

# Attention-Deficit/Hyperactivity Disorder in Adults with High-Functioning Pervasive Developmental Disorders in Japan

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## Abstract

**Aims:** This study was designed to verify the proportion of Japanese adults with pervasive developmental disorder (PDD) who met the diagnostic criteria (other than E) for attention-deficit/hyperactivity disorder (ADHD) in the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision (DSM-IV-TR). Furthermore, we examined to what extent adults with PDD think that they exhibit ADHD symptoms. **Methods:** We developed an original Japanese self-report questionnaire to determine the presence or absence of 18 symptoms from the diagnostic criteria for ADHD in the DSM-IV-TR. We administered the questionnaire to 64 adults with high-functioning PDD (45 men and 19 women) and 21 adults with ADHD (10 men and 11 women), aged 18 to 59 years, with a full-scale intelligence quotient  $\geq 75$ . Target patients were evaluated for ADHD by their psychiatrists. **Results:** Twenty-nine (45.3%) adults with PDD also had ADHD. The percentage of these adults who had over six perceived inattention symptoms from the DSM-IV-TR was 96.6%. The percentage of these adults who had over six perceived hyperactivity-impulsivity symptoms

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was 65.5%. Thirty-five (55.6%) adults with PDD responded that they were aware of having ADHD symptoms at the level of the relevant diagnostic criteria. **Conclusions:** The present study is the first to examine the frequency of objective and perceived ADHD symptoms in adults with PDD in Japan. Our results show that both objective and perceived ADHD symptoms frequently appear in a large number of adults with PDD. This suggests that it is necessary to attend to concomitant ADHD symptoms in the medical care of adults with PDD.

## Keywords

**Adults, Attention-Deficit/Hyperactivity Disorder (ADHD), High-Functioning, Pervasive Developmental Disorders (PDD), Self-Report**

## 1. Introduction

The essential feature of attention-deficit/hyperactivity disorder (ADHD) is a persistent pattern of inattention and/or hyperactivity-impulsivity that interferes with functioning or development [1]. Pervasive developmental disorders (PDD) are characterized by severe and pervasive impairment in several areas of development: reciprocal social interaction skills, communication skills, or the presence of stereotyped behavior, interests, and activities [2]. In 2013, the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision (DSM-IV-TR) [2] was revised to the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) [1]. Due to this revision, the general terminology for autism, PDD not otherwise specified, childhood disintegrative disorder, and Asperger's disorder, all of which were included under the classification for PDD in the DSM-IV-TR [2], was changed to Autism Spectrum Disorder (ASD) in the DSM-5. Moreover, the revision recognizing the comorbidity of PDD and ADHD in the DSM-5, which was not recognized in the DSM-IV-TR, is another significant difference between the two versions of the DSM. The concurrence of PDD and ADHD has been commonly recognized in clinical settings, especially within the field of pediatrics [3]-[6]. Among the youths with PDD, 40% - 78% [3]-[6] experience ADHD symptoms to a degree that meets the DSM-IV criteria for ADHD, a markedly higher rate than the 3% - 7% [2] prevalence of ADHD among school-age children.

It is widely known that PDD is a persistent disorder that can extend beyond childhood [7]. However, only Sweden has examined adults with PDD, reporting that 37% - 43% of adults with PDD also have ADHD symptoms [7]-[10].

To date, ADHD has been recognized as a childhood disorder that improves over time. However, research in some countries shows that in 49% - 66% of individuals, some symptoms persist until adulthood [11]. Furthermore, a large epidemiologic survey of adults in 10 countries (not including Japan) conducted between 2001 and 2003 showed that the prevalence of adult ADHD was 3.4% [12]. Thus, ADHD is emerging as an important disorder in adults.

Few reports have estimated the prevalence of ADHD or PDD in adults in Japan; however, based on our clinical experiences, a relatively high prevalence of PDD with ADHD symptoms is expected. At the same time, we feel that a considerable number of adults with PDD complain about ADHD symptoms, such as those who visit a clinic with the main complaint of ADHD symptoms.

It is necessary to prepare a comprehensive and effective treatment plan for symptoms related to both PDD and ADHD [4] [13], and to treat the symptoms of inattention and hyperactivity individually, as required [14]. Since studies have reported that drugs used for ADHD have therapeutic efficacy in children with PDD with ADHD symptoms [15]-[19], it is meaningful to examine ADHD symptoms in individuals with PDD to develop an appropriate therapeutic strategy.

Now that the DSM has been revised to recognize the concurrence between ADHD and ASD (including what was previously referred to as PDD) even in the diagnostic criteria, there is a need to examine the concurrence between ADHD and ASD further in a wide range of subjects, including children and adults.

In this study, we aimed to estimate the proportion of Japanese adults with PDD who met the diagnostic criteria for ADHD except for criterion E in the DSM-IV-TR. Furthermore, we examined to what extent adults with PDD think that they exhibit ADHD symptoms. Since this study began before the DSM-IV-TR was revised to the

DSM-5, all of the diagnoses made within this study adhered to the DSM-IV-TR.

## 2. Methods

### 2.1. Subjects

We asked psychiatrists, including those in charge of an outpatient clinic specializing in developmental disorders at the Department of Neuropsychiatry, Fukushima Medical University Hospital, and those working at seven affiliated institutions that were familiar with the medical and psychiatric care of developmental disorders, to help gather data for this study. Eleven psychiatrists working in the eight institutions provided informed consent and conducted this study. Psychiatrists included in this study had a median of 16 years of experience in the clinical practice of psychiatry (range, 6 - 37 years). The study period was from June 2007 to March 2008. Study subjects were individuals attending outpatient clinics in the Department of Neuropsychiatry at Fukushima Medical University Hospital, or at the seven institutions that were affiliated with the cooperating psychiatrists.

We chose subjects who met the following inclusion criteria: 1) met the diagnostic criteria for PDD or ADHD in the DSM-IV-TR [2], 2) age of 18 to 60 years, and 3) Full Scale Intelligence Quotient (FIQ)  $\geq 75$ . As mentioned previously, the subjects for this study were limited to patients whose diagnoses were affirmed by obtaining sufficient objective information (*i.e.*, maternity health record book and report cards) and subjective information concerning their childhood (*i.e.*, information provided by one or both parents).

The exclusion criteria were as follows: 1) regular medication treatment for chronic physical disease, 2) under treatment for bipolar disorder, 3) under treatment for schizophrenia, and 4) pregnant or lactating. Inclusion criteria 2 and 3 were included to raise the validity of subjects' self-evaluations. Consecutive individuals who met the inclusion criteria and who did not meet the exclusion criteria during the study period (June 2007 to March 2008) were asked to participate, and informed consent was obtained from those who agreed.

### 2.2. Questionnaire

We developed a self-report questionnaire to determine the presence or absence of 18 symptoms listed from (a) to (i) in criterion A (1), and from (a) to (i) in criterion A (2) of the diagnostic criteria for ADHD in the DSM-IV-TR [2]. The questionnaire was devised so that responses would be "yes" if the symptom was perceived to be present and "no" if the symptom was perceived to be absent (see [Table 1](#)). In addition, the questionnaire asked subjects for their sex, age, and occupation. Answers of "yes" were scored as 1 and "no" answers were scored as 0. The total score from the nine questions concerning symptoms in criterion A (1) in the DSM-IV-TR [2] served as the total score for inattention, and the total score from the nine questions related to criterion A (2) served as the total score for hyperactivity-impulsivity. In addition, an overall score was determined for all 18 questions.

### 2.3. Procedure

The questionnaire, explanatory documents, an envelope to return the completed questionnaire, and a ballpoint pen were distributed to subjects via their psychiatrists. We asked subjects to return their sealed envelope with the completed questionnaires to their psychiatrists. The attending psychiatrists provided basic information about the diagnosis, the results of the intelligence test, age at diagnosis of ADHD or PDD, and information regarding the medical care of the subject. We asked the attending psychiatrists to classify the subjects with ADHD based on four sub-classifications: combined type, predominantly inattentive type, predominantly hyperactive-impulsive type, and in partial remission (psychiatrists' classification). If the subject was diagnosed with PDD, we asked the attending psychiatrist whether the subject satisfied the diagnostic criteria for ADHD in the DSM-IV-TR except for criterion E, and if the subject met the criteria, we then asked the psychiatrist to classify that subject using the same four ADHD sub-classifications. Based on the intelligence test, the psychiatrists provided the subjects' verbal IQ (VIQ), performance IQ (PIQ), and FIQ.

In this study, we divided subjects into three groups as per the psychiatrists' judgments regarding the presence of ADHD symptoms: ADHD, PDD with ADHD, and PDD without ADHD. In addition, for the subsequent data analysis, we categorized the subjects with PDD, as observed by the attending psychiatrists, as "inattention PDD subjects" if they fulfilled the diagnostic criteria for inattention, and as "hyperactivity-impulsivity PDD subjects" if they fulfilled the diagnostic criteria for hyperactivity-impulsivity. Moreover, based on subjects' responses to the questionnaire in this study, we categorized subjects with a total inattention score of  $\geq 6$  or a total hyperac-

**Table 1.** Details of the 18 questions prepared based on the diagnostic criteria for ADHD in the DSM-IV-TR.

- 1) Nine questions about inattention:
  - 1 Do people often tell you that you “make many careless mistakes” in schoolwork, work, or other activities?
  - 2 Do you often have difficulty sustaining attention at work or in play activities?
  - 3 Do you often fail to hear someone speaking to you directly?
  - 4 Do you often fail to accomplish tasks because you missed the instructions?
  - 5 Do you often have difficulty organizing tasks and activities?
  - 6 Are you particularly weak at tasks that require sustained mental effort?
  - 7 Do you often lose things necessary for tasks or activities?
  - 8 Are you easily distracted?
  - 9 Do you often forget your plans or appointments?
- 2) Nine questions about hyperactivity-impulsivity:
  - 1 Do you often fidget with your hands or feet or squirm in your seat?
  - 2 Do you often leave your seat in situations in which you are expected to remain seated?
  - 3 Do you often feel very restless?
  - 4 Are you often unable to play or engage in leisure activities quietly?
  - 5 Do you often spend too much time bustling about?
  - 6 Do people often tell you that you “talk a lot”?
  - 7 Do you often blurt out answers before questions have been completed?
  - 8 Do you often have difficulty waiting for your turn?
  - 9 Do you find yourself butting into conversations or games at times?

Abbreviations: ADHD, attention-deficit/hyperactivity disorder; DSM-IV-TR, Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision.

tivity-impulsivity score of  $\geq 6$  as “perceived ADHD subjects” (see [Figure 1](#)).

## 2.4. Analysis

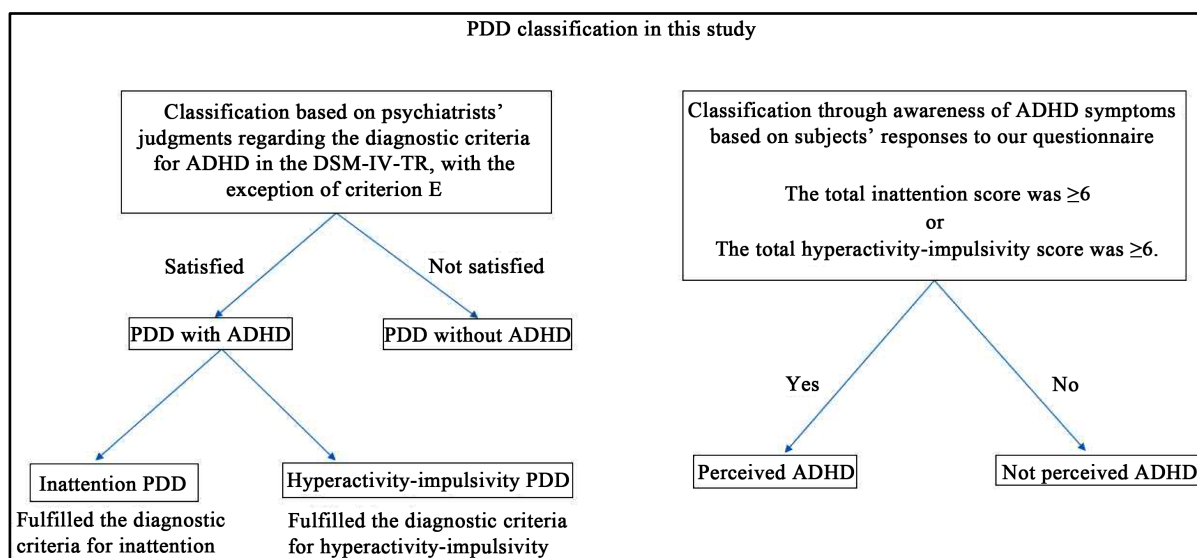
For inter-group comparisons of the number of subjects, the chi-square test was conducted, and for inter-group comparisons of age at diagnosis, age at completing the questionnaire, the respective scores, and the respective IQs, *t*-tests were used for comparing the groups. Analyses were conducted using the Statistical Package for the Social Sciences (SPSS 16.0, SPSS Inc., Chicago, IL), and the level of significance was set at  $P < 0.05$ .

## 3. Results

One hundred and five subjects recruited from the eight institutions completed the questionnaire. Among the 105 respondents, 20 were excluded from analysis (one whose age was inappropriate, three with an FIQ  $< 75$ , ten whose intelligence test results were unknown, and others who lacked a diagnosis of ADHD by the attending psychiatrist). Thus, 85 subjects (81%) were included in the final analysis. Of these, 37 did not take medication, while 48 were undergoing medication treatment. Prescribed medicines, in the order of highest to lowest usage frequency, were sodium valproate, fluvoxamine maleate, and methylphenidate hydrochloride. Among the eligible subjects, 64 had PDD (45 men and 19 women), and 21 had ADHD (10 men and 11 women). Among the 64 subjects with PDD, 13 had autistic disorder (9 men and 4 women), 38 had Asperger’s disorder (30 men and 8 women), and 13 had PDD not otherwise specified (6 men and 7 women). Among the 21 subjects with ADHD, 8 (4 men and 4 women) had the combined type, 9 (4 men and 5 women) had the predominantly inattentive type, and 4 (2 men and 2 women) were in partial remission. None of the subjects had the predominantly hyperactive-impulsive type ADHD. The response rate to each question was high (97.6% to 100%), indicating that all of the questions were appropriate.

### 3.1. Subject Characteristics

Subject characteristics are shown in [Table 2](#). Overall, for men, the number of subjects with PDD was signifi-



**Figure 1.** PDD classification in this study.

**Table 2.** Subject characteristics.

Variable	ADHD		PDD		<i>P</i> <sup>c</sup>
	n	n (%) or M (SD)	n	n (%) or M (SD)	
Number of subjects		21 (100)		64 (100)	**
Male		10 (47.6)		45 (70.3)	**
Female		11 (52.4)		19 (29.7)	ns
Age at diagnosis <sup>a</sup>	21	32.76 (9.74)	64	17.91 (14.39)	**
Male	10	28.60 (10.35)	45	15.09 (13.70)	**
Female	11	36.55 (7.75)	19	24.58 (14.14)	*
Age at answering <sup>b</sup>	21	36.29 (9.49)	64	27.53 (8.46)	**
Male	10	31.50 (9.12)	45	26.27 (8.19)	ns
Female	11	40.64 (7.85)	19	30.53 (8.53)	**
Verbal IQ	20	99.15 (10.35)	60	102.20 (14.61)	ns
Male	10	96.90 (12.29)	42	103.33 (15.19)	ns
Female	10	101.40 (8.00)	18	99.56 (13.18)	ns
Performance IQ	20	96.70 (14.10)	60	98.38 (15.56)	ns
Male	10	90.70 (17.88)	42	98.62 (16.15)	ns
Female	10	102.70 (4.45)	18	97.83 (14.51)	ns
Full scale IQ	21	98.29 (11.82)	64	100.73 (13.29)	ns
Male	10	92.30 (12.46)	45	102.04 (13.21)	*
Female	11	103.73 (8.45)	19	97.63 (13.31)	ns

Notes: \**P* < 0.05, \*\**P* < 0.01. <sup>a</sup>Age at diagnosis of ADHD in the ADHD group and at diagnosis of PDD in the PDD group; <sup>b</sup>Age at answering the self-report questionnaire; <sup>c</sup>Chi-square test for "Number of subjects" or *t*-test for other items. Abbreviations: ADHD, attention-deficit/hyperactivity disorder; PDD, pervasive developmental disorder; M, mean; SD, standard deviation; ns, not significant; IQ, intelligence quotient.

cantly greater than that of subjects with ADHD ( $\chi^2\{1, 85\} = 21.75, P < 0.01$ ). Overall, for men and women, the age at diagnosis was significantly higher in subjects with PDD than in subjects with ADHD (men:  $t\{53\} = 2.93, P < 0.01$ , women:  $t\{28\} = 2.58, P < 0.05$ ). Overall, for women, subjects with ADHD were significantly older than subjects with PDD were ( $t\{28\} = 3.22, P < 0.01$ ). The mean FIQ of subjects with PDD was 100.7 (range, 76 - 127), while the mean FIQ of subjects with ADHD was 98.3 (range, 75 - 120). For men, the FIQ scores were significantly higher in subjects with PDD than in subjects with ADHD ( $t\{53\} = 2.13, P < 0.05$ ).

### 3.2. Diagnosis of ADHD and Perceived ADHD Symptoms

We calculated the ratio of subjects with PDD with ADHD and that of subjects with perceived ADHD among those with PDD in order to elucidate the exact frequencies or proportions of subjects who exhibited ADHD characteristics among subjects with PDD. Among the 64 subjects with PDD, 29 had PDD with ADHD (45.3% in all, 46.7% in men, and 42.1% in women) and 35 had PDD without ADHD (see [Table 3](#)).

In [Table 3](#), we show the proportions of subjects with perceived ADHD in PDD. As shown in the table, 55.6% of subjects with PDD (52.3% of men, 63.2% of women) responded that they were aware of having ADHD symptoms at the level of the ADHD diagnostic criteria. In other words, our results suggest that a high percentage of subjects with PDD think they have ADHD. Note that while calculating the percentages, we excluded one subject who did not answer several of the questions related to inattention and hyperactivity-impulsivity in our questionnaire.

Among the 29 subjects with PDD with ADHD, 28 had inattention (96.6% in all, 95.2% in men, and 100% in women) and 19 had hyperactivity-impulsivity (65.5% in all, 71.4% in men, and 50.0% in women; see [Table 4](#)). Moreover, while it is not shown in the table, in terms of the psychiatrists' classifications of ADHD in subjects with PDD with ADHD, 18 (14 men and 4 women) had the combined type, 10 (6 men and 4 women) had the predominantly inattentive type, 1 (man) had the predominantly hyperactive-impulsive type, and none were in partial remission.

**Table 3.** The ratio of subjects with PDD and ADHD and the ratio of subjects with perceived ADHD among those with PDD.

	PDD with ADHD <sup>a</sup>	Perceived ADHD <sup>b</sup>
PDD		
Total (n = 64)	29/64 (45.3) <sup>c</sup>	35/63 (55.6) <sup>d</sup>
Male (n = 45)	21/45 (46.7) <sup>c</sup>	23/44 (52.3) <sup>d</sup>
Female (n = 19)	8/19 (42.1) <sup>c</sup>	12/19 (63.2) <sup>d</sup>

Notes: <sup>a</sup>Subjects diagnosed with ADHD using the DSM-IV-TR except for criterion E; <sup>b</sup>Subjects whose total score for inattention was  $\geq 6$  or whose score for hyperactivity-impulsivity was  $\geq 6$ ; <sup>c</sup>The proportion of subjects with a diagnosis of "PDD with ADHD" was calculated based on the total number of subjects in each group; <sup>d</sup>The proportion of subjects with "perceived ADHD" was calculated based on the number of subjects showing valid answers to the target questions. Abbreviations: PDD, pervasive developmental disorder; ADHD, attention-deficit/hyperactivity disorder; DSM-IV-TR, Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision.

**Table 4.** The ratios of "inattentive PDD subjects" and "hyperactivity-impulsivity PDD subjects" among subjects with PDD and ADHD.

	Inattention PDD <sup>a</sup>	Hyperactivity-impulsivity PDD <sup>b</sup>
PDD with ADHD <sup>c</sup>		
Total (n = 29)	28 (96.6) <sup>d</sup>	19 (65.5) <sup>d</sup>
Male (n = 21)	20 (95.2) <sup>d</sup>	15 (71.4) <sup>d</sup>
Female (n = 8)	8 (100.0) <sup>d</sup>	4 (50.0) <sup>d</sup>

Notes: <sup>a</sup>Patients diagnosed as inattentive by psychiatrists. (Patients with predominantly inattentive type or combined type); <sup>b</sup>Patients diagnosed as hyperactive-impulsive subjects by psychiatrists. (Patients with predominantly hyperactive-impulsive type or combined type); <sup>c</sup>Patients who satisfied the diagnostic criteria for ADHD in the DSM-IV-TR except for criterion E; <sup>d</sup>The proportion of subjects was calculated based on the total number of subjects in each group. Abbreviations: PDD, pervasive developmental disorder; ADHD, attention-deficit/hyperactivity disorder; DSM-IV-TR, Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision.



## 4. Discussion

The present study is the first to evaluate the frequency and characteristics of ADHD in Japanese adults with PDD. The results showed that PDD with ADHD is present in a high proportion of adults with high-functioning PDD. There are only a few reports that have investigated ADHD in adults with PDD [7]–[10], and they were all conducted in Sweden. Stahlberg, Soderstrom [10] investigated the prevalence of comorbid bipolar and psychotic disorder in adults with ADHD and/or autism spectrum disorders (ASD). They reported that out of 129 subjects with ASD, 14.8% had comorbid bipolar disorder with psychotic features, schizophrenia, or other psychotic disorders, and 38% had comorbid ADHD. Rydén and Bejerot [9] showed that out of 84 subjects with ASD, 37% had ADHD. Hofvander, Delorme [7] reported that 43% of subjects with ASD showed comorbid ADHD.

The proportion of adults with PDD with ADHD in our study was similar to or lower than the incidence of comorbid ADHD in children with PDD [3]–[6], but was similar to or slightly higher than the incidence of comorbid ADHD in Swedish adults with PDD [7]–[9]. The prevalence of PDD with ADHD (45.3%) in our study was remarkably higher than that for adult ADHD (3.4%) [12]. Our data suggest the need to examine the presence or absence of concomitant ADHD, not only in children, but also in adults with PDD.

Moreover, in terms of the presence of inattention or hyperactivity-impulsivity, inattention is more common in subjects with ADHD and subjects with PDD. In the present study, the proportion of subjects categorized as “inattention PDD subjects” in the PDD with ADHD group was 96.6%, replicating the high rates reported in the previously mentioned studies with adults (84.6% [7], 74.5% [8], ≥82% [9], and 75.5% [10]). In Japan, a study on children with PDD with ADHD by Yoshida and Uchiyama [6] reported that 88.9% of subjects with PDD with ADHD were diagnosed as having inattention, similar to the extent of inattention diagnosed in the aforementioned studies [7]–[10] of adults with PDD with ADHD. These findings suggest a high rate of inattention in children and adults with PDD.

Here, we found that the rate of subjects categorized as “hyperactivity-impulsivity PDD subjects” in the PDD with ADHD group was 65.5%; previous studies with adults have reported rates of 59.6% [7], 46.8% [8], and 46.9% [10]. Yoshida and Uchiyama [6] observed hyperactivity-impulsivity in 53.8% of subjects with PDD with ADHD ≤ 10 years old, but this figure decreased to 20% in subjects ≥ 11 years old. Although the rates of inattention exceed those of hyperactivity-impulsivity in adults with PDD with ADHD in both the present and previous studies [7] [8] [10], the rate of hyperactivity-impulsivity is considerable.

## Implication of the Results in Terms of the Diagnostic Revisions in DSM-5

The present paper investigated ADHD symptoms in adults with PDD. As mentioned previously, PDD and ADHD comorbidity is not recognized in the DSM-IV-TR diagnostic criteria for ADHD; however, the DSM-5 does recognize this comorbidity [1]. The present study also showed that there are many cases of PDD with ADHD. Thus, the revision recognizing this comorbidity is considered very meaningful. In addition, for the diagnosis of ADHD under the DSM-IV-TR, patients were required to satisfy at least six of the nine criteria for inattention, or at least six of the nine criteria for hyperactivity-impulsivity. However, the DSM-5 changed this so that only five of the criteria are required for individuals 17 years of age or older. Similarly, diagnostic criteria in the past required that symptoms be recognized before 7 years of age; the age limit has been raised to 12 years in the DSM-5. These revisions will increase the number of adults with ADHD who fit the definitive diagnosis, resulting in an increase in the number of individuals with PDD with ADHD. This expected increase is thought to accurately reflect the true number of individuals with ADHD.

## 5. Limitations

This study had several limitations. First, it included a small number of subjects, and sufficient analysis could only be performed in men with PDD, and not in the other groups. The prevalence of PDD was higher in men than in women, and the male/female ratios of PDD in children were reported to be 3.3:1 [20], 4.8:1 [21], and 3.4 - 6.5:1 [22]. To ensure that these findings clearly reflect the gender differences in these disorders, future studies need to include a sufficient number of both genders. Second, although the questionnaire had symptom-related questions that were based on the diagnostic criteria, the reliability and validity of the questionnaire were not verified. However, no questionnaire about adult ADHD is currently available in Japan, whereas the number of adults requiring medical care and treatment for ADHD symptoms is increasing rapidly. Thus, the 18 questions regarding ADHD symptoms, based on the diagnostic criteria, were developed for self-evaluation.

## 6. Conclusion

To our knowledge, the present study is the first to examine the comorbidity of PDD and ADHD in adults in Asia. It is also the first to examine the frequency of ADHD in adults with PDD in Japan, as well as examine the perceived ADHD symptoms in adults with PDD. Our results showed that PDD with ADHD exists in a large number of adults with PDD in Japan. This suggests that it may be necessary to attend to concomitant ADHD symptoms in the medical care of adults with PDD.

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