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The use of hippotherapy in shaping the body posture and balance in children with Down syndrome

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Wykorzystanie hipoterapii w kształtowaniu postawy ciała i równowagi u dzieci z zespołem Downa

Streszczenie

Zespół Downa (DS) należy do najczęstszych zaburzeń rozwojowych o podłożu genetycznym, których przyczyną jest trisomia 21 pary chromosomów. Częstość występowania zespołu Downa w populacji generalnej szacuje się na 1 na 732 niemowlęta. Odsetek ten wzrasta znacznie w przypadku rosnącego wieku rodzących kobiet. Zespół Downa manifestuje się szeregiem objawów za-

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równy podmiotowy, jak i przedmiotowy. Objawy przedmiotowe dotyczą głównie nieprawidłowości w budowie ośrodkowego układu nerwowego, narządów wewnętrznych, wad narządu wzroku i układu szkieletowego. Oba aspekty rozwoju, tj. fizyczny i umysłowy są opóźnione. Jedną z metod wspomagających leczenie chorych z zespołem DS jest hipoterapia. Przybiera ona różne formy, m.in.: terapii w postaci kontaktu z koniem, psychopedagogicznej jazdy konnej i terapeutycznej jazdy konnej. Celem artykułu było ukazanie wpływu hipoterapii na kształtowanie się postawy ciała oraz zdolności koordynacyjnych ze szczególnym uwzględnieniem równowagi ciała.

Słowa kluczowe: zespół Downa, hipoterapia, postawa ciała, niepełnosprawność intelektualna, równowaga.

Abstract

Down syndrome (DS) is one of the most common genetic developmental disorders that is caused by a trisomy of the 21st chromosome pair. The incidence of Down syndrome in the general population is estimated at 1/732 infants. This percentage increases significantly with the increasing age of women in labour. Down syndrome manifests itself in a variety of signs and symptoms. The signs mainly refer to abnormalities in the structure of the central nervous system, internal organs, eye and skeletal system defects. Both aspects of development, i.e., physical and mental, are delayed. One of the methods that supports the treatment of patients with DS is hippotherapy. It takes various forms, including: therapy in the form of contact with a horse, psycho-pedagogical horse riding and therapeutic horse riding. The purpose of the article was to present the influence of hippotherapy on the shaping of body posture and coordination skills with particular emphasis on body balance.

Keywords: Down syndrome, hippotherapy, body posture, intellectual disability, balance.

Introduction

Down syndrome is a congenital disease; it is the result autosomal chromosomal aberration and manifests itself in the presence of characteristic clinical features. The disease was first described by the English physician Langdon Down (1828–1896) in 1868 [12]. The cause of this disease has been unknown for a long time. It was only in 1959 that the French physician and geneticist Jerome Lejeune (1926–1994) discovered its cause, which was the trisomy of the 21st pair of chromosomes [25]. So far, no specific factors have been established that would indicate the cause of the disease. In the prevalent opinion, this defect is assumed not inherited from the parents, but is considered genetic, although these are rare cases – 2% of all diagnosed [2].

Epidemiology

According to Vallabhajosyula et al. [43], Down syndrome is one of the most common autosomal developmental disorders. The incidence of the syndrome is about 1 in 700 live births. Sherman et al. [40] estimate that DS occurs in about

1/732 infants. In this aspect, maternal age is emphasized as a significant risk factor; in young mothers, it occurs once in 1,200 live births, and among mothers over 40 years of age, the frequency increases to 1 in 40 live births. What follows is that more than 20% of children with Down syndrome are born to mothers over 35 years of age, although older mothers give birth to only 7–8% of all children. The extra chromosome comes from the father less often than from the mother; the difference is about 30% [2].

Signs and symptoms

Infants are usually quiet and calm; they rarely cry and show symptoms of decreased muscle tone. Both physical and mental development are delayed. The average intelligence quotient (IQ) is only about 50. Apart from the whole series of dysmorphic changes concerning individual parts of the body, the frequent occurrence of heart defects is emphasized, and it often determines the shorter life span of these people. People without heart defects reach the age of 40–50 years [2].

The developmental changes observed in people with Down syndrome usually include deficits in controlling posture and maintaining balance, as well as problems with maintaining the right body weight. According to Palisano et al. [30], postural and balance control deficits are associated with decreased muscle tone and an abnormal pattern of muscle response to joint movement. Children with this syndrome are more often than their peers in normal development with hearing loss [37] and atypical flow of agitation from the receptor to the analyzer through the visual route [31]. Moreover, such people usually suffer from disorders of the structure and functions of the organ of sight (60–69%), such as refraction defects, strabismus, and nystagmus [34]. Abnormalities in the functioning of the senses that cause difficulties in controlling balance constitute the picture of sensory integration disorders [36, 37]. According to Łasak and Żuchowicz [22], in the revalidation of people with Down syndrome, great importance is placed on their participation in physical education classes, which facilitate their psychosocial functioning. Physical activity and good physical fitness are important factors influencing the health, lifestyle, and well-being of these people.

Therapies with animals

Therapy with the participation of animals, i.e. zootherapy (animal therapy) has been used in modern medicine since the 1960s. According to Boguszewski [4], in addition to dog therapy, hippotherapy is the most popular of zootherapy method. In Poland, the first attempt to introduce this form of therapy was made in 1946, in Łódź, while the first centre was established in 1962, in Konstancin. The founder of this centre was Prof. Marian Weiss [39]. According to the Polish Hippotherapy Society, hippotherapy is a targeted therapeutic action aimed at

improving human functioning in the physical, emotional, cognitive, and social spheres, during which a specially selected and prepared horse is an integral part of the therapeutic process. In horse therapy, it is important for the patient's safety, as well as for its effectiveness, to choose the right horse. Calm horses with a mild and balanced temperament are recommended [44].

The purpose of the work was to present a review of the research results on the effects of the use of hippotherapy in the treatment of children with Down syndrome, with particular emphasis on the impact on their body posture and balance.

Methods

This work is a narrative review and has been written based on the method of document analysis using qualitative and quantitative techniques. The research tool, however, was Polish and foreign literature from the database, namely AWF Kraków Library, Web of Science, PubMed, and Google Scholar.

The article presents the results of studies related to the efficiency of hippotherapy in the treatment of children with Down Syndrome, from the period of time between 2000-2020, especially from international publications. The articles have been reviewed in the context of the type of therapeutic treatment as well as the documented impact of the therapy.

From the above mentioned database, 25 articles related to hippotherapy have been selected, of which number, 17 articles have been further examined. These articles have met the high methodological standards and at the same time met the following inclusion criteria: (1) showed the effects of the use of hippotherapy in children with Down Syndrome, (2) presented various forms of hippotherapy, (3) included other aspects, e.g., social ones, of hippotherapy.

The analysis excluded unrelated work, systematic reviews, meta-analysis, and case studies. The following key words have been used to search for information: Down syndrome, hippotherapy, body posture, intellectual disability, coordination problems, and balance.

Results and discussion

The balance of the human body

Balance, similar to other coordination abilities, together with fitness abilities, constitutes human motor activity, which, according to Bulicz et al. [7], is one of the most important aspects of physical health. Błaszczuk [3] defines it as

“a specific state of the postural system”. This state is achieved by balancing the forces and their moments acting on the body.

The issue of the balance of the human body, understood as the ability to keep the centre of gravity of the body above the support plane, should be considered in a broader context, i.e., maintaining the correct body posture and spatial orientation. People maintain balance thanks to the work of skeletal muscles under the control of the nervous system, and in particular, it is determined by: proprioception receptors, the organ of balance, and eyesight.

The organ of balance of the human body is the labyrinth located in the inner ear. The labyrinth consists of three elements, i.e. the cochlea (which is the organ of hearing), the semicircular canals, and the vestibule, which we consider to be the proper organ of balance. This organ works closely with the cerebellum, its main nucleus called the cerebellar vermis. The most important functions of the cerebellum include controlling all body movements, maintaining balance and correcting body posture, as well as controlling the eyeballs [45]. In DS, the functions of the cerebellum are altered, which is mainly manifested by hypotonia.

Forms and effects of hippotherapy

Pakulska et al. [29] describe the following forms of hippotherapy activities: 1) therapeutic horse riding – this is therapeutic gymnastics on a walking horse, aimed at improving the patient's mobility; 2) psycho-pedagogical horse riding and vaulting – a set of equestrian, pedagogical and psychological activities carried out to gain intellectual, cognitive, emotional and physical improvement; 3) horse contact therapy – its purpose is to establish contact between the patient and the animal.

In recent years, many publications have appeared discussing the effectiveness of horse therapy. They study mainly groups of patients with cerebral palsy and autism spectrum disorders. Fewer studies focus on people with dyspraxia and psychomotor hyperactivity [10]. Based on the analysis of the literature from databases, it can be concluded that the most widely used form of hippotherapy in the case of intellectual disability is therapeutic horse riding (Table 1).

Table 1. Analysis of the forms and effects of hippotherapy

Author	Form of therapy	Study participants	Effect of therapy
Ajzenman et al. [1]	THR – therapeutic horse riding	Children aged 5–12 (autism spectrum disorder)	Improvement of adaptive behaviour
Hessionet al. [16]	HR – horse riding	Children aged 6–15, (dyspraxia)	Improvement of cognitive functions
Kwon et al. [20]	THR – therapeutic horse riding	Children aged 4–10 (cerebral palsy)	Improvement of gross motor skills

Table 1. Analysis of the forms and effects of hippotherapy (cont.)

Author	Form of therapy	Study participants	Effect of therapy
Gabriels et al. [14]	THR – therapeutic horse riding	Children aged 6–16 (autism spectrum disorder)	Improvement in social communication
Matusiak-Wieczorek et al. [24]	THR – therapeutic horse riding	Children aged 6–12 (cerebral palsy)	Improvement of body posture
García- Gomez et al. [15]	CH – contact with a horse	Children aged 7–14, (psychomotor hyperactivity ADHD)	Improvement of interpersonal relationships
Champagne et al. [8]	HR – horse riding	Children aged 4–12 (cerebral palsy)	Improvement of gross and fine motor skills

Review of results of the studies on the effectiveness of hippotherapy in improving balance in people with Down syndrome

Research by Moriello et al. [26] showed that a walking horse transmits multifaceted movement impulses typical of human walk, which affect the patient's balance, posture, and coordination. Proprioceptive stimulation obtained thanks to the right seat makes it possible to learn and consolidate optimal movement patterns, while regulating muscle tone [38].

The starting point in hippotherapy is the patient assuming the right, functional position on the horse, still motionless, when the horse is standing. The link through which the stimuli are transmitted to and from the horse is the pelvic part, in particular the ischial tuberosity. During hippotherapy, the pelvis of the patient sitting astride on the horse is in a middle position, between the anterior and posterior inclination, it is symmetrically loaded, perpendicularly to the direction of movement. The shoulder girdle is placed in a straight line over the pelvic girdle, not in protraction or retraction, without lateral displacement, perpendicular to the direction of movement. The head is an extension of the spine line; it is neither extended nor retracted. The seat allows the patient to receive any movement stimulation from the horse that affects coordination and joints [39, 44].

Many scientific studies emphasize the positive influence of horseback movements on the shaping of posture and balance reflexes. This relationship was confirmed by Bolach and Kozak [5], who noted an improvement in balance among people with Down syndrome who participated in hippotherapy classes. The authors of the study, using the Eurofit test of standing on one leg and a test of standing on the Balance Master mobile platform, indicated a greater ability to maintain balance, both static and dynamic, in people taking part in horse classes. The positive influence of hippotherapy on the balance of children with Down syndrome was also presented in the studies by Sipko et al. [41]. The purpose of the studies was to assess the influence of 6-month hippotherapy on the effi-

ciency of balance reactions. Eight children aged 8–12 years with mild and high level of intellectual disability were tested. The stabilographic method was used to evaluate the efficiency of their balance reactions. During the test, the children were asked to assume a relaxed standing posture, placing their feet hip-width apart. The measurement time was 10s. Body stability was measured in a relaxed standing position with open and closed eyes. On the basis of the course of the stabilographic curves, two parameters of body stability were calculated: the range of sways (in the sagittal and frontal planes) and the average speed of the sways. It has been proven that six-month hippotherapy had a positive effect on motor coordination. This correlation was also confirmed in the studies by Portaro et al. [33]. Also, Sawaryn [39] in her work emphasizes improved coordination of the patient's movements, balance skills, and the abilities of balancing with the trunk, as well as the normalization of muscle tone during hippotherapy. It is also worth noting Kwolek's results of the experiment [19], who showed an improvement in balance through the use of six-month hippotherapy in children with Down syndrome. The author conducted tests before beginning the therapy (once a week) and after its completion. The test consisted in performing 4 exercises in a standing position and 6 in a four-point kneeling position. The results obtained showed a significant improvement in static balance in people with profound intellectual disabilities.

An interesting assumption of the research was also presented by Lee and Jeoung [23], who undertook to determine the relationship between motor skills and problems related to the behaviour of young people with intellectual disabilities. They confirmed that disorders in terms of balance behaviour significantly influence the incidence of social problems in people with Down syndrome. There is evidence that it is possible to stimulate the mental state of people with Down syndrome through therapy with the participation of a horse [35]. Studies by Debusse et al. [11] have shown a reduction in emotional tension and growing calmness. Similar results were obtained in their work by Murphy et al. [27]. According to Bracegirdle [6], physical activity should not only focus on stimulating balance, but also trigger a sense of success and pleasure. According to reports by Lafferty [21], fitter people are better perceived by their community and have greater self-esteem.

Conclusions

According to Sack and Buckley [36], both static and dynamic balance is one of the main coordination skills, which during the developmental process of children and adolescents allow them to learn and improve motor skills. Rehabilitation development has contributed to the use of neurodevelopmental methods

considered the most effective in improving the fitness of people with Down syndrome. Their main aim is to teach them the right movement patterns and to use the plastic properties of the children's nervous system [9]. On the basis of the analysis of the literature, it can be concluded that the most frequently obtained effects, thanks to the use of this form of therapy, include motor improvement leading to an improvement of balance and symmetrical distribution of pressure forces on the support plane and an improvement of the posture control mechanism [32].

The level of motor fitness is influenced by the relationship between the development of the physical and the intellectual sphere. Ulrich's reports [42] show that people with Down syndrome have difficulties in functioning in social life. One of the causes is body balance disorder as well as cognitive limitations caused by intellectual disability. According to Kasperczyk et al. [17], maintaining a balanced posture depends on the processing and interpretation of sensory information responsible for the neurophysiological regulation of body posture. That is why it is very important to stimulate the motor development of people with Down syndrome as early as possible. The need for early hippotherapy is supported by the fact that the nervous system of children up to the age of three is in the maturation stage and shows high plasticity, which allows the formation of new reflex arcs [28]. Plasticity, in addition to excitability, is the second basic feature of nerve cells, due to which permanent functional transformations occur in certain neuron systems as a result of the action of specific impulses of sensory stimulation or their combination [13]. Describing hippotherapy, Krupiński [18] draws attention to the need to maintain the right position of the child on a horse as long as possible, which contributes to the correct reception, coding and subsequent reproduction of the walk pattern. Moreover, there is a comprehensive motor stimulation and accumulation of multiple motor experiences. A wide base of coordination abilities is created and basic sensory functions are improved. Basic coordination skills are shaped, important in posture regulation, which, according to Kasperczyk et al. [17], has a reflexive character based on a large group of corrective reactions.

In light of the above considerations, it can be concluded that the improvement of balance may be an important component in the process of stimulating and compensating for the development of motor skills in people with Down syndrome. People with disabilities, and in particular those with intellectual disability, require comprehensive rehabilitation, taking into consideration educational, psychological, and social aspects. The latter aspect is particularly important due to the fact that the process involves the participation of therapists and parents or guardians of children who undergo therapy, which gives everyone satisfaction and a much-needed feeling of success.

DECLARATION OF CONFLICTING INTERESTS

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