

# Attention-Deficit Hyperactivity in Elementary School Children in Ulaanbaatar: Incidence, Subtypes and Influencing Factors

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**Objectives:** This study aimed to determine the incidence of Attention-Deficit/Hyperactivity Disorder (ADHD) among primary school children in Ulaanbaatar and identify some of the influencing factors and specific clinical features. **Methods:** A total of 973 primary school children between 6 – 13 years of age in grades 2-5, along with 973 parents/caretakers, and 91 class teachers were recruited from secondary schools of Ulaanbaatar, Mongolia. **Results:** ADHD prevalence for the 973 participants was 16.6% based on teacher's reports and 9.7% based on parent's reports. Using the criteria that both the teacher and parent/caretaker both reported ADHD for a child, 50 children were diagnosed with ADHD, and the estimated prevalence was 5.8% in Ulaanbaatar. Among the 50 children with ADHD, 78% were boys, 22% were girls, with ADHD being four times more common in boys than girls ( $p = .0001$ ). The constituent ratios of ADHD-Inattentive, ADHD-Hyperactive/impulsive, and ADHD-Combined subtypes were 4.07%, 3.3%, and 1.5%, respectively. The risks were 7.5 times higher when the mother smoked during pregnancy and 2.9 times higher when the child lived with a grandparent than with both parents ( $p < .05$ ). **Conclusion:** Our findings suggest that the incidence of ADHD among children in Ulaanbaatar is consistent with previous studies conducted in other countries and regions.

**Keywords:** Attention-Deficit/Hyperactivity Disorder, Smoking, Interview, Attention, Risk Factors, Mongolia.

## Introduction

Attention-deficit/hyperactivity disorder (ADHD) is a disorder that occurs during childhood development, which presents with signs of reduced attention and hyperactivity<sup>1</sup>. Although the cause of ADHD is unknown, there have been numerous studies on the influencing factors. In a meta-analysis of 179 studies worldwide,

the prevalence of ADHD was 31% in Europe, 25% in Asia, 26% in America and 19% in other continents. Most of these studies were school-based (74%), with only 10% being population-based<sup>2</sup>. According to the studies between 2001 – 2010, the incidence of ADHD was estimated to increase in America, while remaining relatively stable in Asia, but increased 5% in Europe<sup>3,4</sup>. Using electronic search engines to identify studies done between

2000 – 2013, a meta-analysis of 739 studies estimated the prevalence to be variable, from 0.04% - 24.5%<sup>5</sup>.

In America, the prevalence of ADHD in boys increased by 9.9% between 1998-2000 and by 12.3 % between 2007 – 2009, while it increased by 3.6 – 5.5% for girls<sup>6</sup>. The prevalence of ADHD among school children in the United States was reported to be 11% or 6.4 million<sup>7</sup>. Three hundred forty-five ADHD studies conducted in Spain between 1980 – 2011 showed an average prevalence of 6.8% (95% CI 4.9 – 8.8) indicating that the rate increased year by year<sup>8</sup>. Asia and Iran had a prevalence of 7.2% (99/1381), comprising 10.3% (75/727) of boys and 3.7% (24/654) of girls<sup>9</sup>. In the meta-analysis of 2638 studies from 1983 – 2015 the prevalence rate was reported to be 6.26% (5.36 – 7.22) in China, 5.37% in Taiwan, 8.5% in Korea, with it being 2.4 times more common in boys girls. In terms of clinical subtypes, 3.1% were inattentive (ADHD-I), 0.7% were hyperactive/impulsive (ADHD-H), and 4.7% were combined (ADHD-C)<sup>10-12</sup>.

From clinical studies in the United States from 2011 - 2013, the prevalence of ADHD increased with age, from 2.7% in children 4 - 5 years of age, 9.5% in children ages 6 – 11 to 11.8% in children 12 –17 of age<sup>13</sup>. In the United States, Parents were asked how old their child was "when you were first told by a doctor or other health care provider that he/she had ADHD?" The median age at ADHD diagnosis was seven years, and about one in three children (30.7%) was diagnosed before age 6. Approximately three out of four children (76.1%) were diagnosed with ADHD before age<sup>9,14</sup>.

Using a primary-school based questionnaire of parents to detect ADHD among 6589 children, Thiago de Oliveira et al. in 2013 years identified 367 children ages 6 – 13 with ADHD<sup>15</sup>. They collected data from boys with clinically diagnosed ADHD and of a group of boys of the same age, without psychiatric symptoms and coming from a community-based sample. Most of the children of the participants lived with both parents (56.8%), while 25% lived with one parent, 17.4% lived with step-parents, and 0.8% live with other relatives. The mothers of 67.7% of participants were uneducated, and 5.2% came from lower-income families. According to the findings of the survey, the risks of childhood ADHD was 2.6 times (95% CI 1.43 - 4.88,  $p < .005$ ) higher in children with uneducated mothers, 2.03 (1.13—3.65,  $p = .006$ ) times more likely where there was maternal alcohol consumption, 4.54 (2.16 – 9.57,  $p < .001$ ) times more common

in pregnancies with stress, 3.63 (1.95 – 6.73,  $p < .001$ ) times more common in homes where there was domestic abuse, and 2.56 (1.21 - 5.43,  $p < .005$ ) times more likely where the family lived in poverty<sup>15</sup>. In a hospital-based case-control study with 100 participants done in Africa, the reported risks for childhood ADHD were preterm birth - 2.84 (0.92 - 8.79), labor complications – 8.77 (1.50 – 51.35), breastfeeding for less than 3 months – 6.65 (1.77 – 24.96), well-educated parents – 16.32 (3.69 – 72.20), parental mental illness - 40.13 (3.92 – 410.34)<sup>16</sup>. A study comparing 132 boys with ADHD to 146 healthy boys reported the perinatal major risk factors for developing ADHD were low Apgar scores, low birth weight, and preterm birth<sup>17</sup>.

Many studies have shown that parental smoking during pregnancy increases the risk of ADHD. In a regression analysis on the relationship between ADHD and parental smoking in 8324 children born between 1991 – 2000, the risk was nearly doubled (OR 1.68, 95% CI 1.11 – 2.53)<sup>18</sup>. A study of the socio-economic status revealed that ADHD risk was 1.7 (0.55 – 2.46) times higher with maternal education, 1.11 (0.61 – 2.03) times higher when living with a single parent and 1.12 (0.44 – 2.86) times higher when living in a rented apartment<sup>19</sup>.

A meta-analysis of 40 studies of factors influencing ADHD between 2013 – 2015 identified that preterm birth (RR 2.64, 95% CI 1.7 – 3.3), low birth weight (OR/RR 1.5 – 9.6 in 19 studies), smoking during pregnancy and secondhand smoke exposure (OR 2.4 in 33 studies) and alcohol use (OR 2.8 – 11.7 in 16 studies) all increased the risk of ADHD<sup>20</sup>.

The Diagnostic and Statistical Manual for Mental Disorders (DSM) is widely used for the diagnosis of ADHD based on its diagnostic criteria and diagnostic classification. DSM-IV has ADHD divided into three subtypes: predominantly inattentive (ADHD-I), predominantly hyperactive-impulsive (ADHD-H) and the combined type (ADHD-C). A meta-analysis of the 179 studies reported that the usage of DSM-IV classification was diagnostically more sensitive<sup>2,21</sup>. The average ADHD prevalence in the United States from 1994 – 2010 was 5.9% according to a meta-analysis of 97 studies (11 adult and 86 adolescent studies) to which DSM-IV criteria were applied. It was concluded that DSM-IV was more sensitive and simpler to use than other criteria<sup>22</sup>.

While much is known about the prevalence and risk factors for ADHD in the developed world, relatively little is known about it in Mongolia. In our study in 2013, ADHD prevalence

was 5.2% among primary school children in Ulaanbaatar with a male:female ratio of 4:1, with a predominance of the combined subtype ( $p < .05$ )<sup>23</sup>. The primary purposes of this study were to provide an updated prevalence estimate of ADHD in elementary school children living in Ulaanbaatar, Mongolia using the DSM-IV classification criteria for ADHD for diagnosis and subtyping, and to determine the effects of complications during pregnancy, social and family factors, the child's age, and gender on its prevalence.

## Materials and Methods

### Study population

This study was conducted in the city of Ulaanbaatar from March 3, 2018, through December 28, 2018. A total of 973 primary school children 6 – 12 years of age belonging to grades 2 - 5, along with 973 parents/caretakers, and 91 class teachers were recruited from secondary schools in the districts of Bayangol, Bayanzurkh, Baganuur, Khan-Uul, Songinokhairkhan, Chingeltei, Nalaikh, and Sukhbaatar. A cross-sectional design was used to determine the number of ADHD cases using clinical interviews.

Parents were administered the Vanderbilt ADHD Diagnostic Parent For Rating Scale, and classroom teachers were given the Vanderbilt ADHD Diagnostic Teacher For Rating Scale both formulated by Oklahoma medical school according to the DSM-IV classification of the American Psychiatric Association to screen for ADHD<sup>24</sup>.

We used an additional questionnaire to investigate possible perinatal, family and social factors influencing ADHD such as age, gender, asphyxia, paternal smoking, family burden, living conditions, nocturnal enuresis, regular use of mobile phones by comparing 50 children diagnosed with ADHD and with 917 children who were not diagnosed with ADHD who were selected as a control group.

### Statistical analysis

The most common characteristics of ADHD reported by parents and their child's teachers were analyzed from the questionnaires from parents and teachers to detect specific clinical features.

Clinical features which were frequently repeated in both questionnaires from parents and teachers were analyzed to detect specific characteristics of children in Mongolia. After determining that the variables were normally distributed,

the chi-square test was performed to determine significant differences in the distribution of the risk factor variables after expressing their incidence as percentages in children with and without the diagnosis of ADHD. Pearson correlation coefficients were obtained between all combinations of risk factors to measure the strength of the association between independent variables and reduce the risk of multicollinearity. Multiple logistic regression was then used to identify the relationship between the risk factors of age, gender, asphyxia, paternal smoking, family burden, living conditions, nocturnal enuresis, regular use of mobile phones and risk for a child having the diagnosis of ADHD. All analyses were conducted using standard statistical software (SPSS version 22), Microsoft Excel 2000, and Endnote X6 for book citations. A p-value of  $\leq .05$  was considered statistically significant.

### Ethical statements

The study protocol was approved by the Research Ethics Committee at Mongolian National University of Medical Sciences (Reg. No. 2018/D-10). All people were informed about the study and gave written informed consent before the study participation. Children with ADHD and their parents were free to continue with their allocation in the ADHD group or control group during the study period or withdraw from the study at any time.

## Results

Out of the 973 participants, 487 (50%) were boys, and 486 (50%) were girls. They were categorized into three age groups: 6 – 8 years old ( $N = 331$ ; 34%), 9 – 10 years old ( $N = 499$ ; 51.3%), and 11 – 12 years old ( $N = 143$ ; 14.7%). The mean age was 9.1 1.2 years, with a standard deviation of 1.2 (Table 1).

We collected data from 8 districts of Ulaanbaatar Bayanzurkh 25% (243), Bayangol 23.3% (226), Baganuur 18.6% (181), Sukhbaatar 8.5% (83), Khan-Uul 8.4% (82), Chingeltei 7.3% (71), Songinokhairkhan 4.6% (45), Nalaikh 4.3% (42).

ADHD prevalence rates of these 973 participants based on teacher's reports were an estimated 17.6% ( $N = 172$ ) and were 9.7% ( $N = 95$ ) based on parents reports. Requiring the presence of positive reports for ADHD features from both parent/caretaker and teacher, 56 children were diagnosed with ADHD, and a prevalence of 5.8% was estimated in Ulaanbaatar.

**Table 1.** Demographic characteristics of the study subjects (N = 973).

Variable	Without ADHD		With ADHD		p-value	
	N	%	N	%		
Gender	Boys	444	48.4	43	76.8	.0001
	Girls	473	51.6	13	23.2	
Age	6-9 years	509	55.5	38	67.9	.04
	10-12 years	408	44.5	18	32.1	
Family structure	Parents	850	92.7	47	84	.03
	Grandparents	57	6.2	9	16.1	
Living conditions	Apartment	417	46	18	32	.01
	Our house or ger	434	47.9	31	55.4	
	Rent an adjacent room	47	5.2	6	10.7	
Family stressors	Yes	81	9	11	19.6	.008
	No	822	91	45	80.4	
Nocturnal enuresis	Yes	43	4.7	6	10.9	.04
	No	868	95.3	49	89.1	
Problems in school	Yes	132	14.4	18	32.1	.000
	No	785	85.6	38	67.9	
Problems in family	Yes	100	11.3	14	25.9	.001
	No	786	88.7	40	74.1	
Total		917	100%	56	100%	

Note: Data expressed as number (%). Abbreviations: ADHD - attention-deficit/hyperactivity disorder

Among the 56 children with ADHD, 43 were boys (76.8%), 13 were girls (23.2%), 3.5 times higher in boys than girls (OR 3.5, 95% CI 1.8 - 6.6,  $p = .0001$ ) (Table 3).

There was no significant difference in ADHD prevalence among the districts studied (Baganuur 26.8%, Khan-Uul 25%, Bayangol 21.4%, Bayanzurkh 10.7%, Chingeltei 10.7%, and Songinokhairkhan 5.4%).

Out of the 56 children diagnosed with ADHD, 44.6% (N = 25) were inattentive, 30.4% (N = 17) were hyperactive and 25% (N = 14) were combined types of ADHD. Males and female showed a comparable constituent ratio of each subtype. There 3.5 times more boys than girls boys in the inattentive types and 3 times more boys than girls in the hyperactivity and combined types ( $p < .05$ ) (Table 1). However, the prevalence rates of the three subtypes did vary with age. Specifically, the 7 - 8 years-old group had the highest prevalence of ADHD-H, the 9 - 10-year-old group had the highest prevalence in ADHD-I and lowest prevalence of ADHD-C.

The most common clinical features of hyperactivity parents and teachers reported were "often fidgets with hands or feet

or squirms in seat", "talking too much", "is often "on the go" acting as if "driven by a motor" observed in 80.3% (N = 45) children identified with ADHD. The most common clinical features of attention deficit were "often fails to give close attention to details or makes careless mistakes in schoolwork, at work, or during other activities", "is often easily distracted by extraneous stimuli", "often has difficulty sustaining attention in tasks or play activities" reported in 78.5% (N = 44).

Using parent/caretaker's and teacher's reports of some known factors that influence ADHD, the 56 children diagnosed with ADHD were compared to the 973 children without the diagnosis of ADHD who served as controls.

Figure 1 shows the distribution of teachers' grades for students with and without the diagnosis of ADHD. The frequency distribution of grades differed between groups with poorer academic performance associated with the ADHD group compared to the control group. It was unclear if poor performance is caused by ADHD or leads to ADHD. The ADHD group had twice the risk of receiving C grades compared to the control group (OR = 2, 95% CI 1.33 - 2.54,  $p < .001$ ).

**Table 3.** Multiple logistic regression of gender, perinatal, and family factors influencing attention-deficit/hyperactivity disorder.

Influencing factors	aOR	95% CI	p-value
Sex			
female	1	[1.8;6.6]	.001
male	3.5		
Asphyxia			
No	1.2	[1.6;2.9]	.581
Yes			
Maternal Smoking during Pregnancy			
No	1		
Yes	7.5	[2;62.6]	.005
Living conditions			
Others	1	[0.7;5.7]	.04
Rent an adjacent room	2.0		
Family structure			
others	1		
grandparents,	2.9	[1.3;8.8]	.007
Maternal alcohol consumption			
No	1	[0.8;3.5]	.001
Yes	1.5		
Family pressures			
No	1		
Yes	3	[1.4;8.4]	.06
Nocturnal enuresis			
No	1		
Yes	2.5	[0.5;11.7]	.23
Problems of school			
No	1		
Yes	3.5	[1.4;8.5]	.005
Regular use of mobile phones			
No	1		
Yes	3.1	[0.3;32]	.3

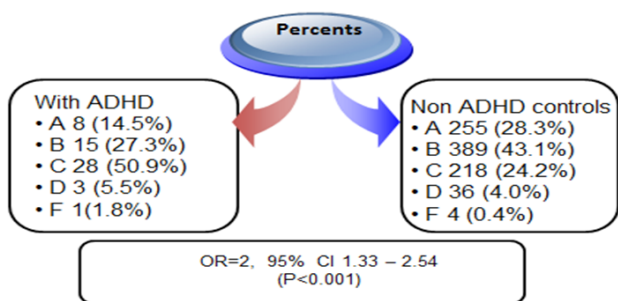
aOR- adjusted OR; CI- confidence interval, Dependent variable: Attention-Deficit/Hyperactivity Disorder.

Challenges such as poor academic performance, difficulty maintaining friendships, and lack of interest in school were identified in 32.2% (N = 18) of the ADHD group and 14% (N = 131) of the control group, which indicates that children with ADHD face are 3 times more likely to face these challenges compared to their normal peers (OR = 3.03; 95% CI 1.09–8.42, p<.05). Among the students with ADHD 57.1% (N = 12) had poor academic performance, 19% (N = 4) had difficulty

maintaining friendships, and 19% (N = 4) had a lack of interest in class.

Complications during pregnancy, social and family factors influence ADHD. If age and sex are removed from consideration, maternal smoking increases the risk of ADHD 7.5 times and asphyxia 1.2 times (Table 3).

In the investigation of family structure, 76.8% (N = 43) of children with ADHD came from dual-parent households



**Figure 1.** Academic performance

compared to 86 % (N = 787) of control children (p = .04), 7.1% (N = 4) of children with ADHD lived in a single parent household compared to and 6.9% (N = 63) of the control group (p = .023), and 16.2% (N = 9) of children with ADHD were living with a grandmother or grandfather compared to 6.2% (N = 57) of the control group (p = .03). A child living with a grandparent had 2.9 times more risk for ADHD than one living in a dual-parent household (p = .007).

In the children diagnosed with ADHD, 25% (N = 14) had one employed family member compared to 26.4% (N = 242) for children in the control group (p<.07), 58.9% (N = 33) of children with ADHD had two employed members compared 50.7% (N = 464) of controls (p = .09), and 4.1% (N = 2) of children with ADHD had caretakers who were unemployed compared to 4.4% (N = 40) of controls (p = .005).

Some risk behaviors of parents/caretakers associated with ADHD in their children were studied (Table 2). The frequency of paternal alcohol abstinence was 49% for both groups. In the ADHD group, the frequency of intermittent paternal alcohol consumption was 30.4% (N = 17) compared to 24.5% (N = 219) in the control group. The frequency of frequent paternal alcohol consumption was 10.7% (N = 6) in children diagnosed with ADHD compared to only 1.1% (N = 10) for controls (p = .003). Children from households with maternal alcohol consumption had 1.5 times more risk of ADHD than households with maternal abstinence (p = .001) (Table 2).

**Table 2.** Correlation analysis of gender, perinatal, and family factors influencing attention-deficit/hyperactivity disorder.

	Gender	Grandparents	Rent an adjacent room	Problems of school	Family burden	Father alcohol consumption	Maternal alcohol consumption	Maternal smoking during pregnancy	Alcohol use during pregnancy	Asphyxia	Nocturnal enuresis	Regular use of mobile phones
Gender	1											
Grandparents	-.048	1										
Rent an adjacent room	-.012	.044	1									
Problems of school	-.125**	.122**	-.041	1								
Family pressures	-.083**	.025	.016	.168**	1							
Father alcohol consumption	-.007	.042	-.022	-.022	.090**	1						
Maternal alcohol consumption	-.040	.059	-.006	.039	.091**	.348**	1					
Maternal Smoking during Pregnancy	-.016	.008	-.007	.031	.018	.084*	.101**	1				
Alcohol use during pregnancy	-.029	.042	.026	.025	.027	.080*	.100**	.449**	1			
Asphyxia	.011	.045	.042	.002	.001	-.004	-.007	.017	-.007	1		
Nocturnal enuresis	-.080*	.051	.007	.046	.026	.024	-.004	.034	.014	.155**	1	
Regular use of mobile phones	-.037	-.020	-.015	-.001	-.007	.060	-.027	-.037	-.036	.017	.021	1

\*\* . Correlation is significant at the 0.01 level (2-tailed); \* . Correlation is significant at the 0.05 level (2-tailed).

Children from families who are renting an adjacent room in an apartment have over twice (OR 2.07, 95% CI 0.7 - 5.7,  $p = .04$ ) the risk of being diagnosed with ADHD.

Children in the ADHD group had regular use of mobile phones 96.4% (N = 54) compared to 88.3% (N = 810) of the control group ( $p = .3$ ). Nocturnal enuresis was not significantly different, being present in 10.9% (N = 6) of the ADHD group and 4.7% (N = 43) of the control group ( $p = .23$ ) (Table 3).

## Discussion

In our study, the prevalence of ADHD was 5.8% which is similar with 7.5% in Iran, 5.37% among 7 – 11 year olds in Taiwan, 3 - 5% in other studies among children who are younger than 19 years of age, but is twice the prevalence in boys in Iraq and Korea<sup>5,9,11,12,25</sup>. This rate falls within the range of the 5.9 - 7.1% of children reported throughout the world.

Worldwide, ADHD is diagnosed approximately three times more commonly in boys than in girls. The gender ratio in our study was similar. It is reported that this gender prevalence difference may reflect either a variation in susceptibility or that females with ADHD are less likely to be diagnosed than males.

As expected, the prevalence of ADHD varied with age. Between the ages of 7 - 12 years of age, 9-year-old children had the highest prevalence rate (25%) and the lowest rates were seen in the 11-year-old (10.7%) and 12-year-old (1.7%) groups.

ADHD-I is the most common subtype followed by ADHD-C and ADHD-H in both males and females in the present study. This ordering of subtypes by frequency of occurrence is the same identified in with the meta-analysis by Willcutt<sup>17</sup>.

Our findings on the risks of ADHD, including 7.5 fold increased risk with maternal smoking are higher than those found by Thiago de Oliveira et al. (OR 1.5, 95% CI 1.03 - 3.65,  $p < .05$ )<sup>15</sup> but our 1.5 fold increase risk with maternal alcohol consumption is consistent with 1.3 fold increased reported by Willcutt et al. and Motlagh et al.<sup>22,26</sup>.

Regarding the ADHD features encountered, studies from Iran and United States reported the predominant sign was being easily distracted (74.5% and 40.9 respectively), while lack of focus and mistakes without caution predominated in our study (50%; N = 16)<sup>7,9</sup>. While hyperactivity types were predominantly described as being "always in motion" in studies from Iran (77.6%) and United States (22.7%; N = 100), our

study demonstrated predominant signs including "Talking too much", "is often "on the go" acting as if "driven by a motor", "often fidgets with hands or feet or squirms in seat" as the predominant feature (88%, N = 44).

This study had some limitations. First, the sample size was small. Second, teachers and parents made an evaluation based only on their observation, which could be biased. Some of our data were collected retrospectively, for example, information on the pregnancy and the perinatal risk factors. Finally, we did not conduct diagnostic interviews in children, so we could only compare reports from parent/caretaker and teacher.

Our future studies of ADHD will assess IQ by Wechsler Abbreviated Scale of Intelligence® Second Edition testing and will determine the effect of zinc and magnesium concentrations on ADHD using inductively coupled plasma mass spectrometry of scalp hair and compare of results of EEG of children with and without ADHD.

## Conclusion

The prevalence of ADHD among primary school children in Ulaanbaatar is 5.8%, occurring 3.5 times more in boys ( $p \leq .05$ ).

The risk of a child having ADHD were nearly eight times higher when the mother smoked during pregnancy (OR 7.5, 95% CI 2 - 62.6,  $p < .005$ ), nearly twice as high with maternal alcohol consumption (OR 1.5, 95% CI 0.8 - 3.5,  $p = .001$ ), two times higher in families renting adjacent rooms (OR = 2.069; 95% CI 0.7 - 5.7,  $p = .04$ ) and nearly three times in children who live with a grandparent than dual-parent households (OR 2.9, 95% CI 1.3 - 8.8  $p = .007$ ).

The typical clinical features of often failing to give close attention to details or making careless mistakes, of being often easily distracted, of often having difficulty sustaining attention were observed in 88% (N = 44) of children with attention deficient disorder. Other characteristic features of often fidgeting with hands or feet, or squirming in their seat, of talking too much, of being on the go, and of acting as if driven by a motor as were observed in 80% (N = 40) of the children we studied.

## Conflict of Interest

The authors have declared that they have no competing or potential conflicts of interest.

## Acknowledgment

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