Bulletin of the *Transilvania* University of Braşov
Series IX: Sciences of Human Kinetics • Vol. 17(66) No. 1 – 2024
https://doi.org/10.31926/but.shk.2024.17.66.1.10

DETERMINING THE RELATIONSHIP BETWEEN LOWER LIMBS STRENGTH PARAMETERS AND BALANCE IN 5-8-YEAR-OLD CHILDREN PRACTICING DANCE

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Abstract: *This paper aims at determining the relationship between parameters of lower limbs strength and balance in 5-8-year-old children practicing dance. Methods. So, an exploratory study was organized with a group of 24 children aged 5-8 years from the National Palace of Children of Bucharest. Tests used: Test 1 (15 jumps free arms), Test 2 - static balance (SB), Test 3 – lateral dynamic balance (LDB) and Test 4 vertical dynamic balances (VDB). Parameters: performance, front and back inside (LDB), left and right inside (VDB), avg. deviation. In this regard, establishing the relationship degree between lower limbs strength parameters and balance in 5-8-year-old dancers depends on the number of negative correlations, especially between average deviation parameters.*

Key words: *parameters, jump test, performance, deviation, correlation analysis.*

1. Introduction

In recent decades, interest in the benefits of physical activity has significantly increased among children [7], [9]. Dance, which is acknowledged for its

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numerous benefits on the health and development of children [4], is gaining more and more popularity among them.

A crucial aspect of physical performance and health of children is the balance and strength of the lower limbs [8], [13].

There is still a need for further research on the relationship between lower limbs strength parameters and balance in young children, especially those engaged in dance. Dance, as a physical activity involving complex movements and specific muscle groups, could have a strong influence on the development of strength and balance capacity in this age group.

This study aims to investigate the relationship between lower limbs strength and balance in children aged 5 to 8 who practice dance. Through specific evaluations and precise measurements, it is intended to deeply understand how dance practice can influence the physical development and motor skills of children during this critical transition of age. This research could have a solid contribution to identifying the needs related to the training and physical development of children who dance. Valuable information is provided for teachers, coaches and parents to develop effective, age-appropriate programs meant to improve the performance and health of children during dance practice.

2. Method

Children aged 5-8 from the National Palace of Children in Bucharest participated in this study. Parental consent was obtained and signed in accordance with the Helsinki Declaration before starting the research. The study was approved by the Ethics Committee of the Doctoral School of Sport Science and Physical Education (ID: 11/24.01.2024), University Center Pitești, Romania.

Lower limbs strength assessment was performed by means of the Opto Jump Next system, using the 15 Jumps free arms Test. The following parameters were measured: TCont. (sec), TFlight (sec), Height (cm), Power (w/kg), Pace (step/s), RSI (m/s). Balance assessment was conducted using the Sensamove Mini Board platform. Obtained parameters: performance (%), front-back inside (%) (LDB), left-right inside (VDB), front-back (degrees), and left-right (degrees).

Statistical analysis was carried out using the KyPlot program, 6.0, in terms of usual descriptive indices, mean; SD - standard deviation; Pearson's linear correlation coefficient.

3. Results

The relationship between lower limbs strength parameters and balance in 5-8-year-old children who practice dance was determined using the descriptive statistical indices and Pearson's linear correlation analysis between the measured parameters. The results obtained are presented in Tables 1 - 4 and Figures 1 - 3.

The results of test 1, 15 Jumps free arms, presented in Table 1, highlight significant differences across multiple measurements.

The contact time and flight time differ by 0.08 sec, with a height reached of 13.26 cm, power of 16.62 w/kg, pace of 1.79 step/s, and RSI of 0.60 m/s. These differences indicate notable variations in the performance of subjects within the test.

The results of static balance (SB) and lateral (LDB) and vertical (VDB) dynamic balance tests are presented in Tables 2 - 4. These results show better performance in LDB, with a 61.29% improvement, particularly in front and back movements in LDB. At the same time, the average deviation in vertical and lateral directions is lower by 15.9% in LDB. The average deviation in front-back and left-right directions is lower by 11.2% (VDB) and 9.6% (LDB), respectively. These findings indicate the advantages of improved performance and of consistency in dynamic and static balance, especially in the context of the LDB test.

Descriptive statistics Table 1

Variables	Mean ± SD	CV (%)	Confidence Level of Mean (0.95)	Confidence Limit of Mean	
				Lower	Upper
TCont. (sec)	0.24; 0.05	22.7	0.02	0.22	0.26
TFlight (sec)	0.32; 0.06	18.4	0.02	0.29	0.35
Height (cm)	13.26; 4.79	36.1	2.02	11.24	15.28
Power (w/kg)	19.62; 7.25	36.9	3.06	16.5	22.7
Pace (step/s)	1.79; 0.16	8.94	0.07	1.72	1.85
RSI (m/s)	0.60; 0.29	49.4	0.13	0.48	0.73

Descriptive statistics Table 2

Variables	Mean ± SD	CV (%)	Confidence Level of Mean (0.95)	Confidence Limit of Mean	
				Lower	Upper
Performance (%)	57.7; 19.6	34.0	8.29	49.4	66.0
Front, avg. deviation (deg.)	1.85; 1.08	58.2	0.45	1.39	2.31
Back avg. deviation (deg.)	-2.21; 1.47	-66.6	0.62	-2.83	-1.59
Left avg. deviation (deg.)	-2.34; 1.42	-60.6	0.60	-2.94	-1.74
Right avg. deviation	2.99; 1.89	63.3	0.80	2.19	3.79

Descriptive statistics Table 3

Variables	Mean ± SD	CV (%)	Confidence Level of Mean (0.95)	Confidence Limit of Mean	
				Lower	Upper
Performance (%)	61.29; 18.8	30.8	7.97	53.3	69.2
Front, inside (%)	28.9; 13.3	46.2	5.64	23.3	34.6
Back, inside (%)	32.5; 11.3	34.8	4.78	27.7	37.3
Front, avg. deviation (deg.)	1.99; 0.86	43.1	0.36	1.63	2.35
Back avg. deviation (deg.)	-2.11; 1.14	-53.9	0.48	-2.59	-1.62
Left avg. deviation (deg.)	-4.20; 1.52	-36.3	0.64	-4.84	-3.55
Right avg. deviation	4.70; 2.02	42.9	0.85	3.85	5.55

Descriptive statistics Table 4

Variables	Mean ± SD	CV (%)	Confidence Level of Mean (0.95)	Confidence Limit of Mean	
				Lower	Upper
Performance (%)	55.5; 23.1	41.7	9.77	45.7	65.3
Left, inside (%)	27.04; 13.2	48.9	5.59	21.4	32.6
Right, inside (%)	28.4; 12.9	45.5	5.45	22.9	33.9
Front, avg. deviation (deg.)	3.37; 1.30	38.7	0.55	2.81	3.92
Back avg. deviation (deg.)	-3.43; 1.99	-58.3	0.84	-4.27	-2.58
Left avg. deviation (deg.)	-2.55; 1.15	-45.04	0.48	-3.04	-2.07
Right avg. deviation	2.91; 1.34	46.2	0.57	2.34	3.48

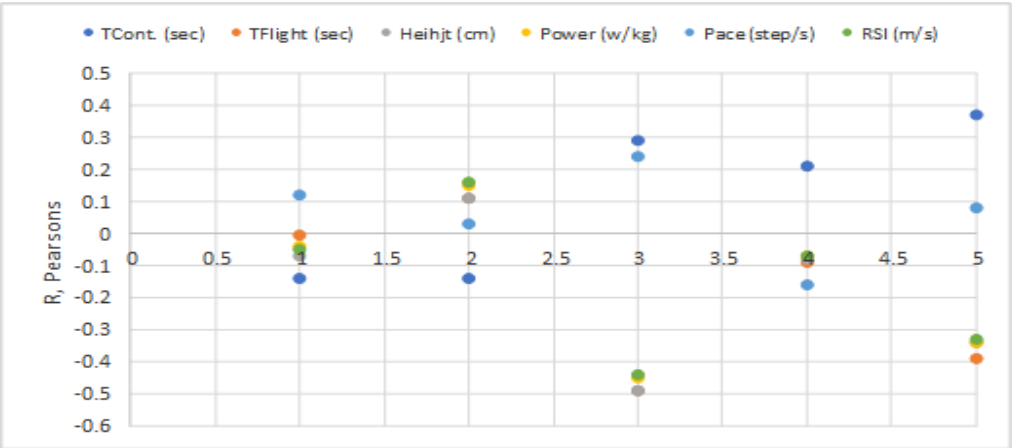

Fig. 1. *Linear correlation analysis*

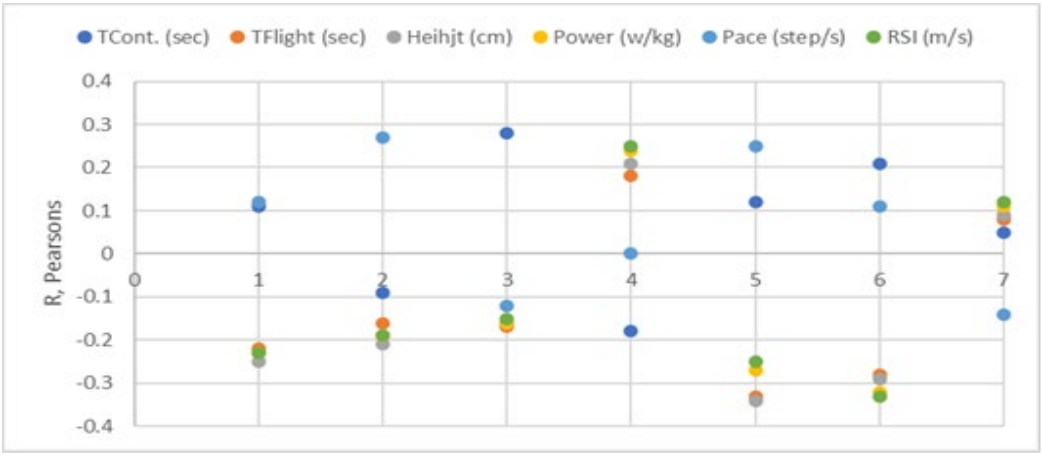

Fig. 2. *Linear correlation analysis*

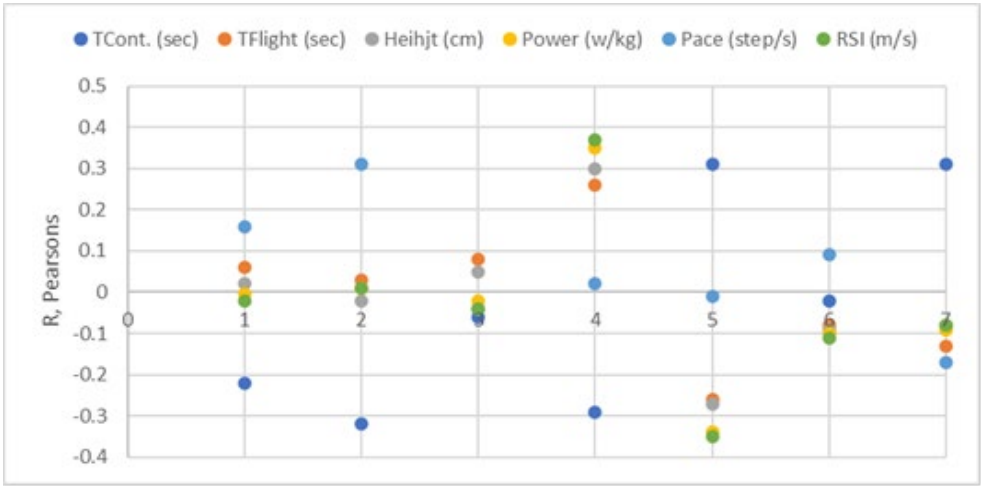

Fig. 3. *Linear correlation analysis*

The results of Pearson's correlation analysis between the parameters of the 15 jump test free arms and the SB, LDB, and VDB test parameters are presented in Figures 1 - 3. The results reveal 13.3% strong correlations in SB (back avg. deviation) at $p < 0.05$ and 59.6% negative correlations between all investigated parameters.

4. Discussions

The results of the 15 Jumps free arms test show significant differences across measurements, with notable variation in contact and flight time, height reached and power (Table 1).

Regarding static and dynamic balance, the results indicate better performance in

the LDB test, with a smaller average deviation in vertical and lateral directions. For example, an important difference of 15.9% in vertical deviation is observed in LDB, highlighting the advantages of improved and consistent performance (Tables 2 - 4).

Pearson's correlation analysis reveals important relationships between the parameters of the 15 Jumps free arms test and the balance test parameters, showing complex interdependencies between performance and balance aspects. Statistical values such as a strong correlation of 13.3% between the average deviation of static balance and the parameters of the 15 Jumps free arms test were found out (Fig. 1- 3).

Some authors such as Healy et al., 2018 [6]; Harry et al., 2018 [5]; Wyon et al., 2006 [14]; Dos Anjos et al., 2019 [3]; Tingman, 2020 [11] explore the relationship between reactive strength and depth jump performance. They highlight how performance strategies and additional training influence vertical jump height. These authors also show the effects of acute fatigue on performance. They suggest further studies on the specific training for lower limbs strength in dancers.

Another study analyzed the use of Microsoft Kinect to evaluate vertical jump ability and predict developmental levels in children aged 9 to 12 years. It was found that jump height and flight height predict the main differences in jump ability development levels, while the Kinect-based assessment discriminates these levels [10]. Another study investigated the effects of educational programs on performance in dance sport among young dancers. The study revealed that supplementary educational sessions improve performance in dance sport in both experimental groups (first and second), but no significant changes are observed in dance performance in the control group [12].

Results from a recent study confirmed the homogeneity of the groups, examining somatic indices, with superior performance in static balance in the control group. The correlational analysis revealed the association between front deviations and somatic indices in children aged 5 to 8 years [1]. In other research, differences were observed among groups of children aged 5 to 8 years regarding dynamic balance. These differences prove the influence of dance and other sports activities on the development of this aspect in the respective age group [2].

5. Conclusions

The significant variations in contact time and flight time, height reached, power, pace and RSI during the 15 Jumps free arms test highlight the diverse performance of subjects and the complexity of measurements associated with free arms jumps.

Improved performances in dynamic and static balance, particularly in the LDB test, suggest that this test may be a sensitive indicator of balance control capacity, with smaller deviations vertically and laterally and increased consistency in performance.

The advantages of improved performance and consistent dynamic and static balance, especially in the context of the LDB test, point out that training and developing these skills could be beneficial for overall performance improvement and injury prevention.

The correlations identified between the parameters of the 15 Jumps free arms test and the parameters of the SB, LDB and VDB tests highlight the complex interdependencies between different aspects of performance and balance. The need for a comprehensive approach in the assessment and training of athletes and active people as well is emphasized.

Acknowledgments

This research is part of the research theme within the Doctoral School of Sport Science and Physical Education in the University Center of Pitești, National University of Science and Technology "Politehnica" Bucharest. We express our gratitude to the director of the National Children's Palace in Bucharest, Romania, and to the children who participated in this research.

References

1. Chilom, D., Potop, V., Grigore, M.F., et al.: *Structure of the dynamic balance indices in the 5-8-year-old children practicing dance and other sports activities*. In: Proceedings of the International Scientific Conference "Actualities and Perspectives of Physical Education and Sport Sciences", 4th edition, April, 05, 2023, p. 57-66.
2. Chilom, D., Potop, V., Onaca, D., et al.: *Influence of somatic parameters on the manifestation of static balance in the 5-8-year-old children who practice dance and other sports activities*. In: Proceedings of the International Scientific Conference "Actualities and Perspectives of Physical Education and Sport Sciences", 4th edition, April, 05, 2023, p.48-56.
3. Dos Anjos, L.F., Galvão, J., Vieira, M.F.: *Performance of contemporary dancers in drop jump test assessed by reactive strength index*. In XXVI Brazilian Congress on Biomedical Engineering: CBEB 2018, Armação de Buzios, RJ, Brazil, 21-25 October 2018, Vol. 1, p. 333-336. (2019, June). Singapore: Springer Singapore.
4. Grigore, M.F., Jurat, V., Moga, C., et al.: *Study on optimizing the dancesport basic training in children aged 6-9 years*. In Scientific Conference, 2022, p. 77.
5. Harry, J.R., Paquette, M.R., Schilling, B. K., et al.: *Kinetic and electromyographic subphase characteristics with relation to countermovement vertical jump performance*. In: Journal of Applied Biomechanics. Vol. 34(4), 2018, p. 291-297.
6. Healy, R., Kenny, I.C., Harrison, A.J.: *Reactive strength index: a poor indicator of reactive strength?* In: International journal of sports physiology and performance. Vol.13(6), 2018, p. 802-809.

7. Landry, B.W., Driscoll, S.W.: *Physical activity in children and adolescents*. In: PM&R, Vol. 4(11), 2012, p. 826-832.
8. Peng, F.: *Influences of abdominal core strength training on sport dancing*. In: Revista Brasileira de Medicina do Esporte, 29, 2023.
9. Sallis, J.F., Prochaska, J.J., Taylor, W.C. *A review of correlates of physical activity of children and adolescents*. In: Medicine and science in sports and exercise, Vol. 32(5), 2000, p. 963-975.
10. Sgrò, F., Nicolosi, S., Schembri, R., et al.: *Assessing vertical jump developmental levels in childhood using a low-cost motion capture approach.* Perceptual and motor skills, Vol. 120(2), 2015, p. 642-658.
11. Tingman, J.: *The effect of acute fatigue on reactive strength index in modern dancers*. A Thesis Presented to Eastern Washington University Cheney, Washington. In: EWU Masters Thesis Collection. Partial Fulfilment of the Requirements for the Degree Master of Science in Physical Education. 2020. – 28 p.
12. Uspuriene, A.B.P., Malinauskas, R.K., Sniras, S.A.: *Effects of Education Programs on Dance Sport Performance in Youth Dancers*. In: European journal of contemporary education, Vol. 8(1), 2019, p. 136-143.
13. Vrânceanu, I., Cojocari, L.: *Dezvoltarea abilităților psihomotrice la elevi prin intermediul orelor de dans classic* [*Development of psychomotor skills in students through classical dance classes*]. In: Problems of humanities and social sciences and the modernization of education, Ed. 24, 25 of March 2022, Chişinău: „Ion Creangă" State Pedagogical University, 2022, Series 24, Vol.2, p. 129-136. DOI:10.46728/c.v2.25-03-2022.
14. Wyon, M., Allen, N., Angioi, M., et al.: *Anthropometric factors affecting vertical jump height in ballet dancers*. In: Journal of dance medicine & Science. Vol., 10(3-4), 2006, p. 106-110.