022;52:1568—86. https://doi.org/10.1007/s10803-021-05046-0.
6. Donev R, Gantert D, Alawam K, Edworthy A, Hässler F, Meyer-Lindenberg A, et al. Comorbidity of schizophrenia and adult attention-deficit hyperactivity disorder. World J Biol Psychiatry. 2011;12 (Suppl 1):52—6. https://doi.org/10.3109/15622975.2011.599212.
7. Gough A, Morrison J. Managing the comorbidity of schizophrenia and ADHD. J Psychiatry Neurosci. 2016;41:E79—80. https://doi.org/10.1503/jpn.150251.
8. Unenge Hallerbäck MU, Lugnegård T, Gillberg C. Is autism spectrum disorder common in schizophrenia? Psychiatry Res. 2012;198:12—7. https://doi.org/10.1016/j.psychres.2012.01.016.
9. King BH, Lord C. Is schizophrenia on the autism spectrum? Brain Res. 2011;1380:34—41. https://doi.org/10.1016/j.brainres.2010.11.031.
10. Fox V, Sheffield JM, Woodward ND. Attention-deficit/hyperactivity disorder in youth with psychosis spectrum symptoms. Schizophr Res. 2021;237:141—7. https://doi.org/10.1016/j.schres.2021.08.027.
11. Sullivan S, Rai D, Golding J, Zammit S, Steer C. The association between autism spectrum disorder and psychotic experiences in the Avon longitudinal study of parents and children (ALSPAC) birth cohort. J Am Acad Child Adolesc Psychiatry. 2013;52:806—14. https://doi.org/10.1016/j.jaac.2013.05.010. e2.
12. Sunwoo M, O'Connell J, Brown E, Lin A, Wood SJ, McGorry P, et al. Prevalence and outcomes of young people with concurrent autism spectrum disorder and first episode of psychosis. Schizophr Res. 2020;216:310—5. https://doi.org/10.1016/j.schres.2019.11.037.
13. Vitiello B, Perez Algorta GP, Arnold LE, Howard AL, Stehli A, Molina BSG. Psychotic symptoms in attention-deficit/hyperactivity disorder: an analysis of the MTA database. J Am Acad Child Adolesc Psychiatry. 2017;56:336—43. https://doi.org/10.1016/j.jaac.2017.01.016.
14. American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders (DSM-5®). Washington, DC: Am. Psychiatr ASSN; 2013.
15. Elsabbagh M, Divan G, Koh YJ, Kim YS, Kauchali S, Marcín C, et al. Global prevalence of autism and other pervasive developmental disorders. Autism Res. 2012;5:160—79. https://doi.org/10.1002/aur.239.
16. Bender L. Childhood schizophrenia; clinical study on one hundred schizophrenic children. Am J Orthopsychiatry. 1947;17:40—56. https://doi.org/10.1111/j.1939-0025.1947.tb04975.x.
17. Rutter M. Concepts of autism: a review of research. J Child Psychol Psychiatry. 1968;9:1—25. https://doi.org/10.1111/j.1469-7610.1968.tb02204.x.

18. Rutter M, Bartak L. Causes of infantile autism: some considerations from recent research. J Autism Child Schizophr. 1971;1:20—32. https://doi.org/10.1007/BF01537740.
19. Lionel AC, Vaags AK, Sato D, Gazzellone MJ, Mitchell EB, Chen HY, et al. Rare exonic deletions implicate the synaptic organizer gephyrin (GPHN) in risk for autism, schizophrenia and seizures. Hum Mol Genet. 2013;22:2055—66. https://doi.org/10.1093/hmg/ddt056.
20. McCarthy SE, Makarov V, Kirov G, Addington AM, McClellan J, Yoon S, et al. Microduplications of 16p11.2 are associated with schizophrenia. Nat Genet. 2009;41:1223—7. https://doi.org/10.1038/ng.474.
21. Moreno-De-Luca D, SGENE ConsortiumMulle JG, Simons Simplex Collection Genetics ConsortiumKaminsky EB, Sanders SJ, et al. Deletion 17q12 is a recurrent copy number variant that confers high risk of autism and schizophrenia. Am J Hum Genet. 2010;87:618—30. https://doi.org/10.1016/j.ajhg.2010.10.004.
22. Nakayasu H. When should we consider Asperger's syndrome in contrast to early schizophrenia in adult psychiatric service? Jpn J Child Adolesc Psychiatry. 2012;53:248—64. https://doi.org/10.3389/fpsyt.2019.00078.
23. Chisholm K, Lin A, Abu-Akel A, Wood SJ. The association between autism and schizophrenia spectrum disorders: a review of eight alternate models of co-occurrence. Neurosci Biobehav Rev. 2015;55:173—83. https://doi.org/10.1016/j.neubiorev.2015.04.012.
24. Bevan Jones RB, Thapar A, Lewis G, Zammit S. The association between early autistic traits and psychotic experiences in adolescence. Schizophr Res. 2012;135:164—9. https://doi.org/10.1016/j.schres.2011.11.037.
25. Poulton R, Caspi A, Moffitt TE, Cannon M, Murray R, Harrington H. Children's self-reported psychotic symptoms and adult schizophreniform disorder: a 15-year longitudinal study. Arch Gen Psychiatry. 2000;57:1053—8. https://doi.org/10.1001/archpsyc.57.11.1053.
26. Owen MJ, MC O'Donovan. Schizophrenia and the neurodevelopmental continuum: evidence from genomics. World Psychiatry. 2017;16:227—35. https://doi.org/10.1002/wps.20440.
27. Morris-Rosendahl DJ, Crocq M-A. Neurodevelopmental disorders-the history and future of a diagnostic concept. Dialogues Clin Neurosci. 2020;22:65—72. https://doi.org/10.31887/DCNS.2020.22.1/macrocq.
28. Singh T, Walters JT, Johnstone M, Curtls D, Suvisaari J, Torniainen M, et al. The contribution of rare variants to risk of schizophrenia in indivisuals with and without intellectual disability. Nat Genet. 2017;49:1167—73. https://doi.org/10.1038/ng.3903.
29. Sayal K, Prasad V, Daley D, Ford T, Coghill D. ADHD in children and young people: prevalence, care pathways, and service provision. Lancet Psychiatry. 2018;5:175—86. https://doi.org/10.1016/S2215-0366(17)30167-0.
30. Willcutt EG. The prevalence of DSM-IV attention-deficit/hyperactivity disorder: a meta-analytic review. Neurotherapeutics. 2012;9:490—9. https://doi.org/10.1007/s13311-012-0135-8.
31. Fayyad J, De Graaf R, Kessler R, Alonso J, Angermeyer M, Demyttenaere K, et al. Cross-national prevalence and correlates of adult attention-deficit hyperactivity disorder. Br J Psychiatry. 2007;190:402—9. https://doi.org/10.1192/bjp.bp.106.034389.
32. Kessler RC, Adler L, Barkley R, Biederman J, Conners CK, Demler O, et al. The prevalence and correlates of adult ADHD in the United States: results from the National comorbidity Survey Replication. Am J Psychiatry. 2006;163:716—23. https://doi.org/10.1176/ajp.2006.163.4.716.
33. Kim-Cohen J, Caspi A, Moffitt TE, Harrington H, Milne BJ, Poulton R. Prior juvenile diagnoses in adults with mental disorder: developmental follow-back of a prospective-longitudinal cohort. Arch Gen Psychiatry. 2003;60:709—17. https://doi.org/10.1001/archpsyc.60.7.709.
34. Hennig T, Jaya ES, Lincoln TM. Bullying mediates between attention-deficit/hyperactivity disorder in childhood and psychotic experiences in early adolescence. Schizophr Bull. 2017;43:1036—44. https://doi.org/10.1093/schbul/sbw139.
35. American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR®). Washington, DC: Am. Psychiatr ASSN; 2000.