

# Life Persistence of Attention-Deficit/Hyperactivity Disorder

**Aran Min, Dong Hyun Ahn**

Department of Psychiatry, Hanyang University College of Medicine, Seoul, Korea

This paper is to review Attention Deficit-Hyperactivity Disorder (ADHD) in the developmental perspective, focusing on clinical features, diagnosis and treatment of ADHD throughout life stage. When diagnosed with ADHD, before entering elementary school early diagnosis and early intervention is encouraged to reduce various impairments that occur during development. Thirty to eighty percent of school-age ADHD symptoms remain throughout the adolescence or meet the ADHD diagnosis criteria. During adolescence, hyperactivity and impulsiveness from other existing symptoms become less severe but children have insufficiency to continue studying or task compared to their peers. Pharmacologic treatment had been shown to be the most effective treatment regimen for adolescents who continue to have ADHD symptoms. In adults, representative symptoms of ADHD, hyperactivity and impulsiveness, often gradually decrease while lack of concentration remains. As Conner's Adult ADHD Diagnostic Interview for DSM-IV (CAADID), a structured interview for the diagnosis of adulthood ADHD has been translated into Korean, it can be applied clinically. Pharmacological and nonpharmacological treatment in adults had been shown to be effective.

**Key Words:** Attention Deficit-Hyperactivity Disorder; Neurodevelopmental Disorder; Children; Adolescents; Adults

**Correspondence to:** Dong Hyun Ahn  
Department of Psychiatry and Institute of Mental Health, Hanyang University Seoul Hospital, 222 Wangsimni-ro, Seoul 04763, Korea  
Tel: +82-2-2290-8425  
Fax: +82-2-2298-2055  
E-mail: ahndh@hanyang.ac.kr

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## INTRODUCTION

Attention-Deficit/Hyperactivity Disorder (ADHD) has been accepted undoubtedly as a neurodevelopmental disorder with main symptoms of inattention, hyperactivity and impulsiveness. Since the 1970's, a number of studies had been performed on ADHD, which was used as a basis to include the disorder as an Attention Deficit Disorder in the diagnosis manual by DSM-III in 1980 [1]. Since, hyperactivity had been emphasized and included in the diagnosis criteria as a symptom through amendment, and the name was changed to ADHD. Although the most recently published diagnosis manual DSM-5 in 2013, did not include major changes in the diagnosis criteria of ADHD, the diagnosis in school-aged children could be made by when 6 or more symptoms from the diagnosis criteria are met and 5 or more for adolescents and adults. In addition, as the age in which symptoms started was changed from 7 to 12, the scope was expanded to include adolescents and adults

from the existing diagnosis that only included children [2].

According to the study by Cantwell and Baker and Barkley, 60-70% of ADHD children continue to have symptoms in adult [3,4]. The prevalence of ADHD in children is estimated to be 3-5%, and assuming 60-70% of these children continue to show the symptoms after reaching adult, prevalence of ADHD in adults is estimated to be around 2-3%. Mick et al. defined cases that do not meet the diagnosis criteria completely as syndromic remission, those that meet the diagnosis criteria only partially as symptomatic remission, and those that experience complete functional recovery as functional remission [5]. It was also reported that 60% of ADHD cases between years of 18-20 show syndromic remission and 20% show symptomatic remission, while only 10% showed functional remission. In a recent study addressing organic causes of ADHD in the brain by Friedmann et al., a low degree of connection between the hippocampus and cerebellum on the DTI has been reported [6]. In a group with persisting ADHD symptom,

thick cortex of the brain was observed on f-MRI compared to the general group, and the degree of connection in the group showing remission gradually became closer to the general group through medication.

The objective of this paper is to investigate ADHD in the developmental perspective, focusing on clinical features, diagnosis and treatment of ADHD throughout the life span. In particular, we focused on adolescence, and adulthood, which was not often discussed in the previous studies.

## INFANT AND TODDLER PERIOD

Although symptoms of ADHD begin to appear in infancy and toddler period, they are only recognized when children reach the school-age in most cases. When looking for characteristics of ADHD children retrospectively, they have irregular and unpredictable physiological manifestations such as eating, sleeping and elimination, as well as shorter sleeping time and longer time spent crying or fretting compared to typically developing (TD) children of similar age [7]. Further, children who explore very enthusiastically, have rapidly changing focus of interest instead of one subject and express their resistance by throwing frequent temper tantrums are likely to show symptoms of ADHD in the future. In a study by Jang et al. on the characteristics of ADHD children, they tended to have high level of interest in new or novel things, seek exciting adventures, feeling excitement through exploring unfamiliar location or situations and seeking changes [8]. In a study by Song et al., ADHD children showed the tendency of easily showing anger when they were not able to obtain what they wanted immediately, preferring no strict rules or regulations, easily disobeying a law or a rule, and having inability to withstand tedious and uncomfortable situations and therefore avoiding them altogether [9]. Such features of the

children affect their relationship particularly with their caretakers continuously. When the caretakers are unable to accommodate the children's personalities sensitively, the level of stress of raising a child increases. Therefore, formation of stable relationship between the children and the caretakers are more important in this period than the diagnosis of fundamental symptoms of ADHD, which will affect the child ADHD prognosis in the future.

## PRESCHOOL PERIOD

The characteristics of ADHD children in the preschool period show constantly active and switching of games and playing them for a short period only. As their actions are not well controlled, they appear to not be listening to other people and having low level of safety awareness [10]. During interactions with adults, they are not willing to complaint to physical punishment, logical explanation, and persuasion. During interactions with peers, they show aggressiveness and destructive behaviors. Age group-specific symptoms including pre-school age are shown in Table 1 [11]. Mothers of ADHD children in pre-school report that their level of stress is higher than those parents of normal children or of older ADHD children. In a daycare center or kindergarten, ADHD children roam around classrooms, interfere with other children playing, are loud, and talkative. The more active and aggressive the children are, they may have to change their kindergarten a number of times until they find the one in which their behaviors are accepted.

In most evaluation tools used for ADHD diagnosis, criteria for children in pre-school age are lacking. Therefore, as it is extremely difficult to evaluate children with the standardized tool, the diagnosis frequently relies on the indirect or clinical judgement from the developmental perspective. Approximately 40% of a 4-year-old child have severe inattention problems requiring attention from

**Table 1.** Attention-Deficit/Hyperactivity Disorder symptoms from preschool period to adulthood

	Inattention	Hyperactivity	Impulsivity
Preschool period	<ul style="list-style-type: none"> <li>• Lose toys</li> <li>• Not listening</li> </ul>	<ul style="list-style-type: none"> <li>• Run around a lot</li> <li>• Touch everything they see</li> <li>• Talk excessively</li> </ul>	<ul style="list-style-type: none"> <li>• No sense of danger</li> <li>• Have difficulty waiting for things</li> </ul>
School period	<ul style="list-style-type: none"> <li>• Have difficulty maintaining focus on one task</li> <li>• Distracted easily</li> <li>• Forget about daily activities</li> <li>• Tend to daydream</li> </ul>	<ul style="list-style-type: none"> <li>• Restless when calm expected</li> <li>• Have trouble playing quietly</li> </ul>	<ul style="list-style-type: none"> <li>• Interrupting other children and blurting out answers</li> <li>• Thoughtless rule breaking</li> </ul>
Adolescence	<ul style="list-style-type: none"> <li>• Lack of focus on the details of a task</li> <li>• Poor planning ahead</li> </ul>	<ul style="list-style-type: none"> <li>• Fidgety</li> </ul>	<ul style="list-style-type: none"> <li>• Poor self control</li> <li>• Reckless risk taking</li> </ul>
Adulthood	<ul style="list-style-type: none"> <li>• Appointments forgotten</li> <li>• Change jobs and perform poorly</li> </ul>	<ul style="list-style-type: none"> <li>• Subjective feelings of restlessness</li> </ul>	<ul style="list-style-type: none"> <li>• Premature and unwise decision making</li> <li>• Have trouble controlling their emotions</li> </ul>

their teachers or parents. In fact, approximately 48% of children diagnosed with ADHD in the pre-school age received the same diagnosis in the later childhood or early adolescence [12]. A core factor that determines the continuity of symptoms is the level of chronicity. Pre-school children having persistent problems over 1 year are more likely to have behavioral problems in the future and be diagnosed with ADHD in mid-childhood [7]. When diagnosed with ADHD before entering elementary school may cause difficulty in learning and may affect development during the childhood and adolescence. To reduce various symptoms that occur during development, early diagnosis and early intervention is encouraged worldwide.

Nonpharmacological interventions are preferentially recommended for pre-school children with ADHD treatment, and parent behavior training had been reported to be effective in particular [13]. While various studies on pharmacologic interventions in pre-school children are ongoing, the Preschool ADHD Treatment Study (PATS) is a long-term clinical study that has been ongoing since 2001 by the National Institute of Health in the US [14]. This study showed the effectiveness and safety of methylphenidate in 303 children aged between 3 to 5.5 years, while also showing to be effective in the long term of 1 year.

### SCHOOL PERIOD

As children of this age start elementary school and are subjected to education that require following rules as a group than an individual, and continuous attentiveness, their problems are further emphasized. At close observation, ADHD children are forgetful and distracted and their activities appear unskilled. In addition to the lack of concentration, as the children are not able to complete a task in an organized manner, difficulties in remembering and learning arise [15,16]. Furthermore, difficulty in abstraction or moral development may also encounter. Their hyperactivity and impulsiveness appear in behaviors such as inability to stay quiet during class, moving from their seats, and difficulty in following rules. In peer relationship, they are often recognized as rude or aggressive as they interrupt activities of their peers and carry out their thoughts into action. About half of ADHD children experience social rejection due to their inappropriate social behaviors such as interrupting others [3]. While some develop low self-esteem from difficulties in peer relationships, some criticize others with the lack of self-awareness. Parents experience difficulty as

ADHD children are unable to understand their responsibilities at home, require continuous monitoring for self care activities such as clothes wearing or bath, throw temper tantrums, and show immature behavioral patterns [12]. Thirty to fifty percent of ADHD children show mild conduct behavior such as lying or lifting around 7-10 years of age, and over 25% show problems such as fighting [7]. As such, many ADHD children have complications with either conduct disorder or learning disorder. ADHD children only show the most flavor outcome, only experiencing difficulties in academic performance during adolescence [3].

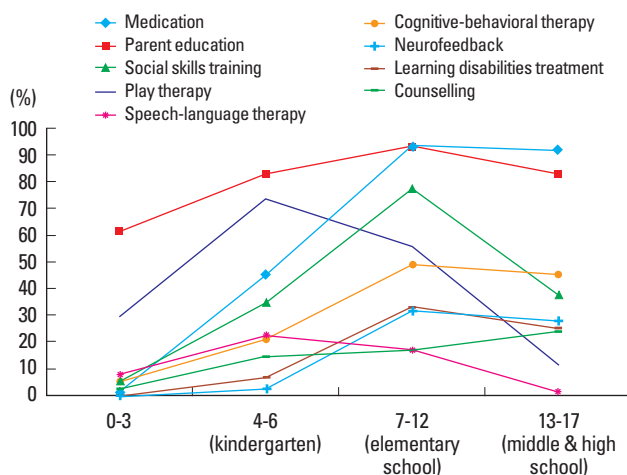
The diagnosis of ADHD during school age requires close investigation of the overall development in order to understand the reason for such problem. Children with high intellectuality may not generally face intelligent significant until they reach grade 3. However, difficulties may increase when they reach grade 4 as school work proceeds into a higher levels from simple tasks to independent work. Furthermore, children may have difficulties during gym class as they may be unable to wait for their turns, follow orders and get frequent warnings due to lack of attention. They may also have difficulties in controlling hand-eye coordination or exercise management. In addition, they may cause problems in peer relationships at this stage or experience damage in self-esteem or social competence. Therefore, evaluation of such areas in children at this stage of development is important. An ADHD diagnosis tool for children at this stage is summarized in Table 2 [1].

Major approach of treatment for children diagnosed with ADHD is psychoeducation for children, parents and teachers [17]. Most of ADHD children were receiving stimulant medication and more than half were receiving some type of individual therapy or family therapy. About one third of the children were receiving support of special education. Childhood ADHD is typically treated with medication for 1-3 years [1]. Every 6 months to 1 year, improved behavior is divided from the difficulty causing behaviors and are thoroughly evaluated. The treatment is continued only when the advantages of pharmacological treatment therapy outweighs the disadvantages. Looking at the combined results 351 study result analysis conducted worldwide from 1980 to 2010 by a research group in the US, receiving continuous pharmacological treatment for over 2 years leads to improvement in various areas of adulthood such as learning, self-esteem, career, social behavior, driving habits and addictive behavior [18]. Aforementioned treatment options for ADHD at different life stages are shown in Fig. 1 [19].

**Table 2.** The interviews and scale of Attention-Deficit/Hyperactivity Disorder for children

Scale	Abbreviation	Developer	Quality	Korean available*
Academic Performance Rating Scale	APRS	Barkley, 1990	Academic performance, 19 items	V
ADHD Rating Scale-IV	ADHD-RS-IV	DuPaul, 1998	DSM-IV diagnostic criteria, 18 items	V
Brown ADD Rating Scale	Brown ADD-RS	Brown, 2001	Including executive function	
Child Behavior Checklist-Teacher Rating Form	CBCL/TRF	Achenbach, 1991	General function scale	V
Conners Parents Rating Scale-Revised	CPRS-R	Conners, 1997	4 subscales; oppositional, cognitive, hyperactivity, ADHD index	
Conners Teacher Rating Scale-Revised	CTRS-R	Conners, 1997		
Conners-Wells' Adolescent Self-Report Scale	CASS	Conners & Wells, 1997	87 items, Family, Conduct, Anger control, Emotional, Cognitive problems, Hyperactive-impulse, DSM-IV symptoms, ADHD index	V
Home Situation Questionnaire-Revised	HSQ-R	Barkley, 1990	Family problem, 14 items	
School Situation Questionnaire-Revised	SSQ-R	Barkley, 1987	School problem	
IOWA Conners Teacher Rating Scale	IOWA CTRS	Loney & Milich, 1982	Differential diagnosis from ODD, 10 items	V
Swanson, Nolan and Pelham-IV Questionnaire	SNAP-IV/SKAMP	Swanson, 1992/Wigal, 1998	DSM-IV diagnostic criteria 26 items, Family and School problem 10 items	
Vanderbilt ADHD Teacher/Parent Rating Scale	VADTRS/VADPRS	Wolraich, 2003	Teacher-ADHD symptoms and performance impairment Parent-School performance and social functioning	

\*Korean available; Translation of this interview or scale was performed and available in Korean. Ref. 1 with permission from Hakjisa publishing limited.



**Fig. 1.** Usually applied treatment modalities in treating children and adolescents with ADHD in South Korea. ADHD, Attention-Deficit/Hyperactivity Disorder. Ref. 19 with permission from Korean Academy of Child and Adolescent Psychiatry publishing limited.

## ADOLESCENCE

Klein et al. showed in their longitudinal study since the 1970's for 33 years, that symptoms from childhood continues into adolescence and have an influence in many areas [20]. Thirty to eighty percent of school-age ADHD symptoms remain throughout the adolescence or meet the ADHD diagnosis criteria [21]. During adolescence, hyperactivity and impulsiveness from other existing symptoms become less severe but children have insufficiency to

continue task compared to their peers. These adolescents tend to wiggle their bodies during class. Generally, adolescents at this age form wider and deeper relationships with their peers, but adolescents with ADHD have few close friends and are often ostracized [22]. As adolescents' enter middle or high school, the number of subjects and the amount of learning requirements increases and their ability to systemically organize their time and tasks become important. Adolescents with ADHD may feel greater difficulties as they have weak planning and organization skills. Hence, likelihood of discontinuing education is 8 times higher in adolescents with ADHD compared to the general group, and the risk of conduct disorder, antisocial behavior, and substance abuse and misuse becomes greater [3]. As many adolescents with ADHD have difficulties in achieving independence and responsibilities, they may show low self-esteem as well as emotional difficulties.

Retaining information on the symptoms during school age or of the past is important for ADHD diagnosis in adolescents. School reports may provide useful information in such case. Symptoms of ADHD are diagnosed by collecting information from the adolescents themselves, parents, homeroom teachers and teachers from private institutions or tutors. When diagnosis is made using self-reports, prevalence of ADHD is approximately 5% in hyperactive adolescents, showing no significant difference with the general population [1]. However, when diagnosis is made based on the reports from parents, 46% of hyperactive adolescents or 1.4% of the general adolescents are diagnosed with ADHD and the preva-

lence increases drastically [23]. Therefore, making diagnosis through interviews with the adolescents is likely to lead to under-estimated diagnosis. As various yardsticks exist for ADHD diagnosis and adolescents can express their difficulties with the development of cognitive abilities, information can be obtained through interviews or self-reports unlike previous stages. However, standardized rating scales for ADHD diagnosis in adolescents in South Korea is not available. Unlike school age, adolescence ADHD can be confused with the symptoms of anxiety disorders, depressive disorders and bipolar disorders. Such confusion should be considered, as well as the possibility of comorbidity with anxiety disorders or mood disorders.

Pharmacological treatment had been shown to be the most effective treatment regimen for children who continue to have ADHD symptoms in adolescence [20]. Effectiveness of methylphenidate and atomoxetine has been proved in adolescence ADHD. However, according to Steinhoff's study, discontinuing medication during adolescence was the most frequent [24]. Brinkman et al. attempted to understand the pharmacological treatment decisions of adolescents through discussion by dividing 44 adolescents aged between 13-18 years into 7 focus groups [25]. Adolescents increase their responsibility in drug management and develop insights into effects of ADHD and drugs as they grew. Furthermore, insights were often obtained by comparing when taking or not taking the drugs. Their learning, social interactions and relationships, creativity, and driving ability were generally affected, but this may not be the case for everyone. Adolescents talked about strategies to achieve autonomy in taking medication and different roles in substance management. Often, side effects contributed to negativity towards medication, which led some to take medication selectively. Many adolescents expressed worries in uncertain future of the medication. Such points to an important factor in changing the treatment subjects of ADHD, from school-aged children to adolescents and adults. Bussing et al. also investigated attitudes in accepting treatments for ADHD [26]. Over half of the adolescents did not continuously take medication although they experienced many impairments. A group investigated on the awareness of ADHD treatment and opinions on potential undesirable effects of 2 drugs (an immediate-release drug and an extended-release drug) and 3 psychosocial treatments (ADHD education, behavior therapy and counseling) in 4 groups (adolescents, parents, health care professionals and teachers). Willingness was closely related to the respondent (lower in adolescents than in adults) knowledge reten-

tion, acceptance and belief in its helpfulness while stigma/embarassment, race/gender and SES were not. In particular, no treatment was well-accepted by the teenagers, and thus better treatment options for the treatment of adolescent ADHD needs to be developed. In cases where the symptoms remain, the most optimal option is to maintain pharmacological treatment to reduce difficulties and taper drugs at an appropriate period based on their progress after discussion with a professional. Nonpharmacological treatment in adolescents had been shown to be effective [27]. Behavior treatment showed effectiveness close to pharmacological treatment and social skill training was effective for those with inexperienced interpersonal skills and cognitive behavior therapy accompanied with depression and anxiety symptoms.

## ADULTHOOD

Recently, number of patients visiting with suspected adult ADHD has gradually increased. In adults, representative symptoms of ADHD, hyperactivity and impulsiveness, often gradually decrease while lack of concentration remains [1]. These adults are unable to look at study details or work materials, often forget their commitments, and lack the ability to predict future events [28,29]. They have difficulty in planning, are poor at decision-making, and are impatient. As they have impulsive personality, alcohol abuse, anti-social personality disorder, impulsive personality disorder, marital discord, reckless money management without plans, illegal activities, frequent job changes and job loss are commonly observed, causing difficulty in daily tasks, marriage, and social adjustment. According to Barkley et al. (1990), prevalence of conduct disorder in ADHD group and the general group was 27% and 8%, and 16% and 3% for substance abuse respectively [3]. Studies on middle-aged adults with ADHD are very rare. Das et al. in Australia applied WHO-Adult Self-Report Screener (ASRS) to 2091 middle-aged local residents and diagnosed 6.2% of them as ADHD, showing no gender differences [30]. Through multiple regression analysis, quantitative correlation was observed between ADHD symptoms and depression/anxiety, while negative correlation was observed between ADHD symptoms and employment, financial stress, relationship and health and well-being measures. Inattention, rather than hyperactivity, was still significant after controlling depression/anxiety [31]. Elders diagnosed with ADHD at similar late ages (average age at diagnosis = 57 years) with an average age of 66 years (n = 24) was investigated for their quality of life



(QOL) through phone interviews. Not only were they experiencing comorbid psychological problems (63%), they also experienced accumulated lifetime burden of illness, financially less well off, lower educational achievement, job performance and greater social isolation with ADHD [32]. Based on the results, adult ADHD can be divided into three different types [1]. First is a group that went through adulthood relatively well and does not show significant difference with the general group. Second is a group that have intermediate level of difficulties in concentration and social, emotional and impulsive problems. They show lowered self-esteem, impulsiveness, sensitivity to stimulation, anxiety and emotional variability. Most study subjects belonged to this group. Third group shows severe psychological or antisocial problems. Individuals in this group experience severe depression, attempt suicide or show antisocial behavior such as alcohol or drug abuse. However, the percentage of individuals experiencing such negative prognosis was low. Adulthood ADHD and childhood ADHD are not different fundamentally. As it is a neurodevelopmental disorder, it occurs for the first time in childhood and continues throughout adulthood or improved in some cases. Differences in the individuals who improve and those who continue are yet to be studied.

For diagnosis of adulthood ADHD, it is important a process of discovering ADHD-related symptoms display in the childhood

with the transcript of school record. Whether such symptoms are continued until present is evaluated and the severity of the symptoms and their effect on daily life are also evaluated. Presence or absence of other problems accompanying adulthood ADHD must be confirmed and when present, the process of diagnosis and treatment may become more difficult. As Conner's Adult ADHD Diagnostic Interview for DSM-IV (CAADID), which is developed by Epstein et al., a structured interview for the diagnosis of adulthood ADHD has been translated into Korean, it can be applied clinically [33]. The CAADID is comprised of part I revolving around disease history and part II involving symptoms experienced currently during adulthood and during childhood, centered around the DSM-IV criteria. It takes approximately 90 minutes to complete the survey. Neuropsychological test on ADHD is useful but not sufficient to diagnose adult ADHD. Of those, assessment tools developed by Conners, Brown and Barkley correspond to this, as shown in Table 3 [34]. Such survey is useful for measuring the frequency or the severity of the symptoms and monitoring changes that occur during the follow-up period. ASRS-v1.1 (ADHD Self Rating Scale) is a useful test developed to screen adulthood ADHD [35]. As mentioned, using DSM-5, it is important to confirm that more than 5 symptoms regarding attention deficiency, hyperactivity and impulsiveness are met in the ADHD diagnosis criteria.

**Table 3.** The interviews and scales for the assessment of adult Attention-Deficit/Hyperactivity Disorder

Scale	Abbreviation	Developer	Quality	Korean available*
Interviews for diagnostic use in adult ADHD				
Adult ADHD Investigator Symptom Rating Scale	AISRS	Adler, 2003	Observer rating, 18 items, 0-3 scale	
Adult Self-Report Scale-VI.1. screener	ASRS-VI.1. screener	Adler, 2003	WHO standard diagnostic tool; 6 items, 0-4 scale	V
Adult Self-Report Scale-VI.1	ASRS-VI.1	Adler, 2003	Self-report; 18 items, 0-4 scale	
ADHD Rating Scale-IV	ASRS-IV	DuPaul, 1998	Informant; 18 items, 0-3 scale	
Brown ADD Rating Scale	Brown ADD-RS	Brown, 2005	Observer ratings, 40 items; included executive function	
Conners Adult ADHD Diagnostic Interview for DSM-IV	CAADID	Epstein et al., 2001	Observer rating	V
Conners Adult ADHD Rating Scale	CAARS	Conners, 1999	Self-report (CAARS-S) and Observer ratings (CAARS-O). short, long and screening CAARS forms	
Current ADHD Symptoms Scale CSS	CSS	Barkley & Murphy, 1998	Self-report and Observer ratings. DSM-IV ADHD (18), ODD(8) + Social function (8)	V
Wender-Reimherr Interview	WRAADD	Wender, 1995	Symptom (28 items), 0-2 scale Domain (7 items), 0-4 scale	
Retrospective Assessment of Childhood ADHD				
Childhood ADHD Symptoms Scale Self-Report		Barkley & Murphy, 1998	Self report, DSM-IV diagnostic criteria (18) + Social functioning (8) + ODD (8) + CD (15)	
Wender Utah Rating Scale	WURS	Wender, 1995, Ward 1998, Retz-Junginger, 2002, 2003	Self report, 61 + 25 items, 0-4 scale	

\*Korean available; Translation of this interview or scale was performed and available in Korean. Ref. 1 with permission from Hakjisa publishing limited.

**Table 4.** Summary of recommendations for treatment

Severity	4-5 years of age	6-11 years of age	12-18 years of age
Mild to moderate	<ul style="list-style-type: none"> <li>• Psychoeducation</li> <li>• Parent training programs</li> <li>• Teacher administered behavior therapy</li> <li>• If no improvement and symptoms are severe, consider methylphenidate</li> </ul>	<ul style="list-style-type: none"> <li>• Parent training programs and CBT</li> <li>• If no access to CBT and in severe cases with uncomplicated ADHD: stimulants or atomoxetine</li> <li>• If no response: add stimulants or atomoxetine (first line medications)</li> <li>• If no adequate response or significant side effects: switch to another first line medication (e.g., from methylphenidate to dexamphetamine or to atomoxetine)</li> <li>• If no response and significant comorbidity: try second line medications</li> </ul>	<ul style="list-style-type: none"> <li>• Stimulants or atomoxetine</li> <li>• If no response: add CBT</li> <li>• If no adequate response or significant side effects: switch to another first line medication (e.g., from methylphenidate to dexamphetamine or to atomoxetine)</li> <li>• If no response and significant comorbidity: try second line medications</li> </ul>
Severe		<ul style="list-style-type: none"> <li>• Stimulants or atomoxetine, if possible combined with CBT</li> <li>• If no adequate response or significant side effects: switch to another first line medication (e.g., from methylphenidate to dexamphetamine or to atomoxetine)</li> <li>• If no response and significant comorbidity: try second line medications</li> </ul>	<ul style="list-style-type: none"> <li>• Stimulants or atomoxetine, if possible combined with CBT</li> <li>• If no adequate response or significant side effects: switch to another first line medication (e.g., from methylphenidate to dexamphetamine or to atomoxetine)</li> <li>• If no response and significant comorbidity</li> </ul>

First line medications: stimulants, atomoxetine. Second line medications: extended release guanfacine. Third line medications: extended release clonidine, tricyclic antidepressants, bupropion. Ref. 28 with permission from IACAPAP publishing limited.

During the interview, it would be helpful to discuss efforts made to overcome ADHD symptoms, such as making habits or taking notes, their advantages and areas of interest, in addition to the symptoms. Furthermore, comorbid disorders along with ADHD symptoms are often shown in adulthood, most of which are learning disorder, anxiety disorder, mood disorder or substance use disorder. Adulthood ADHD in individuals at mid-20's accompany the tendency to have discontinued education and low-income jobs. They also experience difficulties from persistent low self-esteem and lacking in social skills. Furthermore, the proportion of individuals with antisocial personality and drug abuse was higher compared to the general group.

After the diagnosis of adulthood ADHD, the individuals may have increased concentration on pharmacological treatment and stabilized life style. Stimulants therapy of ADHD had long-term beneficial effects and is well tolerated [32]. Through cognitive behavioral therapy, they can learn how to organize, systematically manage their thoughts, express anger through words, and to control anger when they experience at difficulties in controlling emotion through emotion adjustment therapy. Self-care management options include developing habits to manage daily schedules by using an agenda or electronic scheduler and getting hobbies through which they can release their energy. Aforementioned treatment options for ADHD at different stages are shown in Table 4 [28].

## CONCLUSION

In this review, clinical views on ADHD at different life stages from developmental perspectives were summarized. Recently,

ADHD has been understood and approached as a chronic-illness model. It is important to start the treatment early in life if various symptoms of ADHD cause difficulties in children and interfere with their development. In addition, the treatment needs to be continued if various problems persist into adolescence or adulthood. To date, studies on pre-school, adolescence and adulthood ADHD are largely in need. Studies on the diagnosis and treatment of ADHD in all age groups except the school-age group will be able to provide realistic help on the 60-70% of ADHD children, whose symptoms persist into the adulthood.

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