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The role of hippotherapeutic exercises with larger support surface in development of balance in boys aged 15 to 17 years with mild intellectual disability

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Purpose: Maintaining balance in humans involves continuous changes in parameters. The aim of this study was to assess the effect of hippotherapeutic exercises on development of the sense of balance in boys aged 15 to 17 years with mild intellectual disability. *Methods*: The study examined 50 randomly chosen boys aged 15 to 17 years with mild intellectual disability from the special education centre in Leżajsk, Poland. The study participants were divided into two groups: experimental group, who participated for 3 months in hippotherapeutic classes and the control group, with boys attending outdoor or indoor physical education classes. Before and after completion of the study, both experimental and control groups were diagnosed by means of Accu Sway^{Plus} force plate. The force plate was used to determine alterations in the position of the centre of pressure (COP) on the platform in the frontal and sagittal planes in relaxed standing position with feet spread to the shoulder width and with eye control with respect to the base of support (BOS). The description was based on mean displacement of the centre of gravity (COG), mean velocity of displacements of the COG, mean radial displacement and total length of the COP pathway. *Results*: In the experimental group, equestrian exercises induced a series of significant changes that pointed to the improved balance reactions. The character of these changes in the positions analysed was similar: values of body sway in the sagittal plane and their range and mean displacements decreased statistically significantly after training. The same tendency was observed for mean radial displacements in the free open position and with closed support surface. Furthermore, the velocity of displacement and the length of the COP's projection pathway on the support surface in the free open position was also reduced. All significant changes and trends found for the experimental group, which occurred after 3 month of hippotherapeutic classes, suggest improved parameters of balance. *Conclusions*: The lack of changes in balance parameters in the control group shows that the hippotherapeutic classes significantly develop balance abilities in boys aged 15 to 17 years with mild intellectual disability.

Key words: *stabilographic parameters, balance, hippotherapy, intellectual disability, mild intellectual disability*

1. Introduction

Motor abilities depend on many individual determinants: motor and physical aptitudes that reflect potential abilities of a person in terms of motor development and their physical and motor fitness. Improvement of these abilities represent an essential component of psychomotor education [5]. With contemporary human demands, motor coordination viewed as a process of control and regulation of motor activities is becoming more and more important [19].

Body balance is considered as an opportunity to maintain the expected body posture with small lateral sway (static balance), even distribution of body mass between supporting components, ability to maintain standing positions combined with sway and moving without falling (dynamic balance) [7], [14]. Postural balance is also approached under categories of the control and regulation process and as

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a set of individual properties determined by these processes [9].

The ability to maintain postural balance and regulate equilibrium in a standing position represents a process of very accurate neuromuscular control based on sensory information [12]. Balance reactions that occur at various levels of the nervous system form the mechanisms that secure proper location of the centre of gravity (COG) over the support surface [2], [8].

From the neurophysiological standpoint, control of position of individual body segments occurs through integration of the central and peripheral control [4], [12]. The postural control system requires development and improvement. With repeated stimuli, coordination becomes improved, which leads to development of a habitual reaction.

Children with mild intellectual disability (F70, II = 50–69 according to the International Classification of Diseases and Related Health Problems ICD-10 published by the World Health Organization) are characterized by poorer psychomotor activity that depends on the level of disability [6].

A direct cause of intellectual disability is damage of the central nervous system, which causes a reduction in the intellectual abilities. Therefore, children with intellectual disability often show disturbances in intellectual, orientation, cognitive and executive processes and abilities of social adjustment. Large part of these children also show disturbances of motor development, which is directly linked to their mental development [22].

The evaluation of the level of intellectual disability in a person below 16 years of age is based on the criteria defined by the Ordinance of the Ministry of Labour and Social Policy as of 1 February 2002. The disability is evaluated by county (principal unit of territorial division in Poland of the second level), municipal and voivodeship disability boards. Evaluation of the disability in a child takes into consideration physical and mental abilities of the child and the degree of limitation to the body function and opportunities for improvement of the functional status through treatment and rehabilitation (the Ordinance of the Minister of Labour and Social Policy as of 15 July 2003).

Nowadays, the similarity in the psychomotor development of children with reduced mental abilities and children with standard level of intelligence is emphasized, showing that the children with intellectual disability go through the stages of development in the same order as their healthy peers, but much more slowly and they do not always fully utilize their developmental potential [11], [24]. Children with mild intellectual disability suffer from disturbances in intellectual, orientation, cognitive, executive, emotional and motivational processes, have problems with social adjustment and experience problems with motor development. Some of these disturbances are related to the physical damage to the central nervous system while the others remain in close relationship with mental development. Such children are also characterized by disturbed motor coordination and problems with maintaining balance [1], [22].

One of the forms of psychomotor rehabilitation that involves motor, sensory, mental and social effects is therapeutic horse riding based on hippotherapy. With the specific effect of natural movement of a horse on the rider and the choice of the methodology and exercises performed during the classes, hippotherapy enables a multifaceted correction of human function [17], [20]–[21]. It helps normalize muscular tension caused by the damage to the central nervous system, recover body symmetry and improve balance in the frontal plane. Each position, movement and change in body location during horse riding should be regarded as balance exercises. The basic balance exercise is to maintain proper position on the horseback when the horse is walking. The changes in position of individual body parts caused by these movements leads to the displacement of the centre of gravity of the rider and transfer of new stimuli from sensory receptors and the vestibular system, forcing the central nervous system to receive them and attempt to regain balance [9], [18]. The rider straddling a horse during the horse's walk experiences easy, repeated movements of the pelvis, similar to the pelvis movement that is observed during walk of healthy humans [10]. Furthermore, changes in the speed, direction and location of the body experiencing the rhythmic horse's movements stimulate the sense of balance [21]. In terms of the number of steps per minute, horse's walk is similar to human gait. An average human adult, similar to an adult horse, makes around 110 to 120 steps per minute. During the classes of the horse's walk, raiders were allowed to practice the specific skills for many times, particularly those concerning balance [18], [21]. With its specific nature, horse riding has a complex effect on human body, especially on human posture assumed as a response to horse's movements. Horse riding and classes with horses represent a complex holistic effect on human, forming its natural movement necessary for normal function. A horse riding is aimed at automated stabilization of posture with respect to the centre of gravity. The three-dimensional horse's movement stimulates human gait and ensures the balance in body segments, leading to their working without excessive tension and exercise in proper balance and rhythm.

The aim of the study was to evaluate the role of hippotherapeutic exercises in development of balance in boys aged 15 to 17 years with mild intellectual disability through comparison of stabilographic parameters in free standing and closed standing with reduced support surface before and after 3-month hippotherapy classes. We also asked the specific research questions. The first one was how substantially the values of stabilographic parameters in the free standing position and in the position with reduced support surface changed after 3-month cycle of horse riding classes. The second was which differences in body equilibrium were caused by 3-month hippotherapeutic exercises between the experimental and control groups in people with mild intellectual disability and in terms of the parameters studied. Two research hypotheses were adopted. First of all, specialized hippotherapeutic classes should substantially improve balance in the free standing position and in the position with reduced support surface. Secondly, the people with mild intellectual disability who were involved in hippotherapeutic exercises should have fewer problems with maintaining balance in the free standing position and in the position with reduced support surface compared to people who did not perform these exercises.

2. Materials and methods

50 students with mild intellectual disability from a special education centre in Leżajsk, Poland, participated in the study from April to June 2009. All of them were boys aged 15 to 17. The chronological age was evaluated during recruitment for the study according to the statistical principle so that 15 year old people were considered as those at the age from 14 years, 6 months and one day to 15 years and 6 months. Boys were at the older childhood development stage used in the anthropology according to the criterion by Promińska [13]. The inclusion criteria for the experiment were current medical certificate of mild intellectual disability issued by the the multidisciplinary Decision Board of the Psychological and Pedagogical Counselling Centre in Leżajsk confirmed by a psychologist and a school guidance counsellor and the consent of parents (guardians). The first group, with 25 participants, was involved for 3 months and 3 times a week for 45 minutes in hippotherapy classes in the Equestrian Centre in Leżajsk, Poland, from June 2009. The classes were carried out by qualified hippotherapists. The second group, with 25 participants, was the control group and participated in the physical exercise classes with the same time load as the experimental group, based on general fitness exercises according to the curricula used in the special education centre. The characteristic of the research groups is presented in Table 1.

Table 1. Characterization of the research groups: experimental and control groups of body with mild intellectual disability aged 15 to 17 years

	Mass [kg]	Body height [cm]	Age [years]	*N*
GROUP 1 experimental	60.3 ± 12.52	164.8 ± 8.98	16.1 ± 0.72	25
GROUP 2 control	62.4 ± 2.18	170.2 ± 6.35	16.0 ± 0.81	25

The curriculum was developed according to the recommendations of the Polish Hippotherapy Society and Polish Equestrian Association and included balance exercises during both horse's walk and horse's trot and coordination exercises. The following balance exercises during horse riding were performed: riding forward with proper position on the horseback, balance exercises during "Stand" position and horse's walk, resting hands on thighs, lifting hands up, clapping over the head, resting hands on the horse's rump, placing hand under the buttocks, performing the rotated position – one hand holds the mane, the other holds the tail, sitting on a horse while facing backward, reaching to different horse's body parts (scapulae, ears, tail) or rider's own body parts (knee, foot), standing on the stirrups in the "Stand" position, performing the "mill" exercise" – rotation by 180°, performing the "fish" exercise – front scissors. The classes were carried out by a two-person team of hippotherapists.

Before and after the research, both control and experimental groups were diagnosed using the Accu Sway^{Plus} force plate (also used in other research programs) by a trained researcher from the University of Rzeszów, Poland. The force plate was used to determine alterations in the position of the centre of pressure (COP) on the platform in the frontal and sagittal planes in relaxed standing position with foot spread to the shoulder width and with eye control with respect to the base of support (BOS). The measurements were performed in two positions:

- „1" (relaxed, open position, with feet spread to the shoulder width),
- „2" (closed position with reduced support surface: feet connected).

Table 2. Stabilographic parameters (means and standard deviations) in the first examination for the experimental group (1) and the control group (2)

Stabilographic parameter	Position "1"		Position "2"	
	Group 1	Group 2	Group 1	Group 2
Range X [cm]	**2.59 ± 1.188***	2.73 ± 1.902	3.89 ± 1.481	3.24 ± 1.652
Range Y [cm]	6.89 ± 2.723	7.38 ± 3.201	6.86 ± 2.984	7.16 ± 3.170
SX [cm]	0.55 ± 0.284	0.58 ± 0.355	0.80 ± 0.343	0.85 ± 0.333
SY [cm]	1.79 ± 0.804	1.63 ± 0.670	1.66 ± 0.867	1.33 ± 0.679
$S_{mean}X$ [cm]	0.38 ± 0.182	0.40 ± 0.220	0.59 ± 0.213	0.64 ± 0.248
$S_{mean}Y$ [cm]	1.09 ± 0.467	1.02 ± 0.412	1.04 ± 0.482	0.89 ± 0.388
$S_{mean}R$ [cm]	1.20 ± 0.475	1.17 ± 0.432	1.31 ± 0.479	1.22 ± 0.385
V_{mean} [cm/s]	1.68 ± 0.267	1.86 ± 0.604	2.24 ± 0.410	2.52 ± 0.845
L [cm]	50.48 ± 8.013	55.74 ± 18.107	67.09 ± 12.291	75.64 ± 25.346

* $p < 0.05$ (Mann–Whitney U test).

Reliability of the measurement equipment was maintained using the procedure of resetting before each measurement. The measurement of each parameter took about 30 second. Each participant was informed about the details of the test.

A statistical analysis was performed for the selected parameters of Bio Soft software for balance analysis, which recorded the natural sway of the centre of gravity in the frontal and sagittal planes. Based on the measurements, the following parameters were analysed:

- sway range (Range X [cm], Range Y [cm]),
- mean displacement of the COG ($S_{mean}X$ [cm], $S_{mean}Y$ [cm]),
- mean velocity of displacement of the COG (V_{mean} [cm/s]),
- mean radial displacement ($S_{mean}R$ [cm]),
- mean sway velocity [cm/s],
- total length of the pathway of the COP projection on the support surface (L [cm]).

Statistical analysis was performed using the Statistica 8 software package. The descriptive statistics of the variables recorded with arithmetic means and standard deviations was used. The analysis of distribution of the variables was also conducted. This analysis demonstrated the lack of normal distribution and homogeneity of variation. Therefore, intergroup differences were evaluated using the Mann–Whitney U-test, whereas the Wilcoxon test for dependent samples was employed to find significant intragroup changes since the examination was performed twice, before the classes and after 3 months. The comparative analysis carried out for the initial examinations between the experimental and control groups found no statistically significant differences. The participants from both groups had similar stabilographic parameters in the static positions used during the experiments, which reflects the homogeneity of the groups that participated in the experiment (Table 2).

3. Results

Analysis of parameters in the experimental group measured after hippotherapy classes points to the improvement in most of the stabilographic indices.

The results obtained for young people revealed that changes did not concern the parameters measured in the frontal plane along the X axis. Values of the sway range for the stabilogram curve in the frontal plane (Range X) and values of sway range in the X axis (SX) and the mean displacement of the coordinate in the frontal plane before and after classes ($S_{mean}X$) were similar and did not differ statistically significantly. This concerned both open standing position "1" and closed position "2" (Table 3).

Analysis of stabilographic initial and final parameters in the sagittal plane in the experimental group (1) revealed statistically significant changes in values of all the parameters measured along the Y axis (Table 3).

Sway range Y (Range Y) in the case of open free position "1" in the beginning of the experiment was equal to 6.89 cm, whereas after its completion it was reduced to 5.79 cm. (Table 3, Fig. 1).

Similar tendency to changes in the values occurred in the case of sway values (SY). Comparison of the parameters before and after completion of the hippotherapy classes revealed a decline in the value from 1.79 cm to 1.41 cm (Table 3, Fig. 2).

Table 3. Stabilographic parameters (means and standard deviations)
for the first and the second examination in the experimental group (1)

Stabilographic parameter	Position "1"		Position "2"	
	Examination 1	Examination 2	Examination 1	Examination 2
Range *X* [cm]	2.59 ± 1.188	2.43 ± 1.297	3.89 ± 1.481	3.80 ± 1.536
Range *Y* [cm]	**6.89 ± 2.723***	**5.79 ± 2.068***	**6.86 ± 2.984***	**6.12 ± 2.192***
SX [cm]	0.55 ± 0.284	0.49 ± 0.320	0.80 ± 0.343	0.75 ± 0.274
SY [cm]	**1.79 ± 0.804***	**1.41 ± 0.604***	**1.66 ± 0.867***	**1.38 ± 0.671***
$S_{mean}X$ [cm]	0.38 ± 0.182	0.34 ± 0.189	0.59 ± 0.213	0.58 ± 0.187
$S_{mean}Y$ [cm]	**1.09 ± 0.467***	**0.88 ± 0.347***	**1.04 ± 0.482***	**0.87 ± 0.368***
$S_{mean}R$ [cm]	**1.20 ± 0.475***	**1.01 ± 0.318***	**1.31 ± 0.479***	**1.16 ± 0.332***
V_{mean} [cm/s]	**1.68 ± 0.267***	**1.59 ± 0.178***	2.24 ± 0.410	2.07 ± 0.282
L [cm]	**50.48 ± 8.013***	**47.60 ± 5.355***	67.09 ± 12.291	62.14 ± 8.455

* $p < 0.05$ (Wilcoxon test).

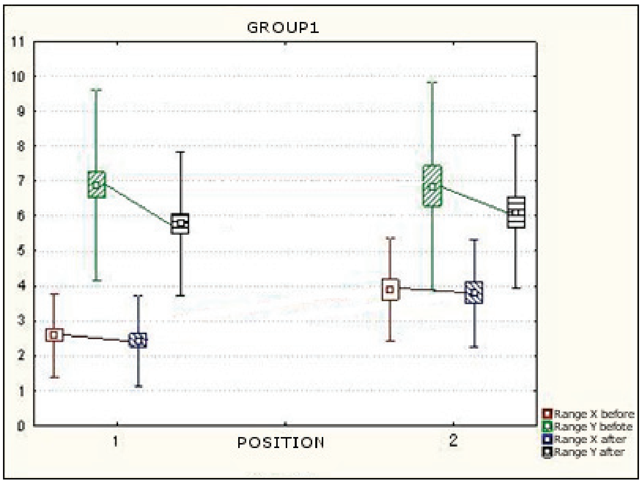

Fig. 1. Sway range for the frontal plane (Range *X*)
and sagittal plane (Range *Y*) before and after hippotherapy classes
in positions "1" and "2": experimental group (1)

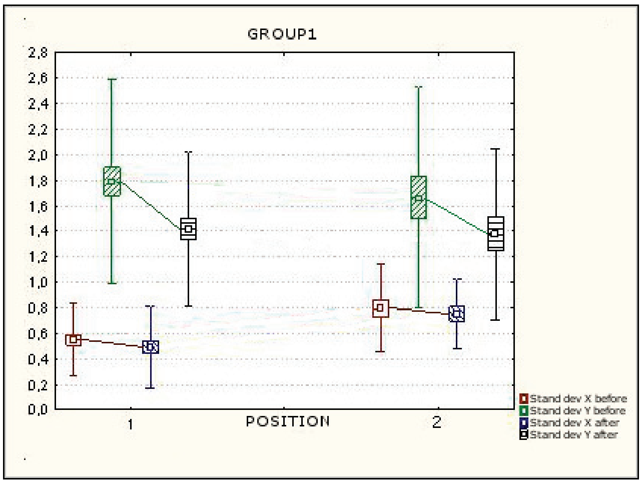

Fig. 2. Sway values for the frontal plane (*SX*)
and sagittal plane (*SY*) before and after hippotherapy classes
in positions "1" and "2": experimental group (1)

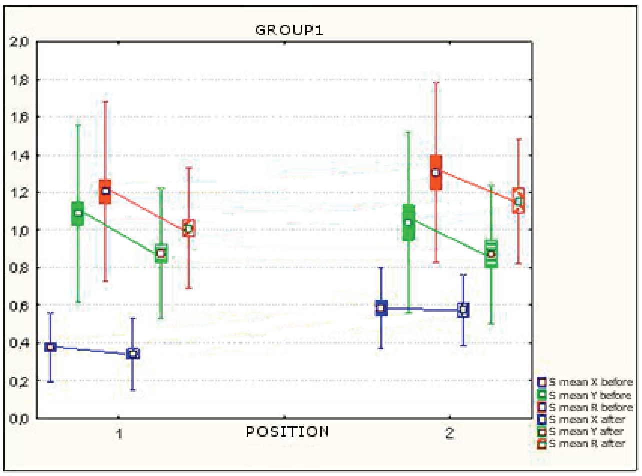

Fig. 3. Mean projection of the COG projection
in both planes ($S_{mean}X$, $S_{mean}Y$) and radial displacement (*R*)
before and after hippotherapeutic classes in positions "1" and "2":
experimental group (1)

The index of mean displacement of the COG projection in the sagittal plane ($S_{mean}Y$) was also changed, showing a statistically significant decrease from 1.09 cm to 0.88 cm (Table 3, Fig. 3).

Analogous changes were observed for these parameters measured in the closed position "2". In the case of the sway range for the sagittal plane (Range *Y*), a decline from 6.86 cm to 6.12 cm was observed (Ta-

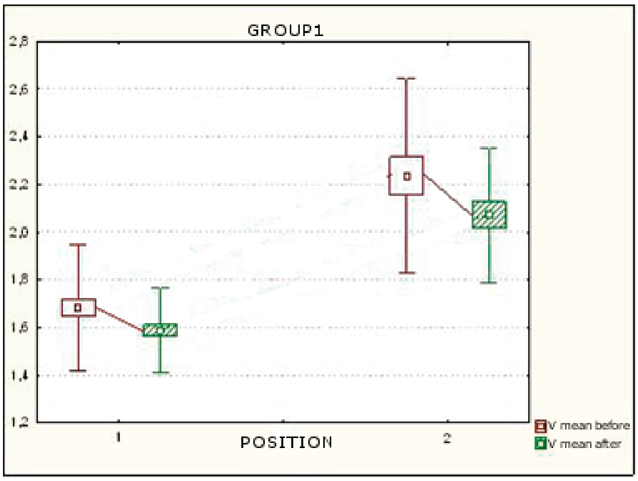

Fig. 4. Analysis of mean sway velocity (V_{mean}) before and after hippotherapy classes in positions "1" and "2": experimental group (1)

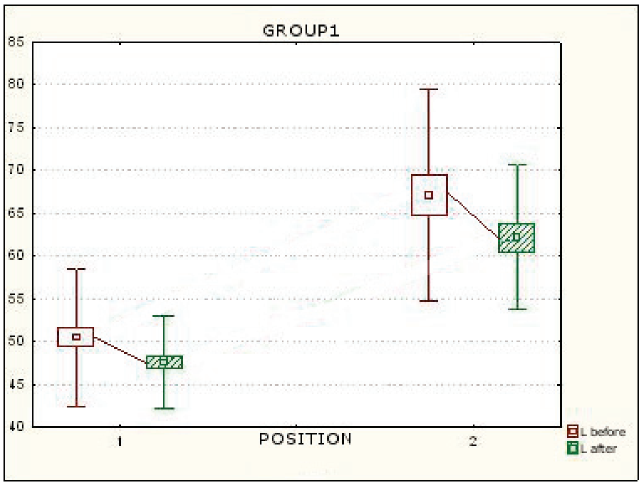

Fig. 5. Length of the pathway of the COG projection on the support surface (L) before and after hippotherapy classes in positions "1" and "2": experimental group (1)

Table 4. Stabilographic parameters in the experimental group (1) and control group (2) in the second examination

Stabilographic parameter	Position "1"		Position "2"	
	Group 1	Group 2	Group 1	Group 2
Range X [cm]	2.43 ± 1.297	2.76 ± 1.903	3.80 ± 1.536	3.44 ± 1.651
Range Y [cm]	**5.79 ± 2.068***	**7.28 ± 3.202***	**6.12 ± 2.192***	**7.18 ± 3.171***
SX [cm]	0.49 ± 0.320	0.58 ± 0.345	0.75 ± 0.274	0.85 ± 0.333
SY [cm]	**1.41 ± 0.604***	**1.62 ± 0.671***	**1.38 ± 0.671***	**1.43 ± 0.677***
$S_{mean}X$ [cm]	0.34 ± 0.189	0.43 ± 0.219	0.58 ± 0.187	0.64 ± 0.248
$S_{mean}Y$ [cm]	**0.88 ± 0.347***	**1.03 ± 0.422***	**0.87 ± 0.368***	**0.99 ± 0.387***
$S_{mean}R$ [cm]	**1.01 ± 0.318***	**1.19 ± 0.431***	**1.16 ± 0.332***	**1.22 ± 0.385***
V_{mean} [cm/s]	**1.59 ± 0.178***	**1.86 ± 0.614***	2.07 ± 0.282	2.52 ± 0.845
L [cm]	**47.60 ± 5.355***	**55.54 ± 18.107***	62.14 ± 8.455	75.64 ± 25.346

* $p < 0.05$ (Mann–Whitney U test).

ble 3, Fig. 1). Sway range (SY) and mean displacement for the Y axis ($S_{mean}Y$) was also reduced from the level of 1.66 cm to 1.38 cm and from the level of 1.04 cm to 0.87 cm (Table 3, Figs. 2, 3). Similar tendencies for changes in both positions were found for mean radial displacements ($S_{mean}R$) from 1.20 cm to 1.01 cm in the open position "1" and from 1.31 cm to 1.16 cm in the closed position "2", pointing to beneficial changes in the sway in the sagittal plane despite the lack of significant differences in sway in the sagittal plane (Table 3, Fig. 3).

Analysis of mean sway velocity (V_{mean}) and total length of the pathway (L) revealed statistically significant changes after completion of hippotherapy classes only for the open free position "1" (Table 3, Figs. 4, 5).

In the case of mean sway velocity (V_{mean}) changes in this parameter were from 1.68 cm/s to 1.59 cm/s, whereas for the total length of pathway (L) the change concerned two values, from 50.48 cm/s to 47.6 cm/s (Fig. 5).

The 3-month classes did not cause a significant change in the parameters measured in the closed position with reduced support surface with exception for the measured parameters in the sagittal plane along the X axis (Table 3).

The repeated measurement after completion of the experiment in both experimental (1) and control (2) groups revealed statistically significant differences between the groups studied (Table 4). In the free position "1", they concerned the following parameters: Range Y (5.79–7.28 cm), SA (1.41–1.62 cm), $S_{mean}Y$ (0.88–1.03 cm), $S_{mean}R$ (1.01–1.19 cm), V_{mean} (1.59–1.86 cm), L (47.60–55.54 cm). In the closed position "2", the differences concerned only the parameters measured in the sagittal plane along the *Y* axis.

The stabilographic parameters confirmed the differences between boys from the groups studied. The 3-month hippotherapy classes caused the improvement in balance reactions in boys compared to the group of boys who followed a similar (in terms of quality and quantity of load) physical education program. The changes concerned parameters measured in the sagittal plane in both free standing position and in the position with reduced support surface. Furthermore, lower values were found in boys from the experimental group in the free standing position for indices of mean sway velocities and total length of pathway, which also suggests the improvement in balance (Table 4).

4. Discussion

Balance is a specific status of the human postural system achieved through control of the forces that act on human body by the nervous system. Maintaining balance in the standing position is also affected by the size and shape of the support surface and location of the centre of gravity with respect to the centre of the support surface [2], [8], [9].

Body balance can be evaluated using many parameters. This study evaluated only certain parameters of the static balance in boys aged 15 to 17 with mild intellectual disability depending on the size of the support surface and opportunities to correct them using a specific program of hippotherapeutic classes.

After 3 months of hippotherapeutic classes, the boys with mild intellectual disability had much better results that reflected maintaining body balance in the standing positions compared to their peers from the group where physical activity was ensured by physical education classes at school. Values of all the parameters analysed in the study were improved. Sway range in the sagittal plane (Range Y) was greater than in the frontal plane (Range X) both before and after the experiment. This is correlated with differences in how the ankle joint and hip joint work. The central nervous system controls the location of the centre of gravity through application of the adequate muscular contraction and joint stabilization. The balanced body trunk, with its centre of gravity located at the height of the ninth thoracic vertebra in the sitting position, in the same axis as the axis going through the centre of horse's gravity, transfers swinging motion on the rider's limbs. The feet receive the movement waves in the location of the midfoot support in stirrups. The foot, amortized in the knee joint, puts the pressure on the stirrup. Lifting the toe tips during pronation occurs through freely lowered foot, which results from the proper position of lower limbs, physiological performance of the hip joint, pelvis mobility and free flow of its movements to body trunk [10], [15], [16], [21]. This is reflected by smaller sway range, lower values of mean sway velocity (V_{mean}) and smaller total length of pathway of COG projection on the support surface (*L*), which were observed in the experimental group after completion of the hippotherapeutic classes.

Greater sway range in the sagittal plane (Range *Y*) is connected with the shape of the support surface, which is similar to the rectangle with sides shorter in the frontal plane, which offers greater possibilities for oscillation of the projection of the centre of gravity in the sagittal plane. So far, the measure of postural stability was commonly adopted as the distance of the centre of pressure from the foot edge assuming that the foot outline that represents the boundary of the support surface is also the boundary of stability. The heuristic model of balance control divides the support surface into several areas with different effect on stability control. The real (subjective) boundary of postural stability is separated from the mechanical boundary of stability, i.e., foot outline, termed the safety margin. The width of this margin changes with age and depends on the capability of the balance system and its regulator, that is, the central nervous system [3], [8]. It can be expected that the safety margin is also lower in the case of people with mild intellectually disability since their balance parameters are worse compared to healthy reference [15], [16]. Reduction in the balance parameters which was induced by participation in the hyppotherapeutic classes may have an important role to the improvement in this component of the balance system.

Straddling a horse releases the lower limbs from the support tasks. Furthermore, the support surface increases from a small quadrangle to a substantially greater support surface of the buttocks and internal surface of thighs, which offers a freedom in performing balance exercises and improvement in balance reactions [21]. After completion of the experiment of hippotherapy, changes were also found in the sway range and their mean velocities in the frontal plane (Range *X*, $V_{\text{mean}}X$) with small values both for the open and closed positions, although these values were not statistically significant. Nevertheless, changes in the sway range in the sagittal plane (Range *Y*) and mean displacement of the COG projection in this plane

($S_{mean}Y$) were so substantial that a significant decline occurred in the value of mean radial displacement ($S_{mean}R$) that takes into consideration the resultant displacement in the centre of gravity in the frontal and sagittal plane. These tendencies can reflect the improvement in regulation of the balance process. In the case of the free position after the experiment, a decline in the velocity of changes in the location of the COG projection on the support surface and length of the projection of the pathway on the support surface in the closed position did not improve these parameters. The greater support surface compared to the closed position has a significant contribution to improved function of the balance system stimulated with hippotherapeutic classes. Lower value of mean sway velocities (V_{mean}) and length of pathway (L) may suggest that the process of balance control is less energy-consuming and more efficient. Proper balance control is conditioned by the inhibitory processes controlled by the central nervous system and even mild intellectual disability is always accompanied by dysfunction of the central nervous system. Balance control for the closed position requires more control from the regulator and the improvement in these parameters were difficult to be achieved.

It turns out that even in this difficult development period connected with pubescence, properly chosen stimulation from the external environment ensures that older children (boys age 15 to 17 years in this study) make progress in balance functions. In order for these functions to work effectively, it is important to ensure the variety of movements but also the frequency and intensity to stimulate psychomotor development of a child. In therapeutical terms, horse riding may be an essential component to support a complex effect on the disabled human. The results obtained in this study lead to the conclusion that the systematic, well-organized hippotherapeutic classes help develop and improve proper balance reactions that may consequently lead to improved coordination and body posture.

5. Conclusions

Three-month therapeutic horse-riding classes improved the values of stabilographic parameters measured in the sagittal plane in both positions, mean sway velocity and total length of the pathway in the free standing with open support surface and it was a statistically significant change. Differences between boys with mild intellectual disability with the group that was involved in hippotherapeutic exercises and the group not involved in this type of exercises revealed statistically significant positive adaptations in terms of balance parameters. After hippotherapeutic classes, changes and tendencies point to improved balance reactions, whereas the lack of changes in balance in the control group show that the exercises with horses stimulate positive changes in the balance of people with intellectual disability.

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