Original Article

Effect of changes by physical program on muscular and skeletal systems of secondary school students

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Abstract:

A lack of physical activity is the risk factor, which is weakening the health of human beings; therefore the aim of research was to identify changes of physical program in muscular and skeletal systems of secondary school students within physical and sport educations. The research group consisted of 13 female students of the first year of secondary school in Trenčín (Slovakia) (age 15.79±0.45 years, body weight 58.13±3.29 kg, body height 172.31±5.48 cm and body mass index 19.62±0.95). The standardized tests and methods, such as Klein and Thomas modified by Mayer and dynamic spine functions were applied in terms of data acquisition methods. In terms of data processing methods, we used the analysis and synthesis, inductive and deductive approaches and comparisons and generalizations. It was followed by the primary statistics, such as percentage frequency analysis (%) and arithmetic mean (±). The changes of physical program and its impact on muscular and skeletal systems of secondary school students were evaluated by the Wilcoxon tests (W_{test} $p < 0.01$, $p < 0.05$), as the statistical significance of differences between pre-tests and post-tests (Practical and material significances) was evaluated by Effect size, Pearson's - r. Within the body postures, the positive shifts and changes were recorded 11 x, as the overall body postures, which were expressed by total points and proven statistically with the large effect size ($p < 0.01$, $Z = -3.1798$, $r = 3.721$). While evaluating the dynamic spine functions, there was recorded the statistical significances within all of the tests ($p < 0.01$, $p < 0.05$), however small and medium effect sizes were recorded in tests of Thomayer ($r = 0.1692$), left ($r = 0.4228$) and right lateroflexion ($r = 0.4748$).

Key words: body postures, dynamic spine functions, muscular and skeletal systems, physical program, physical and sport education.

Introduction

The physical activity plays the key role in every human being's life. The human organism is adapted to the physical activities. The regular physical activities strengthen the health, mental and physical conditions; however its absence causes loss of physical fitness and organism resistance (Bendíková, 2017; Fobelová et al., 2019). The lack of regular physical activities is associated with the sedentary lifestyle, which leads to lifestyle diseases (diseases of civilization) (Ramirez-Lopez et al., 2001; Dasgupta et al., 2006; Müller et al., 2018), such as obesity (Nielsen&Andersen, 2003). The obesity has adverse influence on human organisms, which include the muscular and skeletal systems. The physical inactivity causes various disorders (functional and structural) of muscular and skeletal systems, which occurs in areas of foot and spine and all age groups/genders (Mackett & Paskins, 2008).

The body posture is the complex conception, as the content is not always similar. It occurs in academic and scientific literature, in which the issue extends to various fields and divisions (surgery, pediatrics). The body posture is the complex phenomenon, which is dependent on many factors (bony labyrinth, eye retina, neural pathways of muscular and skeletal systems). Acquiring the body postures is educational process, which is similar to walking; it forms the basis of human motor skills. Even the small change of segments gives the human body negative conditions for the correct organs positions (lung ventilation, muscle development). What is more, the relations between the muscular and skeletal systems are defined as the continuity cooperation with the respect to the requirements, which would not be possible without the central nervous system. The level of body postures is influenced not only by the internal influences (psyche, organs), but by the external influence (stress, sedentary lifestyle), which may cause unwanted changes of the human organisms (Nemček, 2016).

The listed change of muscular and skeletal systems starts from the periods of pre-school age, continues through the younger school age (Nosko et al., 2016; Balkó et al., 2017; Marko & Bendíková, 2019), pubescence and adolescence (Bartík&Adamčák, 2011; Lubkowska et al., 2015; Ludwig et al., 2016; Noll et al., 2016). What is more, it culminates in the periods of adulthood and old age (Ghenot et al., 2012; Singh et al., 2014; Lubkowska&Krzepota, 2019). Being more specific, the bad body postures were stressed by Bendíková et

al. (2018), which occurred in 75.2 % of girls, within the period of adolescence, while 1 year later, Bendíková (2016) recorded the bad and incorrect body postures in 65.2 % of girls (17 - 18 years of age). Kanášová (2006) recorded the higher proportion of incorrect body postures, which occurred, within the school population, mainly during the period of pubescence. The bad body postures occurred in 100 % of boys and 97.6 % of girls. What is more, the decreased mobility of spine was recorded by Bendíková & Stackeová (2015), which occurred in girls, within the period of pubescence (17 - 18 years of age).

By realizing the regular physical activities, in forms of various physical programs (Inani & Selkar, 2013; Tomenko et al., 2017; Alzahrani et al., 2019; Bendíková et al., 2019), the positive influence would not only lead to the muscular and skeletal systems, but also decrease the higher number of related changes of body postures. It also helps to prevent the health in all age groups, mainly of school children. For example, the content of school curriculum was changed, the final part contained 15-minute exercises, aimed at eliminating functional muscular disorders. The research results stressed the effectiveness of targeted exercises within the teaching of physical and sport education, during the period of pubescence (10 - 12 years of age) (Kanásová, 2006). The specific physical program, which was realized 12 weeks and designed for the secondary school students (16 - 17 years of age), proved the improvements ($p < 0.01$), within the muscular system (Bendíková et al., 2018). Bendíková et al. (2019) changed the content of school curriculum, within the teaching of physical and sport education, while the applied physical program was realized 12 weeks and improved the overall body postures by 4.5 points ($p < 0.05$).

The aim of research was to identify changes of physical program in muscular and skeletal systems of secondary school students within physical and sport educations.

Method

Subject characteristics

The research group was selected randomly (year of students) and intentionally (not having any health problems), as it was in terms of aims of research. The research group consisted of 13 female students who were the first year students of secondary school in Trenčín (Slovakia) (age 15.79 ± 0.45 years, body weight 58.13 ± 3.29 kg, body height 172.31 ± 5.48 cm and body mass index 19.62 ± 0.95). The listed group ($n = 13$) did not play any sports, but regularly participated in physical and sport educations, which was twice a week for 45 minutes. The research group ($n = 13$) was in period of pubescence and its primary characteristics are presented in table 1.

Table 1 The primary characteristics of research group ($n = 13$)

Measured values	Research group
Age [years]	15.79 ± 0.45
Body weight [kg]	58.13 ± 3.29
Body height [cm]	172.31 ± 5.48
Body mass index [kg/m^2]	19.62 ± 0.95

Kg - Kilogram, cm - Centimeter, kg/m^2 - Kilogram per square meter

Measurement organization

The research was realized, within the intervals of 28 October, 2019 - 20 December, 2019 and divided in three stages: 1. Pre-testing (realized by physiotherapist), 2. Creation and realization of physical program and 3. Post-testing (realized by physiotherapist). Based on the research organization, it was terrain (Physical and Sport Educations), one group (female students), pedagogical (secondary school) and multifactorial (areas and tests of muscular and skeletal systems). The research realization had started in 28 October, 2019 and had continued until 20 December, 2019, which was 8 weeks. The physical program was realized 2x/10 minutes (Monday/ Friday) and set at final sections of physical and sport educations. The applied physical program consisted of 9 exercises, which principles were based on breathing and strengthening.

Measurement taking

In terms of data acquisition methods, the first method was somatometry, by which was calculated the body mass index (Selekman, 2012). It was calculated by collected data and information, such as age, body weight and body height. The second method, which was standardized, was the method of Klein and Thomas modified by Mayer. The listed method is typical for physical and sport educations and was evaluating the body components: 1. Head and neck posture, 2. Shape of chest, 3. Shape of abdomen and pelvic inclination, 4. Overall curvature of spine, 5. Height of shoulders and position of scapulas.

To evaluate the research group ($n = 13$) and its body postures, to each body component were assigned points (1 - 4), according to quality of body postures. The overall body postures were expressed by total points:

- I. Correct body posture..... > 5 points, II. Good body posture..... 6 - 10 points,
- III. Bad body posture..... 11 - 15 points, IV. Incorrect body posture..... 16 - 20 points.

To evaluate dynamic components of body postures, we used the method of palpation - Dynamic spine function, which consisted of 5 tests (Tests of Schober, Stibor, Otto, Thomayer and Lateroflexion). The listed method is not only typical for physical and sport educations, but also for medical practice, therefore it was

realized by the physiotherapist. The physiotherapist was evaluating the dynamic components of body postures according to (Vojtaššák, 2000):

1. Test of Schober (Lumbar spine). Description: The 5th lumbar vertebra is marked up by 10 cm. Norm: While bending forward the distance increases by 4 - 6 cm. Decreased flexibility: If it is less than the norm.

2. Test of Stibor (Lumbar and thoracic spine). Description: Measuring the distance from the 7th cervical vertebra to the 5th lumbar vertebra. Norm: While bending forward the distance increases by 7.5 - 10 cm. Decreased flexibility: If it is less than the norm.

3. Test of Otto (Thoracic spine). Description: The 1st thoracic vertebra is marked down by 30 cm. Norm: While bending forward the distance increases by 2 - 3 cm. While leaning backward the distance decreases by 2.5 - 3 cm, as the sum of variation should be 6 cm. Decreased flexibility: If it is less than the norm.

4. Test of Thomayer (Spine flexibility). Description: While standing, deeply bend forward with the reach. Norm: The hands (Fingers) reach the ground. Decreased flexibility: Not reaching the ground (Minus centimeters).

5. Test of Lateroflexion (Spine flexibility - Sideways). Description: Measuring the depth of bending (Left and right) and its shift distance of middle fingers on thighs. Norm: While standing, the distance is 20 - 22 cm. Decreased flexibility: If it is less or more than the norm.

The spine development of research group (n = 13) was evaluated with the gradual relaxation, chest symmetry and paravertebral muscles

Data Analyses

The evaluation of research results was realized by statistical and mathematical methods and procedures. To evaluate the muscular and skeletal systems, the primary statistics were applied: Median (Mdn), arithmetic mean ($\pm$), variation range ($V_R = \max - \min$) standard deviation (Sd) and percentage frequency analysis (%). In terms of physical program and its influence on the muscular and skeletal systems of secondary school students, we applied Wilcoxon test ($W_{\text{test}} p < 0.01$, $p < 0.05$) and Effect size (Pearson's - r) to evaluate material and practical significance between observed variables of pre-testing and post-testing (Rosnow & Rosenthal, 2009). While interpreting the research results, there was used analysis and synthesis, inductive and deductive approaches, comparisons and generalizations.

Results and discussions

In terms of aim and results of research, they are subject to more accurate processing and monitoring. It is needed to understand them in context of health, mainly through the prism of muscular and skeletal systems, which was the area of spine. The listed results cannot be generalized; however they stress significance of using the physical programs, within the physical and sport educations.

The results of research are presented in tables (2 - 8), as the reasons of better understanding. The table 2 is showing the results of evaluation body postures of research group (n = 13), which was evaluated by method of Klein and Thomas modified by Mayer. The physical program and its acting factors caused positive shifts and changes, as the given points decreased from 12.31 ± 1.93 to 7.76 ± 1.83 . It was reflected by decrease, within the groups (I. - IV.), which was from 2.76 ± 0.43 to 1.92 ± 0.49 . While pre-testing, the correct body postures were not recorded - 0 % (n = 0), within the research group (n = 13); however the acting factors of physical program changed it to 15.50 % (n = 2). We were surprised by the finding of not having the incorrect body postures - 0 % (n = 0), within the research group (n = 13), but the most recorded body postures were the bad body postures - 76.90 % (n = 10). The good body postures were recorded in 23.10 % (n = 3). After 8 weeks, the bad body postures were recorded in 7.70 % (n = 1) of research group (n = 13) and the most reached body postures were the good body postures - 76.9 % (n = 10). Thus, the positive shifts and changes of overall body postures were statistical significant, even with the large effect size ($W_{\text{test}} p < 0.01$, $Z = -3.1798$, $r = 3.721$). The bad and incorrect body postures have been discussed in many studies and researches.

Within the body components, the head and neck postures, shape of abdomen and pelvic inclination and height of shoulders and position of scapulas are the most stricken areas of body postures (Véle, 2006). The head and neck postures were recorded with positive shifts and changes, as the given points decreased from 2.69 ± 0.75 to 1.46 ± 0.51 . It was proven by the points, as the point 4 and 3 were recorded in 7.70 % (n = 1) and 61.50 % (n = 8). At post-testing, the most common were the points 1 and 2. These were registered in 53.80 % (n = 7) and 46.20 % (n = 6). The points 3 and 4 were not recorded, within the post-testing, as it was proven by the statistics at 1.00 % level of significance, even with large effect size ($W_{\text{test}} p < 0.01$, $Z = -5.4424$, $r = 0.7898$). Within the research group (n = 13), most weakened were the deep neck flexors, which caused the head leaning forward. Even the shape of chest, as the next body component of muscular and skeletal systems, is not considered as problematic, in study of Kocis (2000) was ranked as the second most problematic, causing its pain (15.00 % - 31.00 %) in active pupils/ students. Within the research group (n = 13) the point 4 was not given, not only in the post-testing (0 %), but also in the pre-testing (0 %). The point 3 was recorded 2 x (15.50 %, n = 2), both times in the pre-testing and post-testing (table 2). The highest percentage representation was 53.80 % (n = 7), which was assigned by the point 2 (Pre-testing) and point 1 (Post-testing). The acting factor of physical program caused that

the positive shifts and changes were recorded 6 x. It was statistical significant, even with the large effect size ($W_{\text{test}} p < 0.01$, $Z = -3.9199$, $r = 0.7107$). The listed body component is linked with gradual growth of secondary sexual characteristics. The shape of abdomen and pelvic inclination was recorded with the highest statistical significance ($W_{\text{test}} p < 0.01$, $Z = -5.2316$, $r = 0.8315$), which means that physical program was very successful, because the point 4 was not given in both evaluations (Pre-testing and post-testing) as well point 3, within the post-testing.

The most weaken muscle groups, such as m. rectus abdominis and m. transversus abdominis with the wrong postural stereotype were strengthened, as the point 3, which occurred in 61.60 % ($n = 8$) in pre-testing changed to the points 2 (53.80 %, $n = 7$) and 1 (46.20 %, $n = 6$) in post-testings.

The listed muscle groups and postural stereotypes caused the pelvis to tilt forward and the spinal deformations resulted in incorrect fixation of vertebrae. And again the point 4 was not given, within the research group ($n = 13$), not even points 1 (Pre-testing) and 3 (Post-testing) (table 2). The flat spine, which is known as the thoracic hypokyphosis, occurred in 61.60 % ($n = 8$) of research group ($n = 13$); however after 8 weeks of applying the physical program, the bad body postures modified to the good (61.60 %, $n = 8$) and correct (38.40 %, $n = 5$) body postures. The listed findings were also statistical significant, again with the large effect size ($W_{\text{test}} p < 0.01$, $Z = -5.5786$, $r = 0.7954$).

The positive shifts and changes were also recorded, within the height of shoulders and scapulas position. The statistical significance was proven ($W_{\text{test}} p < 0.01$, $Z = -5.2316$, $r = 0.8170$), as again the point 4 was not recorded in both testings. 0 % ($n = 0$) was registered in post-testing of bad body postures, as well in pre-testing of correct body postures of the research group ($n = 13$).

The weakening of scapular muscles, which is caused by dominance of much stronger muscles (Pectoral muscles) had caused the incidence of bad body postures in 53.8 % ($n = 7$); however the increased incidence positively shifted and changed to the good (53.80 %, $n = 7$) and correct (46.20 %, $n = 6$) body postures of research group ($n = 13$).

Table 2 The body components within the research group ($n = 13$)

Body components/ Given oints	I. *		II. **		III. ***		IV. ****		V. *****	
	Pr.T.	Po.T.	Pr.T.	Po.T.	Pr.T.	Po.T.	Pr.T.	Po.T.	Pr.T.	Po.T.
1 (%)	7.7	53.8	30.7	53.8	0.0	46.2	0.0	38.4	0.0	46.2
2 (%)	23.1	46.2	53.8	30.7	38.4	53.8	38.4	61.6	46.2	53.8
3 (%)	61.5	0.0	15.5	15.5	61.6	0.0	61.6	0.0	53.8	0.0
4 (%)	7.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Pr.T. - Pre-test, Po.T. - Post-test, I. - Head and neck posture, II. - Shape of chest, III. - Shape of abdomen and pelvic inclination, IV. - Overall curvature of spine, V. - Height of shoulders and scapulae position, * - $p < 0.01$, $Z = -5.4424$, $r = 0.7898$, ** - $p < 0.01$, $Z = -3.9199$, $r = 0.7107$, *** - $p < 0.01$, $Z = -5.2316$, $r = 0.8315$, **** - $p < 0.01$, $Z = -5.5786$, $r = 0.7954$, ***** - $p < 0.01$, $Z = -5.2316$, $r = 0.8170$.

The spine bending and its measuring are basis of dynamic spine functions. As it was written, it consists of 5 tests, while the first is the test of Schober, which norm is from 4 to 6 cm. At pre-testing the norm was not reached (0 %, $n = 0$), as the average values were 2.53 ± 0.66 ; however acting factor of physical program caused that at post-testing the norm was reached in 100.00 % ($n = 13$) and the average values were 5.53 ± 0.66 . It was proven by statistical significance, even with the large effect size ($W_{\text{test}} p < 0.01$, $Z = -3.1798$, $r = 0.6230$) (table 3). Similar findings were recorded in studies and researches of Bendíková (2016) in which the decreased mobility was caused by weaken paravertebral muscles, therefore it was not smooth.

Table 3 The test of Schober within the research group ($n = 13$)

Research group/ Measured values	Test of Schober (Norm + 4.00 - 6.00 cm)						
	1	2	3	4	5	6	7
Pre-test	3.00	3.00	3.00	2.00	2.00	2.00	1.00
Post-test	5.00	6.00	6.00	6.00	5.00	4.00	5.00
Research group	8	9	10	11	12	13	
Pre-test	2.00	3.00	3.00	3.00	3.00	3.00	
Post-test	5.00	6.00	6.00	6.00	6.00	6.00	
Wilcoxon text	$p < 0.01$, $Z = -3.1798$						
Effect size	$r = 0.6230$						

The mobility of thoracic spine was detected by test of Stibor, in which were recorded alarming findings, within the pre-testing of research group ($n = 13$). There was not reached the norm (0 %, $n = 0$). To norm (+ 7.50 - 10.00) (Vojtaššák, 2000) was closest the female students 1, 6, 8, 9 and 13 who was missing 0.50 cm. However, at post-testing, the set norm was reached in all research group (100.00 %, $n = 13$), therefore the physical program was acting positively on thoracic spine of research group ($n = 13$). It was proven by statistics, at level of 5 % and with the large effect size ($W_{\text{test}} p < 0.05$, $Z = -2.2428$, $r = 0.7365$) (table 4). After 8 weeks of physical and sport educations, there were positive shifts and changes of larger extensions of pelvis around the joints of hips.

Table 4 The test of Stibor within the research group (n = 13)

Research group/ Measured values	Test of Schober (Norm + 7.50 - 10.00 cm)						
	1	2	3	4	5	6	7
Pre-test	7.00	6.00	6.50	6.00	6.00	7.00	6.00
Post-test	10.00	9.00	9.50	9.10	8.50	8.00	7.50
Research group	8	9	10	11	12	13	
Pre-test	7.00	7.00	6.00	6.50	6.90	7.00	
Post-test	10.00	10.00	8.00	9.00	9.00	10.00	
Wilcoxon text	p<0.05, Z = -2.2428						
Effect size	r = 0.7365						

The next test, within the dynamic spine functions, was the test of Otto, which was divided in inclination and declination approaches. Its norm is + 6.00 cm; however it was not reached (0 %, n = 0) at pre-testing, as the average values were 4.37 ± 0.89 . Cools (2003), Heyman & Dekel (2009) had very similar findings, within the study groups (n = 45). After having the negative pre-testing findings, the acting factor of physical program, which consisted of 9 exercises, again helped and strengthened the weaken thoracic spine and problems with the declination. The weaken areas of lumbar spine were corrected, as the set norm was reached in 84.60 % (n = 11). The female students 3 and 4 were missing from 0.10 to 0.20 cm to set norms; however the listed findings were proven by statistics, at level of 5 % and with the large effect size ($W_{\text{test}} p<0.05$, Z = -2.0166, r = 0.7251) (table 5).

Table 5 The test of Otto within the research group (n = 13)

Research group/ Measured values	Test of Otto (Norm + 6.00 cm)						
	1	2	3	4	5	6	7
Pre-test	5.50	4.00	3.90	2.00	4.00	5.00	5.00
Post-test	6.00	6.00	5.90	5.80	6.00	6.00	6.00
Research group	8	9	10	11	12	13	
Pre-test	4.00	4.00	4.50	5.00	5.00	5.00	
Post-test	6.00	6.00	6.00	6.00	6.00	6.00	
Wilcoxon text	p<0.05, Z = -2.0166						
Effect size	r = 0.7251						

While evaluating the deep bending forward and reaching the ground, the set norm (0 cm) within the test of Thomayer was fulfilled in 15.50 % (n = 2) of research group (n = 13). The both had values at 0 cm; however there were deficits from -2.00 to -15.00 cm, which were linked with the weakened and shortened thigh muscles (Véle, 2006). The physical program, which principles were based on breathing and strengthening, caused that the post-testing results changed to 46.20 % (n = 6) of research group (n = 13). Still, there were deficits of reaching the ground; however it was from -1.00 to -4.00 cm. The average values of pre-testing and post-testing were in the ratios of -7.53 ± 5.31 and -1.07 ± 1.44 . The listed results were statistically significant, but with the small effect size ($W_{\text{test}} p<0.01$, Z = -2.9341, r = 0.1690) (table 6).

Table 6 The test of Thomayer within the research group (n = 13)

Research group/ Measured values	Test of Thomayer (Norm 0.00 cm)						
	1	2	3	4	5	6	7
Pre-test	-5.00	-8.00	-9.00	-12.00	-13.00	-15.00	-15.00
Post-test	0.00	0.00	-1.00	-1.00	-3.00	-4.00	-3.00
Research group	8	9	10	11	12	13	
Pre-test	-10.00	-5.00	-4.00	-2.00	0.00	0.00	
Post-test	-2.00	0.00	0.00	0.00	0.00	0.00	
Wilcoxon text	p<0.01, Z = -2.9341						
Effect size	r = 0.1690						

The last test of dynamic spine functions was the left and right lateroflexions, as pre-testing discovered positive values (Left - 38.40 %, n = 5 and right - 30.70 %, n = 4) of spine motions to both sides of research group (n = 13). At pre-testings, the set norms were reached more in left than right lateroflexions (n = 5 > n = 4), as the average values were 19.23 ± 0.72 and 19.15 ± 0.68 . The post-testing results proved increased mobility of lumbar spines, as the reached values were matching set norms by Vojtaššák (2000) (Left - 100.00 %, n = 13 and right - 100.00 %, n = 13). The average values of post-testings were 21.76 ± 0.43 and 21.81 ± 0.38 . Both of them were proven by statistics, at level of 1 % and with the medium effect sizes (Left - $W_{\text{test}} p<0.01$, Z = -3.1798, r = 0.4228 and right - $W_{\text{test}} p<0.01$, Z = -3.2958, r = 0.4720) (Table 7 and 8). The increased mobilities in areas of lumbar spines were registered by Lee et al. (2013). It was proven at level of 5 %.

Table 7 The test of left lateroflexion within the research group (n = 13)

Research group/ Measured values	Test of Left Lateroflexion (+ 20.00 - 22.00 cm)						
	1	2	3	4	5	6	7
Pre-test	20.00	19.00	18.00	20.00	19.00	19.00	20.00
Post-test	22.00	22.00	21.00	22.00	22.00	22.00	22.00
Research group	8	9	10	11	12	13	
Pre-test	20.00	19.00	18.00	20.00	19.00	19.00	
Post-test	22.00	22.00	21.00	21.00	22.00	22.00	
Wilcoxon test	p<0.01, Z = -3.1798						
Effect size	r = 0.4228						

Table 8 The test of right lateroflexion within the research group (n = 13)

Research group/ Measured values	Test of Right Lateroflexion (+ 20.00 - 22.00 cm)						
	1	2	3	4	5	6	7
Pre-test	20.00	19.00	18.00	19.00	19.00	19.00	20.00
Post-test	22.00	22.00	21.00	22.00	22.00	22.00	22.00
Research group	8	9	10	11	12	13	
Pre-test	20.00	19.00	18.00	20.00	19.00	19.00	
Post-test	22.00	22.00	21.50	21.00	22.00	22.00	
Wilcoxon test	p<0.01, Z = -3.2958						
Effect size	r = 0.4720						

Conclusions

The realization of physical program, in length of 8 weeks (2x/10 minutes) and within the physical and sport educations, caused the positive shifts and changes - 11x, as the overall body postures were expressed by the total points and proven statistically with the large effect size ($p<0.01$, $Z = -3.1798$, $r = 3.721$). While evaluating the dynamic spine functions, there was recorded the statistical significances within all of the tests ($p<0.01$, $p<0.05$), however the small and medium effect sizes were recorded in tests of Thomayer ($r = 0.1690$), left ($r = 0.4228$) and right lateroflexion ($r = 0.4720$).

The positive shifts and changes of muscular and skeletal systems were reached in very short period (8 weeks) of its realization, which is seen as very important, not only for physical, but also clinical practice. The physical programs should be more applied, within physical and sport educations; however the selected exercises should be created to the specific age groups and their muscle imbalances.

The health and movement, as the main education area of physical and sport education consists of 4 main modules, which create the certain time and space for innovation, mainly in fulfilling the interest in the movement through the active approach of school population. What is more, the benefit is considered within the teaching of physical and sport education, which should contain various aids and means, while affecting the health of school population. The new trends - physical programs should respect the interests of school population and affordable for the school institutions. The lack of interest of school population in physical and sport education would also change, as the result of listed innovation, which may affect the prevalence of lifestyle diseases.

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Conflicts of interest

The authors declare no conflict of interest.

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