INFLUENCE OF PROGRAMMED FITNESS EXERCISE ON SCOLIOTIC BAD POSTURE

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ORIGINAL SCIENTIFIC ARTICLE

Abstract: This research included the sample of 79 pre-school boys of 6 and 7 years old, with 40 of them in experimental group and 39 in control group. The experimental group, in addition to regular program activities within the children's sports school (3 times a week), was involved in 48 additional (2 times a week) training sessions in sports (fitness) clubs. In order to determine the effects of six months fitness exercise on scoliotic poor posture of preschool children, the following variables have been used by application of the "Spinal Mouse" instrument: the grade of the curvature in thoracic spine, grade of the curvature in the lumbar spine and inclination of the spine. Although small to moderate effects were obtained by the examinations of two-way mixed analysis of variance (pη2 from .009 to .076), the results show the experimental group achievements as significantly higher advancement then with control group. Unlike control group, differences between initial and final measurements in experimental group was statistically significant at general (Wilks` Lambda .724, F=9.663, p= .000) and partial level (F= 13.891, p= .000 for curvature in thoracic spine, F= 6.181, p= .015 for curvature in lumbal spine and F= 13.551, p= .000 for inclination). As well, with individual eta coefficient findings in comparison with each group measurements it is visible that value of obtained effects is different between groups to the benefit of the experimental group (pη2 from .073 to .151 in experimental group and pη2 from .006 to .018 in control group). Based on the analyzed parameters, we concluded that the constant application of the proposed program can significantly improve postural status, as well as to prevent poor body posture, which in the future can result with appearance of a deformity.

Keywords: postural status, fitness, scoliosis, pre-school age, spinal mouse

INTRODUCTION

Appropriate growth and development of children, especially in preschool and school age, largely depends on proper body posture. Any aberration in the parameters related to good posture, as well as the existence of certain body deformities, can significantly affect the health status in general. That is the reason why it is necessary to monitor systematically and record any deviations timely, because that is the only way to avoid serious consequences in the later development of children.

The muscular system plays a key role in the healthy growth of children (Sabo, 2006; Đurić et al., 2015). Its significance is especially important for the proper functioning of the locomotor system, and thus in all the factors which determine the proper posture of the body. The appearance of any weaknesses and disbalances in the muscular system can significantly affect the appearance of problems related to the spine, chest and feet. This is especially characteristic in so-called "sensitive periods" of development and is the most obviously manifested in preschool and younger primary school age children.

A large number of researchers in the world have investigated this topic, and what is common to most of these researches is that the subject of the research were mainly children of primary and high school age (Bubanj et al., 2012; Jorgić et al., 2015; Šćepanović et al., 2017). A much smaller number of studies encompass preschool children. The aim of most researches was to investigate different physical exercise programs which could represent preventive measures in the future in order to direct the process of physical exercise planning in a positive way within the framework of program activities with pre-school children.

The lack of references of these problems certainly made harder elaboration of the mentioned phenomena that are the subject of this and similar researchs (Ivanović et al., 2020). A large number of authors (Bićanin, 2018; Ivanović et al., 2020) assume that one of the most important reasons for the insufficient number of research dealing with this topic is the lack of attention among children of this age, which consequently leads to the impossibility of adequate and precise anthropometric measurements and the performance of programmed physical exercise. Children of this age are naturally active and impatient so these achievements can be boring to them which makes great difficulty for the work of researchers (Bićanin, 2018). Most of the available studies include a corrective gymnastic as a part of intervention but very small number of them used a physical exercising programmes as a tool for better posture and reduction of the postural deformities. An additional problem represents the fact that the experimental programs in most studies did not include the control group. In most researches, only the effects of the program at the beginning and the end of application have been examined in the experimental group. Unlike those studies, in current research both groups, experimental and control, were involved in exactly the same physical exercises program within the Sport School. This program was based on total motor abilities and functional potentials development.

The main goal of this research was to establish effects of six months long programmed fitness exercising on scoliotic bad posture among pre-school children.

MATERIALS AND METHODS

Participants

The total sample consisted of 79 boys aged six to seven (40 participants in the experimental and 39 participants in the control group). All subjects were involved in regular programmed physical activity three times a week in the children's sports school. Unlike the control group, the participants of the experimental group had additional sports activities during six months through 48 hours of programmed exercise (additionally twice a week) in fitness clubs.

Procedures

In order to evaluate the state of the postural status of the spinal column in the frontal plane, we used the "Spinal Mouse" (Idiag, Fehraltdorf, Switzerland, www.idiag.ch) measuring instrument. The instrument is based on a non-invasive method of measuring postural, along with the use of appropriate software. The validity and reliability of this instrument was evaluated in the several previous studies and this method was already used in studies carried out on the population of preschool and school age children (Kiss, 2008; Ripani et al., 2008; Milenković et al., 2011; Bubanj et al., 2012; Topalidou et al., 2014; Jorgić et al., 2015; Bićanin et al., 2017; Bićanin, 2018).

Variables

The following variables were used to evaluate characteristics of postural status in frontal plane:

- Curvature in thoracic spine – Thoracic spine, in degrees
- Curvature in lumbar spine – Lumbar spine, in degrees
- Inclination of the spine – Inclination, in degrees

Experimental program

All participants in the experimental group, in addition to 3 classes per week of the regular program activities within the children sport school (program focused on the development of children through the essentials of basic sports (gymnastics, athletics), sport games, rhythmic and dance), have realized 2 additional classes per week within 48 additional training classes in six months period in sport (fitness) clubs in Belgrade. A brief description of the experimental program is shown in Table 1 (Bićanin, 2018).

Table 1. Experimental children fitness programme

MONTH	WEEK	EXERCISE	DURATION	SETS	REST (between sets)
1	1 - 2	Walking and Running Progression	2 min	5	1 min
		"Fisherman's net"*	2 min	5	1 min
		"Train"*	5 min	1	1 min
		Stretching	10 sec	5	15 sec
	3 - 4	"Chain Catcher"*	2 min	2	1 min
		"Start - stop running"	1 min	2	30 sec
		"Speed Marching"	2 min	2	30 sec
		"Zigzag Running"	1 min	5	1 min

		"Bench Walking"	1 min	5	30 sec
		Stretching	10 sec	5	15 sec
2	5 - 8	"Rhythm Hunting"*	2 min	2	1 min
		"20m Low Start"		15	45 sec
		"20 m Middle Start"		15	45 sec
		"20 m High Start"		15	45 sec
		"Pair and Group Running"	1 min	10	30 sec
		Stretching	10 sec	5	15 sec
3	9 - 12	"Back Chain Catcher"*	2 min	2	1 min
		"Frogs"*	1 min	2	1 min
		"Obstacle Running"	1 min	5	1 min
		"Bench 180 and 360 Turns"	1 min	5	1 min
		"Pair and Group Running"	1 min	10	30 sec
		Stretching	10 sec	5	15 sec
4	13 - 16	"Run, run..."*	2 min	3	1 min
		"Two-foot ankle hop"	1 min	5	1 min
		"Zigzag Running"	1 min	5	1 min
		"Hurdle hops"	1 min	5	1 min
		"Bent arm hang" (bar, rope)	10 sec	20	45 sec
		Stretching	10 sec	5	15 sec
5	17 -20	"Fisherman's net"*	2 min	5	1 min
		"Zigzag Running"	1 min	5	1 min
		"1 kg Medicine Ball Lift and Run"	30 sec	10	45 sec
		"Obstacle Running"	1 min	5	1 min
		"Squat Jumps"	30 sec	10	45 sec
		Stretching	10 sec	5	15 sec
6	21 - 24	"Train and Chain"*	5 min	1	1 min
		"10 Cone hops with the 10 m sprint"		15	1 min
		"2 kg Medicine Ball Lift and Run"	30 sec	10	45 sec
		"Interval Slalom Running Course"	30 sec	10	45 sec
		"40 cm Box Double Leg Jump"	30 sec	10	1 min
		Stretching	10 sec	5	15 sec

* The program also included the aforementioned elementary games that contained the basic elements of children's fitness (Bićanin, 2018).

The training class structure for realization of the experimental children fitness program with the experimental group of participants contained four parts:

All participants in the experimental group, in addition to 3 hours of regular programmed physical activity per week in the children's sports school, realized during six months additional sports activities through 48 hours of programmed exercise (additionally twice a week) in fitness clubs in Belgrade. The structure of the training unit during the implementation of the experimental children's fitness program consisted of four parts:

“Warming up” (3-5 minutes) – had an aim to introduce the initial trainig loads to body and to familiarize children with the task realization in the main part of training class. This part included simple forms of natural moving or adoption of basic biotic-motoric knowledge (walking and fast walking, directions changing,

running, jumping, etc.) with already formed motoric stereotype to enable dynamic regime of work of the whole body.

"Preparatory phase" (8-10 minutes) – had an aim to engage entire muscle system, and also to prepare muscles, tendons and ligaments for full body engagement regime for the expected demands in the main part of the training session.

"Main phase" (20-25 minutes) – had an aim to contain motoric exercises (basic elements of rudimentary preparation with elements of children fitness as well as set of exercises for postural status improvement).

"Cooling down" (3-5 minutes) – had an aim to provide reconciliation processes by gradual calm down of all body functions among participants. This phase was conducted by application of low intensity physical activities (e.g. relaxing jumping, loosening and stretching of shoulder and pelvic belts).

Statistical Analysis

In addition to the descriptive statistical model, the multivariate statistical method General Linear Model – multivariate procedure were used. Two-way mixed analysis of variance was used to evaluate the effects of the implemented program. The influence of two factors (group and measurement) and the interaction effect were analyzed using the partial coefficient eta (pη2), where the effects were considered: small for values of pη2= .01, moderate for values of pη2= .06 and large for values of pη2= 0.15 (Cohen, 1988). All statistical tests were performed using SPSS 16.0 (SPSS Inc, Chicago, IL, USA) and Microsoft Office Excel 2007 (Microsoft Corporation, Redmond, WA, USA).

RESULTS

Multivariate statistical analysis has established that within experimental group, in relation with measurement, existed statistically general significant difference of all examined parameters for evaluation of the postural status at the level of Wilks` Lambda .724, F= 9.663, p= .000. Results of descriptive statistics and partial differences between initial and final measurements of the experimental group are presented in Table 2.

Table 2. The results of the determined differences between the measurements in the experimental group

	Measurement		Differences		MANOVA test		$_p\eta^2$
	I	II	degrees	%	F	p	
Thoracic spine	3.73	1.88	1.85	98.67	13.891	.000	.151
Lumbar spine	6.15	4.50	1.65	36.67	6.181	.015	.073
Inclination	2.00	1.05	0.95	90.48	13.551	.000	.148

Multivariate statistical analysis has established that within control group, regarding measurements, did not exist statistically general significant difference of all examined parameters for evaluation of the postural status (Wilks` Lambda .968,

F= .845, p= .474). Results of descriptive statistics and differences between initial and final measurements of the control group are shown in Table 3.

Table 3. The results of the determined differences between the measurements in the control group

	Measurement		Differences		MANOVA test		$_p\eta^2$
	I	II	degrees	%	F	p	
Thoracic spine	3.58	3.10	0.48	15.32	.705	.404	.009
Lumbar spine	3.78	4.15	-0.38	-9.04	.465	.497	.006
Inclination	1.85	1.58	0.28	17.46	1.458	.231	.018

Statistical findings of two-way mixed analysis of variance, value of effects and direction of effects of test are presented in Tables 4 for parameters for evaluation of the postural status in frontal plane. For all monitored variables there were spotted small program effects where experimental group had improvement in the final measurement.

Table 4. Values, sizes and direction of the effects of the implemented program

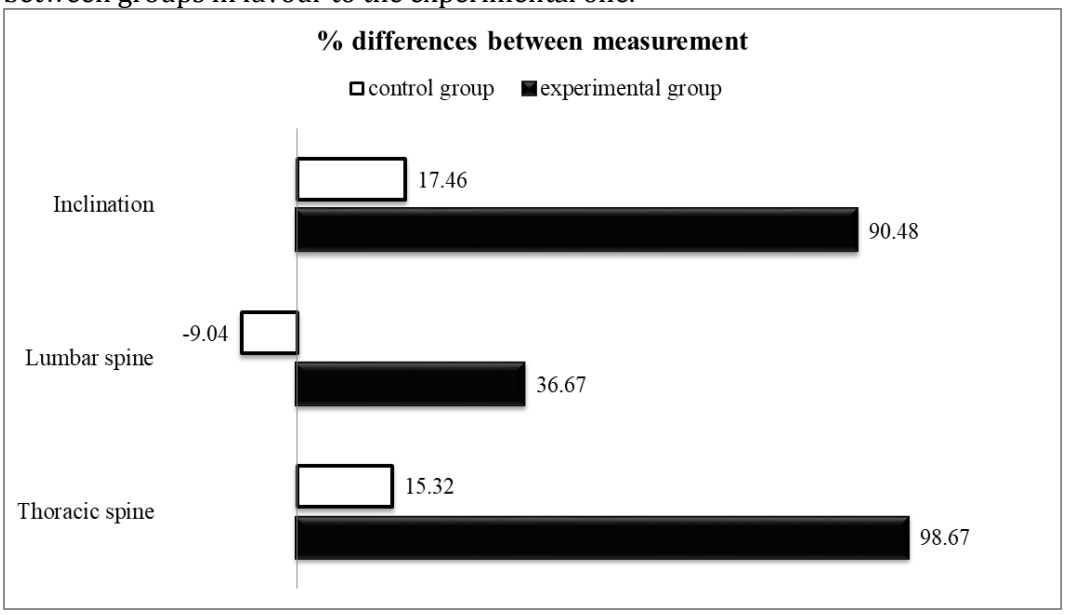
Variables	*Effects*	*Values*			*Effect size*
		F	p	$_p\eta^2$	
Thoracic spine	Group: E > C	1.780	.184	.012	small
	Measurement: I < II	7.640	.006	.051	small
	group * measurement: I: E < C II: E > C	3.451	.065	.024	small
Lumbar spine	Group: E > C	11.727	.001	.076	moderate
	Measurement: I < II	1.709	.193	.012	small
	group* measurement: I: E < C II: E < C	7.669	.006	.051	small
Inclination	Group: E > C	1.332	.250	.009	small
	Measurement: I < II	10.319	.002	.067	moderate
	Group * measurement: I: E < C II: E > C	1.686	.196	.012	small

E – experimental group; C – control group; I - initial measurements; II - final measurements.

DISCUSSION

The results of this research clearly show that the experimental children's fitness program contributed to certain changes in all monitored parameters of postural status in the frontal plane. The results of the multivariate analysis, both at the general and partial level, showed that there are statistically significant differences between the measurements of the subjects of the experimental group in all monitored parameters of postural status in the frontal plane (Table 2). On the other hand, the results of the analysis showed that no statistically significant differences were found in the observed parameters between the measurements in the control group of subjects (Table 3).

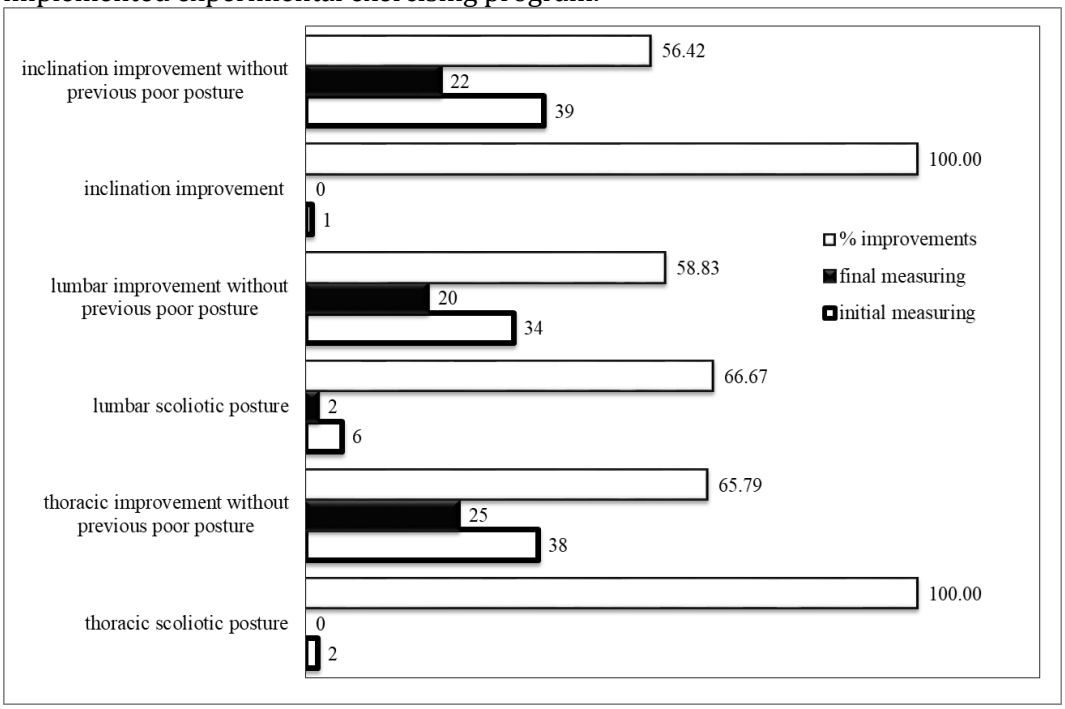
These changes are even more visible in the Graph 1, where were illustrated obtained results and differences between measurements within both observed groups. It is obvious that the experimental group advanced more in relation with the control group with all monitored parameters for evaluation of the postural status in the frontal plane (Graph 1). Regardless of which monitored parameter will be taken as an example, it showed that initial measuring established better body posture in favour to the control group (Tables 2, 3). However, the executed experimental program provided significant changes within the experimental group that were confirmed by final measuring and also by established statistically significant difference between two measurements, while the control group registered almost identical results without significant differences between initial and final measurements (Tables 2, 3). The obtained values of the partial coefficient eta state in favour to this (Table 4) which value in relation to monitored parameters was at the level of small to moderate. If we compare individual findings in relation to each group (Tables 2, 3) it is obvious that the value of obtained effects differentiates between groups in favour to the experimental one.



Graph 1. Percental differences in monitored evaluation parameters of postural status in frontal plane between measurements with both monitored groups of participants

Moderate and big effects of programmed fitness exercising were measured in favour to the experimental group within all monitored parameters. It is obvious that in the case of the experimental group, which had additional two classes per week of the experimental children fitness program, there was achieved statistically significant higher improvement with monitored parameters than in the case of the control group, which only had three regular program activities within the children sport school.

How significant are effects of the programmed fitness exercising to the experimental group we will try to explain by the Graph 2 where illustrated values are absolute and percental, in children with bad posture before and after implemented experimental exercising program.



Graph 2. Absolute and percental improvement values of determined bad body posture among children in the experimental group

At initial measuring it was established that two children in the experimental group have thoracic scoliosis in the frontal plane and after executed program this number was reduced to no childildren, i.e. the program had 100% of influence with children who participated in programmed fitness exercising (Graph 2). Similar influence the program had with inclination of the spine in the frontal plane where generally had been the least established cases of the bad posture. With one child at initial measuring was established improper body posture and through the program it was remedied, or the program influence was in 100% of share (Graph 2). Slightly lower impact the program had at established lumbal scoliosis posture with result of 66.67%, or with six children at initial measurements were established wrong posture which was reduced to only two children at final measurements (Graph 2). The essential fact is that the program did not violate the status with any child where at initial measurements had not been established deviations of the normal status in the frontal plane. On the contrary, On the contrary, it was established the program resulted in improvements and contributed the spine curvature almost to the most ideal values of the curvature among significantly large number of children - from 56.42 to 65.79% (Graph 2).

By review and analysis of available research papers in the field of effects of implemented programs to evidences of bad postures in the frontal plane, the

impression is, and it is possible to conclude, that this field also suffers from the lack of research work with pre-school children. The examinations are mostly based on evaluations and definitions of the actual state with given population, and the effects of implementation of certain treatments were studied mostly with the children of older age. General attitude and conclusion by the authors of former studies, regarding examinations of the space of bad body postures and deformities in sagittal and frontal planes, are that effect of the implemented programs depend to large extent on duration, frequency and intensity of implemented program exercises. On one hand, in certain number of researches executed programmes did not have impact on the postural status in the frontal plane (Protić – Gava et al., 2010; Šćepanović et al., 2017), in the other they had impact only to certain segments in the frontal plane (Perić et al., 2015), while certain number of studies had positive effects of programmed exercising to entire postural status in the sagittal plane (Milenković, 2002; Torlaković et al., 2013).

On a general level, programs that lasted no longer than 4 months, were implemented twice a week and used a program of corrective gymnastics only, had no significant effects on the observed characteristics of postural status. For example, a four-month corrective gymnastics program conducted by Protić et al. (2010) on a sample of eight-year-olds did not have a statistically significant effect on poor posture in the frontal plane. Similar results were obtained by Šćepanović et al. (2017), whose twelve-week program of corrective gymnastics, twice a week for 45 minutes, as an additional exercise to physical education classes in younger elementary school age did not result in significant differences in postural status in the frontal and sagittal planes.

On the other hand, combined treatments of corrective gymnastics with exercises that are dominant in certain sports disciplines and lasting four months or longer resulted in positive effects on postural status parameters. For example, statistically significant differences were found between two repeated measurements of the program lasting 4 months twice a week for 60 minutes on the overall postural status of preschool children (Torlaković et al., 2013). One part of the program consisted of corrective gymnastics exercises and exercises with pilates balance balls that took place in the sports hall. The second part of the program contained hydrogymnastic exercises and basic swimming games and exercises performed in a pool whose depth was from 40 to 90 cm (Torlaković et al., 2013).

Another treatment that used a combination of corrective gymnastics exercises and exercises with Pilates exercises resulted in a reduction of the thoracic curve in the frontal plane by about 45%. The program was conducted on a sample of eleven-year-old children twice a week and lasted four months. It consisted of twenty-seven adapted corrective exercises with a pilates ball (Perić et al., 2015). Also, implementation of a program based on corrective gymnastics and tennis (Milenković, 2002) had a positive effect on changes in anthropometric characteristics, motor skills and especially postural disorders in the frontal plane.

Based on the analyzed parameters, we concluded that the constant application of the proposed program can significantly improve postural status, as well as to prevent poor body posture, which in the future can result with appearance of a deformity. For these reasons, it was very important to perform an adequate

evaluation of the obtained values related to the experimental program, especially those presented in percentages, as they directly reflect the impact of the applied program on the poor posture reduction.

CONCLUSION

The results of the research unequivocally indicate that an additional experimental exercise program which lasts only 45 minutes, twice a week for a period of 6 months, can significantly improve proper and medically justified posture in children development.

Taking into account significance of the effect of implemented programme to improvement of the postural status, it is important to emphasize that any, even the tiniest reduction of the poor posture is extremely important for improvement of the entire child life quality especially in the phases of development of the muscle-skeletal system. It is essential to emphasize that executed program did not compromise any child where at initial measurement had no recognized deviation of the normal status and with these children the program resulted in improvements or contributed approaching the values of the monitored parameters to the most ideal values.

Based on the results of this research, without any doubt can be concluded that it is necessary that children's physical activity need to be realized on daily basis, in which part of the physical activity program must be related to exercises that targeted and purposefully increasing muscle tone in general and especially in muscules responsible for proper body posture.

A certain limitation for the further comparative analysis with the data of other researchers represent the fact that a very small number of them examined the effects on the preschool population. Therefore, the results obtained in this research can serve as very informative and contributive to the further process of monitoring, managing and optimizing of exercising programs, which will be applied as a tool for preschoolers postural deformities elimination.

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