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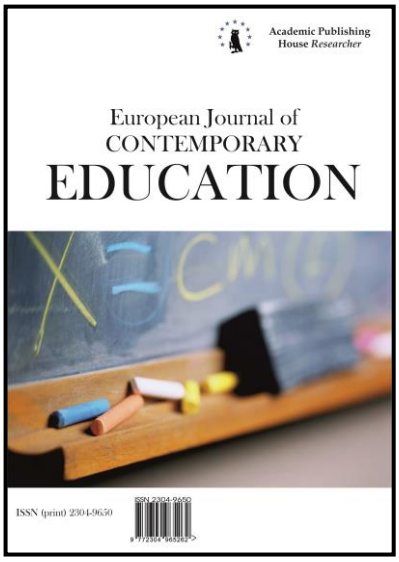

The Problems of Contemporary Education

Influence of Change in Content of Physical and Sport Education as Case Study on Level of Dynamic Function of Spine among Secondary School Female Students

Elena Bendíková [a, *], Michal Marko [a], Lukáš Šmída [a]

[a] Matej Bel University, Faculty of Arts, the Slovak Republic

Abstract

The aim of a pillar research was to find a change in a content of a physical and sport education through a targeted application of a physical program for three months, with a focus on a dynamic function of female students' spine. The monitored group consisted of the female students of an adolescent age (age 16.32 ± 0.42 years, height = 169.56 ± 6.33 cm, weight = 57.32 ± 8.76 kg) of the town, Banská Bystrica who attended the Secondary Health School. From the point of view of data acquisition methods, standardized tests for a physical education and a medical practice were applied. The results in the dynamic spine function of the female students were recorded in an initial assessment during a supervisory period in the most cases of deviations from the standard, in the noncompliance standard in all tests, which means that weaknesses in the dynamic spine function were recorded among all probands. During a final assessment in the supervisory period were recorded only minimal changes, statistically insignificant ($p > 0.05$) in all tests, except for right and left lateroflexion ($p < 0.05$, $Z = -2.1181$, $r = 0.43$), while in an experimental period after application of the physical program we recorded significant changes with a high effect of an effect size, indicating that the results were not influenced by statistical data ($p < 0.01$, $Z = -3.0594$, $r = 0.62$) in all five assessed areas of the dynamic spine function. This project was supported by VEGA 1/0242/17," Physical activity as prevention of functional disorders related to the musculoskeletal system of secondary school students".

Keywords: physical program, posture, physical and sport education, student.

* Corresponding author
E-mail addresses: elena.bendikova@umb.sk (E. Bendíková)

1. Introduction

A good functional condition of a muscular and skeletal system requires an optimal matching of postural and phasic muscle groups, which is manifested in a muscular balance of the muscular and skeletal system. In accordance with requirements of the European strategy aimed to improve a health status of a population in Europe, it is essential to put into practice primary prevention, where the most promising and effective are internationally recognized physical programs, targeting specific age groups. Nowadays, the physical programs play an important role in improving the skeletal and muscular, even in a school population (Cools et al., 2003; Heyman, Dekel, 2009; Azabagic et al., 2016; Brzek, Plinta, 2016; Gurín et al., 2016), which can be appropriately used in the physical and sport education, with an intention of a health-oriented fitness, which function is a preventive effect of a formation and increasing of civilization diseases, which also include functional disorders in the area of the skeletal and muscular system, which are increasing in structural changes, mainly into ascending hypokinesia (Petersen et al., 2006; Müller et al., 2008; Lemos et al., 2012; Tomková, Palaščáková-Špringrová, 2013; Kurková et al., 2015; Kurková, Nemček, 2016; Mitova, 2015; Madarász, Bácsné, 2016), where the most common symptom is a pain (Bendíková et al., 2016; Noll et al., 2016).

The skeletal and muscular system is a phenomenon, on which also depends on a quality of life, not only among adults, but also among children and youth, many of which are disorders associated with posture, particularly by deflection a spinal axis in a sagittal or lateral plane. Therefore, in this context, it is important to highlight the Deep Stabilization System (HSS) of the spine, which is one of the most important functional factors of the posture. The HSS consists of deep spine extensions and a ventral group (m. transversus abdominis, m. obliqus internus, m. multifidus, m. longissimus and m. oliocostalis), pelvic floor muscles and diaphragm forming a central tendon. They have a significant protective function against forces acting on the spine. Its disorders are a significant etiopathogenetic factor of formation vertebrogenic disorders. At the same time, the spine extensions are excitedly activated by deep neck flexors and muscular interplay between the diaphragm, abdominal muscles and pelvic floor, which stabilize the spine from the front by means of an intra-abdominal pressure. The stabilizing muscular function is associated with a quality of central nervous system processes, which are very often disturbed, causing a muscle imbalance in a muscle engagement during the stabilization function.

Buran (2002) states that the muscle imbalance is considered to be the most important cause of the chronic pain in the muscular system and spinal disorders. It also adversely affects the posture, physical stereotypes, muscle coordination and increases vulnerability to injury, wound, and in addition to acting on the changes of static muscular system, limits an extent of movement in joints and their mobility, which aggravates by age and can also cause the vertebrogenic spinal disorders (Véle, 2006). The insufficient level of flexion is also limited by the manifestation of other mobility abilities, which results in increasing demands for economic secure, which results in an earlier onset of a fatigue. In this context, it is necessary to point out an optimum level of the spinal mobility, which is considered as one of the basic prerequisites for the posture as an external manifestation of the interaction between the postural and phasic muscles.

The physical and sport education is currently focused on a value class of a health and active attitude of the students to their own health, which is more and more clearly conditioned by social factors. The physical and sport education through the School Education Program provides teachers and pupils with an opportunity to prefer physical activities for health, fitness (Rozim, 2012; Nagy, Müller, 2016), but also to fulfill an interest in movement (Dobay, 2015) and a diversification of an innovative content of lessons, as stated by Borbély, Müller (2008), Bendíková (2016, 2016a), Uvinha, Velardi (2014), towards the health and its prevention.

2. Aim

The aim of the research was to verify the change of the contents through the impact of the three-month physical program on the dynamic function of the spine among secondary school female students in the context of the teaching physical and sport education. We assumed that the deliberate intervention of the three-month physical program was significantly positive in the area of the dynamic spine function among female students during the experimental period.

3. Methodology

The monitored participants of case study consisted of 12 female students (age 16.32 ± 0.42 years, height = 169.56 ± 6.33 cm, weight = 57.32 ± 8.76 kg) of the second year of the Secondary Health School of Banská Bystrica, whose choice was intentional in the relation to a presence of the functional disorders in the area of the skeletal and muscular system with intention to reduce the spine functionality. Table 1 presents the primary characteristic of the participants of the case study.

Table 1. Primary characteristics of the participants of the case study (n = 12)

Factors	n	Age	Height/cm	Weight/kg	BMI
Girls	12	16.32 ± 0.42	169.56 ± 6.33	57.32 ± 8.76	19.94 ± 2.84

Legend: BMI – Body mass index

Nowadays, Slovak Education Program is according to the Education Act, hierarchically the highest targeted program of the education, which includes frame model of graduate, curriculum of school curriculum and its framework curriculum. The Slovak Education Program should consist of 70 % of the overall content of the education and should be compulsory for schools. The School Education Programs should consist of 30 % of the content of education and the schools create them, based on basis of conditions, focus of school, traditions, staff possibilities and interests of students. Each school has the possibility to offer the education program with its own structure of subjects and its own study plan, which is approved by the school representatives for the physical and sports education and is part of the school's work plan (Bendíková, 2016).

The implementation of the pilot research was carried out in four primary stages, where the first phase (September – December, school year 2016/2017, supervisory period), the physical and sport education was conducted according to the specified School Education Program. The change of the content of teaching according to the valid guidelines and the direct intervention of the physical programs with the health focus on improving the dynamic function of the spine within the classes of the physical and sport education took place subsequently in the period of January – April, 2017, experimental period, twice a week (Tuesday and Thursday) for 45 minutes by the teacher of the physical and sport education.

The assessment of the dynamic function of the spine with five tests (Schober test, Stibor test, Otto inclination and reversal test, Thomayer test and lateroflexion) was performed by the physiotherapist standardized method for the medical and physical practice (Labudová, Thurzová, 1992; Vojtaššák, 2000), where the development of the spine is assessed with a gradual relaxation, symmetry of the paravertebral muscles and chest. During bowing is monitored a spine curve designed to form a smooth arc.

The obtained quantitative data of the monitored variables of the dynamic spine function were processed by a casuistry, while using theoretical (analysis, synthesis, comparison and generalization) and mathematical-statistical methods (x – arithmetic mean, s – standard deviation, $R_{max - min}$ – variation range, m median), where we used the non-parametric Wilcoxon test (W_{test} $p < 0.01$, $p < 0.05$) non-parametric assay for the dependent observation (double-selection) to determine the statistical significance of the difference between the observed variables between the initial and final scores. The practical and material significance was judged by effect size (r).

4. Results and Discussion

According to the aim of the research, we present part of the results, which are the subject for further, accurate processing. The presented results cannot be generalized, but it is necessary to understand them in their overall context as indicative and initial from the point of view of the health prevention.

Based on the partial aim and tasks of the work, we present part of the results that are subject to further more accurate monitoring and processing within the presented project. The mentioned results cannot be generalized, but it is necessary to understand them in an overall context as an orientation for transformations that take place in education, as well as physical and sport education

in primary and secondary schools in Slovakia, with an intention for the health and health-oriented fitness, as well as on specific competencies.

In assessment of the Schober symptom, we recorded during the initial assessment in the supervisory period an achievement of the standard norm according to Vojtaššák (2000) among 4 female students. However, 3 female students were only slightly behind the lower limit of the standard norm (4.0 cm), only female student number 5 showed the spine flexural rigidity in the standard norm of 5.4 cm. Other female students were below the standard norm. The most striking was female student number 9, whose elongation was only 2.9 cm, which is 1.1 cm below the standard norm. The mean assessed value in the initial assessment in the supervisory period was 3.83 cm (Table 2), where in the most cases we found the wrong spine arch, which was not smooth as is believed to be caused by the weakened paravertebral muscles in the dorsal part of the spine of the female student. The final assessment in the supervisory period showed only minor changes that were not statistically significant (W_{test} $p > 0.05$).

On average, we even recorded a worsening of 0.03 cm. The initial assessment values in the experimental period were almost identical to those, in the experimental period. In the experimental period, however, we recorded a significant difference of the assessed values after the application of the three-month physical program. In addition to female student number 3, all other female students achieved the standard form of elongation of the specified distance between points of the spinal area. Even though, the female student number 3 did not reach the standard norm, we considered the shift as positive as we recorded an improvement of 0.7 cm. On average, the difference between the initial (3.38 cm) and final (4.73 cm) assessment of the Schober symptom in the experimental period was 0.9 cm, resulting in the statistically significant change to 1 % significance level (W_{test} $p < 0.01$, $Z = -3.0594$, $r = 0.62$) with the high effect size, therefore the results were not affected by the statistics. The most significant improvement was observed among the female student number 10 whose assessed final value compared to the initial assessed value was 1.4 cm higher.

Table 2. Intraindividual and average values of Schober test (n = 12)

	Schober test (norm +4.0 till +6.0 cm)												
Factors/n	1	2	3	4	5	6	7	8	9	10	11	12	x/cm
Initial 1	3.8	3.3	3.1	3.9	5.4	4.2	4.5	3.6	2.9	3.7	3.5	4.1	3.83
Final 2	3.9	3.5	2.9	4.0	5.4	4.1	4.2	3.6	2.7	3.8	3.3	4.2	3.83
W_{test}	($p > 0.05$)												
Initial 1	3.8	3.4	3.1	4.0	5.3	4.1	4.3	3.8	2.8	3.8	3.5	4.1	3.83
Final 2	4.4	4.3	3.8	5.1	5.6	5.2	5.0	4.6	4.0	5.2	4.3	5.3	4.73
W_{test} Effect size	$p < 0.01$ $Z = -3.0594$, $r = 0.62$												

While testing of the mobility of the dorsal and thoracic spine using the Stibor test, we recorded during the initial and final assessment very similar values in the supervisory period, as well as in the first test, where there were not statistically significant changes (W_{test} $p > 0.05$). Similar values were also assessed in the initial assessment in the experimental period. In these assessments, we found the achievement of reaching the standardized norm (Vojtaššák, 2000) for several female students. The standard norm was not reached among the female students number 2, 3, 4 and 9. However, we believe that all the female students were at the limit of the standard norm. By intervening of the physical program we recorded positive progress in all female students (Table 3).

Table 3. Intraindividual and average values of Stibor test (n = 12)

	Stibor test (norm +7.5 till +10.0 cm)												
Factors/n	1	2	3	4	5	6	7	8	9	10	11	12	x/cm
Initial 1	7.5	7.2	7.1	7.4	9.1	7.9	8.2	7.7	6.9	7.6	7.5	8.1	7.68
Final 2	7.6	7.2	7.3	7.3	9.1	7.8	8.0	7.8	6.8	7.8	7.5	8.3	7.71
W_{test}	($p > 0.05$)												
Initial 1	7.5	7.1	7.1	7.4	9.0	7.9	8.1	7.9	6.8	7.7	7.5	8.4	7.71
Final 2	8.6	8.4	8.2	8.8	9.5	9.2	9.3	8.7	8.6	8.6	8.7	9.6	8.85
W_{test} Effect size	$p < 0.01$ Z = -3.0594, r = 0.62												

The average improvement between the initial (7.71 cm) and final (8.85 cm) assessment was 1.14 cm. This improvement was statistically significant at 1 % significance level (W_{test} $p < 0.01$, Z = -3.0594, r = 0.62) with the high effect size value, therefore the results were not affected by the statistics. The similar findings were also reported in the study by Bendíková, Stackeová (2015).

The Otto test of the inclination and disinclination was during the initial assessment in the supervisory period as reduced mobility in the thoracic part of the spine. The obtained values were on average 0.66 cm below the standard norm (Vojtaššák, 2000). The exception was again female student number 5 who during the initial assessment in the supervisory period reached the values of the standardized norm. The similar findings were also found among female students number 7 and 12. The analogous values were assessed in the final assessment in the supervisory period, where we did not see statistically significant changes (W_{test} $p > 0.05$). The initial assessments of the experimental period were again very similar to the previous two assessments, namely the average value was 5.37 cm. During the final assessment of the Otto test with the average value of 6.32 cm, we recorded in the experimental period a positive increase in all female students that was statistically significant (W_{test} $p < 0.01$, Z = -3.0594, r = 0.62) with the high effect size value, therefore the results were not affected by the statistics. On average, the female students improved by 0.95 cm (Table 4), except for the female student number 8 who was missing 0.1 cm to the standard norm. However, we evaluated her progress positively (0.7 cm). The positive influence of the physical program was reached among all other female students, in the given test.

Table 4. Intraindividual and average values of Otto test (n = 12)

	Otto test (nor 6 cm)												
Factors/n	1	2	3	4	5	6	7	8	9	10	11	12	x/cm
Initial 1	5.4	5.2	5.0	5.1	6.2	5.3	6.0	5.2	4.7	4.9	5.0	6.1	5.34
Final 2	5.4	5.1	5.1	5.0	6.2	5.2	5.9	5.2	4.7	5.0	5.1	6.2	5.34
W_{test}	($p > 0.05$)												
Initial 1	5.3	5.2	5.1	5.1	6.1	5.3	6.0	5.3	4.8	4.9	5.2	6.1	5.37
Final 2	6.1	6.2	6.1	6.4	6.5	6.4	6.5	5.9	6.3	6.6	6.2	6.6	6.32
W_{test} Effect size	$p < 0.01$ Z = -3.0594, r = 0.62												

Thomayer test, which was implemented, helped us to assess the torso flection. While the initial assessment of the supervisory period, we recorded limited movement of the spine. Only one female student (6) reached the standard norm during the initial assessment of the supervisory period, thus touching the fingers on the mat (Vojtaššák, 2000). While final assessment of the supervisory period were the assessed values similar, where the female student number 7, even reached the above standard norm. However, the changes were minimal, statistically insignificant (W_{test} $p > 0.05$, Z = -1.5403, r = 0.31) with the little effect size, therefore the results were not

influenced by the statistics options. The difference between the initial (5.0 cm) and final (0.75 cm) assessment of the experimental period was more significant. The standard norm was reached by 5 female students in total and others came close to the standard norm. On average, our female students improved by 4.25 cm in the experimental period (Table 5), which was a statistically significant change (W_{test} $p < 0.01$, $Z = -3.0594$, $r = 0.62$) with the high effect size. The most significant improvement was recorded among the female student number 9, as it was up to 7.0 cm. Even though, the mentioned female student did not reach the standard norm, as was missing 2.0 cm, we considered this change to be highly positive. Notable is the fact that the female student number 5, who had the best spine mobility results in the previous tests, did not reach the standard norm in the given test. However, this may be associated with shortened back muscles of the thigh muscles (Véle, 2006).

Table 5. Intraindividual and average values of Thomayer test (n = 12)

	Thomayer test (norm 0 cm)												
Factors/n	1	2	3	4	5	6	7	8	9	10	11	12	x
Initial 1	5.0	8.0	9.0	6.0	5.0	0.0	1.0	4.0	9.0	8.0	7.0	3.0	5.42
Final 2	5.0	7.0	9.0	7.0	5.0	-1.0	-1.0	3.0	8.0	9.0	5.0	3.0	4.92
W_{test}	$p > 0.05$												
Initial 1	6.0	8.0	9.0	6.0	6.0	-1.0	0.0	3.0	9.0	7.0	4.0	3.0	5.0
Final 2	3.0	2.0	4.0	1.0	2.0	-3.0	-2	0.0	2.0	1.0	0.0	-1	0.75
W_{test} Effect size	$p < 0.01$ $Z = -3.0594$, $r = 0.62$												

While assessing the right and left lateroflexion, we observed during the initial assessment of the supervisory period a limited movement of the female students' spine on both sides as the average assessment was established above the standard norm (Vojtaššák, 2000). Only two female students of our monitored group were within the range of the standard norm. While the final assessment of the lateroflexion in the right (W_{test} $p < 0.05$; $Z = -2.1181$, $r = 0.43$) and left (W_{test} $p < 0.05$, $Z = -2.1181$, $r = 0.43$), we observed statistically significant changes in the mean value of the effect size, therefore the results were not affected by the statistics. These changes could the female students reach by the exercises during the period of 2.5 weeks, before the end of the supervisory period, which according to the School Education Program, were devoted to the areas of the health (gymnastic ball, overballs and bosu). The mentioned exercises included several elements of the spine movements on the sides, which could improve the lateral movement of the spine. While the initial assessment of the experimental period, the female students achieved approximately the same values as in the previous assessment. Subsequently, the following application of the physical program with the health focus, we recorded a significant increase of the spinal mobility on both sides, except for the female student number 10 who did not reach the standard norm. On average, the right lateroflexion was improved by 2.38 cm and left lateroflexia by 2.34 cm, as both changes were statistically significant (W_{test} $p < 0.01$, $Z = -3.0594$, $r = 0.62$) (Table 6) with the high effect size, therefore the results were not affected by the statistics. The similar findings were reported by Lee, Park, Kim (2013) and Bendíková, Stackeová (2015).

Table 6. Average values of lateroflexion of the participants of the case study (n = 12)

	Lateroflexion test (norm +20 till +22 cm)							
Initial/Final	Initial 1		Final 2		Initial 3		Final 4	
side	R	L	R	L	R	L	R	L
x/cm	18.53	18.65	19.06	19.13	19.09	19.17	21.47	21.57

While in the supervisory period, we recorded statistically significant changes of the spinal function of the spine, only at right and left lateroflexion (W_{test} $p < 0.05$, $Z = -2.1181$, $r = 0.43$), in the experimental period after applying the physical program, we recorded significant (W_{test} $p < 0.01$, $Z = -3.0594$, $r = 0.62$) changes in all of the assessed areas of the dynamic function of the spine with the high effect size value (Table 7, 8).

Table 7. Statistical assessment of changes in experimental period in area of dynamic spine function (n = 12)

Tests	Z-value	p- value	significance	Effect size (r)
Schober test	-3.0594	0.00222	$p < 0.01$	0.62
Stibor test	-3.0594	0.00222	$p < 0.01$	0.62
Otto test	-3.0594	0.00222	$p < 0.01$	0.62
Thomayer test	-3.0594	0.00222	$p < 0.01$	0.62
Lateroflexion R	-3.0594	0.00222	$p < 0.01$	0.62
Lateroflexion L	-3.0594	0.00222	$p < 0.01$	0.62

Table 8. Changes of area of individual symptoms (n = 12)

Group / factors	Content	Th	Sch	St	Ott	Lateroflexion	
						R	L
n = 12	SEP	0.50	0.03	0.03	0.00	0.53	0.48
	PP	4.25	0.90	1.14	0.95	2.38	2.34
W_{test}		$p < 0.01$	$p < 0.01$	$p < 0.01$	$p < 0.01$	$p < 0.01$	$p < 0.01$

Legend: Th – Thomayer test, Sch – Schober test, St – Stibor test,
Ott – Otto inclination and disinclination test, Lateroflexion R – right, L – left

Based on the above findings, we confirm the established hypothesis, in which we hypothesized that the intervention of the three-month physical program with the health focus will significantly affect in the dynamic function of the female students' spine in the experimental period.

5. Conclusion

The objective empirical research by monitoring changes of the dynamic function of the spine of the muscular and skeletal system contributes to the dissemination of the knowledge about the application of the physical programs with the health focus in the teaching of the physical and sport education, in terms of the possibility to apply the content changes within the School Education Program at secondary schools. The results show in our monitored indicators of the dynamic spinal function positive changes and values, which were statistically significant among the female students in all tests as we evaluate it positively.

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