DOI 10.26773/smj.240203

SportMont

ORIGINAL SCIENTIFIC PAPER

Opportunities for the Development of Motor Skills through Music-Movement and Dance Activities of 9–10-Year-Old Pupils

Michaela Slovakova[1], Martina Mandzakova[1], Jana Daubnerova[1]

[1]Matej Bel University, Faculty of Arts, Department of Physical Education and Sports, Banská Bystrica, Slovak Republic

Abstract

The goal of the research was to determine the impact of an intervention program containing musical movement and dance activities on the level of pupils' physical abilities at the elementary level of education in physical and sport education classes. The object of the research consisted of Σ63 pupils, boys (n=30) aged 10.21±0.42 and girls (n=32) aged 10.32±0.37. The content of the movement program was selected means containing music and movement, dance activities and aerobics, which were implemented for 18 weeks, twice a week, 45 min during physical and sport education. In terms of data collection methods, standardized tests for physical education practice were used. Tests were used to assess the level of motor skills: sit-and-reach test, standing long jump, sit-ups in 30s, endurance shuttle run and shuttle run 4x10. The somatometry method was used. The effect of the implemented movement program was confirmed and significant positive changes in the level of the observed movement abilities were observed: the level of mobility in the joints of the trunk in boys (t=-8.471), girls (t=-9.357), explosive power of the lower limbs in boys (t=-14.459), girls (Z=-4.940), the dynamic and endurance power of the abdominal, hip and thigh muscles in boys (Z=-4.325), girls (t=-19.264), running speed in both boys (Z=-4.783), girls (t=7.095) with a large effect size, in endurance skills in both boys (Z=-4.828), girls, (Z=-5.028) also with a large effect size. Based on the results, the regular and purposeful physical activity of pupils in the school environment significantly influences the level of physical abilities, and thus physical fitness as one of the manifestations of health.

Keywords: *aerobic, musical movement and dance activity, PE, physical abilities, primary school pupils*

Introduction

Modern lifestyles and the absence of physical activity result in reduced physical fitness, musculoskeletal disorders, obesity, and the development of various non-infectious diseases carried into adulthood (Morano, Rutigliano, Rago, Pettoello-Mantovani, & Campanozzi, 2016; Di Maglie, 2017; Vukelja, Milanovic, & Salaj, 2022; Caron, Bernard, & Gadais, 2023). The persistence of risk factors during childhood, gives a prerequisite to prevent the development of cardiorespiratory and chronic disorders in adulthood (Ekelund et al., 2012; Negrea et al., 2021). On the other hand, an increase in the amount of physical activity in schoolchildren is directly related to many health benefits such as physical fitness, better bone structure (larger, stronger and firmer bone mass), and a more favourable body weight status (Physical Activity Guidelines Advisory Committee-PAGAC, 2018). New guidelines recommend at least 60 minutes of physical activity per day for children and adolescents (WHO, 2020). One option is to provide healthy lifestyle education for pupils at all levels of education (Gozhenko, Biryukov, Gozhenko, & Zukow, 2018; Diachenko-Bohun et al., 2019; Kashuba et al., 2020). Physical and sport education plays an essential role in the curriculum and is an essential part of the educational process for pupils. It should contribute to the prevention of sedentary lifestyle, ensure physical activity of pupils, act on the holistic formation of the personality of the young individual with the formation of lasting habits into adulthood in accordance with WHO recommenda-

Correspondence:

Michaela Slovakova
Matej Bel University, Faculty of Arts, Department of Physical Education and Sports, Tajovskeho 40, 974 01 Banská Bystrica, Slovak Republic
E-mail: michaela.slovakova@umb.sk

tions (Mantjes et al., 2012; Colella, 2016; Marttinen, Fredrick, & Silverman, 2018; D'Anna, Forte, & Gomez, 2019; Marinho, Neiva, Marques, Lopes, & Morais, 2022). To achieve the aforementioned goal of physical education, it is essential to offer pupils an attractive and varied content with the opportunity to experience success, which creates the basic prerequisite for seeking further activity. Studies point to the fact that fun and enjoyment in physical education (PE) classes can influence the development of positive attitudes towards physical activity (Silverman, 2017; Constantinides & Silverman, 2018). Based on the above, the authors recommend the educators to implement engaging movement programs in school physical education. Cvejić & Ostojić (2017) used the FITT program in their practice, whose main goal was to promote health and increase physical fitness. They recommended practicing in a developmental zone according to the students' abilities and preferences, with a constant increase in the load (intensity or duration) of physical activities. The above program is consistent with the study by Sallis et al. (2012), which means it is Health Optimizing PE or HOPE. The purpose of the FITT programme was to provide pupils with the knowledge, skills, abilities and attitudes that lead to lifelong activity. In relation to the above, it is recognised that pupils' activity alone, based on their interest in a varied movement programme, can lead to spontaneous engagement in the activities on offer, which in turn leads to the development of movement skills or physical fitness.

Such programmes for pupils should include a programme containing music, dance or aerobic activities. Their effectiveness is confirmed by some studies, which report that programs with applied aerobics have been confirmed to have positive effects on physical and mental health or the development of physical fitness for children (Gu, Chang, & Solmon, 2016; Cvejić, Buišić, Mitrović, & Ostojić, 2018). Independent studies of Kouli, Rokka, Mavridis, and Derri (2009), and Podrigalo, Iermakov, Alekseev, and Rovnaya (2016), and Rokka et al. (2019) highlight the popularity of aerobics and dance in physical and sport education classes, which lies in the non-competitive nature of the physical activity with the induction of a pleasant atmosphere in the group by means of a musical background. Some researchers have noted the development of body posture quality by dancing activities intervention (Gao, Zhang, & Stodden, 2013; Andrieieva et al., 2021; Kashuba et al., 2021; May et al., 2021). The following research confirm the effects of the mentioned means of physical education in different age categories. Mavridis et al. (2004) describe the positive effect of aerobic and dance program in physical education in 6-7 years old pupils on health-related abilities (cardiorespiratory fitness, strength, endurance, flexibility etc.), each to a different degree.

The purpose of the study (Kouli et al. 2009) was to evaluate the level of health-related fitness in 10 to 11 years old pupils. Afterwards, Aldemir, Ramazanoğlu, Çamlıgüney, and Kaya (2011) confirm the positive effect of dance activities in adolescents, Pantelić et al. (2019) confirmed the effect of an experimental dance program on children's motor coordination skills. The above-mentioned studies confirm the positive effects of the aerobics and dance program in school physical education for creating a suitable climate, motivating to physical activity, affecting the quality of body posture, increasing the level of physical fitness, or coordination abilities. Also, the movement abilities development in different age categories, but confirmation of the effect of musical movement and dance activities in 9-10 years old pupils is not sufficiently researched. The stated findings were the impetus for the creation of an attractive interventional musical movement and dance program for physical and sport education classes.

The goal of the research was to determine the impact of an intervention program containing musical movement and dance activities on the level of pupils' physical abilities at the elementary level of education in physical and sport education classes.

Material and methods

Participants

In accordance with the goal, the research group included overall Σ n=62 pupils (n=30 boys and n=32 girls) of the town of Banská Bystrica, Slovak Republic, aged 9-10 years, i.e., pupils of early school age (included in I and II health group without impairments), willing to participate in research, with the consent of their parent's takers and of the school. Ethical approval was obtained from the ethical committee at the Matej Bel University, under project n. 1522/2022. Measurements were carried out in accordance with the ethical standards of the Declaration of Helsinki. Each participant voluntarily provided written informed consent before participating. The primary characteristic of the groups is presented in Table 1.

Table 1. Characteristics of the research object

	Research object (n=62)	
Measured values	Boys (n=30)	Girls (n=32)
Age/years	10.21±0.42	10.32±0.37
Body weight/kg	43.21±7.54	35.41±7.11
Body height/cm	145.37±6.54	138.1 ± 6.24
BMI kg/m^2	20.45±2.21	18.57 ± 2.11

Measurement organization

The research has taken place in the academic year 2021/2022 at an elementary school in Banska Bystrica. After a thorough preparation of the research in order to achieve the aim, in February an input diagnostics (V1) of somatometric indicators and a diagnostics of body posture was carried out, which was evaluated by a standardized test used in school practice. Subsequently, an exercise program aimed at health promotion in relation to the correct posture of the pupils, was included in the teaching content of compulsory physical and sport education, twice a week for 45 minutes, for a period of 18 weeks, a total of 36 lessons. Each lesson of exercise program included music-implementing exercise and dance activities (Table 2), contained 10-minute warm-up, 25-minute main part and 5-minute Cool-Down. Every lesson included a 10 min warm up with stretching. The music was played at a soft rhythm 120-128 beats per minute (bpm). Main part included 30 min continuous musical-movement and dance activities, such as aerobic, dances, dance games, exercise on the wall bars, exercise on the over ball and stability ball, skip-

ping rope games. The intensity of the main program was 60-75% of the maximum heart rate with a rhythm of 130-135 bpm in the first six weeks. After six weeks, from week seven to week eleven, the intensity was increased to 75-85% of the maximum heart rate (music 140-150 bpm). In the next seven weeks, the intensity of the program was variable, every other hour was reduced to 60-70% of the maximum heart rate and rest weeks was 75-85% of the maximum heart rate. In the last part of the lesson, the participants were given 5 min. cool down. It included muscular strength exercises with slow and relaxing rhythm music. The said program was inspired by following researches (Mavridis et al., 2004; Kouli et al., 2009; Andrieieva et al., 2021; Mischenko et al., 2023). The process of teaching was led by a qualified teacher with years of experience. Subsequently, output testing (V2) of the same indicators was performed.

Table 2. Timetable of the Movement program for 1 month (sample)

Lesson	Warm-up (10min.)	Main Part (30 min.)		Cool down (5min.)
		A part	B part	
1	Warm-up	Stability ball	Dance games	stretching
2	Warm-up	Low Aerobic	Dance- modern	stretching
3	Warm-up	Stability ball	Dance- folk	stretching
4	Warm-up	Dance Aerobik	Dance - modern	stretching
5	Warm-up	Over ball	Rope Skipping	stretching
6	Warm-up	Exercise on the wall bars	Dance games	stretching
7	Warm-up	Skipping Rope games	Dance- folk	stretching
8	Warm-up	Low Aerobic	Dance Aerobik	stretching
Σ	80min.	240 min/month		40 min.

Measurement Taking

In terms of data collection, somatometry was used, body height, body weight, BMI were collected (anthropometers and digital scales were used). The following tests were used to test physical abilities: sit-reach test, standing long jump, sit-ups test for 30 s, endurance shuttle run (Moravec et al., 1996) and 4x10 shuttle run (Čillík et al. 2013).

Data Analyses

In terms of data processing methods, the mathematical and statistical methods to process the collected data and to calculate basic descriptive statistics were used. Paired-Samples T Test was used to determine the significance of differences between input (pretest) and output (posttest) measurements in the studied variables. Cohen's d coefficient was used to calculate the effect size in the paired-samples t-test procedure, which was interpreted according to the minimum thresholds as follows: d=0.20 - small effect, d=0.50 - medium effect, d=0.80 - large effect (Cohen, 1988). In case of rejection of normality of data distribution by Shapiro-Wilk test, paired Wilcoxon signed rank test (Wilcoxon Signed Rank Test) was used to determine the significance of differences between input and output measurements. The effect size calculation for the Wilcoxon signed rank test procedure used the coefficient r (Corder - Foreman, 2009), which was interpreted according to the minimum thresholds as follows: r=0.10 - small effect, r=0.30 - medium effect, r=0.50 - large effect (Cohen, 1988). The probability of a Type I error was set at α=0.05 in all statistical analyses. Statistical analysis procedures were performed in accordance with the recommendations of the publication Pivovarnicek (2021) using IBM® SPSS® Statistics v28 and Microsoft® Office Excel 2016 software.

Results

In the observed sample of primary school pupils, the effect of the designed movement programme on the level of movement abilities in boys (Table 3, Table 4) and separately in girls (Table 5, Table 6) was evaluated.

Table 3. Comparison of the input and output measurements in boys

			X	SD	Median	Mode	Min	Max
SR	V_1	(cm)	16.6	6.2	16	16	4	30
	V_2	(cm)	20.5	5.04	21	17	11	31
SLJ	V_1	(cm)	139.8	28.5	138	115	89	200
	V_2	(cm)	153.2	27.5	151	128	100	215
SU	V_1	(n)	18	7.7	17	17	6	36
	V_2	(n)	23.1	6	22	21	10	37
4x10	V_1	(s)	13.5	1.6	13	11.9	11.3	17.1
	V_2	(s)	13	1.6	12.6	11	11	16.7
ESR	V_1	(n)	35.7	15	34	33	9	76
	V_2	(n)	40	15	38	41	15	77

SR – sit-and-reach; SLJ- standing long jump; SU- sit-ups; 4x10 the shuttle run; ESR- endurance shuttle run; SD- standard deviation; X- arithmetical mean; V_1 – input, V_2 – output

Table 4. Statistical significance of differences after movement program intervention in boys

	Test statistics			
	Z-value	**t-value**	**p- value**	**Effect size**
SR	-	t=-8.471	p<0.05	d=1.55**
SLJ	-	t=-14.459	p<0.05	d=2.64**
SU	Z=-4.325	-	p<0.05	r=0.56*
4x10	Z=-4.783	-	p<0.05	r=0.62*
ESR	Z=-4.828	-	p<0.05	r=0.62*

* Wilcoxon Signed Rank Test ** Paired-Samples T Test

Table 5. Comparison of the input and output measurements in girls

			X	**SD**	**Median**	**Mode**	**Min**	**Max**
SR	V_1	(cm)	21	6	21	22	5	33
	V_2	(cm)	27.3	3.9	28	31	17.5	34
SLJ	V_1	(cm)	139	23.8	134	115	103	186
	V_2	(cm)	151.2	22.2	141.5	141	119	191
SU	V_1	(n)	17.7	6.3	17	17	4	30
	V_2	(n)	21.9	5.8	22.5	17	10	34
4x10	V_1	(s)	13.3	1.3	13.2	12.9	11.2	16.4
	V_2	(s)	13	1.2	12.9	11	11	16
ESR	V_1	(n)	29.3	12.9	28	28	7	65
	V_2	(n)	33.8	12.4	32	24	13	67

SR – sit-and-reach; SLJ- standing long jump; SU- sit-ups; 4x10 the shuttle run; ESR- endurance shuttle run; SD- standard deviacion; X- arithmetical mean; V_1 – input, V_2 – output

Table 6. Statistical significance of differences after movement program intervention in girls

	Test statistics			
	Z-value	**t-value**	**p- value**	**Effect size**
SR	-	t=-9.357	p<0.05	d=1.65**
SLJ	Z=-4.940	-	p<0.05	r=0.62*
SU	-	t=-19.264	p<0.05	d=3.41**
4x10	-	t=7.095	p<0.05	d=1.25**
ESR	Z=-5.028	-	p<0.05	r=0.63*

* Wilcoxon Signed Rank Test ** Paired-Samples T Test

Sit and reach test. Boys demonstrated a lower level of trunk joint mobility despite an average progression of 3.9 cm, which was confirmed as significant (t=-8.471, p<0.05,). In girls, a significant improvement of 6.3 cm in the result of the given test (t=-9.357, p<0.05) was observed. Differences in the level of joint mobility were demonstrated in the entire study set with a large effect size (d=1.55; d=1.65).

Comparing the input and output values of the measurement in standing long jump test, a significant difference in boys (t=-14.459, p<0.05) was found, when there was an increase in power output by an average of 13.4 cm. At the same time, the increase was higher than in girls, when girls achieved an increase in the level of explosive power of the lower limbs by an average of 12.2 cm, which also proved to be statistically significant (Z=-4.940, p<0.05). Based on the influence of the movement program, the object of the research achieved changes in the level of explosive strength of the lower limbs with a large effect (d=2.64; r=0.62).

In sit-ups test the higher mean values were found in boys, when 5.1 more repetitions were recorded in the output testing, which was shown as a significant improvement (Z =-4.325, p<0.05). In girls, about 4.2 repetitions better performance in sit-ups test was recorded, which also proved to be significant due to the intervention (t=-19.264, p<0.05). At the same time, a large effect of the achieved changes in the level of strength of the abdominal, hip and thigh muscles for the whole group (r=0.56; d=3.41) was noticed.

In the shuttle run 4x10 test, the mean values for girls and boys were almost equal. In the input testing, boys and girls achieved a time of 13.5 s and 13.3 s, respectively. After the influence of the exercise program, an average value of 13 s from both genders was observed, so it can be considered the differences in the level of running speed to be significant in both boys (Z=-4.783, p<0.05) and girls (t=7.095, p<0.05) with a large effect (r=0.62; d=1.25).

In Endurance shuttle run test, boys performed at a higher level, as a significant improvement of 4.3 sections (Z=-4.828, p<0.05) was observed in the output testing as well as 4.5 sections in girls, confirming a significant improvement (Z=-5.028, p<0.05) with a large effect size (r=0.62, r=0.63).

Discussion

This study investigated the effect of an intervention movement program containing music and dance activities on the development of motor performance in 9-10-year-old children. By comparing the acquired data of physical development (body weight, body height, BMI) of the monitored group with the reference standards Sedláček and Cihová (2009), it was found that the groups of girls and boys fall into the average category of Slovak population.

Looking at actual findings, but also the findings of other studies, it can be concluded that the level of movement abilities of 10-year-old pupils in Slovakia is constantly decreasing. By comparing the actual findings with studies by Moravec et al. (1996), Čillík et al. (2015), Mandzák and Slováková (2018) and Lupo et al. (2022). The level of joint mobility of the school population as measured by the Sit and Reach test has a decreasing trend. In Moravec et al. (1996), the average performance for boys in Slovakia was 18.4 cm, and currently, it is recorded as 16.6 cm, which is also in agreement with Čillík et al. (2015). In comparison with the research of Lupo et al. (2022), which investigated the movement performance of students from Turin, it was found that actual research sample performed worse in input testing in terms of joint mobility for both boys and girls. However, after the targeted intervention, the observed population exceeded all the above averages, indicating that a program containing music and dance activities significantly influences the development of joint mobility, as was expected. In girls, the changes in the level of joint mobility of the Slovak population are less pronounced. In comparison, in Moravec et al. (1996) the recorded average value of the seated forward bend was 21.89 cm, in Čillík et al. (2015) at the level of 20.62 cm and the current study shows similar results, namely 21 cm. However, the observed girls were able to significantly increase the level of joint mobility due to the influence of the designed movement program.

The level of explosive strength of the lower limbs was determined by the standing long jump test. In boys, the average level of 139.8 cm was measured. A continuous decline in performance was recorded, while compared to Čillík et al. (2015), boys achieved an average value of 151.93 cm and Mandzák and Slováková (2018), when an average value of 146.7 cm was recorded. In girls, the average value of the parameter was currently 139 cm compared to the value of 144.06 cm recorded in Čillík et al. (2015) and the value of 145.2 cm, recorded in Mandzák and Slováková (2018). Again, a decline in performance was noticed, but due to the impact of the movement intervention program, a significant positive change was achieved in both, boys (153.2 cm) and girls (151.2 cm). An interesting finding is that, compared to the research of Lupo et al. (2022), who investigated the explosive strength of the lower limbs of the Turin pupils with the same test, current findings confirm higher performance for both, boys and girls in present pupils in the input testing.

Chronologically decreasing levels were also observed in the dynamic abdominal muscle strength parameter, as measured by the sit-ups test. While the results of Čillík et al. (2015) are known at the level of 19.75 in boys and 17.86 in girls, currently an average value of 18 in boys and 17.7 in girls was found. However, after the intervention, a significant improvement in the level of abdominal muscle strength skills was observed, namely boys improved by an average of 5.1 (23.1) and girls by 4.2 (21.9) repetitions per 30 s.

Pupils in Čillík et al. (2015) performed at a similar level in speed abilities as it was found in the current testing. In that year, boys and girls achieved an average time in the shuttle run of 12.8 s and 13.34 s, respectively. Currently, values at an average level of 13.5 s for boys and 13.3 s for girls were recorded. Through intentional intervention, an improvement of 0.5 s for boys and 0.3 s for girls was achieved.

The children's current level of endurance ability found indicates approximately the same level of performance that was measured in the research of Čillík et al. (2015). In the endurance shuttle run test, the actual boys achieved an average of 35.7 runs, compared to 37.08 in the aforementioned study. For girls, the current number of runs at 29.3 was measured, while in Čillík et al. (2015) it was 29.51. After the implementation of the movement program, an improvement was observed to a level of 40 crossing runs for boys and 33.8 for girls. Based on the above results, it can be concluded that the movement program, with the content of music and dance activities has a positive effect on the motor performance of the observed children.

During the application of the movement program, with the content of music and dance activities, an increased interest in physical activity associated with joy was found, which corresponds to the findings of Kouli et al. (2009), and Mischenko et al., (2023). The positive progress of movement abilities due to the influence of dance and aerobic activities in pupils of younger school age is also in accordance with other studies. For example, Kouli et al. (2009), specify an improvement in the strength/endurance of the abdominal muscles, flexibility of the muscles of the back and of the hip and an improvement in the strength of the hands. Effects of the FITT program on physical activity and health-related fitness in primary school age pupils (Cvejič & Ostojic, 2017) significantly contributed to the improvement of aerobic fitness, muscular fitness and partially flexibility. Velickovska, Gontarev, and Popovski (2022) researched the effects of innovative tandem hours on physical education on motor capacity of pupils in elementary school level. Experimental group achieved better results in motor tests: dynamometer 50 on the palm, standing long jump, sit-ups for 30 seconds and shuttle run 4x10 m. The findings of this study are consistent with the results obtained by Aldemir et al. (2011) in children of similar age, confirming a positive effect of dance activities on flexibility, coordination, dynamic balance, jump performance, agility, acceleration, and speed. Similar results were also reported by Mavridis et al. (2004) and Pantelić et al. (2019), albeit with slightly younger children. The key element that led to the improvement in the experimental group is stated to be the correct planning, organisation and implementation of the lessons, i.e. the correct and optimal choice of the type, duration, intensity and frequency of physical exercises.

Moreover, such programs contribute to pupils' cognitive and emotional development and significantly ameliorate kinetic skills (Ferdowsi et al., 2010; Kriventsova et al., 2017).

The strength of the study is the fact that the results obtained are unique, as there are few studies that present the use of music-movement and dance activity in physical education for 9-10 years old pupils. Another advantage is the easy implementing a movement program into the teaching process at low cost.

Limitation of the study is the absence of a control group to determine the effect of the program and to generalize the conclusions.

Conclusions

This study was able to demonstrate the effect of a movement intervention program, containing music-movement, dance and aerobic activities, on the development of children's movement performance.

The effect of the implemented movement program and significant positive changes in the level of the observed movement abilities was confirmed: Boys demonstrated a higher level of trunk joint mobility with an average progression of 3.9 cm, which was confirmed as significant. In girls, was observed a significant improvement of 6.3 cm in the result of the given test). In explosive lower limb strength was found a significant improvement in boys, when there was an increase in power output by an average of 13.4 cm. The increase was higher than in girls, when girls achieved an increase by an average of 12.2 cm, which also proved to be statistically significant. In dynamic and endurance strength of the abdominal, hip and thigh muscles, higher mean values were found in boys (+5.1 repetitions) and girls (+4.2 repetitions). After the influence of the movement program, decreasing of the speed abilities was observed. The improvement in the level of running speed was significant in both boys and girls. In endurance abilities a significant improvement was observed. In boys about 4.3 sections in the output testing as well as 4.5 sections in girls, confirming a significant improvement.

Based on the findings, a relevant conclusion can be stated that regular and purposeful physical activity of pupils in the school environment significantly affects the level of movement ability and, therefore, physical fitness as one of the manifestations of health.

Acknowledgement

The article was supported by KEGA grant no. Project Nr. 025UMB-4/2021 2021 Creation of multimedia Tool Focused on Health of Pupils in Primary Education

Conflicts of interest

The authors declare that there is no conflict of interest.

Received: 16 June 2023 | **Accepted:** 08 November 2023 | **Published:** 01 February 2024

References

Aldemir, G. Y., Ramazanoğlu, N., Çamlıgüney, A. F., & Kaya, F. (2011). The effects of dance education on motor performance of children. *Educational Research and Reviews, 6*(19), 979-982.

Andrieieva, O., Kashuba, V., Yarmak, O., Cheverda, A, Dobrodub, E., & Zakharina, A. (2021). Efficiency of children's fitness training program with elements of sport dances in improving balance, strength and posture. *Journal of Physical Education and Sport*, *21*(5), 2872–2879. https://doi.org/10.7752/jpes.2021.s5382.

Caron, T., Bernard, P., & Gadais, T. (2023). Clinical and school-based intervention strategies for youth obesity prevention: A systematic review. *Frontiers in Sports and Active Living*, *4*, 906857. https://doi.org/10.3389/fspor.2022.906857

Cvejić, D., & Ostojić, S. (2017). Effects of the FITT program on physical activity and health-related fitness in primary school age children. *Facta Universitatis, Series Physical Education and Sport, 15*(3), 437-451.

Cvejić, D., Buišić, S., Mitrović, N., & Ostojić, S. (2018). Aerobic activity of students during physical education FITT Classes. *Facta Universitatis, Series Physical Education and Sport, 16*(3), 515-524. https://doi.org/10.22190/FUPES181127047C

Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Constantinides, P., & Silverman, S. (2018). Cypriot urban elementary students' attitude toward physical education. *Journal of Teaching in Physical Education, 37*(1), 69-77.

Colella, D. (2016). *Styles of teaching, motor learning and educational process Training & Teaching* XIV, 1.

Corder, G.W., & Foreman, D.I. (2009). *Nonparametric Statistics for Non-Statisticians: A Step-by-Step Approach*. New Jersey: John Wiley & Sons,

Čillík, I., Kollár, R., Kremnický, J., Pivovarniček, P., Tokárová, M., Ďurják, O., ... & Murínová, A. (2013). *General Physical Performance and Physical Development of Pupils of the 1st Year of Primary School in Banská Bystrica in the School Year 2012/2013*. Banská Bystrica: Faculty of Humanities, Matej Bel University.

Čillík, I., Kremnický, J., Kollár, R., Pivovarniček, P., & Mandzáková, M. (2015). The Level of General Physical Performance and Physical Development of 10-Year-Old Pupils. *Journal of Sports Science, 3*, 89-95. doi: 10.17265/2332-7839/2015.02.005

D'Anna, C., Forte, P., & Gomez, F. (2019). Physical education status in European school's curriculum, extension of educational offer and planning. *Journal of Human Sport and Exercise*, *14*(4), 805- 817. https://doi.org/10.14198/jhse.2019.14.Proc4.43

Di Maglie, A. (2017). Sport for the health and well being of school age: from the data collected, some pedagogical considerations. *Formazione & Insegnamento*, *15*(2), 393–404. https://ojs.pensamultimedia.it/index.php/siref/article/view/2613

Diachenko-Bohun, M., Hrytsai, N., Grynova, M., Grygus, I., Muszkieta, R., Napierała, M., & Zukow, W. (2019). Characteristics of Healthbreakers in the Conditions of Realization of Health-Safety Technologies in Education Structures. *International Journal of Applied Exercise Physiology*, *8*(3.1), 1-8. doi: https://doi.org/10.30472/ijaep.v8i2.391

Ekelund, U., Luan, J. A., Sherar, L. B., Esliger, D. W., Griew, P., Cooper, A., & International Children's Accelerometry Database (ICAD) Collaborators. (2012). Moderate to vigorous physical activity and sedentary time and cardiometabolic risk factors in children and adolescents. *Jama, 307*(7), 704-712. https://doi:10.1001/jama.2012.156

Ferdowsi, M., Marashian, F., & Marashian, S. (2010). The Effects of 12-Week Aerobic Exercises on Rate of Mental Health in Male Students of Ahvaz Payam Noor University. *Human Movement*, *11*(2),167-71.

Gao, Z, Zhang, T, & Stodden, D. (2013). Children' s physical activity levels and psychological correlates in interactive dance versus aerobic dance. *Journal of Sports and Health Science, 2*(3), 146-151. https://doi.org/10.1016/j.jshs.2013.01.005

Gozhenko, A., Biryukov, V., Gozhenko, O., & Zukow, W. (2018). Health as a space-time continuum. *Journal of Education, Health and Sport, 8*(11), 763-777. doi: http://dx.doi.org/10.5281/zenodo.2657000

Gu, X., Chang, M., & Solmon, M. A. (2016). Physical activity, physical fitness, and health-related quality of life in school-aged children. *Journal of Teaching in Physical Education*, *35*(2), 117-126. https://doi.org/10.1123/jtpe.2015-0110

Kashuba, V., Andrieieva, O., Yarmak, O., Grygus, I., Napierala, M., Smolenska, O., ... Zukow, W. (2021). Morpho-functional screening of primary school students during the course of physical education. *Journal of Physical Education and Sport, 21*(2), 748– 756. https://doi.org/10.7752/jpes.2021.02093.

Kashuba, V., Savliuk, S., Chalii, L., Zakharina, I., Yavorsy, A., Panchuk, A., ... & Ostrowska M. (2020). Technology for correcting postural disorders in primary school-age children with hearing impairment during physical education. *Journal of Physical Education and Sport*, *20*(2), 939– 945. doi:10.7752/jpes.2020.s2133

Kouli, O., Rokka, S., Mavridis, G., & Derri, V. (2009). The effects of an aerobic program on health-related fitness and intrinsic motivation in elementary school pupils. *Studies in physical Culture &Tourism, 16*, 301-306.

Kriventsova, I., Pashkevych, S., Iermakov, S., Bartík, P., Michal, J., Nosko, M., & Yermakova, T. (2017). Fitness – aerobic training of 15 -17 years´ age girl students, who have significant risk of deviations in backbone functional state. *Journal of Human Sport and Exercise*, *12*(4), 1289-1297. doi: https://doi. org/ 10.14198 /jhse. 2017.124.15

Lupo, C., De Pasquale, P., Boccia, G., Ungureanu, AN., Moisé, P., & Mulasso, A. (2023). The Most Active Child Is Not Always the Fittest: Physical Activity and Fitness Are Weakly Correlated. *Sports*, *11*(1), 3. https://doi.org/10.3390/sports11010003.

Mandzák, P., & Slováková, M. (2018). *The Efficiency of the BUBO Interveniton Programme in the Development of Primary School Pupils´Movement Abilities*. Hradec Králové : Gaudeamus.

Mantjes, J. A., Jones, A. P., Corder, K., Jones, N. R., Harrison, F., Griffin, S. J., & van Sluijs, E. M. (2012). School related factors and 1yr change in physical activity amongst 9–11 year old English schoolchildren. *International Journal of Behavioral Nutrition and Physical Activity, 9,* 1-12. https://doi.org/10.1186/1479-5868-9-153.

Marinho, D. A., Neiva, H. P., Marques, L., Lopes, V. P., & Morais, J. E. (2022). The influence of a specific high intensity circuit training during physical education classes in children's physical activity and body composition markers. *Montenegrin Journal of Sports Science and Medicine, 11*(2), 29-36. https://doi.org/10.26773/ mjssm.220904

Marttinen, R., N., Fredrick, R., III., & Silverman, S. S. (2018). Middle school

students' free-living physical activity on physical education days, non-physical education days, and weekends. *Montenegrin Journal of Sports Science and Medicine*, *7*(1), 5-12. doi: 10.26773/mjssm.180301

Mavridis, G., Filippou, F., Rokka, S., Bousiou, S., & Mavridis, K. (2004). The Effect of a Health-Related Aerobic Dance Program on Elementary School Children. *Journal of Human Movement Studies. 47*(4), 337-349.

May, T., Chan, E. S., Lindor, E., McGinley, J., Skouteris, H., Austin, D., ... & Rinehart, N. J. (2021). Physical, cognitive, psychological and social effects of dance in children with disabilities: systematic review and meta-analysis. *Disability and Rehabilitation*, *43*(1), 13–26. https://doi.org/10.1080/09638288.2019.1615139

McIllroy, H. B., Roundy, S. E., & Jacobson, C. P., (1989). A Progressive Aerobic Program for Elementary Aged Children. *The Physical Educator*, *46*, 21-26.

Mischenko, N., Kolokoltsev, M., Tyrina, M., Mansurova, N., Chalaya, E., Vrachinskaya, T., ... & Anisimov, M. (2023). Correction of posture disorders using methods of rhythmic gymnastics in 8-10-year-old girls . *Journal of Physical Education and Sport*, *23(4*), 837 – 843. 2023 doi:10.7752/jpes.2023.04106

Morano, M., Rutigliano, I., Rago, A., Pettoello-Mantovani, M., & Campanozzi, A. (2016). A multicomponent, school-initiated obesity intervention to promote healthy lifestyles in children. *Nutrition*. *32*(10), 1075-80. https://doi: 10.1016/j.nut.2016.03.007

Moravec, R., Sedláček, J., Kampmiller, T., Ramacsay, L., Slamka, M., Šelingerová, M., ... Medeková, H. (1996). *EUROFIT Physique and Motor Fitness of the Slovak School Youth*. Bratislava: Slovak Scientific Society for Physical Education and Sport.

Negrea, M.O., Neamtu, B., Dobrotă, I., Sofariu, C.R., Crisan, R.M., Ciprian, B.I, ... & Teodoru, M., (2012). Causative Mechanisms of Childhood and Adolescent Obesity Leading to Adult Cardiometabolic Disease: A Literature Review. *Applied Sciences*, *11*(23), 11565. https://doi.org/10.3390/app112311565

Pantelić, S., Uzunović, S., Đorđević, N., Stosic, D., Nikolić, D., & Piršl, D. (2019). The impact of an experimental dance program on the motor coordination of children. *Facta Universitatis, Series: Physical Education and Sport, 16*(3), 557-567.

Pivovarníček, P. (2021). *Štatistické vyhodnocovacie metódy vo vedách o športe pomocou softvéru SPSS*. [Statistical evaluation methods in sport science using SPSS software]. Bratislava: VEDA, vydavateľstvo Slovenskej akadémie vied & Praha: Nakladatelství Academia, Středisko společných činností AV ČR, v.v.i. 225.

Physical Activity Guidelines Advisory Committee. (2018). *Physical Activity Guidelines Advisory Committee Scientific Report*. Washington, DC: U.S. Department of Health and Human Services. Retrieved on August 15.

Podrigalo, L.V., Iermakov, S. S., Alekseev, A. F., & Rovnaya, O. A. (2016). Studying of interconnections of morphological functional indicators of students, who practice martial arts. *Physical Education of Students*, *1*, 64-70. https://doi.org / 10.15561/20755 279/2016.0109

Rokka, S., Kouli, O., Bebetsos, E., Goulimaris, D., & Mavridis, G. (2019). Effect of Dance Aerobic Programs on Intrinsic Motivation and Perceived Task Climate in Secondary School Students. *International Journal of Instruction*, *12*(1), 641-654. https://eric.ed.gov/?id=EJ1201330

Sallis, J. F., McKenzie, T. L., Beets, M. W., Beighle, A., Erwin, H., & Lee, S. (2012). Physical education's role in public health: Steps forward and backward over 20 years and HOPE for the future. *Research Quarterly for Exercise and Sport, 83*(2), 83-125.

Silverman, S. (2017). Attitude research in physical education: A review. *Journal of Teaching in Physical Education*, *36*(3), 303-312.

Velickovska, L. A., Gontarev, S., & Popovski, L. (2022). *Effects of innovative tandem hours on physical education on motor capacity of children in elementary school level*. Paper presented at the conference International scientific conference. Educational Challenges and future prospects, Ohrid. Macedonia. Retrieved 16.-18. May, 2022, 49-58. from http://hdl.handle.net/20.500.12188/24976

Vukelja, M., Milanovic, D., & Salaj, S. (2022). Physical Activity and Sedentary Behaviour in Croatian Preschool Children: A Population-Based Study. *Montenegrin Journal of Sports Science and Medicine, 11*(1), 37-42. https://doi.org/10.26773/mjssm.220304

WHO (2020). WHO *guidelines on physical activity and sedentary behaviour*. https://www.who.int/publications/i/item/9789240015128