AN INTERVENTION FOR IMPROVING POSTURE IN SCHOOL-AGE BOYS: EVIDENCE FROM OUT-OF-SCHOOL SETTINGS
INTERVENCIA NA ZLEPŠENIE DRŽANIA TELA U CHLAPCOV ŠKOLSKÉHO VEKU: EVIDENCIA Z PROSTREDIA ŠKOLSKÉHO KLUBU

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ABSTRACT
Introduction: Postural deviations in school-age boys represent growing public health concerns, often linked to sedentary behavior, insufficient physical activity, and inadequate ergonomic conditions. While out-of-school settings offer promising settings for preventive interventions, research in this context remains limited.
Aim: The study aimed to evaluate the effects of 8-week intervention on posture in school-age boys, attending out-of-school settings.
Materials and Methods: Quasi-experimental design involved 35 male participants (age: 9.4 ± 0.3 years), with 20 assigned to experimental group receiving the intervention and 15 to non-intervention control group. The program consisted of 20-minute sessions, conducted 3/ week over 8 weeks. Parameters of posture (head/neck, chest, abdomen/pelvis, spine, shoulders/ scapulas) were evaluated pre- and post-intervention using validated observational tools (Klein and Thomas/Mayer method).
Results: Statistical analysis (Wilcoxon and Mann-Whitney U-Tests) revealed significant post-intervention improvements ($p < 0.01$) in all evaluated parameters within the experimental group, accompanied by large effect sizes. No significant change was observed in the control group.
CONCLUSIONS: Results demonstrate that brief, structured interventions can produce clinically meaningful improvements in postural health among school-age boys, affirming the utility of out-of-school settings for posture correction and prevention.

Key words: Out-of-school intervention. Postural health. Preventive program. School-age boys.

ABSTRAKT
Východiská: Posturálne odchýlky u chlapcov školského veku predstavujú narastajúci problém verejného zdravia, často súvisiaci so sedavým spôsobom života, nedostatočnou pohy-bovou aktivitou a nevyhovujúcimi ergonomickými podmienkami. Hoci prostredie školského klubu ponúka sľubné možnosti pre preventívne intervencie, výskum v tomto kontexte je stále obmedzený.
Cieľ: Cieľom štúdie bolo vyhodnotiť účinok 8-týždňovej intervencie na držanie tela u chlapcov školského veku, navštevujúcich š.
Súbor a metodika: Kváziexperimentálny dizajn zahŕňal 35 chlapcov (vek: 9.4 ± .3 roka), pričom 20 bolo zaradených do experimentálnej skupiny s intervenciou a 15 do kontrolnej skupiny bez intervencie. Program pozostával z 20-minútových cvičení, realizovaných 3-krát týždenne počas 8 týždňov. Parametre držania tela (hlava/krk, hrudník, brucho/panva, chrbtica, ramená/lopatky) boli hodnotené pred a po intervencii pomocou validovaných pozorovacích nástrojov (metóda Klein a Thomas/Mayer).
Výsledok: Štatistická analýza (Wilcoxonov Test a Mann-Whitneyho U-Test) preukázala významné zlepšenia ($p < 0,01$) vo všetkých hodnotených parametroch v experimentálnej skupine s vysokými hodnotami efektu. V kontrolnej skupine sa nezaznamenali žiadne významné zmeny.
Záver: Výsledky naznačujú, že krátke, štruktúrované intervencie môžu viesť k klinicky významnému zlepšeniu posturálneho zdravia u chlapcov školského veku, čím potvrdzujú účelnosť realizácie posturálnych programov v prostredí školských klubov.

Kľúčové slová: Mimoškolská intervencia. Posturálne zdravie. Preventívny program. Chlapec školského veku.

INTRODUCTION

Postural health in school-age boys has emerged as an important (e.g., significant) concern in recent years, in particular, in light of increasingly sedentary lifestyles and the pervasive use of digital technology among school-age populations (Bagherian et al., 2023). Poor posture during childhood is not merely an aesthetic issue; it can lead to functional impairments, musculoskeletal pain, and even long-term health consequences extending into adulthood (Murray et al., 2019). Schools, where children spend most of their waking hours, often lack the ergonomic infrastructure necessary to support healthy postural development; therefore, researchers have increasingly turned their attention to school-based and extracurricular interventions as vehicles for postural correction and prevention (Stojanović et al., 2020).

Postural deviations, including forward head posture, rounded shoulders, and spinal asymmetries, are becoming more prevalent in boys aged 6 to 15 (Nosko et al., 2016; Bendíková & Balint, 2024; Azor et al., 2025). These postural defects are often attributed to combinations of prolonged sitting, carrying heavy backpacks, lack of physical activity, and poor ergonomic conditions in classrooms. The consequences can include back and neck pain, reduced motor coordination, and long-term musculoskeletal issues that extend into adulthood (Vranešić et al., 2024).

In response to this growing problem, intervention programs have been developed that aim to improve posture through structured physical activity, postural education, and ergonomic training (Minghelli et al., 2021). Such programs differ in content, duration, and target population; however, several recent studies have supported their effectiveness in correcting postural alignment and enhancing musculoskeletal function (Azor et al., 2025; Slováková et al., 2025).

Out-of-school settings present promising contexts for delivering such interventions. Compared to formal classrooms, out-of-school environments are more variable and less demanding, making them ideal for engaging children in physical activity and posture-related learning (Guimarães et al., 2017). Children may also be more open to behavioral changes in relaxed, play-based settings. Yet, despite this promise, few studies have specifically examined posture-focused interventions in out-of-school settings (Riiser et al., 2017).

The lack of targeted research is concerning, given that early intervention may help prevent more serious musculoskeletal issues. Early treatment of postural problems is associated with better long-term outcomes (Azor et al., 2025); however, developing programs that are both effective and scalable in real-world settings remain challenging. Techniques such as peer involvement and gamification have shown promise in improving motivation and participation (Aresi et al., 2024).

To the best of the authors' knowledge, there is insufficient knowledge (i.e., current) regarding the impact of interventions aimed at improving posture in school-age boys, in particular, in out-of-school settings, based on Slovak-specific data; therefore, the study aimed to evaluate the effects of 8-week intervention on posture in school-age boys, attending out-of-school settings.

MATERIALS AND METHODS

Participants

Considering the chance of participant (N = 35, 100 %) dropout in longitudinal study (Caruana et al., 2015), the target (i.e., final) population consisted of 35 (Σ, 100 %) male school-age boys, attending out-of-school settings.

An intervention (8-week) was carried out 8 weeks; in particular, 3x/ week/ 20 minutes (Monday, Wednesday, Friday) (May 5 – June 28, 2025), aimed at improving posture in 20 (57.14%) school-age boys, assigned to experimental group (age: 9.46 ± 0.24 *years*; weight: 32.42 ± 4.10 *kg*, height: 136.80 ± 4.64 *cm*). Remaining 15 (42.86 %) school-age boys were allocated to control group, without 8-week intervention (age: 9.28 ± 0.46 *years*; weight: 34.20 ± 2.84 *kg*, height: 138.26 ± 2.82 *cm*) (Table 1). School-age boys (N = 35, 100 %) were selected using combinations of purposive and snowball sampling methods (Ahmed, 2024), targeting male school-age boys, attending out-of-school settings. School-age boys (N= 35, 100 %) formed homogeneous groups (i.e., experimental and control) in terms of anthropometric data, ensuring consistency across the groups (Table 1). Because of small sample size (N = 35, 100 %), the study was designed as an exploratory effort, and findings should be interpreted as preliminary, pending validation in larger populations.

Ethical approval was granted by Ethics Committee of Artistic and Pedagogical Council of Faculty of Performing Arts, Academy of Arts in Banská Bystrica (Approval No. 005, FMU-AU/24), was carried out under the standards set by the Declaration of Helsinki (Harriss et al., 2020). Written informed consent for participation in this study was obtained from legal guardians (i.e., parents) of 35 (100 %) school-age boys.

Table 1 Anthropometric data of school-age boys (N = 35, 100%)

Data	Experimental group	Control group
Age (years; $M \pm Std$)	9.46 ± 0.24	9.28 ± 0.46
Weight (kg; $M \pm Std$)	32.42 ± 4.10	34.20 ± 2.84
Height (cm; $M \pm Std$)	136.80 ± 4.64	138.26 ± 2.82

Legend: ^{M} Mean; ^{Std} Standard deviation; ^{N} Number

MEASURES AND PROCEDURES

The study aimed to evaluate the effects of 8-week intervention on posture in school-age boys, attending out-of-school settings; therefore, an experimental design (i.e., quasi) was employed. Assignment by chance (week 1; May 5, 2025) was carried out because of allocating 20 (57.14 %) school-age boys to experimental group, receiving 8-week intervention, while remaining 15 (42.86 %) served as control group with no intervention (Azor et al., 2025). This design (quasi) allowed comparisons (within- and between groups) to assess changes in posture, herein referred to as state (S), attributed to 8-week intervention.

The intervention was from May 5 to June 28, 2025 (*Δt*), with 3 supervised sessions/week (20 minutes each, Monday/ Wednesday/ Friday). Sessions followed consistent structures, including warm-up (2 minutes), core block (6 minutes), postural correctives (6 minutes), functional movement (4 minutes), and cool-down (2 minutes). The sessions were delivered by trained instructors (i.e., 2 authors) who ensured correct execution of 8-week intervention (*Table 2*). 20 (57.14 %) school-age boys who received 8-week intervention informed the instructors, in case of postural issues (e.g., discomfort, pain), and they, in turn, monitored the signs of fatigue, shaking, and loss of control (Azor et al., 2024). The decision to deliver the 8-week intervention in group settings was intentional. It was chosen for its-cost effectiveness, benefits of peer support, and potential to enhance student engagement and motivation throughout the intervention (Gottschalk et al., 2022; Adamčák et al., 2025).

Table 2 An intervention for improving posture in school-age boys (*N* = 20, 57.14%)

Week (*Δt*)	Aim (*S*)
1	Awareness (Mobilization)
2	Core Activation
3	Shoulder Control
4	Pelvic Alignment
5	Balance (Coordination)
6	Movement Patterns
7	Game-Based Integration
8	Habit Reinforcement

Legend: $^{\Delta t}$ Duration; ^{S} State.

20 (57.14 %) school-age boys received an explanation of intervention's aims, measures, and advantages. Evaluation was carried out at 2 points: pre-intervention (week 1; May 5, 2025) and post-intervention (week 8; June 28, 2025), using observational tools – *Klein and Thomas/ Mayer*, focusing on 5 segments (i.e., parameters): head/ neck, chest, abdomen/ pelvis, spine, shoulders/ scapulas and using 1 – 4 scale, reflecting the quality of posture, indicated by scores (total) (Bendíková et al., 2019):

- Correct (< 5 points),
- Good (6 - 10 points),
- Bad (11 - 15 points),
- Incorrect (≥ 16 points).

STATISTICAL ANALYSIS

Available data, from 35 (100 %) school-age boys, attending out-of-school settings, were organized and presented in database formats. Because of small number (*N*) of school-age boys (*N* = 35, 100 %), the authors employed non-parametric tests for comparisons (within- and between groups). Kolmogorov-Smirnov Test (*KS*) indicated that variables did not follow normal distributions; therefore, Wilcoxon Test (*W*) was employed for intragroup (within) comparisons across pre- and post-interventions. Mann-Whitney U-Test (*MWU*) was employed for intergroup (between) comparisons between the experimental group (*N* = 20, 57.14 %) and control group (*N* = 15, 42.86 %). The significance level (*p*) was set at 0.05 and 0.01, and effect size (*r*) was calculated for *W* and *MWU* by dividing the *z* value by the *N* (total) of observations (Nahn, 2016). Mean (group) values (*M*) ± standard deviations (*Std*) were employed to summarize the descriptive data. Statistical analysis was carried out using IBM SPSS Version 27 (Ibm Corp., 2017).

RESULTS

Statistical analysis of intragroup (within) comparisons revealed that the experimental group (*N* = 20, 57.14 %) experienced significant improvements in all five evaluated posture parameters after completing the 8-week intervention. According to Wilcoxon Test, the group showed significant differences ($p < 0.01$) in head/neck ($Z = 3.94$, $r = 0.62$), chest ($Z = 3.00$, $r = 0.48$), abdomen/pelvis ($Z = 4.24$, $r = 0.66$), spine ($Z = 4.38$, $r = 0.70$), and shoulders/scapulas ($Z = 4.00$, $r = 0.62$). Postural score improved from pre-intervention median of 11.50 (*Min-Max:* 8-15) to post-intervention median of 7.00 (*Min-Max:* 5 – 10), with large effect size ($Z = 3.98$, $r = 0.64$), reflecting meaningful shifts from *"bad"* to *"good"* posture classification (Table 3).

Table 3 Intragroup (within) comparisons

Klein and Thomas/ Mayer			
Experimental group			
Parameters (*Med; Min-Max*)	**Pre- (*week 1*)**	**Post- (*week 8*)**	**Wilcoxon Test (*p*)**
Head/ neck	3; 1-4	2; 1-3	$Z = 3.94$, $p < 0.01$, $r = 0.62$**
Chest	2; 1-3	1; 1-3	$Z = 3.00$, $p < 0.01$, $r = 0.48$**
Abdomen/ pelvis	3; 2-4	2; 1-3	$Z = 4.24$, $p < 0.01$, $r = 0.66$**
Spine	2; 2-3	1; 1-2	$Z = 4.38$, $p < 0.01$, $r = 0.70$**
Shoulders/ scapulas	2; 1-3	1; 1-2	$Z = 4.00$, $p < 0.01$, $r = 0.62$**
Postural score	11.50; 8-15	7; 5-10	$Z = 3.98$, $p < 0.01$, $r = 0.64$**
Control group			
Parameters (*Med; Min-Max*)	**Pre-; (*week 1*)**	**Post- (*week 8*)**	**Wilcoxon Test (*p*)**
Head/ neck	3; 1-4	2; 1-4	$Z = 0.58$, $p > 0.05$, $r = 0.10$
Chest	2; 1-3	2; 1-3	$Z = 1.73$, $p > 0.05$, $r = 0.32$
Abdomen/ pelvis	3; 2-4	3; 2-4	$Z = 1.00$, $p > 0.05$, $r = 0.18$
Spine	3; 2-3	3; 2-3	$Z = 0.80$, $p > 0.05$, $r = 0.08$
Shoulders/ scapulas	2; 2-3	3; 1-4	$Z = 0.44$, $p > 0.05$, $r = 0.08$
Postural score	12; 10-15	12; 10-15	$Z = 1.26$, $p > 0.05$, $r = 0.23$

Legend: *Med* Median; *Min-Max* Minimum-Maximum; *p* Value; *z* Value; *r* Effect size; ** Significance (*p*) < 0.01

Table 4 Intergroup (between) comparisons

Klein and Thomas/ Mayer			
Pre- (*week 1*)			
Parameters (*Med; Min-Max*)	**Experimental group**	**Control group**	**Mann-Whitney U-Test (*p*)**
Head/ neck	3; 1-4	3; 1-4	$Z = -0.46$, $p > 0.05$, $r = -0.08$
Chest	2; 1-3	2; 1-3	$Z = -1.02$, $p > 0.05$, $r = -0.18$
Abdomen/ pelvis	3; 2-4	3; 2-4	$Z = -0.54$, $p > 0.05$, $r = -0.10$
Spine	2; 2-3	3; 2-3	$Z = -1.38$, $p > 0.05$, $r = -0.24$
Shoulders/ scapulas	2; 1-3	2; 2-3	$Z = -2.12$, $p < 0.05$, $r = -0.36$*
Postural score	11.50; 8-15	12; 10-15	$Z = -1.36$, $p > 0.05$, $r = -0.22$
Post- (*week 8*)			
Parameters (*Med; Min-Max*)	**Experimental group**	**Control group**	**Mann-Whitney U-Test (*p*)**
Head/ neck	2; 1-3	2; 1-4	$Z = -2.90$, $p < 0.01$, $r = -0.48$**
Chest	1; 1-3	2; 1-3	$Z = -2\text{-}20$, $p < 0.05$, $r = -0.38$*
Abdomen/ pelvis	2; 1-3	3; 2-4	$Z = -3.94$, $p < 0.01$, $r = -0.66$**
Spine	1; 1-2	3; 2-3	$Z = -4.74$, $p < 0.01$, $r = -0.80$**
Shoulders/ scapulas	1; 1-2	3; 1-4	$Z = -4.54$, $p < 0.01$, $r = -0.76$**
Postural score	7; 5-10	12; 10-15	$Z = -4.98$, $p < 0.01$, $r = -0.84$**

Legend: *Med* Median; *Min-Max* Minimum-Maximum; *p* Value; *z* Value; *r* Effect size; ** Significance (*p*) < 0.01; * Significance (*p*) < 0.05

Control group ($N = 15$, 42.86 %), which did not undergo any intervention, did not exhibit significant changes ($p > 0.05$) in any of measured posture parameters. For head/neck ($Z = 0.58$, $r = 0.10$), chest ($Z = 1.73$, $r = 0.32$), abdomen/pelvis ($Z = 1.00$, $r = 0.18$), spine ($Z = 0.80$, $r = 0.08$), and shoulders/scapulas ($Z = 0.44$, $r = 0.08$), Wilcoxon Test results indicated no meaningful improvement. Postural score in control group ($N = 15$, 42.86 %) remained unchanged, with median of 12 (*Min-Max:* 10 – 15) both pre- and post-intervention. Wilcoxon Test confirmed that this change was not significant ($Z = 1.26$, $p > 0.05$, r = 0.23), and posture remained within the "bad" posture classification (Table 3).

At baseline (pre-intervention), no significant differences ($p > 0.05$) were found between the experimental ($N = 20$, 57.14 %) and control group ($N = 15$, 42.86 %) in most posture parameters. The only exception was the shoulders/scapulas. In this parameter, a modest but significant difference was observed ($Z = -2.12$, $p < 0.05$, $r = -0.36$). The findings indicate that both groups had largely similar posture profiles at baseline (Table 4).

Post-intervention (week 8) analysis revealed significant differences ($p < 0.01$; 0.05) between the experimental and control groups across all five posture parameters, favoring the intervention. The experimental group showed better outcomes in head/neck (Z = -2.90, $p < 0.01$, r = -0.48), chest (Z = -2.20, $p < 0.05$, r = -0.38), abdomen/pelvis (Z = -3.94, $p < 0.01$, r = -0.66), spine (Z = -4.74, $p < 0.01$, r = -0.80), and shoulders/scapulas (Z = -4.54, $p < 0.01$, r = -0.76). Postural score was lower (better) in the experimental group (*Med* = 7; *Min-Max:* 5 – 10) compared to control group (*Med* = 12; *Min-Max:* 10 – 15), with large effect size (Z = -4.98, $p < 0.01$, r = -0.84), supporting the effectiveness of 8-week intervention in improving posture (Table 4).

DISCUSSION

The study evaluated the effects of 8-week intervention on posture in school-age boys, attending out-of-school settings. It demonstrated that the structured program led to significant ($p < 0.01$; 0.05) improvements in all 5 parameters; head/neck, chest, abdomen/pelvis, spine, and shoulders/scapulas, in experimental group (N = 20, 57.14 %), while no significant change ($p > 0.05$) was observed in control group (N = 15, 42.86 %) (Table 3 – 4). It reinforces with research (early) showing that interventions (target) can improve posture in children (Azor et al., 2025; Slováková et al., 2025).

Post-intervention, 20 (57.14 %) boys in experimental group displayed reductions in postural scores from “*bad*” (11.50 ± 1.76) to “*good*” (7.00 ± 1.38), indicating not only statistical but also clinically relevant changes. The improvement was substantiated by strong effect sizes across parameters; in particular, in spine (Z = 4.38, r = 0.70) and abdomen/pelvis (Z = 4.24, r = 0.66). The results align with previous research emphasizing the importance of multi-faceted and progressive posture correction programs that integrate awareness, core strength, and motor control (Karacaoglu et al., 2015; Sim et al., 2022).

The control group, on the other hand, did not demonstrate significant ($p < 0.01$; 0.05) changes in any of evaluated parameters of posture, and their scores remained in the “*bad*” classification. The lack of spontaneous improvement underscores the importance of structured intervention in promoting postural health. Without direct action, posture in children is unlikely to improve; in particular, in environments that reinforce sedentary habits and poor ergonomic behavior (Sellschop et al., 2018; Abdallah et al., 2019; Stojanović et al., 2020). Intergroup (between) comparisons at post-intervention uncovered significant ($p < 0.01$; 0.05) differences between the experimental and control groups in all (5) parameters of posture, with large effect sizes (e.g., r = -0.84 for postural score). It validates the intervention’s robustness and practical impact. Postural score in the experimental group (N = 20, 57.14 %), not only improved significantly but surpassed the control group’s results by over 5 points on average, magnitude of changes observed in similar research using non-invasive interventions (Guimarães et al., 2017; Azor et al., 2025).

The program’s success may be attributed to several design elements: (1) session regularity and consistency (3x/ week), (2) progression of thematic focus across 8 weeks, and (3) the use of group delivery that may have enhanced motivation and peer support (Gottschalk et al., 2022). Gamification strategies in weeks 7 – 8 reinforced postural habits through play-based learning, which has been shown to increase adherence and engagement in school-aged populations (Ike et al., 2024).

From clinical and public health standpoints, the results are encouraging. They suggest that brief, low-cost, and scalable interventions, when implemented in out-of-school settings, can lead to meaningful changes in posture. This is crucial given the increasing prevalence of posture-related complaints among children, including neck and back pain, even before adolescence (Dugan, 2018; Vranešić et al., 2024).

Despite the promising results, some limitations should be acknowledged. First, the study focused exclusively on a male cohort, limiting the generalizability to female or mixed-gender groups. Second, the quasi-experimental design, while pragmatic, did not allow for full randomization, leaving room for potential selection bias. Third, while observational posture assessments offer practical insights, more objective biomechanical or digital analysis tools could strengthen reliability. Long-term follow-up was not included, and thus the sustainability of improvements remains unknown.

Future research should explore the differences in gender in response to similar interventions, incorporate randomized controlled trial designs, and test the longevity of postural improvements. Moreover, combining physical interventions with digital reminders or educational components could enhance outcomes. Investigating scalability in different cultural or educational contexts would also be beneficial to expand applicability.

CONCLUSIONS

The results of study demonstrate that 8-week intervention, delivered in out-of-school settings, significantly (p < 0.01; 0.05) improved posture in school-age boys. Boys who participated in the intervention showed improvements across all 5 parameters of posture: head/neck, chest, abdomen/pelvis, spine, and shoulders/scapulas, resulting in shifts from "*bad*" to "*good*" classifications. The improvements were significant (p < 0.01; 0.05) and supported by strong effect sizes. In contrast, the control group, which did not receive any intervention, exhibited no significant (p > 0.05) changes and maintained poor posture scores throughout. The success of 8-week intervention appears to be linked to its consistent session delivery, progressive weekly themes, and group-based, engaging approach, including gamified elements. The results suggest that brief, low-cost, and scalable posture correction programs can be effectively implemented in informal educational environments such as out-of-school settings; however, limitations such as the male-only sample, quasi-experimental design, and lack of long-term follow-up warrant caution. Future research should explore differences in gender, use more objective posture assessments, and examine the sustainability of improvements. Given the small sample size, this study should be regarded as a preliminary investigation; however, it highlights the potential for simple interventions to make meaningful contributions to postural health in children.

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