

# Screening for attention deficit and hyperactivity disorder, autism spectrum disorder, and developmental delay in Taiwanese aboriginal preschool children

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**Objectives:** This study aimed to estimate the percentages of attention deficit and hyperactivity disorder (ADHD) and autism spectrum disorder (ASD) in Taiwanese aboriginal preschool children. Child development level was compared between the two groups.

**Methods:** Teachers completed screening questionnaires for ADHD, ASD, and development level for 36- to 72-month-old children in kindergartens in Taiwan. The questionnaire results were compared between the aboriginal and nonaboriginal children. One child psychiatrist then interviewed the aboriginal preschool children to determine if they had ADHD and/or ASD.

**Results:** We collected 93 questionnaires from the aboriginal group and 60 from the nonaboriginal group. In the aboriginal group, 5.37% of the children were identified to have ADHD, while 1.08% were identified to have ASD. Significantly fewer aboriginal children had developmental delays for situation comprehension and personal-social development ( $P=0.012$  and  $0.002$ , respectively) than nonaboriginal children.

**Conclusion:** Aboriginal children in Taiwan had typical percentages of ADHD and ASD compared to those published in the literature. Aboriginal children showed relative strengths in situation comprehension and personal-social skills. Further studies are required to understand the learning styles of the aboriginal children and to develop effective screening and intervention strategies for ADHD and ASD.

**Keywords:** attention deficit and hyperactivity disorder, autism spectrum disorder, aboriginal children, child development, developmental delay

## Introduction

Few studies have been published regarding attention deficit and hyperactivity disorder (ADHD) and child development in aboriginal children, and none of them has discussed autism spectrum disorder (ASD) in aboriginal children. The Australian longitudinal birth cohort study of urban aboriginal infants reported that 3-year-old Australian aboriginal children performed better in locomotor and personal-social domains and had weakness in language, fine motor, and performance skills.<sup>1</sup> Jorm et al found a higher prevalence of behavioral problems in Australian aboriginal children and adolescents than in nonaboriginal children, according to data collected from parents and caregivers.<sup>2</sup> Baydala et al had indicated that ADHD characteristics, including hyperactivity, rapidly shifting attention, and impulsivity may have offered selective advantage in early hunter-gatherer society, many of whom were represented by aboriginal populations.<sup>3</sup> In their study, a high prevalence of ADHD is reported in Canadian aboriginal children,

and the authors suggested that this finding could indicate a particular aboriginal learning behavior or style, which may be misdiagnosed as ADHD.<sup>3</sup>

In Taiwan, the aboriginal population is 534,007, which accounts for 2.28% of the total population distributed among 14 tribes.<sup>4</sup> Most of the aboriginal communities are located in the central mountain areas. The Atayal tribe resides in the area we studied. The aboriginal communities in Taiwan have experienced socioeconomic changes and related difficulties due to industrialization. Most of the aboriginal adults have moved to urban cities for jobs,<sup>5</sup> whereas their elderly family members and children remain in their hometown. According to a survey conducted in the elementary schools, compared to families of nonaboriginal students, aboriginal families had higher prevalence of “grandparenting” in their families (5.04% vs 1.66%), single parenting (13.69% vs 6.37%), and low household income (9.12% vs 1.92%).<sup>6</sup>

The etiology of ADHD involves genetic factors and environmental disadvantages,<sup>7</sup> whereas genetic factors predominate in the etiology of ASD.<sup>8</sup> The most recent studies have shown overlapping features between ADHD and ASD, and have provided new understanding of the combined phenotype (ADHD + ASD).<sup>9,10</sup> Although developmental delay is reportedly associated with several biological and environmental risk factors,<sup>11</sup> the environmental risk factors appear to occur more frequently among aboriginal families than nonaboriginal families in Taiwan.<sup>6,12,13</sup> Yen et al revealed more severe psychopathology in Taiwanese aboriginal adolescents than nonaboriginal adolescents.<sup>14</sup> Adverse environmental factors, including, but not limited to, low socioeconomic status and family disruption, have been reported to make an important contribution to aboriginal adolescents mental health.<sup>14</sup> Thus, the aim of this study was to screen ADHD and ASD in Taiwanese aboriginal preschool children and to determine if differences existed in childhood development between the aboriginal and nonaboriginal groups with different genetic constitutions and environmental backgrounds.

## Methods

### Participants

The Atayal tribal leader was consulted before conducting the study regarding Atayal tribal culture and the study design and methods. The study was approved by the Institutional Review Board of Chang Gung Memorial Hospital. Aboriginal children from four kindergartens in the mountain areas of northern Taiwan with Atayal communities and nonaboriginal children from a kindergarten in a nonaboriginal community in the city were enrolled in the study.

## Data collection and measurements

A two-stage survey was conducted. First, we collected data about preschool age (36–72 months) aboriginal children with the written informed consent of their parents. We invited their teachers to complete the screening questionnaires for ADHD and ASD. A total of 93 questionnaires were collected. Second, we informed the teachers about the results of the questionnaires and arranged diagnostic interviews with a child psychiatrist after the initial screening of the children. The child psychiatrist had 15 years of clinical experience working with children with ADHD and/or ASD. Nineteen children screened positive for developmental disorders or developmental delay. In the nonaboriginal group, we collected the same data from preschool children in one kindergarten in a nonaboriginal community. We also invited their teachers to complete the same questionnaire used for the aboriginal community. Sixty questionnaires were completed and all were valid.

## Questionnaires

We used questionnaires to screen the children for developmental disorders or developmental delays. The questionnaires were completed by the teachers under the supervision of the child psychiatrist. The questionnaires covered several developmental variables, including inattention and hyperactivity/impulsivity symptoms, autistic symptoms, and developmental level.

## Inattention and hyperactivity/impulsivity symptoms

We used the Chinese version of the Swanson, Nolan, and Pelham, Rating Scale-IV (SNAP-IV) to evaluate inattention and hyperactivity/impulsivity symptoms. This questionnaire consisted of 26 questions. It was filled out according to the severity of the symptoms. A score of 0 was for “not at all”; 1 for “just a little”; 2 for “quite a bit”; and 3 for “very much”. Additionally, the first 18 questions include two subsets of symptoms: nine for inattention symptoms (questions 1–9) and nine for hyperactivity/impulsivity symptoms (questions 10–18). Both were consistent with the core symptoms of the *Diagnostic and Statistical Manual of Mental Disorders*, 4th Edition (DSM-IV) for ADHD.<sup>15</sup> The Chinese version of SNAP-IV used in this study had been verified as a reliable and valid instrument for rating ADHD symptoms.<sup>16</sup> A score of 2 or 3 meant the presence of the symptom. The DSM-IV defined children with at least six inattention symptoms as having significant inattention problems, and children with at least six

hyperactivity/impulsivity symptoms as having significant hyperactivity/impulsivity problems.

## Autistic symptoms

The Chinese version of the Clancy Behavior Scale is the most commonly used valid clinical screening tool for ASD in Taiwan.<sup>17,18</sup> Its 14 questions are completed by teachers or parents according to the frequency of the behaviors. A score of 0 is applied for “not at all”, 1 for “occasionally”, and 2 for “frequently”. The cutoff point for the total score is 14/15.

## Developmental level

The Chinese Children Developmental Inventory (CCDI), a 320-item questionnaire, is used to evaluate the developmental level of children aged 36–72 months. It is the most commonly used clinical screening tool in Taiwan. The validity and reliability of the CCDI are >0.83 and 0.88, respectively.<sup>19</sup> It contains eight developmental domains, including gross motor, fine motor, expressive language, concept comprehension, situation comprehension, self-help, and personal–social and general development. The developmental quotient is defined as the developmental age divided by the chronological age multiplied by 100. Developmental delay is defined as a developmental quotient <70.

## Diagnostic interview

After the initial screening, questionnaires were completed and analyzed, and a child psychiatrist interviewed the children with positive screening results. The child psychiatrist interviewed each aboriginal child for 30 minutes to identify ADHD and/or ASD or neither, according to the DSM-IV Text Revision criteria.<sup>20</sup>

## Statistical analysis

SPSS, version 18.0 (SPSS Inc., Chicago, IL, USA) was used for all analyses in this study. We used the chi-square test and Student's *t*-test to analyze the demographic data. Moreover, the chi-square test was used to analyze differences in ADHD symptoms in the SNAP-IV and the rates of significant developmental delay identified in the CCDI. The statistical significance was set at  $P=0.05$ .

## Results

We collected 153 questionnaires (93 from the aboriginal group and 60 from the control nonaboriginal group).

Among the 93 aboriginal children, 56 were boys (60.2%), 37 were girls (39.8%), and their mean age was

53.5±8.6 months (range, 36–72 months) (Table 1). Among the 60 nonaboriginal children, 38 were boys (63.3%), 22 were girls (36.7%), and their mean age was 55.3±5.7 months (range, 40–68 months). No significant difference in sex composition ( $\chi^2=0.150$ ,  $P=0.699$ ) or age ( $t=-1.508$ ,  $P=0.134$ ) was observed between the two groups. The child psychiatrist identified ADHD and ASD only by in the aboriginal group.

Table 2 shows the numbers of aboriginal and nonaboriginal children with ADHD symptoms and autistic behaviors identified in the SNAP-IV and Clancy Behavior Scale, respectively. The questionnaire results indicated no significant differences between the aboriginal and nonaboriginal children.

Table 3 provides a comparison of development delays according to CCDI domain between aboriginal and nonaboriginal children. No significant difference was observed between the two groups for delays in gross motor, fine motor, expressive language, concept comprehension, self-help, or general development. However, significantly fewer aboriginal children had delays in situation comprehension ( $\chi^2=6.366$ ,  $P=0.012$ ) and personal–social development ( $\chi^2=9.599$ ,  $P=0.002$ ).

After the interviews, five children (5.37%) were identified with ADHD, four of them had the hyperactive/impulsive type while one had the combined type. One (1.08%) child was identified with ASD. All children with ADHD or ASD were boys (Table 1). The percentage of boys with ADHD was 8.93% and with ASD was 1.79%. However, the percentage of girls with ADHD and/or ASD was zero.

**Table 1** Comparison of demographic data in aboriginal and nonaboriginal (control) children

Demographic data and diagnoses	Aboriginal (n=93)	Nonaboriginal (n=60)	Chi-square	P-value
Sex (%)			0.150	0.699
Male	56 (60.2%)	38 (63.3%)	–	–
Female	37 (39.8%)	22 (36.7%)	–	–
Mean age ± SD (months)	53.5±8.6	55.3±5.7	$t=-1.508$	0.134
ADHD <sup>a</sup> (%)				
Inattentive type	0 (0.00%)	–	–	–
Hyperactive/impulsive type	4 (4.30%)	–	–	–
Combined type	1 (1.08%)	–	–	–
ASD <sup>b</sup> (%)	1 (1.08%)	–	–	–

**Notes:** <sup>a</sup>ADHD was identified by a child psychiatrist according to DSM-IV-TR. <sup>b</sup>ASD was identified by a child psychiatrist according to DSM-IV-TR.

**Abbreviations:** ADHD, attention deficit and hyperactivity disorder; ASD, autism spectrum disorder; DSM-IV-TR, *Diagnostic and Statistical Manual of Mental Disorders*, 4th Edition, Text Revision; SD, standard deviation.

**Table 2** Numbers of aboriginal and nonaboriginal children with ADHD and autistic symptoms identified by the SNAP-IV and Clancy Behavior Scale, respectively

Questionnaires for ADHD symptoms and autistic symptoms	Aboriginal (n=93) (%)	Nonaboriginal (n=60) (%)	Chi-square	P-value
<b>SNAP-IV</b>				
Inattention symptoms <sup>a</sup>				
Question 1	9 (9.68)	6 (10.00)	0.004	0.948
Question 2	7 (7.53)	6 (10.00)	0.287	0.592
Question 3	5 (5.37)	6 (10.00)	1.168	0.280
Question 4	2 (2.15)	3 (5.00)	0.937	0.333
Question 5	1 (1.08)	4 (6.67)	3.607	0.058
Question 6	3 (3.23)	4 (6.67)	0.989	0.320
Question 7	5 (5.37)	3 (5.00)	0.010	0.919
Question 8	19 (20.4)	9 (15.00)	0.719	0.396
Question 9	6 (6.45)	7 (11.67)	1.276	0.259
Inattention problems <sup>b</sup>	1 (1.08)	4 (6.67)	3.607	0.058
Hyperactivity/impulsivity symptoms <sup>c</sup>				
Question 10	17 (18.3)	6 (10.00)	1.957	0.162
Question 11	11 (11.8)	5 (8.33)	0.476	0.490
Question 12	11 (11.8)	4 (6.67)	1.099	0.295
Question 13	6 (6.45)	4 (6.67)	0.003	0.958
Question 14	10 (10.8)	4 (6.67)	0.732	0.392
Question 15	14 (15.1)	8 (13.33)	0.088	0.767
Question 16	8 (8.60)	4 (6.67)	0.189	0.664
Question 17	6 (6.45)	3 (5.00)	0.139	0.709
Question 18	9 (9.68)	5 (8.33)	0.079	0.778
Hyperactivity/impulsivity problems <sup>d</sup>	5 (5.37)	5 (8.33)	0.522	0.470
Clancy Behavior Scale <sup>e</sup>	0 (0)	0 (0)	–	–

**Notes:** <sup>a</sup>A score of 2 and 3 means the presence of the inattention symptom. <sup>b</sup>DSM-IV defined a child with at least six inattention symptoms as having significant inattention problems. <sup>c</sup>A score of 2 or 3 indicates the presence of hyperactivity/impulsivity symptoms. <sup>d</sup>DSM-IV defined a child with at least six hyperactivity/impulsivity symptoms as having significant hyperactivity/impulsivity problems. <sup>e</sup>A score > 14 indicates the presence of overt autistic symptoms. Question 1: Fails to give close attention to details or makes careless mistakes in schoolwork or tasks. Question 2: Has difficulty sustaining attention in tasks or play activities. Question 3: Does not seem to listen when spoken to directly. Question 4: Does not follow through on instructions and fails to finish schoolwork, chores, or duties. Question 5: Has difficulty organizing tasks and activities. Question 6: Avoids, dislikes, or reluctantly engages in tasks requiring sustained mental effort. Question 7: Loses things necessary for activities. Question 8: Is distracted by extraneous stimuli. Question 9: Is forgetful in daily activities. Question 10: Fidgets with hands or feet or squirms in seat. Question 11: Leaves seat in situations or in other situations in which remaining seated is expected. Question 12: Runs about or climbs excessively in situations in which it is inappropriate. Question 13: Has difficulty playing or engaging in leisure activities quietly. Question 14: Is "on the go," or often acts as if "driven by a motor." Question 15: Talks excessively. Question 16: Blurts out answers before questions have been completed. Question 17: Has difficulty waiting a turn. Question 18: Interrupts or intrudes on others.

**Abbreviations:** DSM-IV, *Diagnostic and Statistical Manual of Mental Disorders*, 4th edition; SNAP-IV, Swanson, Nolan, and Pelham, Rating Scale-IV.

**Table 3** Comparison of development delays by CCDI domain in aboriginal and nonaboriginal control children

Questionnaire for developmental level	Aboriginal (n=93) (%)	Nonaboriginal (n=60) (%)	Chi-square	P-value*
CCDI domains				
GMDQ	15 (16.1)	9 (15.0)	0.035	0.851
FMDQ	0 (0.00)	0 (0.00)	–	–
ELDQ	1 (1.10)	4 (6.67)	3.607	0.058
CCDQ	0 (0.00)	0 (0.00)	–	–
SCDQ	0 (0.00)	4 (6.67)	6.366	0.012*
SHDQ	2 (2.20)	5 (8.33)	3.193	0.074
PSDQ	4 (4.30)	12 (20.0)	9.599	0.002*
General DQ	0 (0.00)	0 (0.00)	–	–

**Note:** \*P<0.05 is significant.

**Abbreviations:** CCDI, Chinese children developmental inventory; CCDQ, concept comprehension development quotient; DQ, development quotient; ELDQ, expressive language development quotient; FMDQ, fine motor development quotient; GMDQ, gross motor development quotient; PSDQ, personal-social development quotient; SCDQ, situation comprehension development quotient; SHDQ, self-help development quotient.

## Discussion

ADHD and ASD are significant developmental disabilities that impair function, learning, and family relationships. The diagnosis of these disorders is stable over time.<sup>21,22</sup> Of the preschool children with ADHD, 89% will meet ADHD symptom and impairment diagnostic criteria by the time they are 6 years old.<sup>22</sup> In our study, the percentage of ADHD in aboriginal preschool children was 5.37%, which is nearly the same as the worldwide prevalence of ADHD (5.29%) in school-age children<sup>23</sup> but lower than that previously reported in Taiwan (7.5%) by Gau et al.<sup>24</sup> Additionally, our finding was inconsistent with the conclusion of Baydala et al, which indicated that the percentage of ADHD in aboriginal children was higher than the general population due to evolutionary advantage in early aboriginal society.<sup>3</sup> Different genetic constitutions may help to explain this discrepancy.



From the findings of aboriginal genetic studies, the ancestors of Canadian aborigines were traced to a population of people migrating across the Bering Strait (Beringia) to North America.<sup>25</sup> The genetic constitution of Taiwan aborigines was traced to Austronesian people, especially close to the Maori people of New Zealand.<sup>26</sup>

Previous studies have estimated the prevalence of ASDs to range from 0.7/10,000 to 72.6/10,000 people.<sup>27</sup> Several studies have shown the prevalence of ASDs as 0.9% in South Korea<sup>28,29</sup> and 1.7% in the UK.<sup>30</sup> Moreover, one meta-analysis collected past studies from People's Republic of China, Hong Kong, and Taiwan and estimated the pooled prevalence of ASDs as 26.6/10,000.<sup>31</sup> Nonetheless, we did not find any studies of ASD conducted in aboriginal populations in Taiwan. The percentage of ASD (1.08%) of aboriginal children in our study was close to those reported in South Korea<sup>28,29</sup> and the UK.<sup>30</sup> According to our experience, children with ASD need intense behavior therapy, but we found that the resources needed for special education were lacking in the aboriginal community. We have reported the existence of ASD in aboriginal children; therefore, it is necessary to support the development of special education related to the disorder in the aboriginal community.

Although existing data showed significant socioeconomic disadvantage in the aboriginal population in Taiwan,<sup>6</sup> we did not find poorer child development in aboriginal preschool children. McDonald et al analyzed data from the Gudaga study, in which the Griffiths Mental Development Scales, Extended Revised, and the Peabody Picture Vocabulary Test, Fourth Edition were used to evaluate the development of children.<sup>1</sup> Consistent with their findings, we also found aboriginal children had better personal-social development.<sup>1</sup> We propose that genetic and cultural differences may help to explain this finding. The daily schedule for aboriginal kindergarten children emphasized more team work, interpersonal interaction, and play, while the nonaboriginal kindergarten tended to focus on knowledge learning and sedentary activities such as learning English, science, reading books, and playing chess. Aboriginal children were given more time for outdoor activities and less time for watching television or playing computer games.

## Limitations

This study had some limitations. First, the sample size was small. Second, teachers may be biased because they observed only aboriginal students or only nonaboriginal students. Finally, we did not conduct diagnostic interviews in the control group, so we can only compare the percentages of ADHD and ASD in the aboriginal group with those published in the literature.

Despite these limitations, this is the first study to compare the development of aboriginal children with those of non-aboriginal children and identify ASD in aboriginal children. Moreover, the identification of ADHD and ASD was not only made according to the screening questionnaires but was also confirmed by the child psychiatrist.

## Conclusion

Aboriginal preschool children in Taiwan showed the typical percentages of ADHD and ASD and better social ability. Further studies are needed to characterize the learning styles of aboriginal children in order to help to develop effective screening and intervention strategies.

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## Disclosure

The authors disclose no conflict of interest.

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