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Six-week postural intervention program in 10-year-old students in physical and sports education

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Abstract

Background and purpose

Correct posture during the school years is important in children's health, performance (academic) in schools, and well-being. Postural habits (incorrect) in children may lead to significant musculoskeletal disorders; in particular, low back pain and chronic ailments (other); therefore, aims of study was by experiment to validate the influence of 6-week postural intervention program aimed at improving the posture in 10-year-old male students in Physical and Sports Education.

Material and methods

6-week postural intervention program was carried out 6 weeks (May 6 - June 14, 2024), 2 x/ week/ 10 minutes (Tue/ Thu). 6-week postural intervention program was aimed at improving the posture of 20 10-year-old male students: (i) Experimental group (12 (n), 60%; age 10.20 ± 0.40 years, weight 36.20 ± 2.80 kg, height 138.40 ± 2.80 cm); (ii) Control group (8 (n), 40%; 10.20 ± 0.20 years, weight 36.80 ± 2.40 kg, height 136. 20 ± 4.80 cm). Standardized measure in evaluating the posture (utilizing Klein and Thomas's method, as refined by Mayer) was carried out before (Week 1; May 5, 2024) and after (Week 6; June 14, 2024) the 6-week postural intervention program. 6-week postural intervention program and its influence was evaluated using the Wilcoxon Rank-Sum Test, Wilcoxon Signed-Rank Test, and Pearson's r.

Results

Significant differences ($p < 0.05, 0.01$) between 20 10-year-old male students; in particular, experimental group (12, 60%) and control group (8, 40%) was in 4 out of 5 segments of posture (body) in post-test ($p < 0.05, 0.01$); in particular, head and neck ($Z = -2.20$, $p < 0.05$, $r = -0.50$), abdomen and pelvis ($Z = -2.76$, $p < 0.01$, $r = -0.62$), curvature of spine ($Z = -3.20$, $p < 0.01$, $r = -0 .72$), shoulders and scapulas ($Z = -3.12$, $p < 0.01$, $r = -0.70$). Insignificant difference ($p > 0.05$) between 20 10-year-old male students was in shape of chest ($Z = -0.56$, $p > 0.05$, $r = -0.12$; post-test).

Conclusions

6-week postural program (intervention) improved the posture of experimental group (12, 60%), demonstrating the improvements in 4 out of 5 segments of posture. Postural (target) exercises may reduce the risk factors of musculoskeletal disorders and promote better posture in children in critical developmental years. No significant difference ($p > 0.05$) between 20 10-year-old male students was in shape of chest, indicating that certain postural features may require different and/or prolonged interventions.

Key words: 6-week intervention, musculoskeletal health, postural program, younger school-age children.

Анотація

Станіслав Азор, Міхал Марко, Штефан Адамчак, Карін Байсова, Павол Бартік, Хрвоє Сівріч. Шеститижнева програма застосування вправ для формування постави у 10-річних школярів у процесі фізичного виховання та занять спортом

Обґрунтування і мета

Правильна постава в шкільні роки важлива для здоров'я дітей, успішності (навчання) у школі та благополуччя. Погана постава у дітей може призвести до значних порушень опорно-рухового апарату; зокрема, біль у попереку та хронічні захворювання (інше); отже, метою дослідження було експериментально підтвердити вплив 6-тижневої програми постурального втручання, спрямованої на покращення постави у 10-річних учнів чоловічої статі заняття з фізичного та спортивного виховання.

Матеріал та методи

6-тижнева програма постурального втручання проводилася 6 тижнів (6 травня – 14 червня 2024 р.), 2 рази на тиждень/10 хвилин (вт/чт). 6-тижнева програма постурального втручання була спрямована на покращення постави 20 10-річних учнів чоловічої статі: (i) Експериментальна група (12 (n), 60%; вік 10,20 ± 0,40 років, вага 36,20 ± 2,80 кг, зріст 138,40). ± 2,80 см); (ii) Контрольна група (8 (n), 40%; 10,20 ± 0,20 років, вага 36,80 ± 2,40 кг, зріст 136,20 ± 4,80 см). Стандартизований захід для оцінки постави (з використанням методу Кляйна і Томаса, уточненого Майєром) проводився до (тиждень 1; 5 травня 2024 р.) і після (тиждень 6; 14 червня 2024 р.) 6-тижневої програми постурального втручання. 6-тижневу програму постурального втручання та її вплив оцінювали за допомогою тесту суми рангів Вілкоксона, тесту знакового рангу Вілкоксона та r Пірсона.

Результати

Достовірні відмінності ($p < 0,05, 0,01$) між 20 учнями 10-річного віку; зокрема, експериментальна група (12, 60%) та контрольна група (8, 40%) були у 4 із 5 сегментів пози (тіла) у посттесті ($p < 0,05, 0,01$); зокрема, голова та шия ($Z = -2,20$, $p < 0,05$, $r = -0,50$), живіт і таз ($Z = -2,76$, $p < 0,01$, $r = -0,62$), викривлення хребта ($Z = -3,20$, $p < 0,01$, $r = -0,72$), плечі та лопатки ($Z = -3,12$, $p < 0,01$, $r = -0,70$). Незначна різниця ($p > 0,05$) між 20 10-річними учнями чоловічої статі була у формі грудної клітки ($Z = -0,56$, $p > 0,05$, $r = -0,12$; посттест).

Висновки

6-тижнева постуральна програма (втручання) покращила поставу експериментальної групи (12, 60%), продемонструвавши покращення в 4 із 5 сегментів постави. Постуральні (цільові) вправи можуть зменшити фактори ризику розладів опорно-рухового апарату та сприяти кращій поставі у дітей у критичні роки розвитку. Жодної суттєвої різниці ($p > 0,05$) між 20 10-річними студентами чоловічої статі не було у формі грудної клітки, що вказує на те, що певні особливості постави можуть вимагати різних та/або тривалих втручань.

Ключові слова: 6-тижневе втручання, здоров'я опорно-рухового апарату, постуральна програма, діти молодшого шкільного віку.

Аннотация

Станислав Азор, Михал Марко, Штефан Адамчак, Карин Баисова, Павол Бартик, Хрвое Сиврич. Шестинедельная программа применения упражнений для формирования осанки у 10-летних школьников в процессе физического воспитания и занятий спортом

Обоснование и цель

Правильная осанка в школьные годы важна для здоровья детей, успеваемости (академической) в школах и благополучия. Неправильная осанка у детей может привести к серьезным нарушениям опорно-двигательного аппарата, в частности, к болям в пояснице и хроническим заболеваниям (другим); поэтому целью исследования было экспериментальное подтверждение влияния 6-недельной программы постурального вмешательства, направленной на улучшение осанки у 10-летних мальчиков-студентов в области физического и спортивного образования.

Материал и методы

6-недельная программа постурального вмешательства проводилась в течение 6 недель (с 6 мая по 14 июня 2024 г.), 2 раза в неделю по 10 минут (вт/чт). 6-недельная программа постурального вмешательства была направлена на улучшение осанки 20 10-летних студентов мужского пола: (i) Экспериментальная группа (12 (n), 60%; возраст 10,20 ± 0,40 года, вес 36,20 ± 2,80 кг, рост 138,40 ± 2,80 см); (ii) Контрольная группа (8 (n), 40%; 10,20 ± 0,20 года, вес 36,80 ± 2,40 кг, рост 136,20 ± 4,80 см). Стандартизированное измерение при оценке осанки (с использованием метода Кляйна и Томаса, уточненного Майером) проводилось до (1-я неделя; 5 мая 2024 г.) и после (6-я неделя; 14 июня 2024 г.) 6-недельной программы постурального вмешательства. 6-недельная программа постурального вмешательства и ее влияние оценивались с использованием рангового критерия Уилкоксона, рангового критерия знаков Уилкоксона и r Пирсона.

Результаты

Значимые различия ($p < 0,05, 0,01$) между 20 10-летними учениками мужского пола; в частности, экспериментальная группа (12, 60%) и контрольная группа (8, 40%) были в 4 из 5 сегментов позы (тела) в пост-тесте ($p < 0,05, 0,01$); в частности, голова и шея ($Z = -2,20$, $p < 0,05$, $r = -0,50$), живот и таз ($Z = -2,76$, $p < 0,01$, $r = -0,62$), искривление позвоночника ($Z = -3,20$, $p < 0,01$, $r = -0$,72), плечи и лопатки ($Z = -3,12$, $p < 0,01$, $r = -0,70$). Незначительная разница ($p > 0,05$) между 20 10-летними учениками мужского пола была в форме грудной клетки ($Z = -0,56$, $p > 0,05$, $r = -0,12$; пост-тест).

Выводы

6-недельная постуральная программа (вмешательство) улучшила осанку экспериментальной группы (12, 60%), продемонстрировав улучшения в 4 из 5 сегментов осанки. Постуральные (целевые) упражнения могут снизить факторы риска опорно-двигательных расстройств и способствовать улучшению осанки у детей в критические годы развития. Не было выявлено существенной разницы ($p > 0,05$) между 20 10-летними учениками мужского пола в форме грудной клетки, что указывает на то, что определенные постуральные особенности могут потребовать различных и/или длительных вмешательств.

Ключевые слова: 6-недельное вмешательство, опорно-двигательное здоровье, постуральная программа, дети

Introductions

Posture plays an important role in health; in particular, in childhood when musculoskeletal health - structures are developing (still) [1]. Correct posture supports physical growth, prevents strain, and reduces the risk of musculoskeletal disorders (MSDs) later in life [2]. Children with correct postural habits are less likely to experience chronic pain and/or discomfort in adulthood, underscoring the critical need for postural education from young ages [3]. With sedentary activities on the rise due to increased screen time and non-ergonomic classroom settings, posture-focused intervention is more essential than ever [4].

Physical and sports education emphasizes skill development, fitness, and teamwork [5]; however, recent shifts are highlighting the importance of including postural health within the curriculum [6]. Postural interventions (target) in Physical and sports education may help reduce the incorrect alignment habits and enhance physical performance [7]. Integrating postural awareness into regular school programs allows us – teachers to influence children's postural habits [8]. Enhancing engagement (cognitive) and outcomes of learning while promoting health leads to holistic positive impacts on children's well-being [5, 9].

Children around the age of 10 (younger school age) are in crucial stage of development, making it responsive to interventions that shape lifelong habits [10]. Growth (rapid) may impact balance, coordination and posture, leading to declines if not addressed [11-12]. Spurts in growth may cause misalignment and/or muscular imbalances; therefore, postural interventions during the younger school age (formative period) offers chances to instill beneficial postural habits before adulthood when corrective measures may be more challenging and less effective [13].

Postural interventions incorporate mixtures of strengthening, stabilization, and coordination [11, 14]. These are combined with posture education to ensure students understand the rationale behind correct alignment and may monitor their posture independently [15].

Gender differences in development (physical), including posture are well-documented [2]. Boys and girls exhibit differing patterns of muscle development, which may influence their responses to postural intervention programs [10]. Gender-specific approaches may enhance the effectiveness of interventions; in particular, those focusing on postural (musculoskeletal) health. Muscle mass (increased) in male students around the age of 10 may allow for more obvious improvements when they participate in strength-based interventions [8]. Tailoring interventions to reflect the differences ensure that boys and girls (both) receive maximum benefits from their programs [16]. Implementing postural intervention programs in Physical and sports education (settings) is of considerable interest [1]. Schools provide settings (safe environment) that facilitates the systematic inclusion of health-promoting exercises [4]. Intervention programs (postural) may significantly improve children's posture while minimizing disruptions to other education [11, 16]. Schools as settings offer learning (supervised), ensuring exercises are performed correctly, which prevents injuries and maximizes program effectiveness [10].

The present study (our) investigates the effects of 6-week postural intervention program aimed at improving the posture in 10-year-old male students in Physical and sports education. By focusing on this demographic, the study aims to address the gap in gender-specific, age-target postural intervention research.

Material and methods

Participants

10-year-old students (male) participated in: (i) Experimental group (12 (n), 60%; age 10.20 ± 0.40 years, weight 36.20 ± 2.80 kg, height 138.40 ± 2.80 cm); (ii) Control group (8 (n), 40%; 10.20 ± 0.20 years, weight 36.80 ± 2.40 kg, height 136. 20 ± 4.80 cm), attending the elementary school in B. Bystrica (4th year; Table 1). 10-year-old students (20, 100%) consisted of convenience sample, aimed at selective sampling; regarding age, gender, year of study [17]. Evaluating the impact of 6-week postural intervention program in 20 (100%)10-year-old students was carried out in accordance with ethical standards as laid down in 1964 Declaration of Helsinki and its later amendments and/or comparable ethical standards, after obtaining the decisions (positive) from Pedagogical/ Artistic Council of Faculty of Performing Arts, Academy of Arts in Banská Bystrica (October 30, 2024, Banská Bystrica, Slovakia) [18]. 10-year-old students (20, 100%), in representation of parents/guardians provided the written informed consent.

Table 1

Anthropometric data of 10-year-old students (20, 100%)

Anthropometric data	Experimental group (n = 12)	Control group (n = 8)
Age (years)	10.20 ± 0.40	10.20 ± 0.20
Body height (cm)	138.40 ± 2.80	136.20 ± 4.80
Body weight (kg)	36.20 ± 2.80	36.80 ± 2.40
Body mass index (kg/ m^2)	18.90 ± 2.20	19.80 ± 2.60

Procedure

Evaluating the impact of 6-week postural intervention program in 20 (100%) 10-year-old students was carried out 6 weeks (May 6 - June 14, 2024), 2x/ week/ 10 minutes (Tue/ Thu), utilizing the design of experiment - true. Random assignment (week 1) was carried out because of allocating 20 (100%) 10-year-old students in 2 groups - (i) Experimental group (12 (n); (ii) Control group (8 (n), 40%). An experimental stimulus, referred to as "6-Week Postural Intervention Program", was applied to experimental group (12, 60%) targeting a specific state (S), while the control group (8, 40%) was taught following the School Educational Program. Period of time (Δt) of 6 weeks was maintained in both (groups), with measurements of state (S) taken at both, week 1 - 6. 8 (40%) 10-year-old students (control group), instructed under the School Educational Program served as baseline for comparison with 6-week postural intervention program, which was concerned as causal, independent, and experimental variable; however, over the period of time (6 weeks), it evolved to be considered as an outcome-related, dependent, and experimental variable.

12 10-year-old students (60%) of experimental group underwent the 6-week postural intervention program under the guidance of lecturer (S. Azor) who informed the experimental group (12, 60%) with principles of 6-week postural intervention program, chosen because of supporting the musculature of spine, neck, and shoulders [19], allowing the experimental group (12, 60%) to exercise (low-load), advancing to patterns of resistance. 6-week postural intervention program consisted of 8 exercises, carried out 2x/ week/ 10 minutes (Tue/ Thu; cool down). Recommended procedure was maintained with an increased emphasis on mastery. Correct execution of 8 exercises [11]; regarding the fixation and starting positions served as an experimental, dependent and outcome-related stimulus, referred to as the independent variable. S. Azor - lecturer, documented the progress of 6-week postural intervention program, recording the details - number of sets (reps) and/or problems (possible). Experimental group (12, 60%) informed the lecturer in case of musculoskeletal discomfort and/or pain and he (lecturer), in turn, monitored the signs of fatigue (shaking, loss of control) [20]. Social (group) setting as method of delivery was chosen because of its effectiveness (cost).

Standardized measure in evaluating the posture (utilizing Klein and Thomas's method, as refined by Mayer) was carried out before (Week 1; May 5, 2024) and after (Week 6; June 14, 2024) the 6-week postural intervention program [10]. Standardized measure evaluates (visual) 5 segments of body: (i) Head and neck; (ii) Shape of chest; (iii) Abdomen and pelvis; (iiii) Curvature of spine; (iiiii) Shoulders and scapulas. Numerical values (1 - 4) denote the positions of segments, concerning the quality, while posture is indicated by postural scores (scale): (i) Correct posture, 5 points; (ii) Good posture, 6 - 10 points; (iii) Bad posture, 11 - 15 points; (iiii) Incorrect posture, 16 - 20 points [21].

Statistical analysis

6-week postural intervention program on cohort of 20 10-year-old students (100%) was analyzed using combinations of statistical tests, including the Wilcoxon Rank-Sum Test for independent samples, Wilcoxon Signed-Rank Test for dependent samples, Pearson's correlation coefficient (r), and descriptive statistics, all carried out in Ibm Spss Modeler. To determine significant differences ($p < 0.05$, < 0.01) between the experimental and control groups (two independent samples), the Wilcoxon Rank-Sum Test was applied with significance levels (α) set at 0.01 and 0.05. For assessing significant differences ($p < 0.05$, < 0.01) between pre- and post-intervention measurements (Week 1 - 6), the Wilcoxon Signed-Rank Test was used with identical significance levels ($\alpha = 0.01, 0.05$) [22]. Pearson's correlation coefficient (r) was employed to measure linear relationships between paired sets of data (variables) [23]. Descriptive statistics, including arithmetic mean and percentage, were utilized to outline the basic characteristics; in particular, targeting 20 students aged 10 years.

Results

Table 2 illustrates differences (0.01, 0.05) of posture in experimental (12, 60%) and control (8, 40 %) group. Results indicated significant improvements (0.01, 0.05) in postural parameters of experimental group (12, 60%) after the intervention. Using the Wilcoxon Signed-Rank Test, it was found that head and neck improved with mean scores decreasing from 2.62 to 1.50, statistically significant changes with Z = 3. 12, $p < 0.01$, and effect size (strong) of r = 0.64. Shape of chest improved, with scores dropping from 2.00 to 1.62, yielding Z = 2.44, $p < 0.05$, and effect size of r = 0.46. Abdomen and pelvis saw improvements as well, with the initial scores of 2.92 decreasing to 1.66, statistically significant changes with Z = 3.22, $p < 0.01$, and effect size of r = 0.66. Curvature of spine improved from scores of 1.66 to 1.34, achieving high statistical significance with Z = 3.46, $p < 0.01$, and effect size of r = 0.70. Shoulders and scapulas improved, scores decreasing from 2.00 to 1.16 (Z = 3.16, $p < 0.01$, r = 0.64). Postural scores, representing composite measures of parameters, improved, dropping from 11.84 to 7.26, with Z = 3.12, $p < 0.01$, and effect size of r = 0.62. These improvements suggest that the intervention impacted the posture across various alignment measures in experimental group (12, 60%).

Results of control group (8, 40%) exhibited no measurable changes in postural parameters over the 6-week period. Scores remained consistent for parameters (each), including head and neck, shape of chest, abdomen and pelvis, curvature of spine, shoulders and scapulas, and postural scores with values remaining unchanged from pre- to post-test. Lack of changes suggests stability in postural measures in the absence of intervention.

Results demonstrate significant postural improvements (0.01, 0.05) in experimental group (12, 60 %), while control group (8, 40%) showed no changes ($p > 0.05$), highlighting the effectiveness of 6-week postural intervention program in enhancing postural alignment and suggesting its potential as corrective approach to similar populations.

Table 3 illustrates differences (0.01, 0.05) of posture in pre- (week 1) and post- (week 6) test. In pre-test (week 1), there were no significant differences ($p > 0.05$) between the experimental (12, 60%) and control (8, 40%) group. Postural parameters exhibited similar values across groups, with non-significant results from the Wilcoxon Rank-Sum Test.

Table 2

Differences (0.01, 0.05) of posture in experimental (12, 60%) and control (8, 40%) group

	Experimental group		
Test; Week	Pre-; 1	Post-; 6	Wilcoxon S-R Test
Head and neck (x̄)	2.62	1.50	Z = 3.12, p < 0.01, r = 0.64**
Shape of chest (x̄)	2.00	1.62	Z = 2.44, p < 0.05, r = 0.46*
Abdomen and pelvis (x̄)	2.92	1.66	Z = 3.22, p < 0.01, r = 0.66**
Curvature of spine (x̄)	1.66	1.34	Z = 3.46, p < 0.01, r = 0.70**
Shoulders and scapulas (x̄)	2.00	1.16	Z = 3.16, p < 0.01, r = 0.64**
Postural score (x̄)	11.84	7.26	Z = 3.12, p < 0.01, r = 0.62**
	Control group		
Test; Week	Pre-; 1	Post-; 6	Wilcoxon S-R Test
Head and neck (x̄)	2.62	2.62	N/A
Shape of chest (x̄)	1.76	1.76	N/A
Abdomen and pelvis (x̄)	2.62	2.62	N/A
Curvature of spine (x̄)	2.38	2.38	N/A
Shoulders and scapulas (x̄)	2.12	2.12	N/A
Postural score (x̄)	11.50	11.50	N/A

N/A - No answer; * - Significance (α) = 0.05; ** - Significance (α) = 0.01; x̄ - Arithmetic mean.

Head and neck, in both groups scored 2.62, with test statistics Z = -0.24, $p > 0.05$, and effect size of r = −-0.06. Abdomen and pelvis scores were 2.92 in experimental group (12, 60%) and 2.62 in control group (8, 40%), yielding Z = -0.98. $p > 0.05$, and r = -0.22. Results of pre-test (week 1) suggested that baseline of posture was similar in groups (both) prior to intervention.

Within the post-test (week 6), results demonstrated significant differences (0.01, 0.05) between the experimental (12, 60%) and control (8, 40%) group, indicating improvements in experimental group (12, 60%). Wilcoxon Rank-Sum Test showed significant improvements in

head and neck in experimental group (12, 60%), which scored 1.50 compared to control group's (8, 40%) unchanged score of 2.62, yielding Z = -2.20, $p < 0.05$, and effect size r of 0.50. Abdomen and pelvis in experimental group (12, 60%) improved to 1.66 from control group's scores of 2.62, yielding significant scores of Z = -2.76, $p < 0.01$, and effect size r = -0.62. Curvature of spine improved to 1.34 in experimental group (12, 60%) compared to 2.38 in control group (8, 40%), with significant scores of Z = -3.20, $p < 0.01$, and r = -0.72. Significant results were in shoulders and scapulas (experimental group's score of 1.16 vs. control group's score of 2.12 - Z = -3.12, $p < 0.01$, and r = -0.70).

Postural scores of experimental group (12, 60%) improved from pre- to post-test, dropping to 7.26, as compared to control group's (8, 40%) post-test scores of 11.50. It was significant, with Z = -3.48, $p < 0.01$, and effect size r = -0.78. Results suggest that the intervention improved postural alignment (posture) across various (4) parameters in experimental group (12, 60%), with no corresponding improvements ($p > 0.05$) in control group (8, 40%), emphasizing the intervention's potential in enhancing the musculoskeletal (postural) health.

Table 3

Differences (0.01, 0.05) of posture in pre- (week 1) and post- (week 6) test

Pre-; 1			
Test; Week	Experimental group	Control group	Wilcoxon R-S Test
Head and neck ($\bar{x}$)	2.62	2.62	Z = -0.24, $p > 0.05$, r = -0.06
Shape of chest ($\bar{x}$)	2.00	1.76	Z = -0.76, $p > 0.05$, r = -0.16
Abdomen and pelvis ($\bar{x}$)	2.92	2.62	Z = -0.98, $p > 0.05$, r = -0.22
Curvature of spine ($\bar{x}$)	1.66	2.38	Z = -0.18, $p > 0.05$, r = -0.04
Shoulders and scapulas ($\bar{x}$)	2.00	2.12	Z = -0.46, $p > 0.05$, r = -0.10
Postural score ($\bar{x}$)	11.84	11.50	Z = -0.20, $p > 0.05$, r = -0.04
Post-; 6			
Test; Week	Experimental group	Control group	Wilcoxon R-S Test
Head and neck ($\bar{x}$)	1.50	2.62	Z = -2.20, $p < 0.05$, r = .50*
Shape of chest ($\bar{x}$)	1.62	1.76	Z = -0.56, $p > 0.05$, r = 0.12
Abdomen and pelvis ($\bar{x}$)	1.66	2.62	Z = -2.76, $p < 0.01$, r = -0.62**
Curvature of spine ($\bar{x}$)	1.34	2.38	Z = -3.20, $p < 0.01$, r = -0.72**
Shoulders and scapulas ($\bar{x}$)	1.16	2.12	Z = -3.12, $p < 0.01$, r = -0.70**
Postural score ($\bar{x}$)	7.26	11.50	Z = -3.48, $p < 0.01$, r = -0.78**

* - Significance (α) = 0.05; ** - Significance (α) = 0.01; $\bar{x}$ - Arithmetic mean.

Discussion

Current levels of posture display notable variation, with a rise in improper posture beginning as early as preschool years [24] and continuing in younger school age [10, 21, 25-27]. Prevalence of incorrect postures correlates with age and gender (both); therefore, its precise extent remains under discussion [28].

Topics of posture are of particular significance concerning the school-aged demographic (Slovak, in our case) [10-11, 17, 19, 21, 27, 29]; in contrast to research, carried out in other demographics (United States, China), which tend to focus on musculoskeletal pain and its reduction [30-31].

Incorrect sitting postures, ergonomics, and design and weight of school bags are determinants that are influencing postures [32]. Growth dynamics;

in particular, shifts in growth, significantly impact posture in younger school age, with weight increasing by 2.5 kg/ year and height by 6 cm/ year in children aged 6 to 10 [33]. Changes in body proportions; in particular, shape of chest, play an important role. Elongation of limbs and transformation of cartilage to bones occur in younger school age. Spine adopts "S" shape with development of cervical lordosis and thoracic kyphosis, stabilizing around age of 12 [34-35]. Muscle mass (increased) enhances strength and resilience of ligaments; however, development occurs (often) randomly (uneven) across muscle groups, with limb developments outpacing other areas.

Implementation of intervention programs aimed at improving postures in younger school age (6 - 10) is necessary [10]. Integration of such programs in Physical and sports education is advocated, with the exercises tailored to individual factors; in particular, age and gender to minimize musculoskeletal pain [30-31]. Postural programs (intervention) commence with simpler exercises and progressing to more complex movements and postural adjustments [11]. Initial phases incorporate (often) relaxation exercises, focusing on mobility of joints and reducing muscle tone; therefore, lowering reflexive responses to stimulus.

Results from 6-week postural intervention programs underscore significant (0.01, 0.05) findings in developmental Physical and sports education, demonstrating that short, target interventions (postural) may enhance postures in 10-year-old students; therefore, contributing to musculoskeletal health and preventing future disorders. Significant (0.01, 0.05) findings are underscored by consistent emphasis in literature on developmental benefits of early intervention for maintaining musculoskeletal health and reducing postural (musculoskeletal) pain in adulthood. 6-week postural intervention program (our), carried out 2x/ week/ 10 minutes, led to significant (0.01, 0.05) improvements in 4 out of 5 segments of posture (body) in post-test; in particular, head and neck ($Z = -2.20$, $p < 0.05$, $r = -0.50$), abdomen and pelvis ($Z = -2.76$, $p < 0.01$, $r = -0.62$), curvature of spine ($Z = -3.20$, $p < 0.01$, $r = -0 .72$), shoulders and scapulas ($Z = -3.12$, $p < 0.01$, $r = -0.70$). It aligns with other research indicating the efficacy of frequent, short-duration physical interventions for achieving physiological adaptations; in particular, regarding the posture (correct) and awareness (its) in 10-year-old students. 18-week program (2/ 45-minute sessions/ week) in younger school age children using the Klein and Thomas method, as modified by Mayer, resulted in significant posture improvements ($p < 0.05$) [27]. Additional study of 102 children (mean age of 8.8) over 18-week biweekly program (dancing, music) showed significant improvements in posture ($p < 0.05$) [10]. Evaluation of 80 children (mean age of 10.8) in Physical and sports education (intervention program) revealed significant posture improvements ($p < 0.01$; $p < 0.05$) [25]. Another examination of 625 children (325 boys, 300 girls) identified significant 0.01, 0.05) postural (musculoskeletal) issues; in particular, in regions of abdomen and pelvic [21].

Rising rates of incorrect posture in younger school age children are documented, increasing from 33% at age 7 to 42% by age 15 [37]. Upward trend in postural (musculoskeletal) issues was confirmed in study of 120 children, emphasizing the need of preventive measures starting in preschool children [36-37]. 92% of 10-year-old students showed signs of incorrect posture [38], with ensuing findings revealing large increases to 98% in boys and 96% in girls [29]; therefore, importance of implementing postural intervention programs in early school years is emphasized; in particular, regarding its integration in Physical and sports education curriculum.

When examining the segmental responses, lacks of significant improvements (0.01, 0.05) in shape highlights important areas of further discussion. Findings (our) indicate that certain regions of posture may necessitate more than (just) short-term interventions to achieve significant (0.01, 0.05) improvements; in particular, younger school age children. Complexity of chest posture likely involves intricate muscular and skeletal adaptations, suggesting needs for extended and/or more target interventions. Limitations within the current, 6-week postural intervention program underscores critical importances of creating age-appropriate and segment-specific exercises in early postural training in Physical and sports education. Differentiating between these areas is important, as research on postural (musculoskeletal) health consistently demonstrates that specific segments of posture, such as the thoracic region, may develop structural rigidity earlier than others, necessitating prolonged interventions to achieve effective realignment.

Statistical significances (0.01, 0.05) of observed changes within the experimental group (12, 60%) further substantiates the program's efficacy.

Analysis using the Wilcoxon Rank-Sum Test and Pearson's correlation highlights that consistent, short-duration programs (postural) may produce significant (0.01, 0. 05) improvements in postures; in particular, in areas prone to strain or misalignment during adolescence, such as head, neck, and spine. Findings (our) reinforce the strategic effectiveness of early postural programs (intervention), given the developmental state of musculoskeletal system in younger school age children - 10-year-old students (in our case). Improved postural outcomes observed in experimental group (12, 60%) strongly support the integration of similar postural programs in Physical and sports education (settings). Such incorporation may foster habits that promote musculoskeletal health, which is an important factor in mitigating musculoskeletal issues later in life.

Findings (our) illustrate the potential success of targeted postural interventions in achieving large, significant (0.01, 0.05) improvements in important segments of posture; however, results (our) emphasize the necessity of accounting of segment-specific needs; in particular, in regions, such as chest (shape) that may require more prolonged and/or focused interventions. Detailed insights into how various segments of posture (body) respond to postural programs, pave the way for further research into specific adaptation and creation of more comprehensive intervention protocols. Efforts of this nature are important for enhancing childhood musculoskeletal health and building solid foundations for long-term musculoskeletal resilience.

Conclusions

Study's findings suggest that structured, short-term postural exercises may lead to significant (0.01, 0.05) improvements in posture of 10-year-old students. Over the 6-week period, the intervention program (postural) produced measurable enhancements in 4 out of 5 segments of posture in post-test; in particular, head and neck, abdomen and pelvis, curvature of spine, and shoulders and scapulas. Statistical analyses confirmed the significances of improvements, with p-values less than 0.05 and 0.01 across the regions. The intervention's efficacy was verified using the Wilcoxon Rank-Sum and Wilcoxon Signed-Rank tests, along with Pearson's correlation, demonstrating the program's reliability in influencing postures of 10-year-old students; however, 1 segment (shape of chest) of posture did not exhibit significant improvements following the intervention. This suggests that certain postural characteristics may require either different approaches or longer intervention durations to achieve meaningful results. While short-term programs may effectively address general postural misalignments, some aspects of posture may not respond as well to interventions that are short. Findings (our) indicate potential needs for extended program durations or modified exercise regimens to adequately target areas like chest (shape) that may be less responsive to shorter-term efforts. It (study) demonstrates that 6-week postural intervention programs may lead to substantial improvements in postures of younger school age children, providing evidence that structured approaches may help mitigate the risk of musculoskeletal disorders and promote better posture, contributing to long-term health.

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Conflict of interest

The authors declare that there is no conflict of interest.

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