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Changes in the static balance of primary school students after six months of wrestling training

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Abstract

Background and Study Aim Balance plays a key role in many sports, particularly those that require precise movements and continuous body control. The aim of the study was to verify or disprove changes in the ability to maintain static balance after six months of wrestling training under conditions of reduced visual input and limited support surface.

Material and Methods The study included twenty-three male primary school pupils who participated in wrestling training. Their average age was 13.00 ± 1.48 years. The average height was 156.7 ± 35.22 cm, and the average body weight was 58.7 ± 19.00 kg. Training experience ranged from 1 to 2 years. The Romberg test was conducted using a freeSTEP STANDARD stabilometric platform with a sampling frequency of 250–400 Hz to assess static balance. The analysed stabilometric parameters included: total path length (PL) of foot pressure; confidence ellipse area (CEA); mean velocity (MV), defined as the total CoP path in 30 seconds; root mean square (RMS) of sway in the medial-lateral direction (X-RMS); and RMS in the anteroposterior direction (Y-RMS).

Results For the two-leg standing test, the values of PL, CEA, MV, X-RMS, and Y-RMS showed no statistically significant differences ($p > 0.05$). The effect sizes were small ($\eta^2 < 0.10$), indicating low sensitivity of these parameters to the intervention. In the one-leg standing test, on both the right and left legs, no significant differences were found ($p > 0.05$) in PL, CEA, X-RMS, and Y-RMS between eyes-open (EO) and eyes-closed (EC) conditions. However, mean sway velocity (MV) increased significantly under EC conditions compared to EO, with a significance level of $p < 0.05$.

Conclusions The lack of significant differences in the two-leg stance may reflect stable postural control development in this age group. However, selective neuromuscular adaptation in postural control was observed under more demanding one-leg stance conditions. Therefore, it is advisable to modify wrestling training programmes for schoolchildren to include more complex equilibrium and sensorimotor challenges

Keywords: body balance, stabilometria, wrestlers, stabilometric mat

Introduction

Maintaining proper balance is one of the key motor skills in children and adolescents. Its development results from the complex cooperation of multiple body systems. In adolescents over the age of eleven, the ability to maintain a stable posture depends primarily on the coordinated integration of three main sensory systems: visual, vestibular, and proprioceptive.

The visual system provides information about the position of the body in relation to its surroundings. The vestibular organ in the inner ear registers linear and angular accelerations of the head, allowing for rapid detection of changes in movement trajectory [1]. Proprioception enables internal awareness of body position and locomotion control through signals from muscle, tendon, and joint receptors. Integration of these sensory inputs in the central nervous system allows accurate assessment of postural stability and the selection of appropriate corrective strategies [2]. In adolescents, whose nervous systems are still developing through myelination and synaptic formation, the effectiveness of this integration may vary depending on fatigue, visual input, or environmental conditions. Research also indicates gender differences in segmental stabilisation strategies. Girls aged 14–15 years tend to display more effective stabilization mechanisms than boys [3].

The second factor influencing balance is the ability of the muscular system to generate force and maintain tension over time. The deep muscles of the torso, including the transverse abdominis, multifidus, and diaphragm, form a so-called "muscular corset" that stabilizes the spine and pelvis during changes in position. Equally important is the strength and endurance of the lower limb muscles, which control movement in the foot, knee, and hip joints. In children over the age of 11, whose muscle tissue is still adapting to bone growth and changes in body weight, strength training can significantly improve the ability to maintain stable posture

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during tasks that require both weight bearing and dynamic movement [4, 5].

The third factor affecting balance is the flexibility of muscle and tendon tissues, as well as the range of motion in the joints. High flexibility in the posterior chain, calf, and hip-lumbar muscles allows for cushioning shifts in the centre of gravity and smooth adjustment of the support point. In contrast, limited mobility in the hip, knee, or ankle joints can lead to suboptimal movement patterns and impaired postural control. Regular stretching exercises, combined with joint mobilisation techniques, support full range of motion and improve the ability of young athletes to respond precisely to changes in body position [6, 7].

In sports practice and wrestling training, maintaining a wide, stable base of support is essential when performing holds and takedown attempts. This involves consciously positioning the feet and knees at the correct angle to distribute body weight evenly across the ground surface [8]. This positioning helps the competitor minimize force vectors that could cause a loss of balance. These forces may come from their own momentum during the initiation of a technique or from the opponent's defensive actions. A stable base also enables the generation of maximum force without the risk of losing contact with the mat. In techniques that involve transferring the opponent's weight, such as a hip throw, this translates into more fluid and powerful movements. Balance and muscle strength are therefore key factors influencing the ability to perform wrestling techniques [6, 9].

Preventing loss of balance due to external forces, such as pulling on the leg or jerking the belt, requires many hours of practicing automatic postural correction mechanisms. In wrestling training, static balance is developed not only through standard tests or isometric positions but also through resistance simulations using rubber bands, a partner, or special handles. The goal is to develop the athlete's ability to detect shifts in their centre of gravity and produce an appropriate response. This includes both antagonistic reactions, such as crossing the knees, and synergistic ones, such as contraction of the quadriceps or thigh adductors. These responses are essential for maintaining an advantageous position [10, 11, 12].

Dynamic balance plays a key role in a wrestler's combat manoeuvres. This is due to the precise transfer of the centre of gravity during changes in movement level and direction. Shifting the trajectory of movement, such as moving from an upright position to a deep forward bend, causes the centre of mass (CoM) to move forward and downward. This reduces the static margin of stability. To maintain balance, the body must coordinate eccentric muscle activity, which controls the descent, and isometric muscle activity, which maintains position in the new plane. It must also activate signals from the vestibular system and joint proprioceptors to anticipate and compensate for dynamic forces while maintaining contact with the mat. Simultaneously, the central nervous system must quickly shift the base of support to the expected contact point between the feet and the mat. This requires precise correction of the centre of pressure (CoP) trajectory and modulation of muscle-tendon tension [13].

Between the ages of 11 and 15, the nervous system develops at a highly dynamic rate. Synaptic expansion and selection occur first, improving sensorimotor responses. This is followed by increased myelination, which speeds up nerve impulse conduction and enhances the precision of motor coordination. As a result, children in this age group gradually improve their ability to stabilize the centre of gravity in response to mechanical stimuli. This makes the period particularly suitable for training focused on postural control, including in sports such as wrestling.

The aim of this study was to examine changes in the balance abilities of primary school students after six months of wrestling training.

Material and Methods

Participants

All participants were recruited voluntarily and were informed about the nature of the experiment. The purpose of the research and possible risks were clearly explained. Participants could withdraw from the study at any time. Written consent was obtained from the participants' legal guardians before the study began. The study was conducted in accordance with the guidelines of the Helsinki Declaration and was approved by the Research Ethics Committee. The initial study included a group of 33 students. However, only 23 students took part in the second assessment. Only the results of those who participated in both studies were included in the final analysis.

Research Design

The tests were conducted in two periods. The first test took place in October 2024, after the start of the school year and a two-month summer break. The second test was carried out six months later, in April 2025. All tests were conducted before the start of wrestling training sessions.

The testing took place in the same room, under constant environmental conditions. These included uniform lighting, no noise or unnecessary external stimuli, and a stable temperature. To ensure repeatability, the tests were performed individually, in the presence of the examiner. The total duration of the procedure for one person was approximately 2 minutes. This included 1 minute of preparation and two 30-second measurements.

Each subject was measured barefoot, standing in the centre of the platform in a relaxed position. The feet were placed parallel at hip width, and the arms remained lowered alongside the torso. Participants were instructed to stand as still as possible and maintain a stable posture throughout the test.

Wrestling training sessions for young people aged 11–14 were held three times per week, each lasting 90 minutes. The structure of the classes followed the early stage of targeted training. It included the development of basic motor skills, techniques, and elements of task-oriented combat. Each session had four fixed parts: warm-up (15–20 minutes), main technical and motor part (55–60 minutes), task-oriented combat (10–15 minutes), and a cool-down phase (5 minutes). The warm-up prepared the body for exercise, activated the neuromuscular system, and developed basic motor coordination. The technical programme covered the fundamentals of wrestling, adjusted to the participants' level of development. Teaching was conducted in pairs, progressing from static to dynamic, then to semi-task forms. Motor tasks were selected to support the development of functional strength, balance, agility, and adaptability to changes in balance. The training volume was distributed as follows: 40% technique, 35% motor skills, 15% task-based combat, and 10% warm-up and cool-down.

The Romberg test using the freeSTEP STANDARD stabilometric platform (FreeMED BASE, Poland) was used to assess balance ability. The study was planned and conducted in accordance with applicable ethical standards.

Test of balance ability

Postural stabilography was used to assess balance ability [14]. Posturography tests are classified as objective methods for evaluating balance. They are based on measuring the displacement of the point of application of the resultant ground reaction forces. The measurement of body sway indices is used to assess the function of the postural control system and to detect imbalances and risk of falls. Postural stability was measured in static conditions, on a stationary surface, using a FreeMED BASE stabilometric mat (Italy) with FreeSTEP 2.0 software. The device enables analysis of the distribution of foot pressure on the ground, with a sampling frequency of 250 Hz in real time. Two measurements were taken using the standard Romberg test procedure. The first was a 30-second test standing barefoot with eyes open. The second was a 30-second test standing barefoot with eyes closed. During the procedure, subjects were belayed to prevent falls. Measurements were taken before the start of an international wrestling tournament (Figure 1).

Figure 1. Performing the Romberg test, standing on both legs (AI-generated example image)

The analysed stabilometric parameters used to measure the range of centre of pressure (CoP) deviation were as follows: total path length (PL) of foot pressure on the ground; confidence ellipse area (CEA), defined as the smallest ellipse that covers 95% of the CoP points; mean velocity (MV), defined as the total distance travelled by the CoP in 30 seconds; root mean square (RMS) amplitude of sway in the medial-lateral direction (X-RMS); and RMS amplitude of sway in the anteroposterior direction (Y-RMS).

Statistical analysis

The Shapiro–Wilk W-test ($\alpha = 0.05$) was used to assess the normality of distributions. The results showed that the values obtained for the CoP displacement range did not follow a normal distribution, so the data were logarithmised. The Mann–Whitney U test does not require normality or homogeneity of variance. It is suitable for quantitative variables that do not meet the assumptions of parametric tests, which corresponds to the nature of stabilometric parameters. The Mann–Whitney U test (Wilcoxon rank-sum) for repeated measures was used to assess the significance of differences between eyes-open and eyes-closed conditions. Detailed post-hoc comparisons between pairs of means were performed using the Tukey test.

η^2 is a measure of effect size used in both parametric (e.g. ANOVA) and non-parametric comparisons. Since this study involved comparing two sets of results (e.g. eyes open vs. eyes closed), η^2 was used to quantify the influence of the condition on the analysed stabilometric parameters. The thresholds for effect size were: $\eta^2 > 0.01$ for a small effect, $\eta^2 < 0.06$ to < 0.14 for a medium effect, and $\eta^2 \geqslant 0.14$ for a large effect.

Cohen's f^2 was also used to assess effect size independently of sample size. This allowed interpretation of the practical significance of the results. Cohen's f^2 was classified as small ($f^2 \approx 0.02$), medium ($f^2 \approx 0.15$), or large ($f^2 \approx 0.35$).

All analyses were conducted using STATISTICA, TIBCO Software Inc. (2017), version 13. A significance level of $p < 0.05$ was used.

Results

In children who practise wrestling, the ability to maintain static balance remains at a comparable level regardless of the variables analysed. The lack of significant differences may indicate stable development of postural control mechanisms in this age group. Regular sports training, including wrestling, supports the development of proprioception and balance. However, at a certain level of advancement, individual differences may become less apparent. The values of the PL, CEA, MV, X-RMS, and Y-RMS parameters did not differ significantly ($p > 0.05$) (Table 1).

The results of statistical analysis for the one-leg

Table 1. Results, p-values, and effect sizes of the tested athletes before and after 6 months of training while standing on both feet (EO and EC).

Stabilometric variables	Before	After	Effect size f^2	p-value
		PL (mm)		
EO	118.08 ±154.91	283.11 ±439.84	0.098	0.486
EC	168.95 ±168.90	127.39 ±140.19	0.056	0.687
Effect size η^2	0.021	0.091		
p-value	0.880	0.050		
		CEA (mm²)		
EO	243.39 ±118.85	247.85 ±130.30	0.011	0.942
EC	262.74 ±.131.85	232.14 ±89.30	0.011	0.942
Effect size η^2	0.058	0.066		
p-value	0.674	0.634		
		MV (mm/s)		
EO	8.51 ±4.13	8.55 ±4.39	0.013	0.925
EC	8.95 ±4.48	7.87 ±3.13	0.069	0.621
Effect size η^2	0.009	0.052		
p-value	0.949	0.721		
		X-RMS (mm)		
EO	0.34 ±0.16	4.36 ±1.47	0.005	0.969
EC	0.42 ±0.24	0.32 ±0.12	0.107	0.440
Effect size η^2	0.043	0.042		
p-value	0.754	0.762		
		Y-RMS (mm)		
EO	0.23 ±0.09	0.31 ±0.27	0.053	0.705
EC	0.31 ±0.17	0.29 ±0.10	0.042	0.762
Effect size η^2	0.098	0.001		
p-value	0.481	0.996		

NOTE: EO – eyes open; EC – eyes closed; PL – total path length; CEA – confidence ellipse area; MV – mean velocity; X-RMS – root mean square of sway in the medial-lateral direction; Y-RMS – root mean square of sway in the anteroposterior direction.

standing test, both on the right and left leg, showed no statistically significant differences ($p > 0.05$) in PL, CEA, X-RMS, and Y-RMS between the EO and EC conditions. This indicates that the ability to maintain balance in a one-leg standing position was similar regardless of visual control. At the same time, mean velocity of sway (MV) increased significantly under visual restriction (EC) compared to eyes-open conditions (EO), with a significance level of $p < 0.05$. This increase suggests greater neuromuscular activity required to compensate for the loss of visual input and to maintain postural stability (Tables 2, 3).

Table 2. Results, p-values, and effect sizes of the tested athletes before and after 6 months of training while standing on the right leg (EO and EC).

Stabilometric variables	Before	After	Effect size f^2	p-value
		PL (mm)		
EO	432.52 ±228.89	390.14 ±229,23	0.032	0.839
EC	24782.75 ±41944.76	9506.83 ±26938.64	0.093	0.504
Effect size η^2	0.183	0.290		
p-value	0.215	0.041		
		CEA (mm^2)		
EO	372.57 ±236.29	321.14 ±246.23	0.115	0.474
EC	1072.47 ±396.08	787.68 ±249.97	0.056	0.687
Effect size η^2	0.231	0.224		
p-value	0.109	0.109		
		MV (mm/s)		
EO	26.55 ±26.24	21.59 ±11.83	0.077	0.626
EC	95.19 ±37.28	64.63 ±21.16	0.242	0.080
Effect size η^2	0.543	0.387		
p-value	0.001	0.006		
		X-RMS (mm)		
EO	7.44 ±6.97	6.15 ±5.75	0.097	0.545
EC	11.77 ±8.51	9.13 ±5.39	0.088	0.534
Effect size η^2	0.134	0.201		
p-value	0.342	0.152		
		Y-RMS (mm)		
EO	3.98 ±4.50	2.76 ±3.13	0.063	0.696
EC	8.64 ±5.21	4.34 ±2.71	0.104	0.453
Effect size η^2	0.147	0.255		
p-value	0.288	0.069		

NOTE: EO – eyes open; EC – eyes closed; PL – total path length; CEA – confidence ellipse area; MV – mean velocity; X-RMS – root mean square of sway in the medial-lateral direction; Y-RMS – root mean square of sway in the anteroposterior direction.

Table 3. Results, p-values, and effect sizes of the tested athletes before and after 6 months of training while standing on the left leg (EO and EC).

Stabilometric variables	Before	After	Effect size f^2	p-value
		PL (mm)		
EO	550.54 ±576,42	367.94 ±186.32	0.031	0.826
EC	2779.34 ±1427.59	3066.41 ±1222.86	0.037	0.795
Effect size η^2	0.207	0.232		
p-value	0.136	0.097		
		CEA (mm^2)		
EO	360.68 ±99.27	361.71 ±114.43	0.055	0.698
EC	738.73 ±239.63	766.76 ±203.95	0.104	0.453
Effect size η^2	0.110	0.277		
p-value	0.434	0.048		
		MV (mm/s)		
EO	24.88 ±7.24	25.63 ±8.36	0.098	0.481
EC	65.30 ±23.49	63.61 ±16.69	0.029	0.833
Effect size η^2	0.428	0.378		
p-value	0.002	0.006		
		X-RMS (mm)		
EO	7.13 ±4.61	6.66 ±4.18	0.056	0.687
EC	6.17 ±4.54	8.19 ±3.43	0.077	0.576
Effect size η^2	0.039	0.117		
p-value	0.776	0.399		
		Y-RMS (mm)		
EO	1.64 ±0.65	1.59 ±0.85	0.072	0.605
EC	4.84 ±2.82	3.59 ±1.79	0.118	0.393
Effect size η^2	0.233	0.067		
p-value	0.093	0.627		

NOTE: EO – eyes open; EC – eyes closed; PL – total path length; CEA – confidence ellipse area; MV – mean velocity; X-RMS – root mean square of sway in the medial-lateral direction; Y-RMS – root mean square of sway in the anteroposterior direction.

Discussion

The aim of this study was to evaluate changes in the ability to maintain static balance among school-aged boys after six months of wrestling training. The analysis focused on stabilometric parameters under different visual and support conditions. The results showed no statistically significant changes in the parameters of postural sway (PL, CEA, MV, X-RMS, Y-RMS) during the two-leg standing test. This suggests that basic postural control mechanisms remained stable over the training period. Similarly, no significant differences were observed in most parameters during the one-leg standing test, regardless of whether the eyes were open or closed. However, a significant increase in mean velocity (MV) under eyes-closed conditions was found, indicating an elevated neuromuscular response required to maintain balance without visual input.

Muehlbauer et al. found an increase in postural sway when the base of support was reduced, such as moving from a two-legged stance in step and tandem positions to a one-legged stance. Changes in sensory input also affected sway, progressing from standing with eyes open on a hard surface, to eyes open on a foam surface, and finally to eyes closed on a hard surface [15].

In our study, during the two-leg standing test with EO and EC, no statistically significant changes were observed in the length of the centre of pressure (PL) trajectory, the range of maximum deflections, or the confidence ellipse area (CEA). This lack of improvement in basic static stability parameters suggests that in children aged 11–15, the mechanisms for maintaining balance under full visual conditions were already relatively well developed before the intervention.

In young, healthy, and physically active individuals, it is often observed that under standard test conditions (full visual input, stable surface), the adaptive reserve of the postural system is small or difficult to detect. The literature on balance training in young people emphasizes that greater effects are seen when high-difficulty stimuli are used (e.g. altered support conditions, sensory changes) rather than during simple static tasks [16].

Although the research group had limited training experience (1–2 years), it can be assumed that the participants had already achieved a high level of stability under 'easy' conditions. This may explain why the intervention did not result in significant further improvements in the same parameters.

Studies by other authors indicate that none of the training modalities examined had a measurable effect on balance performance in adolescents. However, the results of one-dimensional analyses should be interpreted with caution, as training modalities were treated as single factors, without accounting for potential interactions between them [17, 18].

In addition, physical fitness and physical activity may play an important role, as they help mitigate the negative effects of excess body fat on postural control in children [19]. Training in direct combat sports, even in milder forms, is particularly valuable as part of a comprehensive approach to youth physical development [20, 21].

Although average values did not change significantly, individual differences (e.g. between more and less 'talented' participants) may be substantial. This increases variance and reduces the ability to detect effects (statistical power). Standard static posturography may also lack the sensitivity to detect subtle adaptations in well-trained groups.

A noticeable, though statistically insignificant, tendency toward increased deviations in the front–back axis may indicate a subtle shift in corrective strategies. Participants more frequently made small movement adjustments (micro-corrections) to stabilize their centre of gravity. This may be an early sign of sensorimotor adaptation that is not captured by standard parameters such as PL or CEA, but may suggest the direction of adaptive changes in more demanding tasks.

Although trends such as shorter trajectories and reduced sway areas were observed, their statistical insignificance ($p > 0.05$) suggests that interventions based mainly on static or moderate tasks may not provide sufficient stimulation for balance control systems under conditions of visual deprivation. In sports like wrestling, where athletes must react dynamically to the opponent's movements and sudden shifts in the centre of gravity, static training is likely insufficient.

The results of our study are consistent with the findings of Muehlbauer et al. [15], who demonstrated a significant increase in postural sway with a reduced base of support and altered sensory input. Their effects were clear ($p < 0.01$; $\eta^2 > 0.30$), indicating that difficult conditions, such as standing on one leg or tandem positions with limited visual information, strongly engage the postural system.

In our study, the lack of significant changes in bipedal standing with EO and EC (all $p > 0.05$; small effects: $\eta^2 < 0.10$, $d < 0.20$) confirms that the tasks used were likely not demanding enough to trigger measurable adaptations.

It is important to note that static stability parameters, such as COP trajectory length (PL) and confidence ellipse area (CEA), are relatively resistant to change in young, healthy, and physically active individuals. This has also been confirmed by earlier studies on adolescents [16]. In the 11–15 age group, especially among those with some sports experience, the postural system functions effectively even before training. This is evident in our study, where participants showed stable baseline parameters. Training effects in easy conditions are therefore difficult to detect and usually only appear in tasks with greater sensorimotor complexity.

Given their short training history (1 to 2 years), it can be assumed that the participants are still developing their motor skills. However, their level of static stability is already relatively high. This is consistent with the findings of Gebel et al. [17] and more recent analyses by Muehlbauer and Schedler [18]. These studies indicate that training modalities in adolescence do not always lead to significant improvements in classic balance tests. In addition, analysing only single-factor effects may overlook potential interactions between types of stimuli.

It is also important to consider the role of physiological factors. Physical activity and general fitness can partially compensate for the negative impact of excess body fat on postural stability [19]. Therefore, training activities for children, especially during periods of rapid physical development, should be varied. They should also include forms of combat adapted to the age and abilities of the participants, as confirmed by studies on mild forms of combat sports [20, 21].

Although statistically insignificant trends were observed in our measurements, such as a slight shortening of the COP trajectory and a reduction in CEA, these effects were small ($\eta^2 < 0.06$) and did not reach significance. This may result from the limited sensitivity of classical posturography and from considerable individual differences between athletes. These differences increase variance and reduce statistical power. They are particularly noticeable in populations of young athletes.

A subtle but insignificant tendency toward increased deviations in the anterior–posterior (AP) axis was also observed. This may suggest a shift in stabilization strategy, with participants using micro-movement corrections more frequently. Although this effect was small ($d < 0.30$), it may represent an early sign of sensorimotor adaptation. Such changes may become more visible in more demanding tasks.

In summary, the absence of statistically significant changes ($p > 0.05$) in the presence of small effects ($\eta^2 < 0.10$) suggests that training based mainly on static or moderately difficult tasks is not a sufficient stimulus to improve balance under conditions of visual deprivation. In sports such as wrestling, where quick reactions to an opponent›s movements and dynamic shifts in the centre of gravity are essential, static tasks are not enough. Exposure to dynamic, unpredictable, and multitask conditions may be more effective.

Therefore, attention is drawn to the method and results of body balance disturbance tolerance skills (BBDTS) using the Rotational Test (RT) [22]. This test alternates between two phenomena referred to in operational terms as dynamic balance and static balance. A four-point quantitative and qualitative scale is used for each of the six landings on a fixed line after alternating jumps with a 360° rotation to the right and left. The score ranges from 0, for both feet landing on the line again, to 3, for conventional penalty points in the case of hand support or a fall. This scoring system provides sufficient differentiation between participants.

The brief moment of posture correction while standing symmetrically on a fixed line, before performing the next rotational jump, represents the static balance component. This is part of the six-task RT set and can be interpreted as a motor simulation of situations in which a wrestler attacks or counterattacks by rotating their body after compensating for a loss of balance caused by the opponent.

The results of several studies using RT show that the main differentiating factors are an individual's innate or trained abilities, external circumstances (such as darkness or location of rescue operations) [23, 24, 25, 26], or internal circumstances (such as physical exertion) before performing RT [27, 28, 29, 30].

Combining the results from both tools, the posturography test and RT, may provide new insights and practical applications in combat sports, self-defence, or rescue training. This approach is also consistent with the concept of complementary somatic health diagnosis [31, 32].

Limitations of the study

Due to possible high individual variability, training should be tailored to the individual. For example, reactions such as changes in sway speed or deviations can be monitored, and difficulty levels adjusted based on the results. It is therefore advisable to consider longer intervention periods or more frequent sessions to allow for advanced adaptations, particularly under visual deprivation conditions.

Conclusions

As a result of wrestling training in schoolchildren aged 11 to 15 over a period of six months, no statistically significant changes were found in static balance ability. In groups with relatively well-developed balance, such as children who practise wrestling, standard static tasks performed on a stable surface with eyes open may not lead to further improvement in bipedal postural control.

It is advisable to modify the sports training programme for schoolchildren who practise wrestling by increasing the complexity of balance and sensorimotor challenges. Current static training, performed on a stable surface with full visual control, may be insufficient for further development of postural control.

However, signs of selective neuromuscular adaptation were observed in more demanding one-leg standing tasks. Therefore, it is recommended to introduce more difficult exercises into the training programme. These should stimulate the vestibular, proprioceptive, and visual systems in more complex sensory conditions.

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Conflicts of interest

The authors declare no conflicts of interest.

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