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THE INFLUENCE OF RECREATIONAL PHYSICAL ACTIVITIES ON ATTENTION AND STATIC BALANCE OF 6–9-YEAR-OLD GIRLS

Otilia Teodora LIBER*
Babes-Bolyai University Cluj-Napoca, Faculty of Physical Education and Sport. Doctoral School.
e-mail: burz.teodora@yahoo.com

Luminița Iolanda Edittha MLADONICZKY
CJRAE Bihor, School Cunselor
e-mail: mladoedita@yahoo.com

Iacob HANȚIU
Babes-Bolyai University Cluj-Napoca, Faculty of Physical Education and Sport. Doctoral School.
e-mail: iacobhantiu@gmail.com

Abstract: Physical activities practiced for recreational purposes contribute to the development of essential skills that allow the efficient performance of daily tasks or sports activities. The aim of this study was to analyse the impact of recreational contemporary dance training on static balance and attention level of 6- to 9-year-old girls. The sample of the study was made of 26 girls, divided into two groups: 12 in the experimental group (EG) and 14 in the control group (CG). Subjects from the first group participated in recreational contemporary dance training for 1 hour, twice a week, for 6 months, and those from CG participated only in measurements. Static balance was assessed using the Wii Balance Board connected to See Sway software by analysing the distance (DCOP) and velocity (VCOP) and the deviation of center of pressure (COP) while maintaining balance in standing positions on both legs (SBL) and on one leg (SOL). The level of attention was measured using the Knock and Tap (K&T) test from the NEPSY neuropsychological test battery, making a quantitative interpretation of the direct score (DS) but also a qualitative one by transforming the direct scores into percentiles and classifying them on the 5 Attention Levels. Mean and standard deviation were calculated and compared using SPSS. The results showed that in EG, progress was recorded in both tests of balance maintenance, but statistically significant results were in the position of standing on one leg (DCOP: p =.017, VCOP: p =.018). At the control group were found the stagnation of the averages for balance on both legs and statistically insignificant progress on one leg (DCOP: p =.403, VCOP: p =.397). The level of attention showed increases in values in both groups, but they were statistically significant only in the experimental group, both for the direct score (p =.008) and for Level (p =.025). The conclusion of the study was that recreational contemporary dance training, practiced for 6 months twice a week, can positively influence the attention and postural control of 6 to 9year-old girls.

Key words: attentional control, balance, Wii Balance Board, See Saw, recreational contemporary dance, girls 6-9 years.

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* Corresponding author

BACKGROUND

Attention is one of the basic executive functions of humans, being essential in the qualitative processing of information (Cooley & Morris, 1990; Crețu, 2009). Although it is often studied by specialists from several fields, it is not presented by a unanimous definition Souza & Naves, 2021). Even more, Hommel et al. (2019) state that "no one knows what attention is". However, its role is known as vital to carry out tasks that require mental effort. According to Hasher et al. (2007), attention involves the ability to self-regulate in order to achieve a proposed goal through the capacity to focus on essential information and inhibit irrelevant ones. At the same time, according to Pashler et al. (2001), attention can be directed to internal or external stimuli depending on the requirement of the task. Provided that, the ability to control attention is vital in conducting daily activities as well as to obtain academic or sports achievements.

According to Wulf (2007), in order to learn a body movement, the attention must be directed towards the contraction of the required muscles together with coordination. When the skills are formed correctly, attention is used to achieve other goals that lead to performance improvement. Thus, in dance, attention it is constantly demanded, regardless of the level of the dancers. In the early stages is centred in the correct execution, in learning and memorizing the choreography and later can be directed to the expressive interpretation. Researchers Davis et al. (2011) and Diamond (2013) suggest that practicing physical activities can contribute to improving cognitive abilities in children, while being sedentary can alter these abilities. Therefore, it is believed that practicing recreational contemporary dance can have a positive impact on the development of attention in early aged children.

Balance plays an important role in the motor development of the human body. is an ongoing necessity to carry out various movements, making its advancement crucial for individuals to possess the necessary fitness for effectively accomplishing both everyday activities and sports-related endeavours (Cordun, 2009; Huxham et al., 2001). Also, Bressel et al. (2007) suggest that balance plays an important role in injury prevention. Often, athlete´s performance depends directly on the development of postural control (Hrysomallis, 2011). Dancers are most frequently called upon to perform pirouettes, as well as other specific movements that require them to balance on one leg (Bronner, 2012). In certain sports disciplines, balance assumes a technical aspect, wherein athletes are required to assume specific body positions and maintain them on a limited area support. These positions may include balancing on tiptoes, standing on one leg, or even balancing on the tip of one leg.

Children employ different strategies to maintain balance compared to adults, primarily because their neuromuscular system is not yet fully developed (Berard & Vallis, 2006; Ganley & Powers, 2005). Also, according to McNevin & Wulf (2002), the ability to focus attention directly influences balance.

THE AIM OF THE STUDY

The aim of this study was to analyse the influence of recreational contemporary dance training for 6 months on body balance and attention level in 6 to 9 year-old children.

HYPOTESIS

Considering the benefits that physical activities offer to people across all age groups, the following hypothesis was formulated for this research: Implementing an intervention program that incorporates recreational physical activity, specifically contemporary dance, will have a substantial impact on the attention and balance levels of girls aged 6-9 years.

MATERIALS AND METHODS

Sample: At the start of the study, a total of 47 girls aged between 6 and 9 volunteered to participate. They were initially divided into two groups: the experimental group (EG) consisting of 22 members, and the control group (CG) with 25 members. The grouping was based on the participants' own choices to engage in training and measurements. In the experimental group, two subjects declined to participate in the study, and eight subjects were excluded due to frequent absences. In the control group, 11 subjects did not participate in the final measurements.

Ultimately, the study included 26 girls as subjects – 12 in the experimental group and 14 in the control group. To be eligible for participation, the subjects were required to not have a diagnosis of attention deficit disorder and had not previously engaged in extracurricular physical activities, except for the experimental group. The participants in the experimental group underwent an intervention program that involved recreational contemporary dance training for one hour, twice a week, over a span of six months (29.11.2021, to 3.06.2022).

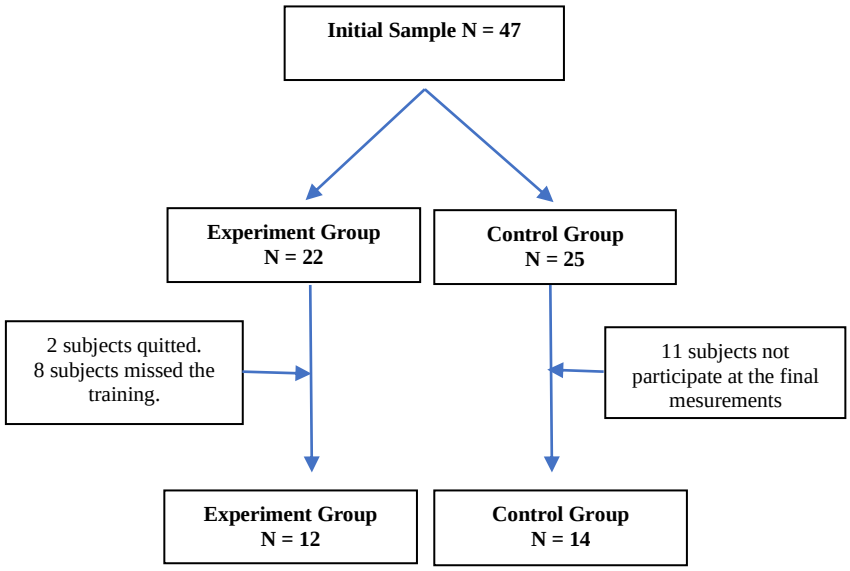

Figure 1. The research study flowchart

Intervention programme

Each lesson started with a synchronized body preparation routine accompanied by music, following the standard methodology of contemporary dance. This was continued by exercises aimed at enhancing flexibility in the lower limbs and back. In the first session of the week, the lesson progressed to static ballet exercises and artistic jumps, while the second session incorporated acrobatic elements from gymnastics. All exercises were tailored to match the subjects' training level. Towards the end of each lesson, the children were given the task of freely expressing themselves through body movements without any technical elements, accompanied by various musical rhythms. Subsequently, a slow rhythmic stretching routine was performed as a cool-down.

Measurements

To evaluate attention, the Kick and Tap (K&T) neuropsychological test from the NEPSY test battery was used in both groups before and after the intervention. The K&T test focuses on assessing self-regulation and inhibition by measuring the ability to adapt motor responses to conflicting verbal and visual instructions. It is a reliable test for children aged between 5 and 12 years in Romania (Korkman et al., 2007).

The K&T test consists of 30 items divided into two parts (Table 1). In the first part, the child learns and maintains instructions received, avoiding imitating the examiner's movements [e.g., hitting the table when the examiner taps, and tapping the table when the examiner hits; Figures 1 a) and b)]. The second part (items 16-30) involves self-regulation by inhibiting the previous tasks and learning a different cognitive set (e.g., performing a side punch when the examiner hits; remaining still when the examiner hits; punching when the examiner performs a side punch). Prior to each part of the test, examples of the movements are provided. The movements are performed with the preferred hand, while the other hand is relaxed with the palm open on the table (Korkman et al., 2007).

Figure 2. a) Kick **b)** Tap **c)** Side fist

Table 1. Items from the first and second part of the test „Kick and Tap".

First part of the test			Second part of the test		
Nr item	Examiner	Correct answer	Nr item	Examiner	Correct answer
1	Kick	Tap	16	Kick	Side fist
2	Kick	Tap	17	Side fist	Kick
3	Tap	Kick	18	Tap	Nothing
4	Kick	Tap	19	Kick	Side fist
5	Kick	Tap	20	Kick	Side fist
6	Tap	Kick	21	Tap	Nothing
7	Tap	Kick	22	Side fist	Kick
8	Kick	Tap	23	Kick	Side fist
9	Tap	Kick	24	Tap	Nothing
10	Tap	Kick	25	Tap	Nothing
11	Kick	Tap	26	Kick	Side fist
12	Tap	Kick	27	Side fist	Kick
13	Tap	Kick	28	Tap	Nothing
14	Tap	Kick	29	Side fist	Kick
15	Kick	Tap	30	Kick	Side fist

In the assessment using the K&T test, each correct answer was given a score of 1, while incorrect answers received a score of 0. The total direct score was obtained by summing the points from both parts of the test, with a maximum possible score of 30. To interpret the data qualitatively, the total score of each subject was converted into specific percentiles based on their age. These percentiles were used to classify the subjects into five categories or levels of attention, as shown in Table 2. The statistical analysis was conducted for the following variables: the direct score (DS), the levels of attention (Level) determined by converting the total direct score into specific percentiles, and separately for each of the five levels of attention.

Table 2. Conversion of direct score to percentiles and rank them by age.

Age	Direct Score	Percentile	Rank
6-9	30	≥ 75	Over the expected level
6	26-29	26-75	At the expected level
7/8	27-29		
9	28-29		
6	17-25	11-25	On the limit
7	24-26		
8	25-26		
9	26-27		
6	6-16	3-10	Under the exected level
7	16-23		
8	19-24		
9	19-25		
6	0-5	≤2	Far below the expected level
7	0-15		
8/9	0-18		

Source: Korkman et al., 2007

For the measurement of static balance, the researchers utilized the Wii Balance Board (WBB) from Nintendo, which was connected to SeeSway software. The WBB is a portable balance plate that has been validated for assessing the displacement of the center of pressure (COP) and has demonstrated comparable efficiency to laboratory force plates (Clark et al., 2018). The parameters analysed were the distance of the projection of the center of pressure (DCOP) and the velocity of displacement of the center of pressure (VCOP). The measurements were taken while the participants-maintained balance for 30 seconds in the standing positions on both legs (SBL) and on one leg (SOL), with arms by the body and looking forward.

RESULTS

After collecting the initial measurements, a t-test for independent samples was conducted to compare the values obtained in the experimental group (EG) with those in the control group (CG). The results indicated that there were no statistically significant differences in the means of the direct scores from the attention assessment test between the two groups at the beginning of the study [$t(24) = 1.21$, $p = .240$]. Additionally, the differences in the means of the balance parameters for both standing on both legs (SBL) [DCOP: $t(11.34) = 2.03$, $p = .067$; VCOP: $t(11.35) = 2.02$, $p = .067$] and standing on one leg (SOL) [DCOP: $t(24) = 1.01$, $p = .324$; VCOP: $t(24) = 1$, $p = .328$]

were not significant. These findings suggest that the two groups were homogeneous in terms of the analysed parameters.

Following the completion of the intervention program, final measurements were taken in both groups, and the averages were compared. The data from the initial and final measurements allowed for the calculation of the number of subjects, means, and standard deviations for each level of attention based on the conversion of the direct scores into specific percentiles, as presented in Table 3. The majority of subjects in both the experimental group (EG) and control group (CG) were classified at levels 2, 3, and 4. The evolution of the two groups was similar, with higher mean direct scores observed in the final measurements for both groups, except for levels 1 and 5.

In the experimental group (EG), no subjects were classified at the lowest level of attention, while the control group (CG) had one subject in both the initial and final measurements, with an initial mean of 17 and a final mean of 13. At level 5, the experimental group had a mean of 30 in both the initial and final measurements, with one subject before the intervention and two subjects at the end of it. The control group did not have any subjects in this category, not only at the initial measurement but also at the final measurement.

Table 3. Number, means, and standard deviations of pre- and post-test total direct scores by attention levels on EG (N = 12) and CG (N = 14)

Level	Group	N Pre	N Post	Mean Pre	Mean Post	SD Pre	SD Post
1 - Far below the expected level	EG	0[a]	0[a]				
	CG	1	1	17.00	13.00		
2 - Under the expected level	EG	2	0[a]	23.00		0.00	
	CG	4	3	22.25	23.33	2.22	2.89
3 - On the limit	EG	5	2	24.40	25.00	0.89	0.00
	CG	5	3	25.00	25.67	0.71	1.53
4 - At the expected level	EG	4	8	27.25	27.88	0.50	0.83
	CG	4	7	27.25	27.43	0.50	0.79
5 - Over the expected level	EG	1	2	30.00	30.00		0.00
	CG	0[a]	0[a]				

A paired t-test was performed to compare the initial and final means of DS and Level of Attention parameters for EG and CG (Table 4). Statistically significant differences were found in DS (p =.008) and Level of Attention (p =.025) and large effect sizes in EG, while no statistically significant differences were found in CG (DS: p =.396; Attention Level: p =.414). However, the means also increased slightly in the CG, although the difference was not significant.

Table 4. Comparison of pre- and post-test means on the attention parameters DS and Attention Level

Group	Pair	Variable	Mean	SD	t	df	Sig (2 - tailed)	Size effect (d)
EG	Pair 1	DS pre	25.58	2.23	3.22	11	.008	.939
		DS post	27.75	1.66				
	Pair 2	Level pre	3.33	0.89	2.60	11	.025	.750
		Level post	4.00	0.60				
CG	Pair 1	DS pre	24.29	3.10	0.88	13	.396	
		DS post	25.14	4.11				
	Pair 2	Level pre	2.86	0.95	0.84	13	.414	
		Level post	3.14	1.03				

The paired t-test was performed to compare the mean values from the first and second measurements for the parameters analysed in the SBL test in the two groups. According to the results, no statistically significant differences were identified for the analysed parameters in any group (Table 5). These results suggest that the applied program did not influence balance in maintaining the standing position on both legs.

Table 5. Comparison of pre- and post-test means of the DCOP and VCOP variables for the SBL sample.

Group	Pair	Variable	UM	Mean	SD	t	df	Sig. (2-tailed)
EG	Pair 1	DCOP pre DCOP post	cm	72.92 42.31	58.15 7.75	-1.92	11	.081
	Pair 2	VCOP pre VCOP post	cm/s	2.43 1.40	1.92 0.26	-1.95	11	.078
CG	Pair 1	DCOP pre DCOP post	cm	38.66 38.66	7.76 9.28	0	13	1.000
	Pair 2	VCOP pre VCOP post	cm/s	1.29 1.29	0.26 0.32	0.08	13	.939

For the parameters of the SOL, a paired t-test was performed to compare the averages recorded before and after the intervention. According to the data in Table 6, at GE, statistically significant differences were identified both in the variable DCOP [t (11) = -2.8, p =.017] and in VCOP [t (11) = -2.79, p =.018], the size of the effect being large (d =.81 for both variables). At GC, the differences were not statistically significant for any of the parameters. These results suggest that the program applied to the experimental group had a positive impact on maintaining balance while standing on one leg.

Table 6. Comparison of pre- and post-test means at DCOP and VCOP in the SOL sample.

Group	Pair	Variable	UM	Mean	SD	t	df	Sig. (2-tailed)	Size effect (d)
EG	Pair 1	DCOP pre DCOP post	cm	224.18 146.51	105.87 32.76	-2.8	11	.017	-0.81
	Pair 2	VCOP pre VCOP post	cm/s	7.47 4.89	3.52 1.08	-2.79	11	.018	-0.81
CG	Pair 1	DCOP pre DCOP post	cm	176.49 146.44	131.27 46.69	-0.86	13	.403	
	Pair 2	VCOP pre VCOP post	cm/s	5.89 4.88	4.37 1.56	-0.88	13	.397	

DISCUSSIONS

The findings of your study align with existing literature on attention and executive functions in children. Attention is indeed considered one of the basic executive functions, and its development is closely linked to the maturation of the prefrontal cortex in children (Shaheen, 2014). While both groups may have experienced some natural improvement in attention due to this developmental process, the greater progress observed in the experimental group suggests that the intervention program, specifically contemporary dance practice, had a positive impact on attentional control.

The positive association between extracurricular physical activities and higher levels of attention during childhood has been reported in previous studies (Davis et al., 2011; Diamond, 2013). Your study's results support this notion, indicating that recreational contemporary dance can positively influence attention in 6- to 9-year-old girls.

The analysis of attention levels based on the converted direct scores revealed that most subjects in both the experimental group and control group were classified in the middle categories (2, 3, and 4) of attention. This suggests that attention levels were already relatively good for most participants at the beginning of the study. However, there were noticeable changes in attention levels among some individuals during the intervention.

In the sub- and borderline attention categories, the number of subjects decreased while the means increased, indicating that some participants moved to higher attention levels following the intervention. In the above-expected category, the mean increased, and the number of subjects in this category also grew. This suggests that some participants showed significant progress, achieving higher levels of attention.

At the extreme levels, specifically in the category "well below expected" attention, there was stagnation in the number of subjects and a regression of the mean in the control group. However, it is important to consider that attention is influenced by various factors, such as individual interest in the task and motivation (Lupșa & Bratu, 2005). Therefore, it is challenging to generalize that the lack of practicing extracurricular physical activities was the sole cause of this result. Nonetheless, it is worth noting that the experimental group did not have any subjects at the lowest level of attention but showed improvements in the opposite extreme (level 5) with two subjects at the final measurement. The analysis of attention levels and the paired t-test results indicate that attention significantly increased in both groups, but the experimental group showed greater progress following the intervention program compared to the control group. The statistically significant greater increases in the K&T direct score in EG ($p = .008$) compared to CG ($p = .396$) support the finding of improved attention in the experimental group. Additionally, the experimental group achieved a statistically significant higher average level of attention ($p = .025$) following the training, in contrast to the control group ($p = .414$).

Regarding the effect of the intervention program on balance, the results from analyzing the displacement of the center of pressure indicate that the program influenced balance primarily when maintaining a standing position on one leg. In this condition, the experimental group demonstrated a decrease in the average COP displacement and velocity, suggesting improved balance control. On the other hand, the control group showed stagnant results, with the distance and velocity of COP movement remaining the same in the sample maintaining balance on both legs (SBL). These findings suggest that the applied program had a significant impact on balance in the SOL sample but had limited effects in the SBL sample.

The greater impact on maintaining SOL balance in the experimental group may be attributed to the frequent requirement of unipedal stance in dance lessons, which may have helped the subjects become more accustomed to this task. Specific exercises targeting balance development, as observed in dance, have been shown to enhance performance in discipline-specific movements rather than daily activities (Hugel et al., 1999; Giboin et al., 2015). However, your study also revealed improvements in postural control in the common SBL test, which is not characteristic of dancing. This suggests that practicing recreational contemporary dance can contribute to the development of static balance in girls aged 6–9, beyond the specific movements of the dance discipline.

CONCLUSIONS

The recorded results support the notion that contemporary dance training has a positive impact on postural control, particularly in maintaining balance on one leg. This is consistent with the nature of dance lessons, where unipedal stances are frequently practiced. The intervention program effectively enhanced postural control in this specific aspect of balance. Regarding attention, the results demonstrate that both groups experienced improvements in attentional control, but the experimental group showed greater progress. This finding aligns with previous research suggesting that attention and cognitive skills generally improve with age in children, but extracurricular physical activities can further enhance their development. In conclusion, engaging in recreational contemporary dance training for a duration of 6 months, twice a week, with each session lasting an hour, can have a positive impact not only on postural control but also on attentional control in girls aged 6-9.

Limitations

We believe that the main limitations of the research are related to the small number of subjects and trainings that were attended during the research period.

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