

ADHD refers to

a disorder which manifests as attention deficit, hyperactivity and impulsive behaviour. ADHD stands for Attention Deficit Hyperactivity Disorder.

ADHD is the most common neuropsychiatric disorder among children and adolescents. In Finland, the estimated incidence is about 5% of the population. This means that in each class in the comprehensive school, there is at least one pupil who has ADHD or exhibits ADHD symptoms, which interfere with the pupil's life. Among adolescents, the incidence is slightly lower. Their childhood symptoms of ADHD have alleviated to the extent that they no longer disrupt their daily life, because some of these individuals have developed ways to cope with their symptoms. After adolescence, ADHD continues to disrupt the daily routines of some adults.

ADHD is three times more common among boys than among girls. By contrast, attention deficit without hyperactivity and impulsivity (formerly called ADD), which is a subtype of ADHD, is more common among girls.

ADHD is often associated with concurrent symptoms, which can make the patient's situation significantly worse. On the other hand, there are several illnesses that resemble ADHD. They have been considered in the examinations performed on you.

Attentiveness

is a complex series of events resulting from seamless cooperation of different parts of the brain, in which a person's own actions are directed, organised and monitored. It enables us to work hard, engage in meaningful activities and concentrate on the task we want. Good motivation and alertness support attentiveness.

An example of attentiveness could be a pupil solving a demanding math problem. The pupil knows that doing this homework is his or her obligation. If he or she is alert and enthusiastic, the problem might seem challenging in a good way. Thus, the pupil is already motivated to solve the problem. He or she has grasped and understood the exercise while reading it. All this has already required attentiveness. When the information is important to the pupil, he or she is even better able to concentrate on the exercise to be completed. At the same time, to process important information, he or she is able to shield him-/herself against other information coming from the surroundings, which is

irrelevant in terms of the completion of the exercise, and against interrupting stimuli and sudden desires.

Attentiveness is essentially associated with **the control of one's own actions**, or executive functions, and **the working memory**. Executive functions mean the execution of a complex series of cognitive events, which is discussed in greater detail below.

The pupil continues to work on the exercise. Thus, he or she has



activated in order to solve the problem provided in the exercise. **Activation** means orientation to work on the exercise so that the pupil analyses the exercise and

then starts solving it. The pupil must **take the trouble** to complete the entire exercise. If the exercise is difficult, it may take several efforts due to erroneous attempts. This may be associated with feelings of disappointment and giving up, which may be strong. Thus, attentiveness is also essentially associated with **emotions**. Keeping the exercise details in mind requires the use of **working memory**, which refers to a short-term memory for momentary storage of information. The information is erased shortly afterwards, and the working memory is again available for new information.

In the math exercise, the working memory is needed several times, and it must be possible to retrieve (=remember) information from

the long-term memory in order to solve a certain part of the exercise. For the pupil to solve the math problem correctly, he or she should also be able to **monitor** his or her own actions in terms of how he or she decided to solve the problem. He or she must be **flexible** in how he or she approaches the exercise; perhaps he or she needs to redo part of the exercise, perhaps disappointment distracts him or her for a while. Nevertheless, flexibility enables him or her to proceed according to the original action plan despite drawbacks and possible other interference.

Normally, attentiveness is controlled completely automatically. With an ADHD patient, the situation is totally different. There might be weakness in each action that attentiveness is composed of, and this essentially impacts the completion and outcome of the exercise. When attentiveness fails repeatedly, the ramifications may be far-reaching and extend all the way into adulthood.



ADHD may be due to

a variety of factors. On the other hand, it is possible that no specific cause is ever found or diagnosed for a patient's ADHD.

Hereditary factors play a role in a large number of cases. It is estimated that in population studies, their share is as much as 60–90%. This means that often one parent or both parents have had or still have clear ADHD symptoms, if they do not have actual ADHD. Due to the hereditary nature of the disorder, the same family may have more than one child with ADHD.

ADHD may be associated with various chromosomal abnormalities. Some of them may be hereditary and others “new mutations”, in which chromosome-level abnormalities are not found in the other family members. ADHD may also be a neuropsychological manifestation of abnormalities in the number of sex chromosomes (either too few or too many).

A mother's high alcohol consumption during pregnancy is a very

high risk factor for ADHD, even if the child was not diagnosed with structural abnormalities typically caused by alcohol. If such are detected, the child having ADHD is the rule rather than the exception.

Smoking during pregnancy is also an important factor that increases the risk of the child having ADHD, regardless of the mother's alcohol consumption during pregnancy. Smoking during pregnancy also causes other abnormalities, such as increased premature births, low birth weight in relation to the duration of pregnancy, and several complications during pregnancy. All these other abnormalities caused by tobacco are also directly linked to the possibility of the child having ADHD.

Various factors during pregnancy, such as diseases, injuries, prematurity, low birth weight in relation to the duration of pregnancy and lack of oxygen, may cause ADHD. The aforementioned disorders that may occur during pregnancy also have a number of different causes.

Abnormal events during pregnancy are linked to ADHD, as are many central nervous system illnesses and brain injuries in childhood. In addition to the aforementioned risks factors of ADHD, there are a number of other factors connected to the incidence of ADHD. One of these is an unfavourable environment for childhood development.

Some other neuropsychiatric disorders may be associated with ADHD as concurrent symptoms or illnesses. Such disorders include Tourette's syndrome and disorders falling on the autism spectrum.



The core symptoms of ADHD are

attention deficit, hyperactivity and impulsivity (Table 1, page 9). They vary depending on the patient's age. The international criteria for diagnosing ADHD apply to children at the age of 6–12, in particular. The symptoms of children and adolescents vary somewhat.

Infants: Although it is not possible to diagnose ADHD in infants, many parents notice such abnormalities in their infant that his or her siblings did not have and never developed ADHD. Such symptoms described by the parents in the infant include various sleeping disorders. On the other hand, a child who later exhibits ADHD symptoms may have been much calmer than his or her siblings.

Pre-school age: The child may be temperamental, easily irritable, restless and inattentive. A suspicion of ADHD should be raised no later than at pre-school age.

School age: No later than in the second grade, a full-fledged ADHD should be present, including all characteristics described. As early as at school age, various consequences of ADHD (e.g. self-esteem issues, symptoms of oppositional defiant disorder, low mood or anxiety) or concurrent neurological disorders (such as difficulty reading, writing or learning mathematics, problems in social interaction), diseases (such as Tourette's syndrome, disorders on the autism spectrum or symptoms thereof) may emerge.

Adolescence: The range of ADHD symptoms may be complete or partial in adolescence. Depending on the range of symptoms, ADHD is unfortunately often diagnosed only in adolescence. However, the ADHD symptoms are always required to be present at the age of 5–7 years. Consequences of ADHD are often present in adolescence (such as symptoms of a behavioural disorder or depres-

sion). They may also be separate symptoms in patients who have not been diagnosed with ADHD before. This carries a risk of ADHD left undiagnosed.



Adulthood: ADHD may continue in adulthood in the same way as in adolescence. On the other hand, it may have changed, for example, so that hyperactivity has reduced or transformed into internal restlessness, or some of the attention deficit symptoms have been alleviated as the patient has learned to control their symptoms.

ADHD patient's behaviour based on the main symptoms

Attention deficit

- The child has difficulties concentrating or is a daydreamer.
- The child does not seem to listen.
- The child is easily distracted in play activities or tasks.
- The child does not seem to care about details or makes careless mistakes.
- The child does not follow through on instructions and fails to finish play or homework.
- The child has trouble organising tasks and activities.
- The child loses things necessary for tasks or activities.
- The child keeps forgetting things or exercises.
- The child avoids tasks that suit his or her development level but require sustained mental effort.

Hyperactivity and restlessness

- The child is "on the go" or often acts as if "driven by a motor".
- The child has trouble being still.
- The child fidgets with hands or feet and squirms in seat.
- The child talks excessively.
- The child runs about or climbs excessively in situations where it is inappropriate to do so.
- The child has difficulty playing or engaging in activities quietly.

Impulsivity

- The child acts and talks without thinking.
- The child may run around in traffic without assessing potential danger.
- The child has difficulty waiting turn.
- The child is unable to wait for gratification.
- The child blurts out answers before a question has been completed.
- The child interrupts or intrudes on others.

The ADHD diagnosis

is based on a thorough review of the background information, interviews and clinical examination with the help of the criteria from the international classification of diseases.

The diagnostic criteria of ADHD are met if at least six out of the nine attention deficit criteria are fulfilled and six of the nine hyperactivity-impulsivity criteria are fulfilled. When examining the patient, it is important to not rely solely on the responses to the diagnosis criteria statements. Instead, the situation of each child should be examined carefully to determine the extent to which the behavioural traits included in the statements interfere with the child's day care, schoolwork, life at home and leisure activities. The C-GAS assessment, which describes the child's or adolescent's level of activity, can be used to measure how interfering the symptoms are.

In accordance with ICD-10 (=International Classification of Diseases Number 10) applied in

Finland, when all criteria of attention deficit, hyperactivity and impulsivity are met, we talk about a hyperkinetic disorder. This corresponds to ADHD, which is used in clinical and everyday language and originates from the mental disorder classification DSM (Diagnostic and Statistical Manual of Mental Disorders) of the American Psychiatric Association.

If only some of the criteria in the attention deficit section are met, without an abnormality listed in the hyperactivity-impulsivity section, the disorder is a "pure" attention deficit (formerly ADD).

If both the attention deficit criteria and at least six items in the hyperactivity-impulsivity section are met, the diagnosis is ADHD, in other words, the aforementioned hyperkinetic disorder. If less than six of the attention deficit criteria are met but all hyperactivity-impulsivity criteria are met, the expression predominantly hyperactivity-impulsivity disorder is used.

A prerequisite of an ADHD diag-

The treatment of ADHD

nosis is that the symptoms have started before the age of seven and that they are present in at least two unrelated environments, for example, day care or school, at home, in leisure activities or at the physician's appointment. If the symptoms appear in only one environment, diagnoses other than ADHD must be considered. In addition, it is required that the child's symptoms cannot be explained by any other illness or psychiatric disorder.

Diagnosing ADHD in adulthood differs somewhat from diagnosing children and adolescents. With adults, at least five hyperactivity-impulsivity criteria and five attention deficit criteria must be met. Furthermore, the patient must have exhibited distinct ADHD symptoms before the age of 12 (DSM-V).



is divided into non-pharmaceutical and pharmaceutical therapy. Treatment usually begins with non-pharmaceutical therapy and continues for years. The best results are achieved with the combination of non-pharmaceutical and pharmaceutical therapies.

Pharmaceutical therapy is considered in moderate or severe ADHD. Medicinal therapy is started if non-pharmaceutical treatment has been unsuccessful within 6–12 months of the ADHD diagnosis. Sometimes, in difficult cases or when non-pharmaceutical support measures are not available, pharmaceutical therapy can be initiated immediately after ADHD is diagnosed and its severity has been estimated. The child's neurological or psychiatric monitoring will continue for years.

Non-pharmaceutical therapy

is divided into several areas and depends on the type of each patient's symptoms. Non-pharmaceutical therapy is markedly different depending on whether the patient has only ADHD or concurrent other interfering illnesses or neurological symptoms.



Treatment methods

- Psychoeducation of the family (increasing understanding of ADHD, its management and treatment options).
- Supporting the development of attentiveness
- Guidance provided to the family
- Guidance provided to day care, school and activity groups
- School arrangements (postponement of school, selection of the type of school, special education)
- Various forms of rehabilitation (when concurrent other disorders exist)
- Adaptation training
- ADHD guidance/coaching

Pharmaceutical therapy

is warranted when other support measures are insufficient. Pharmaceutical therapy uses drugs that activate the central nervous system, i.e. psychostimulants (methylphenidate, dexamphetamine, lisdexamphetamine), or drugs that have a different type of effect (atomoxetine, guanfacine). The mechanism of action of methylphenidate is shown in Figure 1 on page 14. Treating illnesses that are concurrent with ADHD may require other medications as well, in addition to those used for treating ADHD.

Pharmaceutical therapy should rarely be used in children under six years of age, although it is possible in very serious cases. The response of children under six years of age to pharmaceutical therapy may be weaker than that of pre-schoolers and schoolchildren. Pharmaceutical therapy in ADHD is not curative but alleviates the symptoms. Pharmaceutical therapy often improves the effectiveness of non-pharmaceutical therapy. Non-pharmaceutical therapy is continued in parallel to pharmaceutical therapy and will continue



Mechanism of action at the synapse

(Synapse = the interface between two nerve cells)

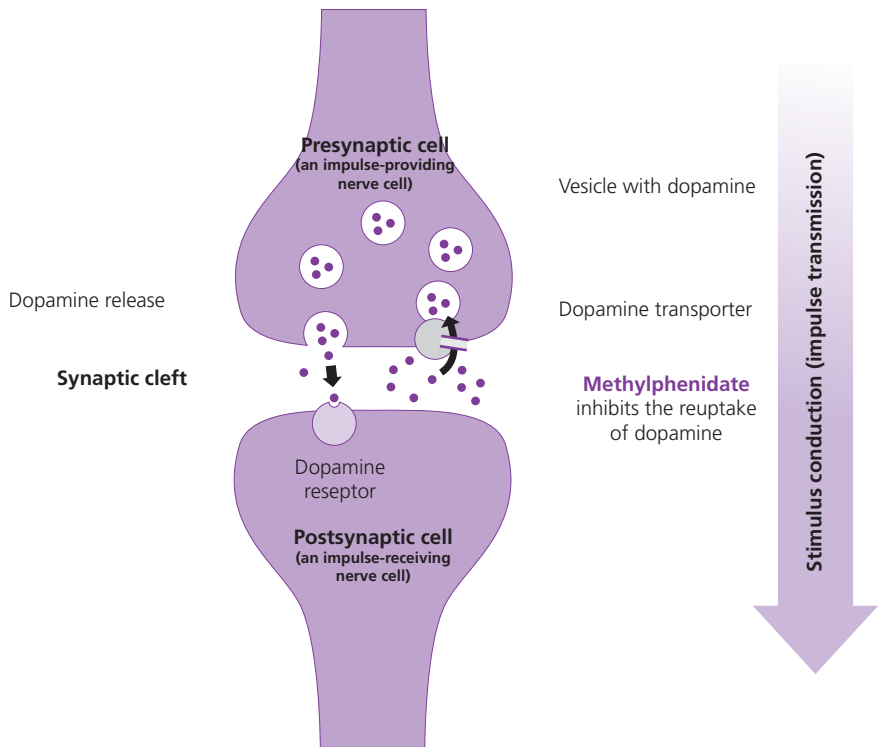


Figure 1. The impact mechanism of methylphenidate used in the treatment of ADHD.

after medication is discontinued.

Methylphenidate **inhibits the reuptake of dopamine in the presynaptic brain cells**. As a result, the dopamine concentration in the synaptic cleft remains higher, which facilitates the conduction of nerve impulses from the presynaptic nerve cell to the postsynaptic nerve cell (see the figure above). This increases brain activity, which may manifest as the alleviation of the core symptoms of ADHD (attention deficit, hyperactivity and impulsivity) and an improvement of the person's ability to function.

Methylphenidate

Products that contain **methylphenidate** are available under various trade names in Finland. The selection of the drug depends on the desired effect and any previous side effects. One dose of short-acting methylphenidate may sometimes be sufficient for children of day care age if the ADHD symptoms at home are not severe. Otherwise, medium-acting or long-acting methylphenidate is used.

The adverse effects of methylphenidate are experienced by a small share of patients. Methylphenidate causes adverse effects resulting in discontinuation of treatment in a small percentage of patients only.

The adverse effects can be divided into gastrointestinal, neurological and sleep-related adverse effects. Psychiatric adverse effects, such as aggression or emergence or serious worsening of behavioural problems, are rare. Gastrointestinal symptoms can be avoided by taking the medication with food. The lack of appetite that a child may experience in the morning is compensated by him or her wanting larger portions in the evening. Headache, the most common neurological side effect, usually subsides over time, as seen in follow-up. If the patient experiences difficulties falling asleep, the medication should be administered earlier or the dose should be reduced.



Special situations related to the use of methylphenidate

include certain other illnesses, which may affect the ADHD medication, or drug interactions caused by the medication for such illnesses and the ADHD drugs. Such situations include Tourette's syndrome, epilepsy, psychiatric disorders, disorders in the autism spectrum as well as developmental disability. A family member's narcotic or alcohol abuse must be taken into consideration when selecting the medication. In some of these situations, the use of the non-stimulant medication should be considered.

A follow-up visit for pharmaceutical therapy

is scheduled with a physician approximately one month after the therapy is initiated. Thereafter, follow-up visits are scheduled first 2–3 times per year and later 1–2 times per year. More frequent follow-up visits may be needed with children and adolescents who have multiple issues. No blood samples are needed from patients to determine drug con-

centrations, nor are pharmaceutical safety tests. They are warranted if the patient is also on antidepressants or psychosis medication.

The patient's teacher and/or assistant compile a written summary of how the patient is doing in day care/school and the patient brings this report to the visit. In addition, the parents and, depending on his or her age, the patient are interviewed during the visit using a follow-up form. The physician assesses the effect of the pharmaceutical therapy based on the information received and the interviews. Moreover, the patient's height, weight, blood pressure and heart rate are measured to ensure that the medication is not affecting them adversely.

Texts

Pertti Rintahaka

MD, Specialist in Paediatric Neurology and Adolescent Psychiatry 2011,
(updated in 2017)

Jane Oinonen

Product Manager, Biocodex Oy, page 12

Images

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Heidi Koivisto, Biocodex Oy