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The Contribution of Isometric and Stretching Exercises to Youth Postural Behavior Improvement in the Physical Education Program

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Abstract Considering "posture" as a representation of an individual's well-being, activity, and personality demonstrates how critical its improvement is for the next generation, which appears to be more delicate and quickly influenced by postural risk factors. This study's goal was to evaluate the impact of isometric and stretching exercises on postural performance improvement, focusing on kyphotic and lordotic behaviors. Our focus group was supposed to be drawn from children aged 10 to 13. However, due to parental opposition, only 67 youngsters aged 10 to 11 participated in our study. In order to carry out the comparison method between groups, we splatted them into an experimental group (EG=16 males and 18 females) and a control group (CG=16 males and 17 females). The 12-week training session that made up the intervention approach was held in a separate session from the physical education class. Stretching and isometric muscle contractions were chosen for the workout because of their consistent motor scheme, general body control and stability effects, and emotional impact that can easily be made entertaining among youngsters. We utilized the Posture Screen Mobile App as a standardized method for postural examinations to evaluate postural performance improvement. The statistical program SPSS's descriptive analysis, and ANOVA test were used to evaluate the collected data. Comparing the results between the control group and the experimental group for tests T1 *(test one before intervention)* -T2 *(test two after intervention)*, the descriptive data demonstrated a decrease in "thoracic and lumbar displacement" median values. The results of the ANOVA with two repeated measurements (before and after the intervention) indicated that the intervention had a statistically significant positive impact on both of the dependent postural variables. The findings of our study demonstrated how effectively the intervention program improved children's posture.

Keywords Postural Evaluation, Postural Displacement, School, Posture Performance, Intervention Program

1. Introduction

Posture, as the position of the spine, is considered one of the primary and objective indicators of young physical–functional well-being. Unfortunately, the modern youth generation appears increasingly affected by skeletal and decreased functional muscle disorders [1-4]. Due to children's fragility of spine position to risk factors, prevention, and postural deviation treatment are considered essential and crucial to provide normal postural development [5]. Unfortunately, because of the long time spent in one static sitting position, it becomes difficult to change the position of the body from sitting to standing and continue different movements. This movement reduction occurs because of the imbalance and the back-pain production [6,7]. According to studies, variables including obesity, a change in lifestyle, and a lack of regular physical activity have been linked to a rise in the incidence of bad posture [8,9]. As a result, it has been seen that among the younger generation, the "upright posture" position, is decreasing. This has also been seen in Czech schoolchildren and Ukrainian females [10,11]. These factors are all so interconnected that they might all negatively affect motor habits in the younger generation [8]. Unfortunately, parents are not usually aware of their children's muscular and skeletal development, despite it being the foundation for their healthy and optimum growth. Additionally, parents demonstrate a lack of ability to fully engage their children in physical activities during the day due to their jobs or other responsibilities [12-14]. Given the scientific evidence that a young child's musculoskeletal system is still developing, the occurrence of bad posture may be easily avoided. It is important to emphasize that exercise that improves postural performance may still be used as an effective intervention to prevent and correct postural deviation [6].

Similar worries were highlighted in a 2017 study by Balko et al. [10] who discovered that children who are less physically active have a higher risk of having bad posture. These results suggest that young people should be encouraged to engage in regular physical activity as a necessity for everyday living. A different author focuses on the emotional and social benefits of postural education, emphasizing that it is important and helpful for more than just physical attributes. This is because their posture position affects how they come across to other people [13,15]. In this context, it is important to seriously consider the execution of the postural education program during school hours. Regarding the prevalence of postural abnormalities in Albanian youngsters, namely in 308 children between the ages of 10 and 13, we found that 3.57 percent had kyphotic behavior, and 6.49 percent displayed lordosis behavior as well as scoliosis behavior [9,16]. The detailed analysis we completed in 2015 of the programs used by prior researchers to enhance postural performance is another important result of our study.

As a result of continuing our studies, we noticed that it has not yet been possible to identify a complete program based on unified exercises for the correction of postural deviations [6]. But we noticed that the researchers, despite the various exercises applied, referred to the application or use of strength and stretching techniques to the muscles responsible for posture. Through eccentric and concentric muscle contractions, the postural muscles were strengthened and stretched to minimize muscular imbalance [17-21]. Oliver [20] and Misra [19] recommend stretching and isometric workouts to increase motor unit recruitment, firing rate, and whole-body control and stability as an excellent option for correcting juvenile postural patterns. These workouts were also considered since they are simple to use, need little to no equipment, and may be made fun [19, 20]. Furthermore, because of their constant motor pattern, they were deemed to be motions that youngsters could easily comprehend [22]. However, one of the most important considerations when creating an intervention program is the norming of exercise load. Teachers must consider the rate at which exercises are performed because low loads or high loads may not affect how muscles adapt to the exercises or may have adverse effects on the central nervous system and the musculoskeletal system. They may also cause children to become less interested in participating in physical education classes [15,23]. All types of exercise are beneficial for a healthier life and proper posture; thus, children should be encouraged to be active in their everyday lives and to participate in every Physical Education Class [12,24]. The earlier postural education classes are used, the better the possibilities for proper posture development are, because once the growing process is complete, the exercises' benefits diminish. In order to identify and change young people's postural behavior, it is thus necessary to start early [5,17,25].

The study's goal was to evaluate the role of intervention programs in improving postural performance in youngsters as a methodology that would influence the improvement of this phenomenon (postural performance).

2. Material and Methods

Literature review: This literature was chosen using various internet-based research sectors such as "Jab Ref," "Pub Med," "Google Scholar," "Medline," and "And Sports Discuss," taking into account stated data on scientific research articles published in various conferences, particularly the "Journal of Physical Education and Sport".

2.1. Selection of the Subjects

Children between the ages of 10 and 13 from Tirana, the capital of Albania, public schools, grades 5 and 6, were required to participate in our study as inclusion criteria. Unfortunately, only 67 children aged 10 to 11 took part in our study due to parental objections. In our study, females participated at a higher rate than males (52% versus 48%, respectively). The research's demographics were dominated by females since they outnumber males in the class, and parents of females were more interested in allowing their daughters to participate in this study. Subjects that were excluded from our study are a) those with the highest degree of postural avoidance (>45 grade); b) children who stated fears or earlier occurrences related to their posture (impairment); c) children who suffered from any other health condition; d) children who regularly engaged in physical activities other than the school program. After this selection, we randomly divided them into two groups: the experimental group (N = 34, 16 males & 18 females) and the control group (N = 33, 16 males &

17 females). We followed all the appropriate steps to obtain the "Commissioner for the Right to Information and Protection of Personal Data" approval, as well as that of the school director and the parents, who signed off on the measurement before it began. The study's objective was clearly explained to the parents, and they all supported it due to its advantages. They will learn about their children's postural health through this study, as well as the improvements their child will experience after completing the postural education activities.

In our study, only those who didn't report previous posture concerns or incidents or suffered from any other health concerns participated.

Measuring Instruments: The following instruments are used to evaluate the postural displacement:

- Postural Analysis Grid Chart (grid chart size: 80 cm x 2 m, square size: 36 mm x 82 mm) is a useful tool for posture assessment. Posture grids are designed to provide quick visual cues of an individual's posture to aid in postural correction and posture education. In our study, it was used as an added asset to increase the accuracy of the postural analysis.
- Posture Screen Mobile® (PSM), is an app discovered in 2010 by Dr. Joe Ferrantelli, an orthopedist at Life University. It is known for its diagnostic and educational benefits, providing analytic notes about posture shape in relation to the sagittal axis [26,27]. All individuals who undergo this test may easily understand the provided report. In our study, it was used to measure the angle of the averaged thoracic and lumbar displacement in lateral view.
- IPAD- Android is the instrument used to take digital photos in lateral view, administered in the schools that participated in the study.

The test methodology was as follows: the study took six months to complete, including time for subject selection, testing, and the experiment itself. The duration of the tests and the retest varied for two weeks. Testing and retesting were performed in the same ways and conditions. The tests were conducted in the selected primary public schools. Before the tests started, we informed the subjects about the specifics and test protocol. To ensure the accuracy of the postural evaluation, the subjects wore light clothing; males wore shorts, females wore shorts and a short blouse, and both were sockless. The subjects posed upright for a short time on a little rubber platform to be photographed. At the end of all the photographs taken in the lateral view, we quickly submitted them to the PSM software for analysis and interpretation.

To analyze the impact of the researched variables, we used the SPSS analytical system with different analytical techniques, such as Descriptive Analyses, to provide simple summaries of the observed data before and after the intervention. Additionally, we have used the ANOVA test (T1 "*test one before intervention*" -T2 "*test two after intervention*") to assess the significance of the intervention program's contribution to the improvement of kyphotic and lordosis postural behaviors.

2.2. The Experiment

In our study, we involved 67 children aged 10 to 11. To perform the group comparison method, we randomly assigned them to an experimental group (EG = 16 males and 18 females) and a control group (CG = 16 males and 17 females). The 12-week training session that made up the intervention approach was held in a separate session from the physical education class.

While the control group was not part of any intervention approach. The first two weeks of the training program were used for learning and adaptation to exercise techniques. The work-rest ratio between the series and exercises was set to 1: 1. The planned exercises for the workout included stretching and isometric muscular contractions. The planning of exercises used in our study is based on the literature on various postural education methods.

To prevent performance variations caused by the effect of loads increasing progressively, variable loads are constant throughout the experimental phase. The experimental group (n = 34) conducted 3 (three) training sessions per week with 6 (six) isometric exercises and 6 (six) stretching exercises. The training load of isometric and stretching exercises was 6x3x20 sec for each. Part of the 30 minutes of the training session even included various postural education games focusing on maintaining proper posture and balance too. The characteristics of these exercises were inducing eccentric and concentric contractions of the muscles responsible for posture, as their goal strengthening relaxed muscles and extending tensed muscles. The used exercises are presented in Table 1:

Table 1. Exercises used during the Intervention program

Isometric Exercise	**Back strength (Right/Left)**	**Bridge pose (Legs open/closed)**	**Abdominal strength (Arms after head /on chest)**	**Back extension strengthening**	**Abdominal strength (Right/Left)**	**Plank on the wall**
Stretching Exercises	Lower Backstretch	Happy baby pose	Cat-back stretch	Cobra abdominal stretch	Cobra abdominal stretch in the wall	Side stretch right/left

3. Results

- Socio-demographic features of the participants.

Our study included 67 youngsters (aged 10-11) from Albanian public schools, grades 5 and 6, including 32 males (48%) and 35 females (52%). Females participated more in our study than males, which was an expected finding because classes were made up of more females and their parents were more supportive of their involvement in our study. There are N=30 children aged 10 years (45%; N=16 female & N=14 males) and N=37 children aged 11 years (55%; N=19 females & N=18 males) among our participants (Table 2).

Table 2. Participants of the study

Age	Gender	Frequency (N)	Percent (%)
10 age (N=30)	Female/ Male	16 /14	53 /47
11 age (N=37)	Female/ Male	19/18	51/49

Results from the descriptive analysis tables 3 and 4 of the dependent postural variables such as "averaged thoracic and lumbar displacement" for both groups (experimental and control group) and in two conditions (pre and post-intervention) showed that the median, minimum, and maximum values in the experimental group decreased compared to the control group.

- Averaged Thoracic Angulation: CG = median values from 4.180 (pre) to 4.420 (post)/minimum values from -2.30 (pre) to -2.280 (post)/maximum values from 10.20 (pre) to 10.340 (post); EG = from 3.350 (pre) to 1.720 (post)/minimum from -1.90 (pre) to -1.30 (post)/maximum values from 9.210 (pre) to 6.520 (post).
- Averaged Lumbar Angulation: CG = median values from -2.90 (pre) to -4.050 (post) and minimum values from -12.80 (pre) to -13.520 (post) and maximum values from 2.910 (pre) to 5.120 (post); EG = from -3.090 (pre) to -0.240 (post) and minimum from -8.730 to -8.520 (post) / maximum values from 50 to 3.550 (post).

Table 3. Descriptive Analysis of Averaged Thoracic Displacement

Descriptive Analyses		Control group (CG)				Experimental group (EG)			
Angle of Averaged Thoracic Displacement		**pre**		**post**		**pre**		**post**	
Pre & Post		Statistic	Std. Error	Statistic	Std. Error	Statistic	Std. Error	Statistic	Std. Error
Average		3.93	0.52	*4.09*	*0.55*	3.62	0.45	*2*	*0.28*
Interval Confidence 95% for the Mean	Upper limit	2.86		*2.96*		2.70		*1.42*	
	Lower limit	4.99		*5.23*		4.55		*2.58*	
Average without 5%		3.90		*4.12*		3.63		*1.94*	
Median		4.18		*4.42*		3.35		*1.72*	
Variance		9.06		*10.28*		6.98		*2.78*	
STD		3.01		*3.20*		2.64		*1.66*	
Min		-2.3		*-2.28*		-1.9		*-1.3*	
Max		10.2		*10.34*		9.21		*6.52*	
Width variation		12.5		*12.62*		11.11		*7.84*	
Interquartile range		4.89		*4.67*		3.52		*2.41*	
Asymmetry		0.1	0.4	*-0.2*	*0.4*	0.04	0.40	*0.57*	*0.40*
Slope		-0.5	0.79	*-0.4*	*0.8*	-0.09	0.78	*0.43*	*0.78*

Table 4. Descriptive Analysis of Averaged Lumbar Displacement

Descriptive Analyses		Control group				Experimental group			
Angle of Averaged Lumbar Displacement		pre		post		pre		post	
Pre & Post		Statistic	Std. Error	Statistic	Std. Error	Statistic	Std. Error	Statistic	Std. Error
Average		-4.2	0.7	*-4.4*	*0.9*	-3.07	0.59	-1.11	0.44
Interval Confidence 95% for the Mean	Upper limit	-5.78		*-6.2*		-4.28		-2	
	Lower limit	-2.63		*-2.56*		-1.8		-0.21	
Average without 5%		-4.12		*-4.43*		-3.18		-0.96	
Median		-2.9		*-4.05*		-3.09		-0.24	
Variance		19.8		*27.2*		12.1		6.6	
STD		4.45		*5.2*		3.49		2.58	
Min		-12.8		*-13.52*		-8.73		-8.52	
Max		2.91		*5.12*		5		3.55	
Width variation		15.71		*18.64*		13.73		12.07	
Interquartile range		6.52		*6.73*		5.22		3	
Asymmetry		-0.31	0.40	*-0.01*	*0.41*	0.39	0.4	-1.01	0.4
Slope		-0.85	0.79	-0.85	0.79	-0.36	0.7	1.1	0.7

Table 5. Contrast Test between Groups

The Angle of Averaged Thoracic Displacement	Type III Sum of Squares	df	Mean Square	F	Sig.
intervention	17.814	1	17.814	14.461	.000
intervention* GROUPS	26.923	1	26.923	21.855	.000
Error (intervention)	80.072	65	1.232		

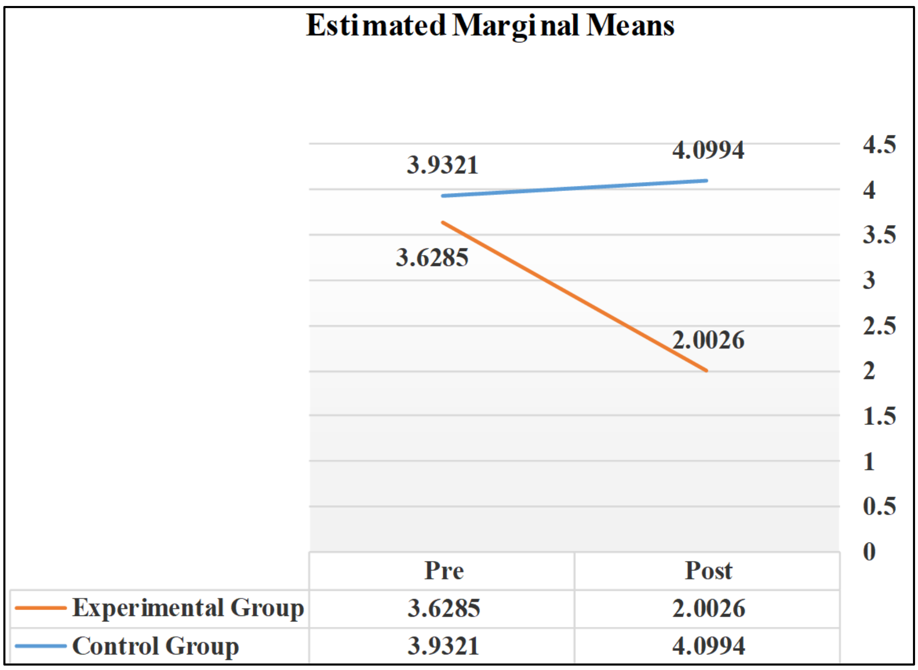

Figure 1. Marginal Means of the Averaged thoracic displacement angle, pre, and post, EG & CG

The results of an ANOVA with 2 repeated measurements (pre and post-intervention program), presented in Table 5 and illustrated in Figure 1, showed that the contribution of the intervention program in the experimental group resulted in a statistically significant improvement (F (1,65) = 21.85, p<0.005) compared to the control group for the dependent variable "averaged thoracic displacement angle".

The results of the ANOVA with 2 repeated measurements (pre and post-measurement), obtained in Table 6 and illustrated in Figure 2, showed that the intervention of the experimental group resulted in a statistically significant improvement (F (1,65) = 39.48, p = 0.001) in comparison with the control group for the dependent variable "angle of averaged lumbar displacement".

The results of the ANOVA with 2 repeated measurements (pre- and post-measurement) showed that the intervention in the experimental group resulted in a statistically significant improvement for the 2 dependent variables of posture. These results determine the efficiency of the interventional exercise program implemented in our study.

Table 6. Contrast Test between Groups

Angle of Averaged Lumbar Displacement	Type III Sum of Squares	df	Mean Square	F	Sig.
intervention	25.563	1	25.563	7.357	.009
intervention* GROUPS	39.484	1	39.484	11.364	.001
Error (intervention)	225.845	65	3.475		

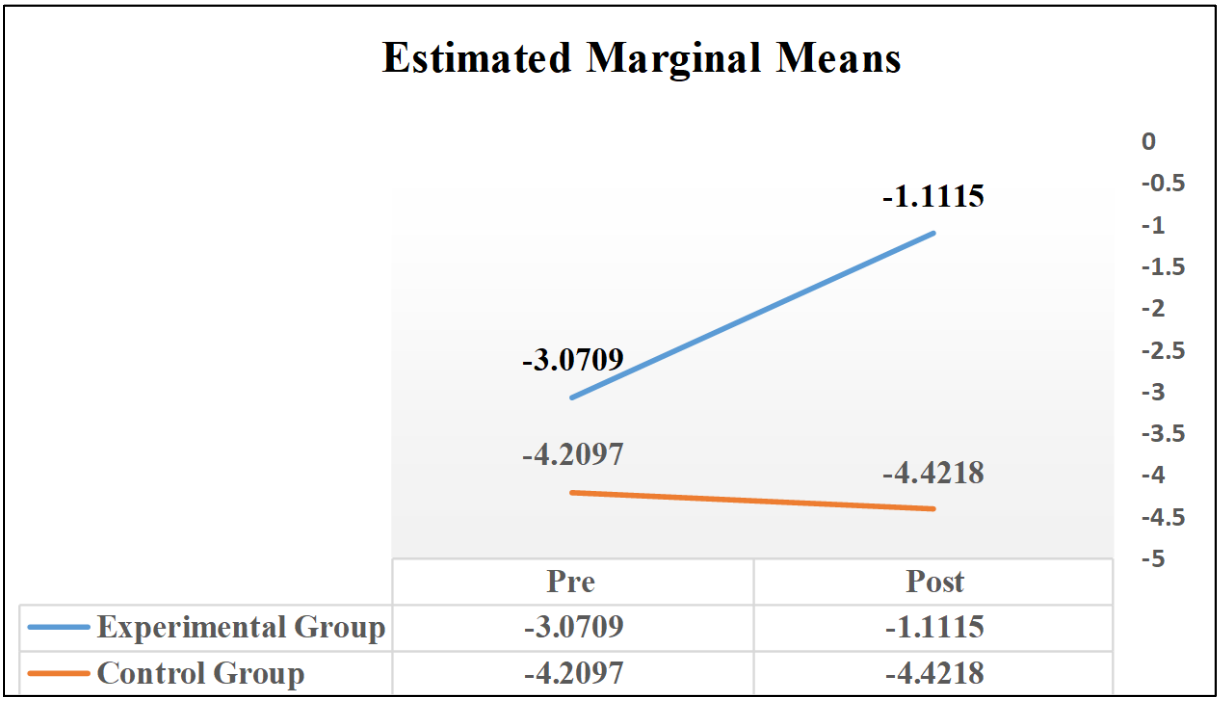

Figure 2. Marginal Means of the Averaged lumbar displacement angle, pre, and post, EG & CG

4. Discussion

It was reasonable for our study to concentrate on children aged 10 to 13 to examine the impact of an intervention program on posture improvement because children are those whose posture can easily be modified by various factors, leading to a postural displacement [11], and who can easily be improved since the growth process isn't complete and the incorrect posture isn't fixed yet [5,17,25]. After our research, we found that the intervention program, which was used with students aged 10 to 11 in a separate session from physical education, had positive effects on postural performance. In our study, the workouts intended to "strengthen and stretch postural muscles" demonstrated their impact on the restoration of balanced muscular contraction. Similar to our findings, Grissaffi [28] emphasized the significance of training postural muscles on having excellent posture and effectively coping with everyday life activity, hence permitting the decrease of damages. Our developed experimental method has demonstrated excellent efficacy in improving posture performance in youngsters by employing a series of isometric workouts that strengthen and stretch core muscles. Others have noted similar advantages about the use of postural exercise education and its impact [17,19,20,29]. One of the researchers, Cosma [17], used a corrective gymnastics regimen consisting of dynamic and isometric exercises with an emphasis on posture strengthening and muscular flexibility. With the same guiding principle of impact and attention, Cordeiro [29] discovered via the use of Pilates as a type of exercise that by stretching and strengthening the core muscles, postural habits and even balance were improved. Our findings go with Misra [19] and Oliver's [20] database, which showed the influence of stretching and isometric activities on posture deviation in young people. By minimizing the static load in the classroom and adjusting the physical routine of kids in their free time, poor posture can be avoided either naturally or under control by utilizing physical activities during the school day. Children's regular and sufficient physical activity, along with the prevention of bad posture, can be seen as a wise long-term investment in the development of the next generation [10]. To prevent children from adopting a sedentary daily lifestyle, researchers emphasize the significance of parental support for children to lead active lives [10,14]. Prevention of juvenile bad posture must be given top priority in the present research. Our study was planned and carried out with this issue as the cornerstone. The transitional phase between childhood and adolescence is essential for determining the possible longevity of intervention effects due to the typical mechanical and psychological demands of puberty [5]. In light of the fact that children's posture may be easily influenced by and modified by a range of situations, our study concentrated on posture performance in children aged 10 to 11 [3]. Additionally, exercise can be used to improve bad posture, especially if the diagnosis and treatment are carried out before the growth process is complete [25,29]. In summary, we emphasize the need for implementing postural education exercises in schools due to their benefits, which were discovered via both our study and those of other researchers [17,19,20,29]. Even though our intervention program was intended to be carried out among youngsters aged 10-13, due to objective considerations, the study was constrained to a limited age group (10-11 years old), reducing the number of participants. Such issues have arisen as a result of a lack of coordinated and supportive efforts by educational institutions and individuals participating in scientific research.

5. Conclusions

Our findings lead us to the conclusion that a postural education program is essential for a person's physical, mental, and social well-being. It is critical to use any type of exercise as long as it is aimed to "strengthen and stretch the relevant muscles of postural control competence." One of the most significant aspects of developing an intervention program is the selection of the physical load level, which must not be insufficient because it will not result in expressed health-related consequences but also not excessive since it may result in unpleasant after-effects. The improvement will be certain if the aforementioned requirements are followed properly and strictly. This is clearly demonstrated in our investigation by the significant values of the kyphotic and lumbar displacement improvements.

In this context, we recommend that parents, children, and teachers replace static daily activities with more dynamic ones. As long as postural problems in children continue to be present in their lives, studies should be continued in order to minimize the possible risk factors for the modern generation.

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