

ORIGINAL ARTICLE

Prevalence and contributing factors to attention deficit hyperactivity disorder: A study of five- to fifteen-year-old children in Zhabei District, Shanghai

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attention deficit hyperactivity disorder, features, questionnaire

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Abstract**Introduction:** This work aims to understand the features among 5- to 15-year-old children with attention deficit hyperactivity disorder (ADHD) in Zhabei District in Shanghai.**Methods:** Children with ADHD were studied using general background questionnaire, ADHD symptom rating questionnaire, and cluster-stratified sampling. A total of 9,900 valid questionnaires were utilized in this study. We conducted diagnostic interviews with suspected ADHD children and their parents using the criteria of the Diagnostic and Statistical Manual of Mental Disorders (4th Edition) for ADHD.**Results:** The prevalence rate of ADHD among the children was 4.6%, of which 2.4%, 0.4%, and 1.8% had ADHD-I ADHD-HI, and ADHD-C types, respectively. The prevalence rates in boys and girls were 6.6% and 2.7% (ratio, 2.41 : 1), respectively. Significant differences in prevalence rate were found among children with different age groups and ADHD types. Children aged 7–10 years had the highest prevalence rate (6.3%). Externally, residence children had higher prevalence than local residents. Significant differences in prevalence rate were also found among children with parents having different educational and socioeconomic level.**Discussion:** The prevalence of ADHD-HI was higher than the other two types. The highest prevalence was observed in 7- to 10-year-old children. The influential factors of ADHD prevalence were age, gender, and educational level.**Introduction**

Attention deficit hyperactivity disorder (ADHD) is the most common mental and behavioral disorder for school-age children (Biederman, 2006). This disorder is manifested as age-inappropriate distractibility, reduced attention span, and overactivity across different settings (Levin *et al.*, 2007). It often has a chronic course and persists into adulthood in many individuals. In addition, it may have clinically important effects on the health-related quality of life in children, the emotional health of parents, and the activities/cohesion of families (Buitelaar, 2010). Both substan-

tial health risks and benefits may be associated with medication treatment for ADHD; hence, further study on a population of children with ADHD is needed (Mental Health in the United States, 2005).

ADHD is accompanied by cognitive disabilities and learning difficulties, with near-normal or normal intelligence. This disorder has a comparable overall effect on the quality of life compared with other mental health conditions and severe physical disorders. Increased symptom level and impairment predicts poorer quality of life (Danckaerts *et al.*, 2010). Investigations on ADHD prevalence, population distribution, and related etiology epidemiology can be

helpful for the development of health policies and prevention strategies. These developments would yield important social implications in promoting public health, particularly the mental health of children. However, the effects of race/ethnicity, sex, age, and socioeconomic status on the prevalence of ADHD remain poorly described. One reason is that difficulties in the diagnosis of ADHD have translated into difficulties in developing an adequate case definition for epidemiologic studies. The diagnosis of ADHD depends heavily on parent and teacher reports, and no laboratory tests can reliably predict ADHD. Prevalence estimates of ADHD are sensitive to who is asked what and how information is combined. Consequently, recent systematic reviews have reported ADHD prevalence estimates as wide as 2–18%. In addition, data suggest that both underdiagnosis and overdiagnosis occur frequently (Paule *et al.*, 2000; Spencer *et al.*, 2002). The diagnosis of ADHD is complicated by the frequent occurrence of comorbid conditions, such as learning disability, conduct disorder, and anxiety disorder. Symptoms of these conditions may also mimic ADHD. Nevertheless, we suggest that developing an adequate epidemiologic case definition based on the current diagnostic criteria is possible and is a prerequisite for further understanding the epidemiology of ADHD (Rowland *et al.*, 2002). ADHD may persist into adulthood and affect the academic, social, occupational, and familial performance of an individual. It may also increase the use and abuse of alcohol and psychoactive substances and the risk of having accident. The prevalence of ADHD throughout the world varies widely; hence, further knowledge about this situation would be valuable for the development of policies in the sector of education (Cornejo *et al.*, 2005). Child psychologists, educators, psychiatrists, and the affected parents and teachers have given increased attention to children with ADHD. This disorder is considered a global problem (Robison *et al.*, 1999; Biederman *et al.*, 2010). Epidemiologic studies can clarify whether the patterns of ADHD diagnosis and treatment in community settings are appropriate. Population-based epidemiologic studies may shed new insights into ADHD, and its natural history, treatment, and consequences. Moreover, more efficient methods are needed for monitoring the prevalence and understanding the public health implications of ADHD.

Family is the first and most important adjective developmental environment for children. Parents shape the cognitive coping styles and behavior of children. Parents in close contact with their children can understand their children's behavior better (Gottesman, 2003; Fernandez *et al.*, 2009). Our

research hypothesizes that using parents as the target population for the survey will facilitate early detection of children with ADHD. Consequently, specified and feasible prevention strategies can be carried out on these children. Through collecting questionnaire responses from parents, the present study investigated the conditions of 5- to 15-year-old children with ADHD. The contributing factors of ADHD were also determined. The findings of this study provide theoretical bases for the prevention and intervention of ADHD and other childhood conduct problems.

Methods

Subjects

From April to May 2009, under the one million population frame in the Zhabei District, Shanghai, China, we conducted random cluster sampling in kindergartens, primary schools, and secondary schools with 5- to 15-year-old children. A total of 12 kindergartens, 13 primary schools, and nine junior secondary schools were included in this study. A total of 15,412 students participated; the parents of each student were given questionnaires. A total of 12,954 questionnaires were collected, of which 865 were invalid (important information missed out and informed consent forms not signed), 2,189 were blank, and 9,900 were completed. The effective questionnaire rate was 64.2%. Students who were suspected to have ADHD were selected based on the questionnaire responses collected from their parents. The diagnoses were then confirmed by professional child psychiatrists through clinical interviews from December 2009 to January 2010. The questionnaire survey lasted for more than six months. Given that the participants started their new year of study, contacts with some students were lost. Students and their parents from three kindergartens, two primary schools, and one secondary school did not take part in the interviews. Kindergarten, primary school, and junior students who were in their final year and outside the target age group were excluded. Thus, 5,648 participants were included in the final analysis. This study was conducted in accordance with the Declaration of Helsinki. This study was conducted with approval from the ethics committee of Zhabei District in Shanghai. Written informed consent was obtained from all participants.

Assessment methods

The present study adopted the international common second-stage survey methodology, which combines both survey and interviews.

First, questionnaires were printed in a standardized format and then distributed to the school principals or psychology teachers. The project investigators were responsible for giving the instructions to parents on how to complete the questionnaires. The psychology teachers assisted in collecting the completed questionnaires. Finally, after identifying the potential ADHD population based on the results from the questionnaires and the teachers' reports, the students and their parents were invited to the one-on-one diagnostic interviews conducted by professional child psychiatrists in the school counseling room. The interview adopted the Diagnostic and Statistical Manual of Mental Disorders, 4th Edition (DSM-IV), using symptom, course, severity, and exclusion criteria to confirm the diagnosis of ADHD (American Psychiatric Association [APA], 1994).

Assessment tools

The general questionnaire consisted of general demographic information that includes parents' age, gender, ethnicity, educational levels, family backgrounds, parenting styles, child personal development history, and child learning abilities. The informed consent form was attached in the front of each questionnaire.

The attention deficit and hyperactivity symptom questionnaire was adopted from the DSM-IV ADHD diagnostic criteria. This questionnaire consisted of nine attention questions, nine hyperactivity questions, and one time limit question. Based on the criteria, the children were divided into attention deficit predominant (ADHD-I), hyperactivity-impulse predominant (ADHD-HI), and mixed (ADHD-C) subtypes (APA, 1994).

Questionnaire quality management

Prior to the study, the investigators were given standardized training to ensure that they carried out the study in a consistent manner. First, one student each in kindergarten, primary school, and junior secondary school were randomly selected, with 10–11 people in each year group, thus comprising 114 participants for the pilot study. Exactly 103 valid questionnaires were retrieved. The following problems were revealed in the preliminary data. Some parents refused to sign the informed consent forms. Some sections of personal information were incomplete. Many questions were left unanswered because the questionnaire included too many questions. The completion rate for the open questions was low, as parents felt that they were too

cumbersome and time-consuming to complete. As a result, the number of invalid questionnaires was high. For the formal investigation, the informed consent forms and questionnaire instructions were rectified to improve the parents' understanding and cooperation. Questions requesting the children's general information were added, whereas the open questions were deleted. To reduce the number of errors and incomplete questions, special instructions were given to parents on questions that may cause confusion. All data were collected and verified by investigators and recorded by designated assistants. Strict verifications were conducted on the collected data.

Statistical analysis

Data were analyzed using SPSS 13.0 (SPSS Inc., Chicago, IL, USA). Descriptive analyses were conducted on the demographic data of the children and their parents. Prevalence and risk factors were analyzed using binary and multinomial logistic regression.

Results

General data

Respondents' kinship with the children were as follows: father, 37.1%; mother, 58.2%; others, 3.5%; and missing data, 1.2%. Respondents' gender were as follows: male, 39.2%; female, 59.8%; and missing data, 1.0%. Gender of the targeted children and adolescents were male, 49.3%; female, 50.1%; and missing data, 0.6%. Respondents' age was 25–80, with a mean (39 ± 7) years old. Birthplace of the targeted youths were as follows: local, 69.1%; out of Shanghai, 29.9%; overseas, 0.3%; and missing data, 0.7%.

Educational levels of the fathers were junior secondary school and below, 25.7%; senior secondary school or junior vocational school, 44.8%; and senior vocational school or above, 29.5%. Educational levels of the mothers were junior secondary school or below, 34.3%; senior secondary school or junior vocational school, 39.6%; and senior vocational or above, 26.1%.

Total prevalence of ADHD

Students and their parents from three kindergartens, two primary schools, and one secondary school were absent from the interviews. Kindergarten, primary school, and junior students who were in their final year and outside the target age group were excluded. Thus, 5,648 participants were included in the final

analysis. The total prevalence of ADHD was 4.6% (261/5648), of which 2.4% (136/5648), 0.4% (33/5648), and 1.8% (101/5648) had ADHD-I, ADHD-HI, and ADHD-C types, respectively. The prevalence rate was in the order of ADHD-I > ADHD-C > ADHD-HI. Significant differences in prevalence rate were found among the children having the three subtypes of ADHD ($\chi^2 = 48.616$, $P < 0.001$).

Data on gender were missing in 33 questionnaires. The prevalence rate in boys was 6.6%, of which 3.3%, 0.6%, and 2.7% had ADHD-I, ADHD-HI, and ADHD-C types, respectively. The prevalence rate in girls was 2.7% (77/2828), of which 1.5%, 0.3%, and 0.9% had ADHD-I, ADHD-HI, and ADHD-C types, respectively. No significant differences were observed among the subtypes in boys and girls ($\chi^2 = 1.148$, $P > 0.05$). The boy-to-girl prevalence ratio was 2.41 : 1. Significant differences in prevalence rate were observed between boys and girls ($\chi^2 = 47.660$, $P < 0.001$).

Prevalence of ADHD in various age groups of children

The participants were divided into 5- to 6-year-old group (kindergarten), 7- to 10-year-old group (primary school), and 11- to 15-year old age group (junior secondary school). The prevalence rates of the 5–6, 7–10, and 11–15 age groups were 5.2% (29/559), 6.3% (177/2801), and 2.4% (55/2288), respectively. Significant differences in prevalence rates were found among the children from different age groups ($\chi^2 = 53.294$, $P < 0.001$, Table 1).

In the ADHD-HI and ADHD-C subtypes, the 5–6 age group had the highest prevalence rate. In the ADHD-I subtype, the 7–10 age group had the highest prevalence rate.

Different nationalities of children with ADHD

A total of 5,591 questionnaires had complete nationality information. City residence children had a prevalence rate of 4.3% (166/3904), whereas foreign children had a prevalence rate of 5.4% (91/1687). Significant differences in prevalence rate were found between the city and foreign children ($\chi^2 = 6.504$, $P < 0.05$). The city and foreign children of various types of differences in prevalence gave no statistical significance. ($\chi^2 = 7.173$, $P > 0.05$).

Different parental educational levels of children with ADHD

A total of 5,480 and 5,453 questionnaires had complete information on the educational level of the father and mother of the children with ADHD, respectively. Significant differences in prevalence rate were found among the children with parents having different educational levels ($P < 0.001$). Children whose father or mother had an educational level under junior secondary school had the highest prevalence rate of ADHD, whereas those whose father or mother had an educational level of secondary school, secondary school, junior college, or above had the least prevalence rate (Table 2).

Different domestic economic levels of children with ADHD

Significant differences in prevalence rate were found among the children with different levels of income per capita ($\chi^2 = 10.926$, $P < 0.05$). The highest prevalence rate (6.2%) was found in the ADHD children with a family per capita monthly income of less than 1,000 yuan. The prevalence rates of the ADHD children with

Table 1. Various age groups of children of various types ADHD prevalence *n*/%

Age	Number	ADHD-I (<i>n</i> = 136)	ADHD-HI (<i>n</i> = 24)	ADHD-C (<i>n</i> = 101)	χ^2 value	<i>P</i> -value
5–6 years	559	9 (1.6)	4/0.7	16 (2.9)	53.294	<i>P</i> <0.001
7–10 years	2,801	90 (3.2)	18/0.6	69 (2.5)		
11–15 years	2,288	37 (1.6)	2/0.1	16 (0.7)		

ADHD, attention deficit hyperactivity disorder.

Table 2. Different parent education level of children ADHD prevalence *n* (%)

Education level	Father (<i>n</i>)	The prevalence of	χ^2 value	<i>P</i> -value	Mother (<i>n</i>)	The prevalence of	χ^2 value	<i>P</i> -value
Junior secondary school and below	1,411	101 (7.2)	30.521*	<0.001	1,873	130 (6.9)	34.806*	<0.001
Secondary school/secondary school	2,456	104 (4.2)			2,156	84 (3.9)		
College degree or above	1,613	49 (3.0)			1,424	41 (2.9)		

ADHD, attention deficit hyperactivity disorder.

family per capita monthly incomes of 1,000–3,000 yuan and 3,000–5,000 yuan were 5.5% and 3.8%, respectively. The lowest prevalence rate (3.7%) was found in the ADHD children with a family per capita monthly income of greater than 5,000 yuan.

Factors that impact the prevalence of ADHD

To explore the risk factors that affect ADHD prevalence, this study performed single-factor analysis. ADHD diagnosis was used as the dependent variable, whereas children's age, sex, mother pregnancy reaction, caesarean section, term production, at birth, health status, ADHD family history, household, family structure, family economic level, and parental educational level were used as independent variables.

Gender, caesarean, full production, at birth, health status, family structure, and ADHD family history individually were subjected to single-factor analysis (some of which were due to missing data). Gender showed a significant effect on prevalence rate ($\chi^2 = 47.660$, $P < 0.001$); the remaining factors did not ($P > 0.05$, Table 3). The following factors were used for χ^2 examination to diagnose ADHD: children's age, mother's pregnancy reaction, household, household income per capita, and parental educational level. The results are as follows: children's age, $\chi^2 = 44.252$, $P < 0.001$; mother's pregnancy reaction, $\chi^2 = 1.027$, $P = 0.598$; household situation, $\chi^2 = 6.504$, $P = 0.032$; family's economic level (per month), $\chi^2 = 10.926$, $P = 0.012$; father's cultural level $\chi^2 = 30.521$, $P < 0.001$; and mother's educational level $\chi^2 = 34.806$, $P < 0.001$.

Final single-factor analysis showed that children's age, gender, household, family and economic level, and parental educational levels are influential factors of ADHD ($P < 0.05$).

Logistic regression analysis of ADHD prevalence factors

Using single factors with statistical significance, children's age, gender, household, household income per capita, and parental educational level were used as independent variables, and ADHD diagnosis was used as the dependent variable. After conducting multiple-factor logistic regression analysis, household situation, household income per capita, and father's educational level were rejected. Children's age, sex, and low educational level of mothers (junior secondary school and below) showed significant effects on prevalence rate ($P < 0.05$, Table 4).

Discussion

Many countries already had many large-scale investigation reports. However, the prevalence of ADHD varies greatly among individual countries and regions. The difference is considerable even in different regions of the same country. The present study selected 5- to 15-year-old children through cluster sampling and interviewed them using the DSM-IV diagnostic criteria. The total ADHD prevalence was 4.6%, which was greater than the 4.25% found in Guilin (2003) but

Table 3. ADHD prevalence II classification variables single-factor analysis

Factors	Consultation broken (n)	No diagnosis (n)	χ^2 value	P-value	Odds ratio value	95% confidence interval
Child sex						
Male	184	2,603	47.660	<0.001	2.425	1.868–3.147
Female	77	2,751				
Caesarean						
Yes	88	1,919	0.039	0.844	0.974	0.751–1.264
No	141	2,992				
Full production						
Yes	216	4,525	2.858	0.091	1.424	0.947–2.142
No	24	346				
Health status at birth						
Good	243	5,034	0.309	0.578	1.277	0.541–3.016
Asphyxia	5	80				
Family structure						
Single-parent families	12	216	0.222	0.637	0.873	0.497–1.534
Non-single-parent families	249	5,171				
ADHD family history						
Yes	4	76	0.026	0.871	0.923	0.353–2.417
No	257	5,311				

ADHD, attention deficit hyperactivity disorder.

Table 4. ADHD prevalence many factors logistic gradually regression analysis

Factors	Coefficient estimates	Standard error	Wald value	P-value	OR value	95% confidence interval
Children's ages	-0.011	0.002	19.171	<0.001	0.989	0.985–0.994
Child sex	-0.796	0.159	25.021	<0.001	0.451	0.330–0.616
Mother culture level (for junior secondary school and below)	0.784	0.198	15.688	<0.001	2.189	1.486–3.227

ADHD, attention deficit hyperactivity disorder.

lower than the rates in Spain (1995), Netherlands (2000), and Hunan Province (1993) (Cardo and Servera-Barcelo, 2005; Skounti *et al.*, 2007). The reasons for the difference in the reported prevalence may be as follows. First, no objective test to diagnose ADHD is available to date. Providing an objective diagnosis is difficult because of the subjective definitions of ADHD and the lack of biological markers. Second, the diagnostic criteria that were used varied in different studies. Clinical diagnoses were largely influenced by subjective factors. Third, different investigation times, area sample sizes, features, symptoms of domain values, information sources, and data collection methods were used. Fourth, the parents and teachers have different levels of ADHD awareness and education. Thus, they have different levels of understanding and tolerance to children with ADHD, and cannot provide a true reflection of the children's conditions. This survey adopted the internationally recognized DSM-IV diagnostic criteria using two-stage investigation methods. The first phase was screening, and the second phase was the clinical diagnostic and quality control. Therefore, a more objective and realistic response from the participants was obtained.

The prevalence rates in boys and girls in this study were 6.5% and 2.7% (ratio, 2.41 : 1), respectively. This result is consistent with that of a recent research that also adopted the DSM-IV diagnostic criteria for findings (Biederman *et al.*, 2002). The main reasons that caused the differences are as follows. First, boys show mainly expressive behaviors, such as physical attacks and violation of rules and social norms. By contrast, girls show more repressive behaviors that are less noticeable. Second, scholars from other countries believe that social and cultural factors cause the higher prevalence in boys than girls. In addition, the society possibly exerts different requirements, standards, and expectations to boys and girls. For example, families tend to have higher expectations for boys, causing them to exhibit greater psychological and behavioral problems than girls. Compared with boys, girls are more likely to be inattentive without being hyperactive or impulsive. Hence, the symptoms may not be diagnosed until secondary school or when the aca-

demical work becomes more demanding (Faraone *et al.*, 2000). For many years, girls with ADHD have been ignored and overshadowed by hyperkinetic and impulsive boys, but they are now attracting interest in an effort to understand the similarities and differences in the prevalence, symptoms, familial risk, comorbidities, and treatment of ADHD in the two sexes (Staller and Faraone, 2006).

McBumett *et al.* (1999) argued that hyperactivity can be observed at a younger age. By contrast, inattention may not be noticed by parents until their children have entered schools, during which their children experience higher academic pressures and greater demands on their attention abilities. Some scholars also observed that as age increases, symptoms of attention deficits remain relatively stable and hyperactivity symptoms are gradually reduced (Widiger *et al.*, 1997). Regarding the age of onset, past research in China indicated that the age of onset for ADHD peaked between 8 and 9 years old. Findings of the present study revealed that the 7–10 age group had the highest prevalence rate (6.3%). The prevalence rate of ADHD-HI was the highest in preschool children but decreased as the children's age increased. The prevalence rates of ADHD-I and ADHD-C reached their peaks in school children aged between 6 and 11 years old. In this age group, children lack self-control. These children have difficulty with constraint and control, weaker active attention, and higher passive attention. Children in this age have defective perception and memory capacity, which are likely to cause learning difficulties and decrease academic performance. Therefore, at this age, hyperactivity symptoms are the most prominent. As age increases, the prevalence rate declines, suggesting that ADHD etiology and pathogenesis can be related to neuroanatomical, physiological, pathophysiological, and neurobiochemical abnormalities (Szatmari *et al.*, 1989). Child development science believes that ADHD is the result of the interaction between the child's behavior and the environment. Poor family environment easily makes children have hyperkinetic symptoms or exacerbation of existing symptoms; rearing factors affect disease development and prognosis (Concannon and Tang, 2005).

Parental occupations and educational levels determine their lifestyle, concern for their children, child-rearing style, and family relationships. Therefore, the quality of parenting has a significant effect on the child's psychological and behavioral development (Pouretamad *et al.*, 2009). Parents' educational levels largely determine their career choices, and thereby determine the lifestyle and parenting style. Different family environments produce different effects on the development of children. As shown in the present study, ADHD prevalence declines with increasing economic level. To reduce ADHD prevalence, parents should pay attention to the education of their families and their own. This survey showed that mothers with low educational level had a significant impact on the emergence of ADHD. This finding may be attributed to the fact that the mother is often responsible for the education of children. Mothers rather than fathers had more time with their children. Mothers with low educational levels and poor employment may provide inadequate parenting. However, ADHD prevalence rate in children outside the city is significantly higher than that in children in the city. This finding may be attributed to the fact that foreign households immigrate to Shanghai and integrate into mainstream society. In addition, foreign residence parents have higher expectations, which may be attributed to their different educational and income levels.

The levels of understanding of ADHD from different families are largely different. Some parents have positive expectations on their children but also do not want their children's weaknesses to be exposed in front of others. By contrast, some families exaggerate the problems of their children. In addition, parents of children in school behavior assessment may not be appropriate. This study selected a school sample and had no interviews with the teacher, which may lead to inaccurate results. More scientific assessments should be completed by the parents, teachers, and clinicians with the guidance of doctors. Parents and teachers should assess their children's behavior at home and in school, respectively (Pieter *et al.*, 2004).

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