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The impact of horseback riding on the balance of 7 years old children

Authors' Contribution:
A Study Design
B Data Collection
C Statistical Analysis
D Data Interpretation
E Manuscript Preparation
F Literature Search
G Funds Collection

Predrag Ilić [ABCDEF], **Aleksandra Aleksić-Veljković** [ACDEF], **Miljan Hadžović** [CDEF]

Faculty of Sport and Physical Education, University of Niš, Serbia

abstract

Background: This research aimed to determine the impact of horseback riding on the balance ability of first-grade students.

Material and methods: Fifty-eight students were divided into two sub-groups: twenty-eight riders and thirty non-riders. The subtest of balance is composed of nine items which were grouped into five variables: Total balance, Static balance, Dynamic balance, and Open and Closed eyes balance. The Mann-Whitney U test was used to determine the significance of the difference between the groups, and the strength of the effect of intergroup differences was determined using the Cohen criteria.

Results: The results showed that there were statistically significant differences between groups in Total balance, Static, and Balance with closed eyes. Cohen's criterion indicates that there was a strong effect of intergroup differences in performance demanding balance tasks of 7-year-old children.

Conclusions: It can be observed that horseback riding has the effect of reducing the difference between the maximum and minimum balance points by enhancing competencies at the minimum level.

Key words: static balance, dynamic balance, motor efficiency.

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Corresponding author: Aleksandra Aleksić-Veljković; Faculty of Sport and Physical Education, University of Nis; email: aleksic.veljkovic@gmail.com

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INTRODUCTION

During growth and development, morphological and physiological changes that occur are linked by successive stages determined by the interaction of hereditary and external factors, leading to psychophysical changes in children [1]. Balance, as a motor ability, with a high coefficient of heredity, has the task of maintaining a stable body posture when moving or at rest with a fundamental role in the development of movement [2]. The process of establishing and maintaining balance activates neuromuscular processes controlled by sensory stimulation, processing by the central nervous system with the neuromuscular response [3]. Fatigue, age, gender, weight, height, the amount of support, emotional status, degree of physical activity and motor development, injuries, health status, condition of the vestibular apparatus, state of vision and tactile analyzers, are all factors that affect balance [4,5]. Researchers emphasize that physical activity in the form of customized sports programs for children significantly influences the development of a large volume of motor knowledge and skills. Thus, researchers have found that the role of balance is particularly pronounced in sporting activities and enhancing sports performance [6, 7].

Horseback riding requires a subtle physical and mental skill, followed by delicate two-way communication [8], during which the horse disrupts the rider's balance while the rider is in charge of maintaining the balance and of properly distributing the weight. In this sport, the horse and rider are partners, while managing the trajectories is crucial [9]. The authors of the studies point out that the dominant factors for establishing and maintaining the posture of the body on the horse are the balance and general physical fitness of the rider [10–12]. The primary goal of the rider is adequate muscle contraction during riding to stabilize the body from a labile balance position as well as to control and maintain proper posture [13]. Several studies indicate that children of both sexes start to ride equally at the age of five to six [14–18], but there is still a lack of investigations. This research aims to determine whether there is a statistically significant difference in the balance of children involved in riding compared to the control group of children, namely whether riding has an impact on the development of balance in first-grade elementary school children.

MATERIAL AND METHODS

SAMPLE OF RESPONDENTS

Fifty-eight students (Mage =6.88±0.38 years; M body height = 127.18±4.23 cm; M body mass = 27.29±4.19 kg) volunteered for the study. They were divided into two sub-samples, ie. to a group of n=28 (M body height 127.73±3.49 cm; M body mass = 27.24±3.79 kg, BMI 16.79±1.69) students who have been practicing horseback riding for one year, twice a week for 30 minutes each, and students n=30 (M body height 127.22±4.88 cm; M body mass = 27.34±4.60 kg; 17±2.28) who do not practice riding. All respondents were enrolled in regular physical education classes, three hours per week. All respondents were clinically healthy and had no locomotor obstruction at the time of the measurement nor any other medical interference that would limit or interfere with the performance of the tests. Parents gave their consent to be tested and all respondents voluntarily participated in the measurement and testing.

SAMPLE OF INSTRUMENTS

The sample of measuring instruments consisted of the measurements for the body composition according to the protocol of the International Biological Program (IBP). Physical characteristics of the sample were estimated using the following parameters: Body height - TV (cm) was measured by a meter with an accuracy of 0.1 cm; Body mass –TM (kg) was measured with a Body Composition Monitor BF511 (OMRON) scale, which is used for children at the age of six and older, which allows the measurement accuracy of 0.1 kg, and Body Mass Index (BMI) (kg/m²) was calculated using the formula:

$$BMI = weight\ (kg) / height\ (m^2)\ for\ children.$$

The subtest Balance of the BOT-2 test for children's motor performance (19) was applied to evaluate the balance. The subtest of balance is composed of nine items: Standing with Feet Apart on the Line – Eyes Open, Walking forward on the Line, Standing on One Leg on the Line – Eyes Open, Standing with Feet Apart on the Line – Eyes Closed, Walking Forward Heel-to-Toe on the Line, Standing on One Leg on the Line – Eyes Closed, Standing on One Leg on the Balance Beam – Eyes Open, Standing Heel-to-Toe on the Balance Beam, and Standing on One Leg on the Balance Beam – Eyes Closed. Items were grouped into five variables: Total balance, Static balance, Dynamic balance, Open eyes balance and Closed eyes balance.

EXPERIMENT DESCRIPTION AND OPERATING CONDITIONS

In this paper, a transversal research model was applied. Testing of a sample of non-riding children was conducted during regular physical education classes while testing a sample of children who were enrolled in horseback riding, was conducted at the Impuls Plus Equestrian Club. The subjects were verbally explained and given a practical demonstration on how to perform each test. Before the testing began, the respondents warmed up for 10 minutes under the guidance of professors, coaches, and volunteers. All respondents were tested under identical conditions and in the same order under the guidance of professors, coaches, and volunteers. During the measurement, the respondents were not wearing shoes, while during testing in they were equipped with adequate physical education equipment for the physical education classes, wearing sneakers and sweatpants. Measurement and testing were assisted by trained volunteers, who were thoroughly familiar with the protocol before measuring and testing. The study was conducted following the Declaration of Helsinki and approved by the Ethics Committee of the Faculty of Sports and Physical Education in Niš (Number 04-2115).

STATISTICAL ANALYSIS

All data were processed by the statistical program "SPSS 19." and basic statistical parameters were calculated for examined variables. The distribution of normality of the results was examined by the Kolmogorov-Smirnov test, while the Man-Whitney U test was used to determine the significance of the difference between the values of the median and the arithmetic mean of the sample. The the strength of the effect of intergroup differences was determined using the Cohen criteria.

RESULTS

Table 1 shows the values of the central and dispersion parameters of the applied balance tests. The normality of the results for the variables was determined using the Kolmogorov-Smirnov test and the assumption of normality of distribution was confirmed for all variables.

Table 1. Descriptive statistics and normality of distribution

Variable	Mean	SD	Skew.	Kurt.	KS test
Non-riders (n=30)					
Total Balance score	30.77	3.20	-0.30	0.28	0.68
Static Balance	22.93	3.13	-0.25	0.27	0.62
Dynamic Balance	7.63	0.67	-1.64	1.45	2.42
Open Eyes Balance	22.43	1.75	-1.5	1.93	1.61
Closed Eyes Balance	8.13	2.16	0.59	-0.58	0.94

Variable	Mean	SD	Skew.	Kurt.	KS test
Horseback riders (n=28)					
Total Balance score	34.28	1.67	0.12	-1.25	0.91
Static Balance	26.00	1.78	0.08	-0.83	0.63
Dynamic Balance	7.50	0.84	-2.84	10.81	1.75
Open Eyes Balance	22.79	1.32	-1.26	1.42	1.29
Closed Eyes Balance	10.71	1.39	0.06	-0.60	0.89

Mean – arithmetic mean, SD – standard deviation, Skewness – value of asymmetry, Kurtosis – flattening, KS test – Kolmogorov-Smirnov test.

In further analysis (Table 2), Mann-Whitney U test results revealed a significant difference in the Total Balance Score, Static Balance, and Closed-Eyes Balance, between the rider and non-rider group of children at the significant level ($p < 0.05$).

Table 2. Man-Whitney U test and Cohen's criterion

Variable	Man-Whitney U (Z)	Sig.	Cohen's criterion	r
Total Balance score	-4.43	0.00	-0.58	0.6
Static Balance	-3.95	0.00	-0.52	0.6
Dynamic Balance	-7.93	0.43	-0.10	0.1
Open Eyes Balance	-0.55	0.58	-0.07	0.1
Closed Eyes Balance	-4.40	0.00	-0.58	0.6

Sig. – (2-tailed) significance level (p), Z – value of approximation. r – size of influence

The magnitude of the differences (r) of test variables was calculated using the formula $r = Z / \sqrt{N}$. (N is the total number of respondents – 58) according to Cohen's criteria (0.1 = small influence, 0.3 = medium influence and 0.5 = large influence). It can be concluded that riding contributes to the improvement with a large impact of the variables Total Balance Score, Static Balance, and Closed-Eyes Balance.

Considering the results in Table 2, the Mann-Whitney U test showed a statistically significant difference between three variables of balance at a significance level of 0.05. Median and arithmetic mean (Mean) in Table 1 emphasize better results in riding students than non-riding students and also show a positive direction of riding influence on balance development. Cohen's criteria ($r = 0.58$) indicate a large effect of intergroup differences. It can be observed that horseback riding has the effect of reducing the difference between the maximum and minimum balance points by enhancing competencies at the minimum level.

DISCUSSION

The results of the study showed that a thirty-minute, twice a week riding exercise program for the primary school children involved in the first year, improves static and dynamic balance, because the respondents showed better test results, compared with a non-riding group of children. Since the research is not longitudinal, these results must be confirmed in future studies. The riding program was tailored to the individual competencies of the child to the extent necessary so that it was implemented through play, in order not to overburden the child, but to produce positive persistent effects [20] which gradually led to improvements in the full control of capabilities [21] with the effect of improving balance. The results obtained in this study suggest that the use of the BOT-2 sub-test, which was used to evaluate balance, is potentially useful for monitoring changes in balance as an indicator of pedestrians' stability. Balancing also leads to enhancement of motor interaction between a rider and the horse [22].

Horseback riding requires the rider's ability to stabilize his/her body, due to the loss of balance, caused by the movements of the horse's body. It must be emphasized that the periodic nature of the movement of the horse plays an important role in the mobilization of the rider's competencies to achieve dynamic coordination of the rider with the horse. Through a combination of musculature and learning effect, more experienced riders noticed an additional decrease in balance-induced amplitude of body movement characteristic of less experienced riders [13]. During the walking movement of the horse, for each step, the rider's body is pulled out of the balance twice relative to the transverse axis with a combined twisting motion around the vertical axis [23]. Deriving from the balance due to the three-dimensional equine movement requires the rider to stabilize the torso from the labile balance position and maintain postural status [13, 24] relying on a small contact surface of stirrups of the most common dimensions 4.5 x 12 cm. The concept of balance is based on a synergistic relationship between the musculature of the body, legs, joints, impulses of visual control, the vestibular and somatosensory systems and the response of the body in phase timeline with the use of supports: the hinges of the rider, through which the vertical force is exerted through the vertical movement of the horse's body up and down, and the rider’s weight, through its flexibility and endurance on the stirrups, maintains the rider’s balance position. The fact that the rider must adapt to the horse in a phased manner contributes to the development of all designated balance systems. Lagarde et al. [23] emphasize that the horse–rider relation comprehensively, spatially and temporarily activates the rider’s sensory-motor system, activating the brain rhythms of isolated brain regions [23]. The ability to accomplish this task influences the development of balance [25].

Riding exercises have a positive effects on the development of balance, as shown in this study because the primary goal of the rider’s muscle contraction during riding is to stabilize the rider, control and maintain posture, and coordinate the rider’s movements, rather than to produce muscle strength [13]. During movement, dynamic horse movements improve muscular contractions with reflex stresses, dynamic postural balance, stabilize joints, anticipation, and control of balance in riders [26]. Children as young as seven have no strength in basic musculature. Riding exercises improve strength and, as a result, there is an improvement in balance in children riders, which may clarify the difference in balance between the experimental and the control groups in this research.

Rhythmic and repetitive movements of the horse in motion strongly affect proprioceptive stimulation, also stimulating the upper-system of the motor neurons and entering information similar to patterns of pelvic movement while walking [26], thus improving balance. Caused by the rhythmic movements of the horse during various strokes, the muscles of the lower extremities, abdomen, back, and pelvis are constantly activated [13, 27, 28] applying the same movement pattern and resisting the force of gravity to establish and maintain a posture on a horse. Improved balance is a result of the activation of strengthened muscles and joints and helps to establish and maintain static and dynamic postural stability [26] as well as to improve general fitness. This study suggests that riding affects balance improvement, which can be found in the views of other authors who emphasize that better control of the body muscles increases the proprioceptive and vestibular functions induced by riding exercise and has a positive effect on improving balance [29]. The conclusion of this research that riding improves balance is also found in the study of Lagarde et al. [23] conducted on experienced and less experienced riders, indicating decreased phase mobility of the body in the sagittal, vertical and horizontal planes of experienced riders, suggesting that riding exercises lead to better balance [23]. Among other things, the coincidence of the period of initial motor skills specialization [30] and the period of riding practice leads to better balance in riding children.

CONCLUSION

This transversal research was conducted to determine whether there is a difference in balance among first-grade students who, in addition to physical education, practice riding, as compared to non-riding students. Based on the analysis of the results of this research, it can be concluded that there is a statistically significant difference in the numerical values of balance between first-grade elementary school students who, besides physical education classes, also practice horse riding, and students who attend only regular physical education classes. Therefore, hypothesis H0 can be accepted. It can be concluded that the combined effect of riding programs and physical education classes leads to a better improvement in balance compared to the physical education program, and that riding has a great influence on the development of balance, whereby hypothesis H1 can be accepted. From the riding theory, although the balance is highly genetically conditioned, this study indicates that an additional program of riding exercises, twice a week, for one year, in addition to regular physical education, can improve balance.

LIMITATION

A limitation of this study is the inability to generalize, due to the small number of transversal research respondents, suggesting that research should be conducted on a larger representative number of samples to confirm the association and influence of riding exercise on balance. The results of this study could be used in future research into the development of motor skills in students and their relationship to riding, although studies exploring the impact of riding exercise on balance are still lacking.

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