

PEDAGOGY & PE

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The influence of karate training on preparing preschool girls for school education

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Abstract

Aim. Future health conditions and psychosocial functioning depend on development during early childhood. The aim of this study is to verify the effectiveness of the educational intervention program on the development of preschool girls.

Method. Participants for both the experimental (n=21) and control (n=27) groups were picked randomly from 4 preschool establishments whose level of educational programs meets the requirements of the Ukrainian state pre-school educational program. All participants in the current study are girls with an age range of 5 to 6. Girls in the control groups (CG) were participating in normal physical education classes according to the Ukrainian State “Sure Start” program for preschool children. Girls in experimental group (EG) are participating in a program designed by the authors.

Results. Results have shown significantly greater physical development in the EG, especially in terms of chest circumference, which may indicate that karate-related exercises have a better influence on the development of the respiratory system than standard interventions.

Conclusion. The findings of this study indicate that the experimental program is more beneficial for both the mental and physical development of preschool girls. Karate could serve as a means of physical education even before school education starts. The experimental program should be considered a preventative program, which will significantly reduce possible future health care costs.

Introduction

Nowadays, disturbing trend of shifting towards sedentary lifestyle can be observed even among the youngest kids. Overloaded with responsibilities, parents do not pay enough attention to their own physical activity and as consequence also negligence of development of their kids [Barkin *et al.* 2017], and leave them with modern technology devices like computer games, smartphones and television [Hesketh *et al.* 2012]. Sedentary lifestyle and lack of proper diversification of stimuli, lower social integration with other people and entertainments as an end-user without opportunity to be creative leads towards worse development of both mental and physical sphere among preschool kids [De Onis *et al.* 2010]. This may affect future health problems and leads to premature deaths [Barbosa *et al.* 2016]. Lower level of physical activity and health indicators among preschool children were noticed all around the globe [Van Cauwenberghe *et al.* 2012; Cadenas-Sanchez *et al.* 2016; Kim *et al.* 2012].

Also in the Ukraine, 69.9% of older preschool children have lower than average or low levels of health, physical fitness; about 23% of preschool children are not ready to start studying at school [Bodnar 2014].

Physical exercises lead to many studies, which found that physical exercises improve health level indicators, both physical [Figueroa, An 2017] and mental [Carson *et al.* 2016]. Breathing exercises lead to improvement of chest and allow to avoid underdevelopment of postural control system [Silva, Motta 2013]. For physical development, sport exercises [Lloyd *et al.* 2018] and choreography [Carson *et al.* 2017] classes are beneficial. Thus, the traditional range of physical education offered to children of preschool age is gradually expanding. There are premises that martial arts could be beneficial for children development [Dimond, Lee 2011].

Karate is one of the most popular martial arts. As all far-east martial arts, it provides a way of harmonious development of both physical and mental sphere.

Development of muscular-skeletal system, better perception and senses, aerobic capacity and more awareness and mindfulness are the most prominent benefits from practicing martial arts [Alesi *et al.* 2014].

In one previous studies, the use of authorship program of karate-related activity for preschool boys was investigated [Pavlova *et al.* 2018].

The researchers assume that despite the gender differences, physical education (PE) classes with the use of karate will improve the level of physical and mental fitness of girls aged 5-6 years old, indicators of health and physical development and therefore can promote full readiness of children to studying at school in similar way as in case of preschool boys.

Material and Methods

Participants for both experimental (n = 21) and control (n = 27) groups were picked up randomly from 4

preschool establishments whose level of educational programs meets the requirements of Ukrainian state pre-school educational program. Girls from experimental group (EG) and control group (CG) groups age are girls with an age range of 5 to 6, with mean age of 5.25 for CG and 5.33 for EG. Girls from CG were participating in normal physical education classes according to the Ukrainian State program for preschoolers "Sure Start". Girls in EG participated in the program designed by the authors.

A set of measurements were performed to determine the physical condition of participants. Then, from obtained data, health indicators were computed and each participant was placed in one out of five categories (table 1).

Children of CG were engaged in the traditional program 3 times a week and children of EG were engaged in the experimental program in the same manner. The experimental program was designed and realized of the duration of 12 months (12 lessons per month, 4 structural

Table 1. Scale of evaluation of children's physical condition.

Investigated indicators	Quantitative and scoring rates of physical condition			
	Low (L; 1 point)	Below average (BA; 2 points)	Average (A; 3 points)	Above average (AA; 4 points)
Biological age, units $BA = HC / BL \times 100$,	>51	49-51	44-48	43
Body mass and growth index, g / cm	<150	150-162	163-191	192-196
The duration of acute respiratory infections during the year, days / year	>24	19-24	7-18	5-6
Heart rate, beats / min	>101	98-101	88-97	76-87
Shoulder arc, cm	<33	33	34-36	37-38
Respiratory rate, times / min	>26	24-26	20-23	18-19
Posture index, % $PI = HA / SW \times 100$,	<76	76-79	80-84	85-91
Chest circumference, cm	<54	54-55	56-58	59-60

Note. where: BA – an index of biological age, HC – head circumference (cm); BL – body length (cm); PI – posture index; HA – shoulder arc (an arc distance between the shoulder points behind, cm); SW – shoulder width (distance between points in a straight shoulder front, cm).

Table 2. Comparative characteristics of indexes of the experimental program and the traditional physical education programs of preschoolers

Indexes	Traditional program	Experimental program
According to the priority development of physical qualities, %		
Agility	30	35
Power-speed skills	25	15
Speed	20	20
Endurance	15	10
Flexibility	5	15
Power	5	5
According to the type of physical activity, %		
Oriental martial arts	0	30.76 – 35
Outdoor games	35.30 – 40	23.08 – 25
Gymnastics	23.53 – 30	23.08 – 25
Athletics	16.47 – 15	15.38 – 15
Swimming	17.65 – 15	0
Other criteria		
Test sessions, % of time	15	10
Motor density of classes, %	60-65	80-85
Hear rate after the preparatory part of lesson, beats/ min	120-130	120-130
Heart rate after the main part of lesson, beats/ min	140-150	150-160

Table 3. Standards of child's physical preparedness.

Numbers	Tests	Standard
1	Standing long jump, cm	100
2	Throws of the ball against the wall and catching it from a distance of 1 m for 30 seconds, times	19
3	Flexion and extension of arms lying on the floor, times	6
4	Jumping with a rope to fatigue, times	24
5	Raising of the body from the initial supine position, times	30
6	The maximum number of squats to fatigue, times	40

Table 4. Scale for evaluation of child's psychophysical preparedness.

Rating	Number of writing the letter “O” in 10 seconds	Number of squats in 10 seconds	Number of claps in 10 seconds	Number of numerical digits pronounced by 10 seconds	Keeping the “Flamingo” pose, seconds
5	≥ 14	≥ 15	≥ 30	≥ 20	≥ 18
4	10–13	12–14	22–29	16–19	14–17
3	7–9	9–11	16–21	12–15	10–13
2	4–6	6–8	10–15	8–11	5–9
1	≤ 3	≤ 5	≤ 9	≤ 7	≤ 4

modules lasting 3 months), which led to total amount of 144 sessions.

The experimental program changed the time distribution in favor of exercises aimed at the development of physical qualities, which sensory period was observed at preschool age. Coordination exercises took 30% of the time, flexibility (both static and dynamic) – 15%, speed – 20% (linear movements). High-speed exercises occupied 15% of the time, the development of endurance (aerobic capacity) – 10%, strength (based on own body weight) – 5% (table 2). The distribution of elements in the traditional program was focused mainly on outdoor game. According to the experimental during mobile games, children could improve motor skills in karate, so a large percentage of classes were conducted with their use.

For gymnastics, it was planned about the same time as in the traditional program. This is explained by the fact that gymnastic exercises promote the development of coordination and dexterity, that is, qualities that are well developed at the senior preschool age. For better development of speed capabilities, we planned 15% of the time for exercises in athletics.

To control the studied actions and consolidate motor skills in the experimental program was allocated 10% of the time. It was supposed that in the experimental program, motor density of classes would be 80–85% due to the use of more exercises and time reduction consumed for organization of children. The task of the preparatory part is the readiness of an organism for the main part of the lesson, so the heart rate will be the same number of reductions – 120–130 beats per minute, as in the traditional program. Heart rate was measured by a teacher's assistant using palpation method and stopwatch.

Due to more dense basic part of the exercise, the heart rate after it was within 150–160 beats per minute, and during outdoor games or kumite (duel) – up to 200 beats.

Set of tests were used to assess physical and psycho-physical preparedness for children. The following tests were used: standing long jump, throws of the ball against the wall and catching it, flexion and extension of arms lying on the floor, jumping with a rope to fatigue, raising of the body from the initial supine position and squats. To evaluate the psychophysical readiness of a child a series of special 10-second tests (writing the letter “O”, squats, claps, pronouncing of digits) and keeping the “Flamingo” pose were used. Standards and scales for assessing of these tests are submitted in table 3–4.

Data analysis

The characteristics of subjects were described analyzed by mean value (*M*), mean square deviation (*S*), a coefficient of variation (*V*). The normal distribution of empirical rows was checked using the Shapiro–Wilk test. The results show that the empirical distribution of practically all indicators does not correspond to the normal distribution (an exception was the body mass index and throws and catching of a ball for 30 seconds). Therefore, for statistical verification of the hypothesis about the probability of differences between the indicators of different groups *W*-criterion of Wilcoxon was used.

Spearman's correlation test was performed to evaluate the association between indices of psychophysical preparation and physical readiness after participation in programs.

For all conducted tests, the level of significance was set at least to $p < 0.05$.

Results

At the beginning of the pedagogical experiment, according to the indicators of physical development, the girls

Table 5. Anthropometric indices and indices of physical development of girls. Significant p-values are bolded.

Indexes	Stage	Groups	M ± S	Level	V, %	t _{EG-CG}	t _{CG} (initial-endpoint)	t _{EG} (initial-endpoint)
Height, cm	initial	EG	112.95±4.63	A	4.10	0.740	0.001	0.001
		CG	112.48±5.00	A	4.44			
	endpoint	EG	120.71±3.89	AA	3.22	0.706		
		CG	120.15±5.89	AA	4.91			
Body weight, kg	initial	EG	19.23±3.50	A	18.19	0.740	0.000	0.000
		CG	18.94±2.77	A	14.64			
	endpoint	EG	23.76±3.27	A	13.76	0.423		
		CG	22.96±3.56	A	15.49			
Body mass and growth index, g / cm	initial	EG	169.55±24.96	A	14.72	0.797	0.001	0.001
		CG	167.92±18.88	A	11.24			
	endpoint	EG	196.44±22.65	AA	11.53	0.431		
		CG	190.80±25.60	AA	13.42			
Chest circumference, cm	initial	EG	54.52±1.60	L	2.94	0.040	0.244	0.000
		CG	51.63±6.10	L	11.81			
	endpoint	EG	58.86±2.74	A	4.66	0.004		
		CG	53.78±7.26	L	13.50			
Posture index, units	initial	EG	85.60±5.96	AA	6.97	0.688	0.207	0.038
		CG	84.86±6.24	A	7.36			
	endpoint	EG	89.00±4.15	AA	4.66	0.291		
		CG	87.16±6.69	AA	8.01			
Respiratory rate, acts/min	initial	EG	23.19±1.78	A	7.67	0.355	0.000	0.000
		CG	23.74±2.19	A	9.24			
	endpoint	EG	17.90±2.41	H	13.44	0.059		
		CG	19.30±2.52	A	13.08			
HR, beats / min	initial	EG	93.33±3.32	A	3.56	0.649	0.057	0.000
		CG	92.93±2.83	A	3.04			
	endpoint	EG	87.19±3.06	AA	3.51	0.152		
		CG	89.81±7.80	A	8.69			
Lung capacity, ml	initial	EG	1038.57±235.68	-	22.69	0.737	0.012	0.002
		CG	1055.56±101.27	-	9.59			
	endpoint	EG	1216.67±65.83	-	5.41	0.001		
		CG	1125.93±98.42	-	8.74			
Biological age, units	initial	EG	44.77±1.61	A	3.59	0.758	0.057	0.001
		CG	44.62±1.81	A	4.05			
	endpoint	EG	43.46±1.51	A	3.48	0.988		
		CG	43.45±2.53	AA	5.82			
Index of physical development, units	initial	EG	39.20±3.42	AA	8.72	0.133	0.538	0.353
		CG	41.91±7.52	AA	17.95			
	endpoint	EG	38.10±4.13	AA	10.85	0.028		
		CG	43.41±10.10	H	23.27			
The level of physical development		EG	-	AA	-	-	-	-
		CG	-	AA	-	-	-	-

of the control and experimental groups did not differ from each other (with the exception of the indicator “Chest circumference”) (table 5). Height, as indicator of the physical development of girls at the beginning of the pedagogical experiment was at the average values. Both groups of children were homogeneous in terms of the coefficient of variation ($V < 4.45\%$).

During the pedagogical experiment, the means of the body mass and growth index ($p < 0.001$) significantly increased in girls of both groups. The group that was engaged in the experimental program of physical education became homogeneous in terms of the mass-growth index, as the coefficient of variation decreased from 14.72% to 11.53%. During the experiment, there was a significant increase in the growth of girls in both groups ($p < 0.001$), which was accompanied by an increase in the level of physical development from

the average to above the average. At the beginning of the pedagogical experiment, chest circumference was described as low. Under the influence of the experimental curriculum, there was a significant increase in the level of chest circumference in the experimental group ($p < 0.001$). The average values of the chest circumference of two groups at the beginning of the experiment differed insignificantly ($p > 0.005$): in the experimental group they were higher than the average, in the control group – the average at the border with the above the average.

In terms of implementation of the experimental curriculum, the posture index significantly increased in girls of the experimental group (3.98%, $p < 0.05$). In the conditions of the experiment, the biological age of the girls in the control group improved ($p = 0.05$) and the biological age parameters in the experimental group sig-

Table 6. Girls' indicators of psychophysical preparation. Significant p-values are bolded.

Indexes	Level	Group	X ± S	Rating	V, %	t _{EG-CG}	t _{CG} (initial-endpoint)	t _{EG} (initial-endpoint)
Writing the letter “O”	initial	EG	6.62±3.63	2-3	54.78	0.320	0.002	0.000
		CG	5.67±2.94	2	51.80			
	endpoint	EG	10.95±2.75	4	25.08	0.000		
		CG	7.81±1.75	3	22.46			
Squats in 10 seconds	initial	EG	9.76±0.89	3	9.11	0.514	0.120	0.000
		CG	9.96±1.16	3	11.64			
	endpoint	EG	14.38±1.91	4	13.28	0.000		
		CG	10.48±1.25	3	11.94			
Claps in 10 seconds	initial	EG	18.42±2.52	3	13.70	0.321	0.416	0.000
		CG	19.58±4.52	3	23.08			
	endpoint	EG	41.48±3.41	5	8.23	0.000		
		CG	20.85±7.55	3	7.55			
Numeral digits scoring in 10 seconds	initial	EG	16.52±4.18	4	25.29	0.853	0.046	0.000
		CG	16.78±5.02	4	29.91			
	endpoint	EG	23.86±1.80	5	7.53	0.000		
		CG	19.41±4.40	4-5	22.65			
Keeping the “flamingo” pose, sec	initial	EG	7.10±5.23	2	73.76	0.572	0.711	0.000
		CG	7.93±4.85	2	61.20			
	endpoint	EG	20.95±6.63	5	31.64	0.000		
		CG	7.48±3.87	2	51.68			
Overall, scores	initial	EG	-	2.8	-	-	-	-
		CG	-	2.8	-			
	endpoint	EG	-	4.6	-	-		
		CG	-	3.4	-			

Table 7. Girls' indicators of physical readiness. Significant p-values are bolded.

Indexes	Stage	Group	X ± S	% of normal	V, %	t _{EG-CG}	t _{CG} (initial-endpoint)	t _{EG} (initial-endpoint)
Standing long jump, cm	initial	EG	97.05 ± 9.92	97.05	10.22	0.254	0.002	0.000
		CG	93.74 ± 9.78	93.74	10.43			
	endpoint	EG	124.29 ± 9.33	124.29	7.51	0.001		
		CG	107.33 ± 19.22	107.33	17.90			
Throwing and catching of a ball for 30 seconds	initial	EG	18.50 ± 3.00	97.37	16.22	0.546	0.937	0.005
		CG	17.96 ± 2.98	94.54	16.59			
	endpoint	EG	21.38 ± 3.14	112.53	14.68	0.001		
		CG	18.04 ± 3.51	94.93	19.48			
Push-ups on the floor, times	initial	EG	3.10 ± 1.26	51.59	40.74	0.653	0.000	0.000
		CG	3.30 ± 1.71	54.94	51.74			
	endpoint	EG	14.67 ± 3.14	244.44	21.38	0.000		
		CG	7.41 ± 7.80	116.05	112.02			
Jumping with the rope, times	initial	EG	0.81 ± 1.86	3.37	229.84	0.939	0.260	0.000
		CG	0.85 ± 1.92	3.55	224.87			
	endpoint	EG	31.14 ± 8.62	129.76	27.66	0.000		
		CG	1.52 ± 2.36	6.33	155.38			
Lifting the body, times	initial	EG	13.19 ± 3.61	43.97	27.40	0.281	0.003	0.000
		CG	14.59 ± 4.95	48.64	33.91			
	endpoint	EG	45.00 ± 8.75	150.00	19.44	0.000		
		CG	19.67 ± 7.01	65.56	35.65			
Two-leg squats, times	initial	EG	16.95 ± 2.99	42.38	17.56	0.060	0.000	0.000
		CG	19.04 ± 4.19	47.59	22.02			
	endpoint	EG	47.76 ± 14.47	119.40	30.30	0.004		
		CG	35.41 ± 13.76	88.52	38.86			
The general level of physical preparedness	initial	EG	-	55.95	-	-	-	-
		CG	-	57.17	-			
	endpoint	EG	-	146.74	-	-		
		CG	-	79.79	-			

nificantly decreased. An increase in the lung capacity, a decrease in heart rate and respiratory rate were observed in both groups.

At the beginning of the pedagogical experiment (table 6), there was no significant difference in the indicators of psychophysical preparedness of children ($p > 0.05$).

The average score for psychophysical preparedness was 3.0 points in both groups.

Before the pedagogical experiment, the number of letters written by children in 10 seconds indicated an unsatisfactory level of readiness to school. The coefficients of variation showed an extremely low level of

readiness of the hand to writing in separate children of both groups. Under the influence of the experimental program of physical education, the score increased from “2” to “4”, significant and reliable improvement (100.77%, $p < 0.001$) of this indices was indicated. Under the conditions of the traditional program of physical education, the growth rate was not so significant (59.80%), but also reliable ($p < 0.001$). The score increased from “2” to “3”.

The number of squats in 10 seconds in children of both groups met the level of state requirements and was evaluated as “satisfactorily”. In the pedagogical experiment, the results of the children of both groups increased ($p < 0.001$), but the improvements in the experimental group were larger, which was reflected in the assessment. With the claps in palms (in 10 seconds), preschoolers managed more successfully than writing the letter “O”. The rapid strength and agility of children by the number of claps was valued at “good”. Scoring digits in 10 seconds indicated a sufficient level of readiness of 5-year-old preschoolers before beginning schooling and were assessed as “good”. The average values of the girls of both groups approached the standard in the “Throws and catching of a ball” (19 reps) but did not reach the standard level (table 7).

Classes in the experimental program led to a significant improvement ($p < 0.05$) of girls’ results. The traditional program was not very effective, as the results of children in its application, practically, have not changed.

Girls successfully coped with the practice of push-ups on the floor. Their results were higher than the norm (by 144.44% and 139.51% respectively) at the beginning of the pedagogical experiment. Positive dynamics of the results with the applying of the traditional program were not observed. While in the conditions of the experimental program there was a significant improvement in the results of the girls ($p < 0.001$), which led to a significant ($p < 0.001$) prevalence of the level of preparedness of girls in the experimental group after the completion of the pedagogical experiment.

The final level of physical fitness of girls (experimental group) exceeded the normative by 46.74%, whereas in the children of the control group satisfying the level of state requirements only by 79.79%.

Average values in all exercises exceeded the standard values. In the pedagogical experiment, the level of physical preparedness increased by 90.79%, while under the influence of the traditional program of physical education only 22.62%.

Regarding the relationships between psychophysical preparedness and physical readiness, the analysis revealed significant links only in EG group – positive correlations between the result of writing the letter “O” and throws and catching of a ball test ($r = 0.610$), numeral digits scoring test and throws and catching of a ball test ($r = 0.473$), results of claps in 10 seconds test and jumping with the rope test ($r = 0.520$).

Discussion

An increase in height was accompanied by an increase in the body weight of girls ($p < 0.001$). Obviously, the reason for an increase in this anthropometric indicator was the acceleration of growth rates, rather than the application of physical education program. Nevertheless, body weight at the beginning of the experiment and after its completion characterized the physical development of girls as an average. The decrease in the coefficient of variation in the experimental group indicates a narrowing of the range of variations of their individual indicators due to the relatively weak girls.

The results have shown significantly larger physical development in the EG, especially in terms of chest circumference, which may indicate, that karate-related exercises have better influence of respiratory system development than standard interventions. Also posture index increased to a higher values in EG group. Overall increase in the lung capacity, a decrease in heart rate and respiratory rate ($p < 0.05-0.001$) in the control group after experiment could be explained by the processes of physical development of children. As the natural processes of growth and maturation, groups increased their results under the influence of the physical education program, the increase in functional indicators of experimental group was significantly higher ($p < 0.01-0.001$) and contributed to a qualitative increase in levels of physical development from the middle to higher than average.

The age 5-6 years is important for the formation of the foundations of health, full physical development, the formation of mental processes, education of the basic features of personality. This period of life is most favorable for the development of a number of physical qualities: speed, agility, flexibility [Walker *et al.* 2007]. The senior preschool age is a sensational period for the development of the components of the cognitive activity of the child: perception, memory, thinking, imagination, attention [Peisner-Feinberg *et al.* 2003]. Physical and mental qualities are interrelated parties of one and the same process of psychophysical development [Yu *et al.* 2016].

The initial level of psychophysical preparedness was not the poor indicator, taking into account the fact that children have not reached the age of 5 years. However, experts unanimously expressed the need to form a “reserve of strength” of readiness for school education. In the experiment, there was an improvement in the performance of all girls, but not in all cases, it was statistically confirmed.

After the pedagogical experiment, girls of both groups successfully coped with the standard of readiness for school. At the same time, the results of the experimental group were still higher than the control. After the completion of the pedagogical experiment, the level of hand writing readiness of the preschool children of the control group was significantly behind the experimen-

tal ($p < 0.001$). In our opinion, this is due to the use of a large number of exercises for coordination in the author's program of classes, which contributed to improving the coordination of children, including hands.

The girls of the experimental group in test "number of squats in 10 seconds" achieved excellent marks (5/5 points), and children of the control group had good results (4/5 points). That is, psychophysical training of children according to the experimental program of classes was more complete.

We found in EG the results of 10 seconds writing and scoring tests correlated with the performance of agility and coordination tests ($r = 0.610$, $r = 0.473$). It means karate training contributes not only to motor ability improvement among children, but stipulate association between motor skills and cognitive abilities that are important for improving the level of readiness to school. The experimental program contributes to the development of dexterity, in particular hands, that will probably affect the ability of children to write. The rate of speech speed improvement (numeral digits scoring test) correlates with the results of coordination exercises, thus the experimental program contributes to the development of articulatory muscles. The results of the speed test of numerals correlate with the results of the coordination exercises provided in the author's program of classes, also contributed to the development of articulatory muscles.

Regular classes in martial arts contribute to the formation of high-speed information processing, which allows acting successfully in unforeseen circumstances. Children who engaged in karate relatively better developed resistance to interference in stressful situations, there is a relatively low level of personal anxiety [Vertonghen, Theeboom 2010].

The coefficients of variation showed significant variations in the individual results of children in both groups according to "scoring digits in 10 seconds" test. This testifies to the need to improve the speed of speaking in separate children for the purpose of full-time preparation for schooling. The changes that have taken place in the control group's children indicate the natural character of the dynamics of the increase in the psychophysiological indicators of children. Therefore, the tests conducted at the end of the experiment have shown a higher efficiency ($p < 0.001$) of the author's program of lessons in comparison with the traditional one.

The growth of "claps in 10 sec" and "writing of the letter "O", indicates the significant opportunities of the experimental program in the development of dexterity of hands. The pace of improving the speed of the pronunciation of digits in 10 seconds ranked the third most rated place in the pedagogical experiment. Coordination exercises, envisaged in large volumes in the experimental program of classes, also contributed to the development of the coordination of articulation muscles.

Development of all both anthropomorphic characteristics and also motor competences could be explained by high complexity and variety of techniques in karate. Both complex forms set in a manner of shadow fighting ("kata"), variety of unilateral and contralateral combination of both hand and foot techniques lead to a more harmonious development. Set of rules, manners and necessity of social interaction is also a beneficial factor for mental development [Movahedi *et al.* 2013]. The last factor that should be mentioned is the necessity of confrontation in karate. Many exercises, even in playful forms are based on competition, like elements of wrestling, kicking and punching in a pairs, trying to avoid being touched etc. Elements of challenge boost the brain potential and lead to creating new solutions in order to effectively compete with friends [Theeboom *et al.* 2009]. Eastern martial arts not only increase physical fitness, but also teach the ability to self-control [Tsos *et al.* 2017; Pobratyn *et al.* 2017; Cynarski 2014]. Encouraging to practice martial arts at early childhood may contribute to future continuation of practicing different martial arts, which is an attractive way of maintaining good health through life [Cynarski 2018; Cynarski, Sieber 2015].

The results correspond with the other findings about effectiveness of this program for boys [Pavlova *et al.* 2018]. Further studies will indicate the differences between genders and will allow to better develop this kind of intervention.

Conclusions

The findings of the present study provided evidence and verified the experimental program implemented in the present study is more beneficial for both the mental and physical development of preschool girls. Based on its attractiveness and effectiveness, such interventions should be implemented to other countries, so that more substantial evidence will be obtained. Maybe that will prove that martial arts, karate in particular, could serve as a means of PE even before school education starts, it could help to eliminate some of developmental disturbances before they start to cause real problem during their elementary school. Therefore, considering martial arts as auxiliary part of standard PE system could be beneficial in terms of better development, especially of increasing number of developmental disorders, which are harder to correct as children get older.

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Wpływ treningu karate na przygotowanie dziewczynek w wieku przedszkolnym do edukacji szkolnej

Słowa kluczowe: sztuki walki, wiek przedszkolny, wychowanie fizyczne, szkoła

Abstrakt

Wprowadzenie. Stan zdrowia i funkcjonowanie psychospołeczne zależy w dużej mierze od rozwoju we wczesnym dzieciństwie. Obecnie na całym świecie obserwuje się niższy poziom aktywności fizycznej i wskaźników zdrowotnych wśród dzieci w wieku przedszkolnym. W ten trend wpisuje się bardzo dużo dzieci na Ukrainie. Wiele z nich nie jest gotowych do rozpoczęcia nauki w szkole. Istnieją przesłanki mówiące, że

karate i inne dalekowschodnie sztuki walki mogą być korzystne dla rozwoju dzieci. Dlatego, że zapewniają one harmonijny rozwój zarówno w sferze fizycznej i psychicznej. Celem tych badań jest weryfikacja efektywności wpływu wdrożonego programu edukacyjnego na dziewczynki w wieku przedszkolnym. Materiał i metody. Uczestnicy badań zarówno w grupie eksperymentalnej (n=21), jak i kontrolnej (n=27) byli dobrani losowo z czterech placówek przedszkolnych, które spełniały wymogi edukacyjne Ukraińskiego programu edukacji przedszkolnej. Dziewczynki były w wieku od 5 do 6 lat. Dziewczynki z grupy kontrolnej (CG) uczestniczyły w regularnych zajęciach wychowania fizycznego zgodnie z Ukraińskim programem rządowym „Pewny start”. Dziewczynki z grupy eksperymentalnej (EG), uczestniczyły w programie opracowanym przez autorów. Wyniki. Otrzymane wyniki ujawniają istotnie wyższy poziom rozwoju fizycznego w grupie eksperymentalnej, zwłaszcza w obszarze obwodu klatki piersiowej, co może wskazywać, że ćwiczenia z elementami karate mają lepszy wpływ na rozwój układu oddechowego niż standardowe programy.

Wnioski. Otrzymane wyniki uprawniają do konkluzji, że eksperymentalny program jest bardziej korzystny zarówno dla rozwoju fizycznego, jak i mentalnego u dziewczynek w wieku przedszkolnym. Ten program powinien być postrzegany, jako prewencyjny, z uwagi na możliwość znacznej redukcji kosztów opieki zdrowotnej w przyszłości.