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DIFFERENCE IN BALANCE AND SUCCESS IN PERFORMING BASIC GYMNASTICS ELEMENTS BETWEEN 7-8 YEARS OLD BOYS AND GIRLS

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SUMMARY

This study aimed to determine the status of motor skill of balance and possible differences between girls and boys, of younger school age, in predicting the performance of selected gymnastic elements on the floor (shoulder stand, headstand, handstand). Eighty-four young participants were divided into two groups participating in the study (Group Males: n=42; Group Females: n=42). The participants had to perform four tests to evaluate motor ability of balance that have the necessary metric characteristics: standing on one leg with eyes open transversely on a balance bench - MBAP, standing on two legs longitudinally on a balance bench with eyes closed - MBAU2Z, standing on two legs longitudinally on balance benches with eyes open - MBAU2O and Flamingo test - FLAM. The success of the execution of the selected gymnastics elements was evaluated by the commission, which consisted of five licensed judges of the Gymnastics Federation of the Republic of Srpska, with marks from 0 to 10. Minor differences were found in the motor ability of balance and the results of predictable values for these gymnastic elements ($p=0.05$). Girls had lower results in the motor tests but better scores in the performance of the gymnastic elements, but it is no significant differences. The average results of all respondents in this research are lower than in previous research. The relatively low scores of the motor ability test results indicate the need to introduce additional pre-exercises to improve results in performing essential gymnastic elements.

Keywords: lesson organization, success, teaching physical education.

INTRODUCTION

Motor movement, represented by various movements and motions, can be observed and expressed through the realization of motor skills and abilities. Motor skills themselves can be divided into primary and specific. The balance represents one of the basic skills expressed in the static and dynamic maintenance of the body's position in space (Lubans et al., 2010). Achievement in gymnastic element training has long left behind an approach in which strength is dominant. Over time, the importance of motor skills and their influence on the performance of gymnastic elements has been differentiated. Introduction to gymnastics takes place in preschool and younger school age to provide optimal conditions for individual development. In the local community, most children of younger school age are introduced to gymnastics in regular physical education classes (Novak et al., 2008; Zivcic, 2007). Here, the teacher faces another challenge: the motor skill of balance could be statistically different (p =.05) for girls and boys as they mature (Aleksic-Veljkovic et al., 2014), which could influence the choice and application of methodological means in the implementation of the gymnastics lesson. Few studies have investigated the balance of gymnasts concerning non-athletes (Asseman, Caron & Crémieux, 2008), Carrick, F. R., Oggero, E., Pagnacco, G., Brock, J. B., & Arikan, T., 2007; and other athletes (Bressel, Yonker, Kras & Heat, 2007) with the conclusion that balance is not a primary motoric skill for establishing more significant differences between these groups. In contrast to that findings, few studies have considered balance as a potentially important motor skill that could have a significant influence on the execution of gymnastics elements (Jovanović et al., 2021; Miletić, 1998; Prassas et al., 2006; Sleeper et al., 2016,Von Cagno A. et al., 2008;). Attention should be focused on these details at the beginning of training at a young age. Balance as a motor skill can be significantly affected at this age because it depends on the maturation of the functions of the vestibular, kinesthetic, tactile, and visual analyzers (Massion, 1998). Shoulder stand, headstand, and handstand (in a static position) are the most commonly performed elements of floor gymnastics at the beginner level. This study was conducted under the assumption that there is a gender difference in predicting the quality of their performance, using balance as the criterion variable. This study aimed to determine the status of motor skill of balance and possible differences between girls and boys, of younger school age, in predicting the performance of selected gymnastic elements on the floor (shoulder stand, headstand, handstand).

METHODS

The sample consisted of 84 participants aged 7-8 years (42 girls and 42 boys) with no previous gymnastics experience. During gymnastics training in physical education classes, all participants were healthy and able to participate in class. This project was approved by the Institutional Review Board of the Faculty of Physical Education and sport, University of Banja Luka. All experiments were conducted according to the latest version of the Declaration of Helsinki (World Medical Association, 2002). The predictor variable was tested using four tests of motor balance ability (Metikoš, Prot, Hoffman, Pintar, Oreb, 1989): standing on one leg crosswise on a balance beam with eyes open (MBAP); standing on two legs lengthwise on a

balance beam with eyes closed (MBAU2O); standing on two legs lengthwise on a balance beam with eyes open (MBAU2Z) and a flamingo test (FLAM).

Standing on one leg crosswise on a balance beam with eyes open (MBAP)

Starting position: Barefoot, the examinee stands with one foot crosswise on the partition of the balance bench while the other touches the ground. The palms are pressed against the thighs. The choice of the leg is left to the examinee. Performance of the task: The examinee's task is to raise the leg sat la and remain balanced on one leg with the hands on the thighs for as long as possible. The task is repeated six times with breaks between repetitions. Completion of the task: The task is terminated if the examinee: moves any hand away from the body, touches the bench or the ground with a foot in the air, moves the foot of the landing leg, or stands in a balanced position for more than 180 seconds.

Standing on two legs lengthwise on a balance beam with eyes open (MBAU2O)

Starting position: While keeping one hand on the wall, the examinee steps barefoot with both feet along the vertical balance bench. The feet are one behind the other. The palm of the free hand is next to the body. The examinee keeps his eyes open. Performance of the task: When the examinee has established a balanced position, he moves his hand away from the wall and brings it closer to his body. Both hands are held close to the thighs during the task. The task is to stay in as long as possible in a balanced position. The task is repeated six times with a break between repetitions.

Completion of the task: The task is interrupted if the examinee moves any hand away from the body, moves any foot, and stands in a balanced position for more than 90 seconds.

Standing on two legs lengthwise on a balance beam with eyes closed (MBAU2Z)

Starting position: While keeping one hand on the wall, the examinee steps barefoot with both feet along the vertical balance bench. The feet are one behind the other. The palm of the free hand is next to the body. The examinee keeps his eyes open until he starts; before the start of the task examinee closes his eyes. Performance of the task: When the examinee has established a balanced position, he moves his hand away from the wall and brings it closer to his body. He closes his eyes. Both hands are held close to the thighs during the task. The task is to stay in as long as possible in a balanced position. The task is repeated six times with a break between repetitions. Completion of the task: The task is interrupted if the examinee moves any hand away from the body, moves any foot, and stands in a balanced position for more than 90 seconds.

Flamingo test (FLAM)

Starting position: The examinee stands on a small bench with his wanted leg while the other leans on the ground. Performance of the task: The examinee balances as long as possible on the longitudinal axis while standing on the leg he wants. He bends the free leg backward with the same hand, holding it by the upper part of the foot, standing like a flamingo. The

other hand is in renunciation; at the beginning, it holds the measuring stick. The test begins when the tester withdraws his hand. Completion of the task: Testing is terminated each time the examinee loses balance (i.e., lowers the free leg he is holding) or touches any part of the body. The test is repeated three times, and the better time is counted.

The criterion variable was formed by the evaluated success in performing selected gymnastic elements: shoulder stand, headstand, and handstand. The performance was evaluated by three licensed judges of the Gymnastics Federation of the Republic of Srpska with scores from 0 to 10 (Table 1).

Table 1. Scale for assessing the quality of performing movement of acrobatics elements

SCORE	DESCRIPTION
0	Unsatisfying technique and amplitude
1	Satisfying technique, small amplitude
2	Satisfying technique, large amplitude
3	Good technique, small amplitude
4	Good technique, large amplitude
5	Very good technique, small amplitude
6	Very good technique, large amplitude
7	Great technique, small amplitude
8	Great technique, large amplitude
9	Excellent technique, small amplitude
10	Excellent technique, large amplitude

Scoring was based on a predetermined set of values, given in tens of points for each exercise, according to the set penalties, resulting in a final score 10.00. Scoring followed the FIG Rules and Regulations for Scoring and Activities of Referee Panel "B" regarding deducting performance points and scoring for compulsory exercises - GAY-GASMN Rules and Regulations (Petković et al., 2004). Tests were performed before the beginning and at the end of the training program. The testing procedure lasted two days. On the first day, the respondents were tested for the performance of motor tests for balance, while on the second day, they performed selected gymnastic elements. The physical education teacher performed Motor tests in the school hall after an adequate warm-up. Statistical analysis was performed using SPSS 20.0 for Windows (SPSS Inc., Chicago, IL). In addition to basic descriptive statistical parameters for all variables (mean value (Mean), standard deviation (SD), and standard error (Std. Error)), multiple regression analysis was performed to determine the presence of relationships with p=0.05 level of significance.

RESULTS

The values of the intraclass correlation coefficients (Table 2), used to determine the agreement of the different judges in the evaluation of the performance of the acrobatic elements. All the coefficients obtained were above 0.90, confirming the measurement's very high objectivity.

Table 2. Intraclass correlation coefficients

shoulder stand	0.991
head stand	0.986
hand stand	0.985

Table 3 shows the values of the arithmetic mean for the balance tests and the evaluation of the performance of each gymnastics element, where the obtained results indicate the highest values for the execution of the shoulder stand (for B: 5.27 and G: 5.76) and the test FLAM for the girls and the MBAU2O test for the boys.

Table 3. Mean and standard deviation for all scores in motorically and gymnastic tests

	P	M	SD	SEM
MBAP	Boys	2.61	1.73	.26
	Girls	1.63	.88	.13
MBAU2O	Boys	2.85	1.81	.28
	Girls	2.43	2.06	.31
MBAU2Z	Boys	1.71	.78	.12
	Girls	1.24	.54	.08
FLAM	Boys	2.66	1.32	.20
	Girls	2.46	.92	.14
Shoulder stand	Boys	5.27	3.71	.57
	Girls	5.76	3.50	.54
Head stand	Boys	2.63	2.74	.42
	Girls	3.92	3.23	.49
Hand stand	Boys	2.84	2.65	.41
	Girls	3.29	2.68	.41

Legend: G-gender (B-boys, G-Girls), M-Mean, SD-standard deviation, SEM-standard error mean, MBAP-standing on one leg crosswise on a balance beam with eyes open , MBAU2O- standing on two legs lengthwise on a balance beam with eyes open , MBAU2Z- standing on two legs lengthwise on a balance beam with eyes closed, FLAM- Flamingo test

Table 4 presents a plot of the results' normal distribution, verified by statistical processing with the KS test. The values obtained for the variables used are at the lower limit of the normal distribution.

Table 4. Results of the Kolmogorov-Smirnov test

	Stat. val.	**Sig.**
MBAP	0.112	.200
FLAM	0.089	.200
MBAU2O	0.122	.200
MBAU2Z	0.098	.200

Legend: Stat. val. - statistical value, Sig. - statistical significance, MBAP-standing on one leg crosswise on a balance beam with eyes open , MBAU2O- standing on two legs lengthwise on a balance beam with eyes open , MBAU2Z- standing on two legs lengthwise on a balance beam with eyes closed, FLAM- Flamingo test

Table 5 shows the regression analysis results for the performance of all three gymnastic elements. The determined value of coefficient of determination for the value of the results of the performance of the shoulder stand is 0.345 and 0.394 for the boys and girls, respectively. This means that the predictive model used explains 34.5% and 39.4% of the variance. These results are followed by the values for the performance of the headstand (0.489) and the value

of the results for the variable of the handstand (0.474), which was obtained only for the girls' results. This means that the predictive model used explains a total of 48.9% and 47.4% of the variance of these gymnastic elements. The results obtained in the prediction of the used model showed statistical significance in the performance of all three gymnastic elements at the level of p = .005.

Table 5. Results of regression analysis for all criterion variables

	P	R	R^2	F	Znač.
shoulder stand	Boys	.587	.345	4.873	.003
	Girls	.628	.394	6.022	.001
head stand	Boys	.355	.126	1.332	.276
	Girls	.699	.489	8.860	.000
hand stand	Boys	.357	.128	1.352	.269
	Girls	.688	.474	8.319	.000

Legend: G-gender (B-boys, G-Girls), R- the share of variance in the dependent variable, R 2- coefficient of determination, Sig. - statistical significance

The presented values of beta coefficients (Table 6) show that the highest BETA coefficient in predicting the results of performing the gymnastic elements is based on the test results of FLAM (4/6). The highest predictive value of this individual criterion variable was obtained in the execution of a head position by girls (0.514), with a statistically significant contribution (0.000). Similarly, in the execution of the shoulder stand (stand for boys and girls), a statistically significant predictive result (0.003) and (0.004) was obtained with the values of beta coefficients 0.458 and 0.455, respectively. The values of the BETA coefficient for girls' performance in handstand showed the highest value in the MBAU2Z test (0.435), followed by the values for the FLAM (0.314) and MBAP (0.255) tests, with all three variables making a statistically significant contribution in the regression model (0.003; 0.025;0.046).

Table 6. Selected significant predictor coefficients for all variables

criterion variables	predictor variable	Stand. B. Coef.	Sig.
head stand - girls	FLAM	.514	.000
shoulder stand- girls	FLAM	.458	.003
shoulder stand- dječaci	FLAM	.455	.004
hand stand- girls	MBAU2Z	.435	.003
hand stand- girls	FLAM	.314	.025
hand stand- girls	MBAP	.255	.046

Legend: Stand.B coef. - standardized Beta coefficient, Sig. - statistical significance, MBAP-standing on one leg crosswise on a balance beam with eyes open , MBAU2Z- standing on two legs lengthwise on a balance beam with eyes closed, FLAM- Flamingo test

DISCUSSION

This research focuses on determining the level of motor ability of balance, and determining differences in the prediction of the performance of selected gymnastic elements between boys and girls of younger school age, using balance as a criterion variable. Looking at the results of the motor balance tests, the boys performed slightly better in all tests. The slightest difference was in the results of the FLAM test, while the most significant difference was in the MBAP test. However, it should be noted that these are much worse results than the results obtained on a similar sample in the research of Tanas, Dumitru, and Budac (2020) and Veljković et al. (2014). On the other hand, the performance results of all gymnastic elements show that the girls had better performance scores on average. The slightest difference in the obtained results is in the execution of the handstand, while the most significant difference in the obtained results is in the execution of the headstand. The obtained results are similar to those of Donti O, Bogdanis GC, Kritikou M, Donti A & Theodorakou K., (2016),and Radanovic (2013) in which the girls had lower results in the motor tests but better scores in the performance of the gymnastic elements. It should also be noted that the average results of all respondents in this research are lower than in the previous research. The relatively low scores of the motor ability test results indicate the need to introduce additional pre-exercises that would lead to improved results (Gavojdea, A.M., 2016, Tanasa et al., 2020,). In order to obtain information about the possibility of predicting success in the performance of selected gymnastic elements, we have used a statistical regression method. The obtained results showed that based on the selected set of motor balance tests, it is possible to predict the success of performing the stance on the shoulder blades in all subjects. Regarding predicting the success of performing the headstand and handstand, obtained results show statistical significance ($p < .001$) only in girls. Girls at this age show greater seriousness than boys, which is shown by paying attention to the performance of the aesthetic components of the elements. They showed more attention and interest during the training, which is also shown by their assessment of the performance of gymnastic elements. The results of predicting the performance of selected gymnastic elements using individual tests indicate that the FLAM test stands out. The FLAM test can predict the success of performing all three selected gymnastic elements in girls and the performance of shoulder blade position in boys. As for the other tests, the results indicate the possibility of using individual tests MBAU2Z and MBAP when performing head posture in girls. Research by Popović et al., (2009), Radanovic et al., (2013), Radanović, D. et al. (2016), and Madić et al., (2011) suggest that it is possible that the difference in flexibility, primarily in the part of the hip flexors, enabled the girls to perform the test itself better, in contrast to boys, who have a slightly lower level of flexibility, girls reached more optimal positions of criterion and predictor variables in their performances. Although the results showed relatively satisfactory levels of predictive values in this sample, the research should be repeated with the application of a more comprehensive prediction system and on a larger sample to be able to generalize the results.

CONCLUSIONS

Based on the results obtained, there is a need to apply a more significant number of different exercises that would contribute to developing the motor ability of balance. In this way, the obtained predictive results would be improved and more credible in evaluating the performance of selected gymnastic elements. Based on a relatively small number of tests of the motor ability of balance (on a similar sample), it would be possible to predict the success of the selected gymnastic elements. In this way, the quality of work and monitoring of subjects at the beginning of the training of gymnastic elements would be improved, which would undoubtedly lead to better results and better performance of the selected elements. Observing the development of skills is essential because, in this period, significant changes occur in children of younger school age, which can lead to greater efficiency in applying classical teaching models. On the other hand, the inadequacy of physical education resources prevents more detailed and extensive testing on a more significant number of students without the need for additional staff and time, which is challenging to fit into students' schedules. The selected balance tests, at this age, can be used to determine part of the examinee's motoric status and the realization of teaching units in gymnastics.

REFERENCES

1. Asseman, F. B., Caron, O., & Crémieux, J. (2008). Are there specific conditions for which expertise in gymnastics could have an effect on postural control and performance? Gait & posture, 27(1), 76–81. https://doi.org/10.1016/j.gaitpost.2007.01.004
2. Aleksic-Veljkovic, A., Madić, D., Veličković, S., Herodek, K., Popović, B., (2014). Balance in young gymnasts: age-group differences. Facta Universitatis Series Physical education and Sport. 12. 289-296.
3. Bressel, E., Yonker, J.C., Kras, J., Heat, EM. (2007). Comparison of static and dynamic balance in female collegiate soccer, basketball, and gymnastics athletes. Journal of Athletic Training, 42 (1), 42-6. PMCID: PMC1896078
4. Carrick, F. R., Oggero, E., Pagnacco, G., Brock, J. B., & Arikan, T. (2007). Posturographic testing and motor learning predictability in gymnasts. Disability and Rehabilitation, 29(24), 1881–1889. doi:10.1080/09638280601141335
5. Gavojdea, A.M. (2016). Study Regarding Balance in 9-10 Years Old Gymnasts. In: Future Academy, 10, 218-225. http://dx.doi.org/10.15405/epsbs.2016.06.30
6. Donti O, Bogdanis GC, Kritikou M, Donti A, Theodorakou K. (2016). The relative contribution of physical fitness to the technical execution score in youth rhythmic gymnastics. J Hum Kinet. 2; 51:143-152. https://DOI: 10.1515/hukin-2015-0183.
7. Jovanović, S., Bijelić, S., Ljubojević, A., Fulurija, D., & Belić, Aleksandra. (2021). Relacije motoričke sposobnosti ravnoteže i uspjeha izvođenja gimnastičkih elemenata na parteru. Sportlogia, 17 (1), 33-42. https://doi.org/sgia.se.211701.jbljfb
8. Lubans, D. R., Morgan, P. J., Cliff, D. P., Barnett, L. M., Okely, A. D. (2010). Fundamental movement skills in children and adolescents review of associated health benefits. Sports Medicine, 40(12), 1019–1035. DOI: 10.2165/11536850-000000000-00000
9. Madić, D., Popović, B., Tumin, D., Obradović, J. & Radanović, D. (2011). The impact of motor abilities on the learning of gymnastics exercises of girls 11-12 years of age. In: M. Mikalački & G. Bala (edt.). Proceedings book Exercise and quality of life (p. 323-328). Novi Sad: University of Novi Sad, Faculty of Sport and Physical Education.
10. Massion, J. (1998). Postural control systems in developmental perspective. Neuroscience & Biobehavioral Reviews, 22, 465-472. DOI: 10.1016/s0149-7634(97)00031-6.
11. Metikoš, D., Hofman, E., Prot, F., Pintar, Ž., Oreb, G. (1989). Mjerenje bazičnih motoričkih dimenzija sportaša. Zagreb: Komisija za udžbenike i skripta Fakulteta za fizičku kulturu Sveučilišta u Zagrebu.

12. Miletić Đ., Srhoj Lj. i Bonacin D., (1998). Utjecaj inicijalnog stanja motoričkih sposobnosti na učenje motoričkih znanja u ritmičko sportskoj gimnastici. Kineziologija, 30 (2), 66-75.
13. Novak, D., Kovač, M., Čuk, I. (2008). Gimnastična abeceda. Ljubljana: Fakulteta za šport Univerze v Ljubljani.
14. Petković, E. (2004). The relation of situational-motor coordination to the competitive success of female gymnasts. Physical Education and Sport, 2(1), 25–33
15. Popović, B., Radanović, D. (2009). Relacije morfoloških karakteristika i koordinacije kod devojčica koje se bave gimnastičkim aktivnostima. [Relations of morphological characteristics and coordination in female subjects included in gymnastic activities.] Glasnik Antropološkog društva Srbije, 45: 243-252, Novi Sad.
16. Prassas, S., Kwon, Y.X., Sands, W.A. (2006). Biomechanics Research in Artistics gymnastic, Sports Biomechanics 5(2), 261-291. DOI: 10.1080/14763140608522878.
17. Radanovic, D., Stajer, V., Popovic, B., & Madic, D. (2013). Differences between 11-12-year-old boys and girls in success of gymnastic exercises adoption. Sport Mont, XI (37-38-39), 137-144.
18. Radanović, D. et al (2016). Impact of motor abilities on performance of gymnastic elements on floor in girls. Acta Kinesiologica, 10 Suppl 1: 30-34.
19. Sleeper, M. D., Kenyon, L. K. Elliott, J. M., & Cheng, M. S. (2016). Measuring sport-specific physical abilities in male gymnastics: The men's gymnastics functional measurement tool. International Journal of Sports Physical Therapy, 11(7), 1082-1100. PMID: 27999723; PMCID: PMC5159633.
20. Tanasa, R.A., Dumitru, I.M. and Budaca, M.V. (2020). The Effects of Gymnastics Training on Static Balance among Children Aged 4 to 8. Bulletin of the Transilvania University of Braşov Series IX: Sciences of Human Kinetics, 13(62), 111-118.
21. https://doi.org/10.31926/but.shk.2020.13.62.1.14