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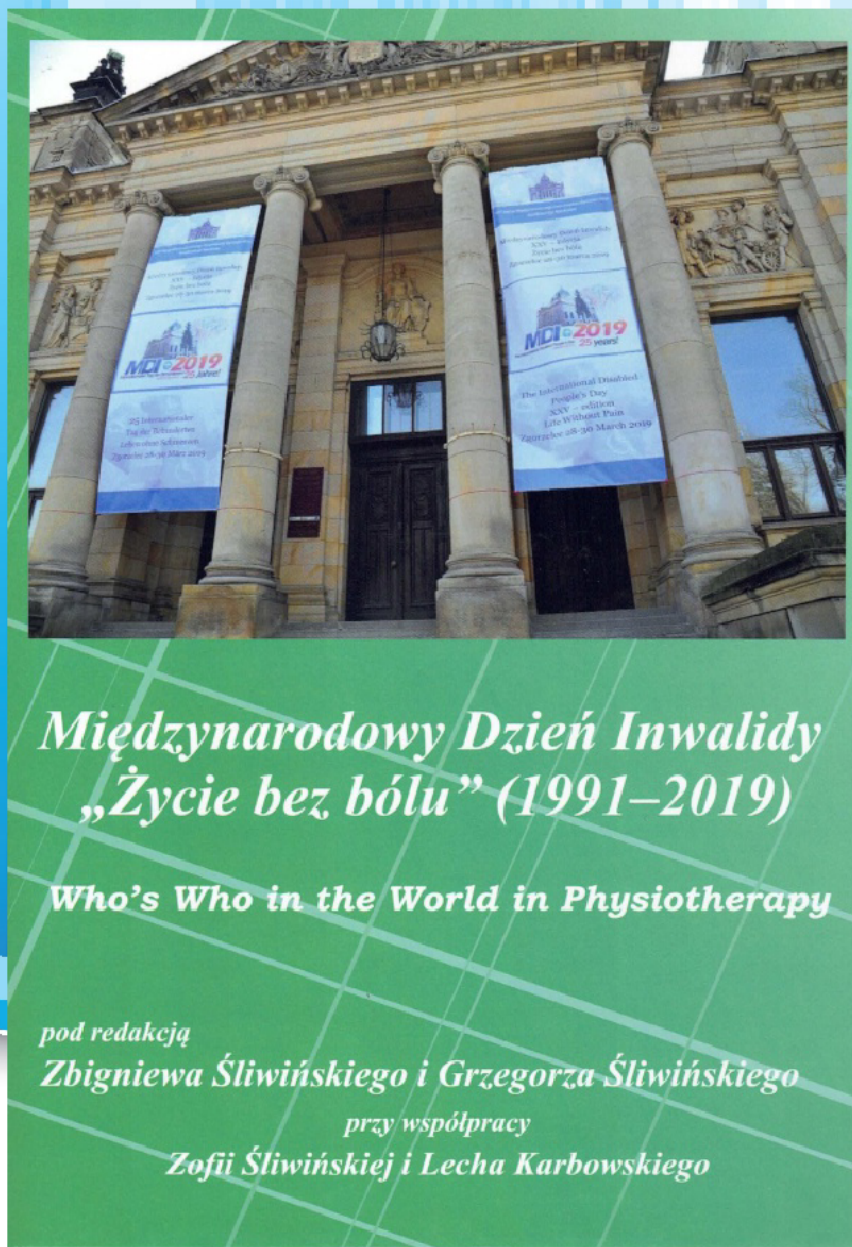


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# Gross motor impairments in autism

## Zaburzenia motoryki dużej w autyzmie

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### Abstract

Gross motor impairments occurring in children with autism spectrum disorders result from abnormal distribution of muscle tone and abnormalities in sensory processing, mainly in the vestibular and proprioceptive systems. The very important role of exercise therapy and sensory integration therapy in children with autism is emphasized for the improvement of the child's functioning.

### Key words:

autism, gross motor impairments, dyspraxia, praxis, abnormalities in processing sensory processes, sensory integration

### Streszczenie

Zaburzenia motoryki dużej występujące u dzieci z zaburzeniami ze spektrum autyzmu wynikają z nieprawidłowej dystrybucji napięcia mięśniowego oraz z nieprawidłowości w przetwarzaniu procesów sensorycznych, głównie w układzie przedsionkowym oraz proprioceptywnym. Podkreśla się bardzo dużą rolę prowadzenia terapii ruchowej oraz terapii integracji sensorycznej u dzieci z autyzmem, aby wpływać na lepsze funkcjonowanie dziecka.

### Słowa kluczowe:

autyzm, zaburzenia motoryki dużej, dyspraksja, praksja, nieprawidłowości przetwarzania procesów sensorycznych, integracja sensoryczna

According to the ICD-10 classification **childhood autism** is one of the whole-body developmental disorders, a group of disorders that begin early in the child's development, manifested by qualitative disorders of communication, social interactions, behaviour or interests [1].

Autism spectrum disorders constitute a group of general developmental childhood disorders, similar in terms of emotional and social, cognitive and behavioural symptoms, which can be ranked, ranging from those with the lowest severity to those with the most severe symptoms [2]. Disorders in social functioning, communication and behaviour are called the triad of autistic impairments. In autism spectrum disorders, in addition to the above-mentioned dysfunctions, we can also distinguish gross motor impairments and fine motor impairments. Motor disorders result from incorrect distribution of muscle tone and incorrect processing of sensory processes. Children with autism spectrum disorders have difficulties with certain physical exercise, they seem clumsy. When writing, the grip of the pencil or pen is inappropriate, so is the pressure of the hand. In such situations, physiotherapeutic assistance may be invaluable. Great motor skills are a priority in the child's motor development. The child's mobility is built from the first weeks of life, and the first year of the child's life is an extremely dynamic time. An infant showing generalized and uncoordinated mo-



vements in the first period of life becomes a bipedal creature after about 12–16 months. However, before this happens, the child acquires a number of abilities and skills at the appropriate pace and time, achieving the so-called milestones of proper motor development. The combination of these skills creates a diagram of the child's motor development.

There are milestones in lying on the stomach:

- in the 3<sup>rd</sup>–4<sup>th</sup> month: support on the elbows and pelvis,
- in the 6<sup>th</sup>–7<sup>th</sup> month: support on the hands and pelvis with straightened elbows,
- in the 9<sup>th</sup>–10<sup>th</sup> month: support on the hands and knees, the all-fours position,
- in the 12<sup>th</sup>–16<sup>th</sup> month: support on the hands and feet, the bear position.

In lying on the back, we observe the following milestones:

- in the 3<sup>rd</sup>–4<sup>th</sup> month: eye-hand-mouth contact,
- in the 6<sup>th</sup>–7<sup>th</sup> month: eye-hand-feet-mouth contact [3].

Correct transition from position to position and achieving milestones affect the formation of gross motor skills. The child's motor development is therefore important for many reasons, as it also influences movement skills and physical fitness, i.e. gross motor skills. Acquiring and adapting motor skills to the needs is called motor learning, and the ability to regulate and direct the mechanisms necessary for its performance – motor control [4]. Proper development of gross motor skills affects skills, such as sitting, standing, walking, running, jumping, playing ball, throwing, cycling. Gross motor abnormalities affect dysfunctions in these areas and are manifested in the functioning of the child in daily life. In some children, motor development is normal, which means that they acquire certain skills in their own time, and in others it is significantly accelerated. Then, the lack of harmony is observed in a child's development, as well as its dynamics; for example, a child started to sit up early, but learned to walk on its own late. Motor development of some children may also be delayed, which is manifested by low muscle tone and poor motor control [5]. Children with autism spectrum disorders experience gross motor problems. They mainly result from incorrect processing of sensory processes, meaning sensory integration and incorrect distribution of muscle tone. Muscle tone in children with autism spectrum disorders is reduced. Reduced muscle tone – hypotonia – can have many causes. The most common damages include the reflex arc, i.e. the path that the stimulus runs from the receptor to the effector, and the reduction in the amount of excitatory stimuli or the increase in inhibitory stimuli from higher levels of the nervous system [6]. Sensory integration is the ability to register information and stimuli that flow from the outside world, transmit them through the sensory organs, and process them by the central nervous system. Moreover, it is the use of these stimuli for deliberate actions, e.g. for cycling. Sensory integration is therefore a function, activity of the central nervous system, a neurological process that organizes these very sensations from the environment in such a way that the child can use them in a targeted manner, for a specific action. We are talking about the following senses: si-

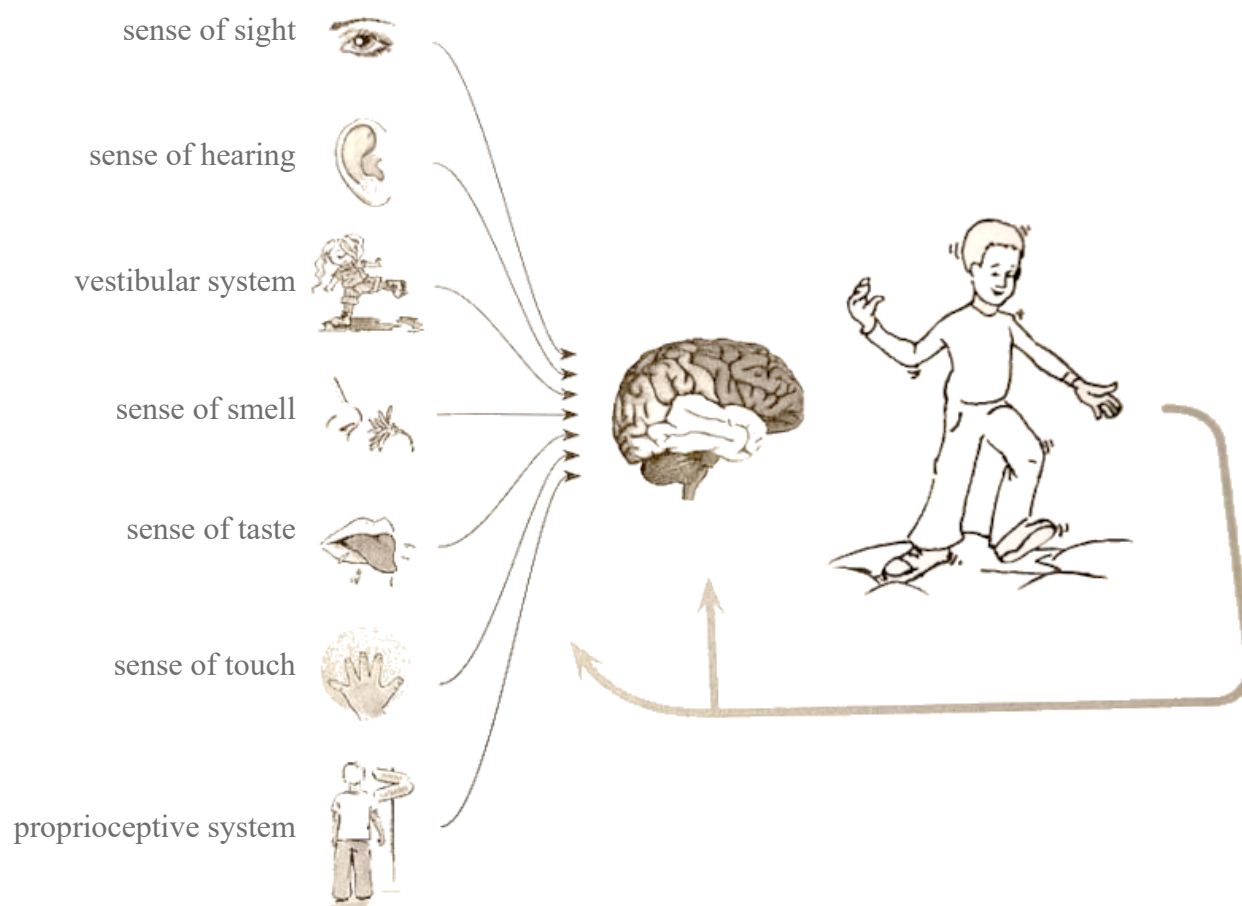
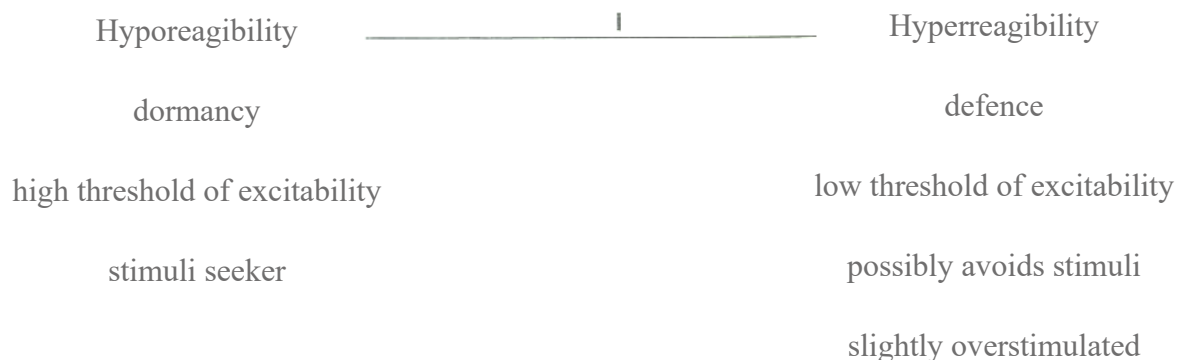


Figure 1. Process of sensory input, organization, motor output, and constant feedback [7]

ght, hearing, taste, smell and exteroceptive sensation system, proprioceptive system and vestibular system, and it is these three systems that we will focus on when it comes to gross motor disorders. Figure 1 presents the process of sensory input, organization, motor output, and constant feedback. The tactile system, or exteroceptive sensation, is responsible for the sensations of touch on the skin's surface. It is one of the earliest developing sensory systems, has a great influence on arousal and attention, participates in building the body schema and self-image. It affects the sense of security, emotional functioning and motor planning. The proprioceptive system, or kinaesthesia, perceives the sensations of muscles, tendons and joints, activated by stronger pressure. Thanks to this system, the brain receives information about the position of the body, about where its individual parts are and what movements they are making. In turn, the vestibular system is responsible for movement, balance and all situations related to lifting the feet off the ground. It is responsible for the perception of sensations from movement caused by the change in the position of the body in space, particularly the head. Disturbing the reception of this type of stimuli may affect the development of postural mechanisms and control of body movements, i.e. balance. It may be difficult to adjust muscle tone to body positions. Children with autism show abnormalities in the





**Figure 2. Kontinuum of sensory registration. Materials from the Ayres SIAT® Sensory Integration Therapy course**

functioning of sensory systems, meaning abnormalities in the processing of sensory processes. Sensory processes give us information about how the child reacts to sensory information - whether it is possible to interact effectively with the physical and social environment and whether there is a so-called adaptive response. Abnormalities in the processing of sensory processes that affect gross motor impairments in autism can be divided into three groups:

- Sensory Modulation Disorder (SMD),
- Sensory Discrimination Disorder (SDD),
- Sensory Based Motor Disorder [7].

Sensory modulation disorders involve difficulties in responding to a sensory stimulus in a way that could be assessed as adequate to the degree, nature and intensity of this stimulus [8]. Modulation is a process by which incoming nerve impulses are matched in their intensity to create internal order in the body, so it adjusts the intensity of incoming nerve impulses to external conditions, which is very important for homeostasis. In this area we distinguish:

- modulation disorders of sensory hyporeagibility or undersensitivity nature. People with this type of dysfunction do not respond sufficiently to a stimulus from the environment. The failure to perceive the sensory experience is noted;
- modulation disorders of sensory hyperreagibility or hypersensitivity nature. People with this type of disorder react faster, more intensely or longer than typical people. It may be noticeable in one system, e.g. tactile defence, or in many systems, the so-called sensory defence;
- increased search for stimuli leading to hyperactivity in all sensory systems. People with this dysfunction want a large amount of sensory experience [9].

Figure 2 shows the continuum of sensory registration, on the one hand we observe hyporeagibility – undersensitivity, on the other hand hyperreagibility – hypersensitivity, while in the middle there is a norm that should be pursued through therapy in order to influence the better functioning of the child.

**Sensory discrimination disorders**, i.e. difficulties in sensory differentiation, concerning interpretation of the quality of the stimulus; problems with the inability to separate the main stimulus from the secondary stimuli. They lead, for example, to poor orientation in space and problems in daily activities. People with this dysfunction have problems with the interpretation of sensory stimuli. Difficulties with noticing similarities and differences between the stimuli are observed.

**Sensory based motor disorders** are motor dysfunctions related to abnormalities and postural-motor disorders that occur on a sensory basis, impaired movement control and disorders of correct body posture. Figure 3 illustrates the category and sub-types of sensory processing disorders. Controlling body posture in motion and at rest leads to, for example, motor awkwardness. In this group of disorders, we observe abnormalities related to dyspraxia. People with these disorders are characterized by poor quality of free and postural movements. Dyspraxia is a condition in which an individual's ability to act intentionally is disrupted. According to the ICD-10 classification, dyspraxia is defined

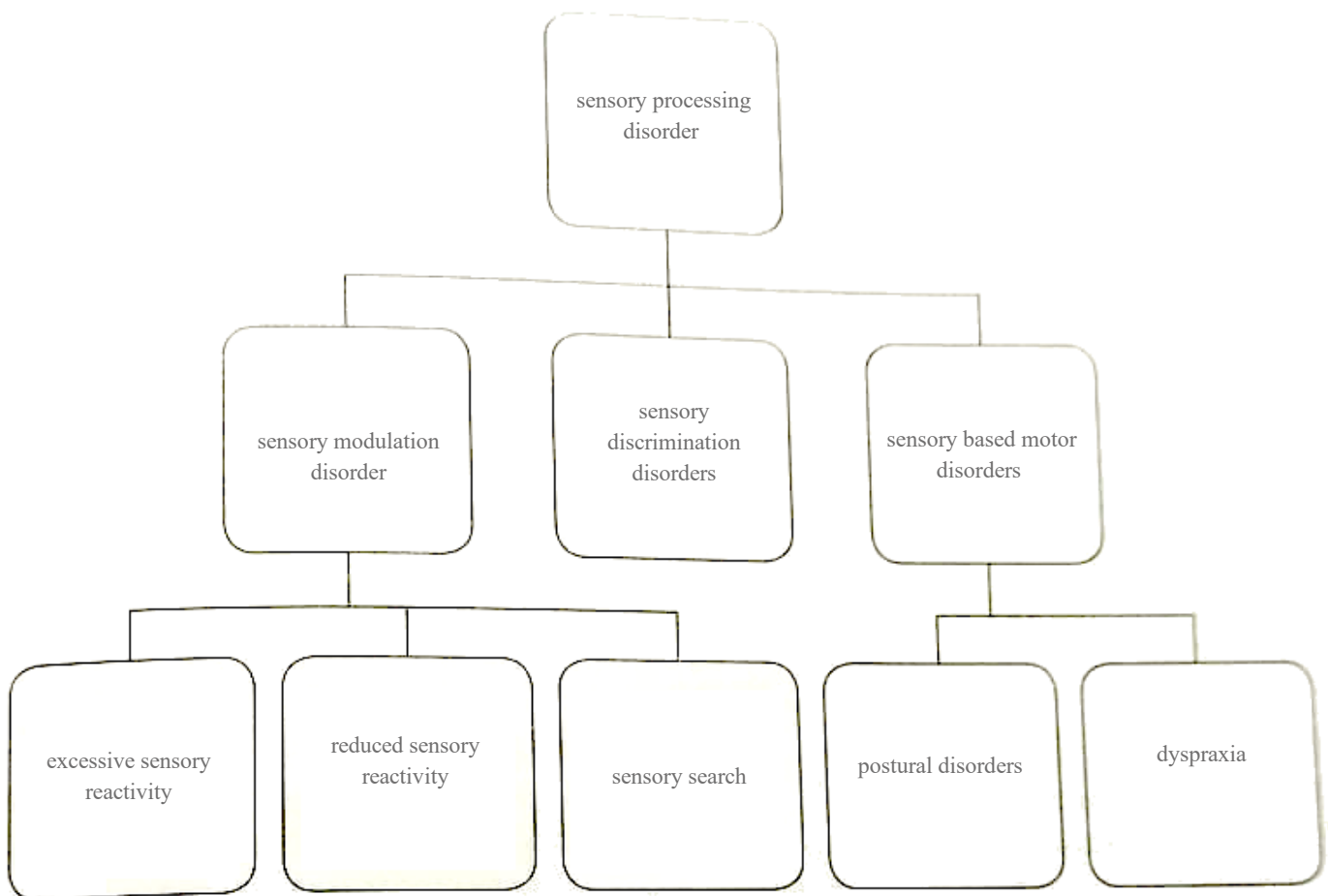


Figure 2. Kategorie i podtypy zaburzenia przetwarzania sensorycznego [7]

as specific developmental motor disorders (F82), which include an 'awkward child' syndrome, developmental coordination disorders and developmental dyspraxia. A specific feature of this syndrome is a serious disturbance in the development of motor coordination accompanied by problems in the performance of visual-spatial cognitive tasks. Additionally, choreoathetosis and mirror movements can be observed - symptoms of the immaturity of the nervous system [5]. Therefore, dyspraxia involves motor planning. According to Ayres, praxis is correct sequencing, ideation, i.e. an idea for the performance of a given task and motor planning. So it is the ability to invent motor tasks, organize and perform them. Children who have a problem in this area are dyspractic. It manifests itself primarily in delayed motor development, i.e. a delay in achieving milestones for proper development and an unsmooth course of movement, clumsy gait, frequent falling, difficulties in climbing stairs, riding a scooter or a bicycle when it comes to gross motor skills. In dyspraxia, the child's ability to act intentionally is disturbed, which is reflected in its functioning.

When analysing children with autism spectrum disorders, it can be noticed that modulation disorders in the vestibular and proprioceptive systems have a large impact on gross motor skills disorders. Symptoms of hypersensitivity - hyporeagibility in the vestibular system include:

- significant stimulations of a child within the vestibular system, e.g. it spins around its axis, is in constant motion;
- the child cannot stand properly on one leg, has big problems with balance – has the so-called gravitational uncertainty (manifested by difficulties in maintaining balance).

Symptoms of hypersensitivity - hyperreagibility in the vestibular system include the opposite:

- such children prefer activities in a sitting position,
- they lose orientation in space while performing quick movements.

Symptoms of hypersensitivity - hyporeagibility in the proprioceptive system:

- clumsiness,
- provoking falls,
- jumping from furniture,
- entering narrow spaces.

Symptoms of hypersensitivity - hyperreagibility in the proprioceptive system include:

- avoiding movement,
- quick fatigue,
- reluctance to lift heavy objects.

It all affects gross motor skills. When assessing the balance of children with autism, we observe problems that affect their functioning. Good balance is essential to successfully complete numerous daily activities. By observing a child riding a bicycle, we see how movement experiences give rise to adaptive responses, which in turn lead to sensory integration. Maintaining balance on the bicycle requires the child to react to gravity and be aware of its body movements [10]. Movement is the most important aspect of life. It is the basis of such skills as walking, running, eating,



communication, and work. It determines our survival skills. Motor control determines the ability to regulate or direct the essence of movement. Movement is the interaction between three indicators: an individual system, a task, and the environment. An individual system is an interaction between many systems, including sensory, cognitive, and motor processes. A large number of studies have confirmed that stable posture cannot be achieved without continuous sensory feedback, including vestibular, visual and somatosensory information input [11]. Therefore, it should be emphasized how important movement is in shaping motor skills of children with autism spectrum disorders. It is presented in research on how movement influences changes in motor skills, coordination and behaviour. In autistic people, significant, beneficial changes were noticed, expressed in locomotion skills, such as: independent walking, running around the house, kicking a ball, getting of the train efficiently and others. There were also improvements in jumping, throwing, balance and agility skills [12]. Conducting exercise therapy in a child with autism spectrum disorders is preceded by an in-depth diagnosis of the processing of sensory processes and the inclusion of exercises related to shaping balance and motor coordination in therapy. In children with autism spectrum disorders, disturbances in the regulation of sensory integration processes are very common, which are mainly due to disturbances in sensory processing. They appear when the nervous system improperly perceives, organizes sensory stimuli within the CNS, and reacts incorrectly to them. The occurrence of such dysfunctions most often results from damage to the sensory organs related to improper processing of reception stimuli [13]. Stereotypical behaviour and limiting oneself to a very narrow repertoire of interests mean that a child with autism spectrum disorders may be inhibited to a large extent in terms of motor development. Characteristic neurological symptoms occurring in children with autism spectrum disorders (ASD) include poor coordination, lateralization disorders, walking on tiptoes, abnormal reflexes, balance disorders, psychomotor hyperactivity, impaired motor skills, impaired perception of sensory impressions, impaired attention and concentration [14]. Various other symptoms of developmental abnormalities can also be observed in children with autism spectrum disorders, ranging from problems with the perception of the body schema, spatial and temporal orientation, decreased muscle tone, ataxia, and impaired eye-hand coordination. Disorders of the body schema can cause problems with simple activities such as dressing. Delayed motor skills can often be associated with a series of pointless global and fine movements. However, in order to prevent further negative consequences in development, such as the occurrence of posture defects, psychomotor retardation, and weakening of self-service activities, it is necessary to apply a whole series of rehabilitation activities [15]. Neuromotor deficits most often do not manifest themselves as severe neurological disorders, so they are difficult to diagnose in medical examinations.

However, they can be noticed in situations requiring good motor integration, e.g. when cycling or when throwing and catching a ball [16].

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