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Original Article

Effects of Implementing Spinning as a Complementary Discipline on Psychomotor Development in 11th-Grade Students

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Abstract

This study examined the effects of a 12-week indoor cycling program on psychomotor and physical performance in eleventh-grade students. Forty students were allocated to an experimental group and a control group, with equal sex distribution. The experimental group completed two 45-minute indoor cycling sessions weekly, while the control group followed circuit-based physical training. Outcomes included static balance, simple reaction time, eye-hand coordination, spatial orientation, an applied agility route, cycling endurance, pedaling cadence, abdominal muscular endurance, and the Cooper test. The experimental group showed greater improvements than the control group across most outcomes, including balance, reaction time, eye-hand coordination, spatial orientation, agility, cycling endurance, cadence, abdominal endurance, and aerobic performance. These findings indicate that structured indoor cycling can complement school physical education by supporting psychomotor development and physical fitness in high-school students

1. Introduction

Physical education contributes to motor, cognitive, and socio-emotional development and provides an important school-based context for sustained physical activity. School systems that create regular opportunities for movement may support both physical fitness and learning-related outcomes (Ciotto & Fede, 2014; Invernizzi et al., 2022; Solmon, 2015). A systematic review by Singh, Uijtdewilligen, Twisk, van Mechelen, and Chinapaw (2012) reported an overall positive relationship between physical activity and academic performance, while observational data from school populations have also linked physical fitness with academic outcomes (Van Dusen, Kelder, Kohl, Ranjit, & Perry, 2011).

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Psychomotricity integrates motor execution with perceptual, cognitive, and affective processes involved in the regulation of behavior (Preda, 1999). Consequently, activities used in physical education may be evaluated not only through traditional fitness indicators but also through balance, reaction, coordination, spatial orientation, and agility. Multi-teaching approaches in physical education have produced improvements in motor creativity and executive functions, emphasizing the value of structured and varied motor tasks (Invernizzi et al., 2022).

Indoor cycling is characterized by rhythmic, repetitive lower-limb activity that can be regulated through cadence, resistance, perceived exertion, and heart rate. Variable-intensity spinning produces substantial metabolic and perceptual demands (Kang et al., 2005), while repeated indoor cycling training can improve cardiorespiratory fitness (Bianco et al., 2010).

Acute spinning exercise also produces marked thermoregulatory and cardiovascular responses (Hazelhurst & Claassen, 2006; Duttaroy, Thorell, Karlsson, & Börjesson, 2012). Previous studies by Scheuleac and Vizitiu (2023) and Scheuleac (2025) further support the use of structured spinning for monitoring and developing exercise capacity.

In adolescents, physical activity is associated with school performance and health-related outcomes, although the direction and magnitude of these relationships vary by study design and population (El Oirdi, Eloirdi, Belghyti, & El Kharrim, 2023). The present study therefore examined whether a 12-week indoor cycling program, implemented as a complementary activity, was associated with greater changes in psychomotor performance, cycling-specific endurance, muscular endurance, and aerobic performance than circuit-based physical training in eleventh-grade students.

2. Material and methods

The purpose of the study was to evaluate the effects of a structured indoor cycling program on psychomotor indicators, cycling-specific endurance, muscular endurance, and aerobic performance in high-school students.

Research hypothesis: participation in the indoor cycling program would produce greater improvements in coordination, balance, agility, and endurance than circuit-based physical training.

The 12-week intervention was conducted at Wonder Gym Suceava between March and May 2025. The sample comprised 40 eleventh-grade students divided into two equal groups: an experimental group and a control group, each including 10 girls and 10 boys. Both groups completed two 45-minute sessions per week.

Research methods included literature review, systematic observation, standardized motor testing, and descriptive statistical analysis. Results were summarized using arithmetic means, standard deviations, and pre-post differences.

Intervention protocol: 12 weeks, two sessions per week, 45 minutes per session.

The experimental group followed the indoor cycling protocol presented in Table 1. The control group performed a strength-and-endurance circuit of the same session duration, presented in Table 2.

The assessment battery included five psychomotor tests, two cycling-specific tests, and two general strength/endurance tests, administered before and after the intervention.

- The two training protocols were standardized by session structure and duration to facilitate comparison between groups.

Table 1. *Indoor Cycling Program for the Experimental Group (45 Minutes)*

Interval	Duration	Segment	Intensity (Perceived Exertion/RPM/Heart Rate)	Objective	Execution Notes
0–8	8 min	Progressive flat warm-up	RPE 3-4 ; 80-90 RPM ; 60-70% HRmax	General activation, joint mobilization	Low resistance; 5 min at 80-85 RPM, then 3 min at 85-90 RPM.
8–13	5 min	Cadence build on flat terrain	RPE 4-5 ; 90 to 100 to 105 RPM	Pedaling efficiency and cadence control	Slight resistance increase every 90 s; relaxed upper body.
13–20	7 min	Seated climb	RPE 6 ; 60–70 RPM ; 75-80% HRmax	Foundational strength (sweet-spot)	Add 1-2 resistance "clicks"; maintain trunk stability.
20–27	7 min	Intervals 40 s work / 20 s recovery	WORK: RPE 8 ; 95-105 RPM ; 85-90% HRmax ; RECOVERY: RPE 3	Anaerobic capacity with brief recovery	approx. 7 repetitions; moderate resistance during work, low during recovery.
27–33	6 min	Standing climb with surges	RPE 7 ; 55-65 RPM ; 80-85% HRmax	Strength and postural control	Every 60 s, 15 s surge at RPE 8; moderate-high resistance.
33–40	7 min	Sustained tempo on flat terrain	RPE 6 ; 85-95 RPM ; 75-80% HRmax	Aerobic endurance	Rhythmic breathing, relaxed shoulders, forward gaze.
40–45	5 min	Cool-down / return to baseline	RPE 2-3 ; 70-80 RPM ; <65% HRmax	Heart-rate reduction, relaxation	Gradually lower resistance; light off-bike stretching afterward.

Table 2. *Strength and Endurance Circuit for the Control Group (45 Minutes)*

Block	Interval	Duration	Content	Intensity	Objective	Notes
Warm-up	0–8	8 min	Dynamic mobility (marching with high knees, arm/ankle circles, “good morning” hip hinge, easy squats, scapular push-ups)	RPE 3-4	Global activation, joint preparation	No pain; controlled range of motion.
Circuit - Round 1	8–20	12 min	**6 stations** × (1:30 work + 0:30 transition)	RPE 6	General strength and endurance	Progress through stations 1-6 sequentially.
Circuit - Round 2	20–32	12 min	**Repeat the same 6 stations**	RPE 6-7	Consolidation and volume	Slightly higher reps or marginally faster tempo.
Finisher EMOM (×2)	32–40	8 min	**Min 1:** 10–12 burpees ; **Min 2:** 15–20 kettlebell swings ; **Min 3:** 40 mountain climbers ; **Min 4:** easy walk/breathing	RPE 7-8 during work minutes	Work capacity and lactate tolerance	Repeat the 4-minute sequence twice.
Cool-down	40–45	5 min	Breathing + static stretching (quadriceps, hamstrings, back)	RPE 2-3	Recovery, heart-rate downshift	Hold each stretch 20–30 s / avoid ballistic movements.

Circuit stations: goblet squats, push-ups, bent-over rows with dumbbells or resistance bands, alternating reverse lunges, plank with shoulder taps, and jump rope or high-knee running in place.

To evaluate psychomotor performance, cycling-specific endurance, and general physical capacity, both groups completed the same assessment battery at baseline and after 12 weeks.

Psychomotor assessment

1. Flamingo Test (unipedal static balance): performance was quantified by the number of balance losses during a 60-second trial on a narrow support. Fewer balance losses indicated better static balance.

2. Simple Reaction Test: participants responded to a visual stimulus by pressing a button. Reaction time was recorded in milliseconds; lower values indicated faster visuomotor response.

3. Alternate-Hand Wall-Toss Test (eye-hand coordination): participants stood facing a wall and repeatedly threw a tennis ball against it with one hand and caught it with the opposite hand, alternating hands throughout a 30-second trial. The total number of successful catches was recorded, with higher values indicating better eye-hand coordination. This field test is used to assess eye-hand coordination and has been examined in school-aged populations (Cho, Yun, & So, 2020).

4. Spatial Orientation Test: participants completed a predefined motor route involving direction changes, zig-zag running, and obstacle negotiation. Completion time was recorded in seconds; lower values indicated better spatial orientation and agility.

5. Applied Route (agility and coordination): participants completed a complex motor course including rolling, crawling, jumping, and running between cones. Completion time was recorded in seconds; lower values indicated better performance.

Cycling-specific assessment

6. Pedaling at 75% of maximum heart rate: participants maintained cycling at the prescribed intensity and constant resistance for as long as possible. Duration was recorded in minutes.

7. One-minute pedaling cadence: the number of complete crank revolutions performed in one minute was recorded as revolutions per minute; higher values indicated greater cadence capacity.

General strength and endurance assessment

8. Crunches Test (30 seconds): participants performed the maximum number of correctly executed abdominal crunches in 30 seconds. The number of valid repetitions was recorded.

9. Cooper Test (12 minutes): participants covered the greatest possible distance in 12 minutes; distance was recorded in meters as an indicator of aerobic endurance.

All tests were administered by the same examiner using the same procedures at the initial and final assessments. Participants were familiarized with the tasks before data collection. Descriptive statistics were used to characterize pre-post changes within each group and differences in the magnitude of change between groups.

3. Results and Discussions

Table 3. *Descriptive Summary of Initial and Final Results in Both Groups*

Outcome	Experimental Pre	Experimental Post	Δ	Control Pre	Control Post	Δ
Flamingo (errors)	6.75 ± 1.94	3.40 ± 2.04	−3.35	6.70 ± 1.98	6.25 ± 2.10	−0.45
Reaction (ms)	290.20 ± 24.60	249.70 ± 26.24	−40.50	290.50 ± 32.50	282.45 ± 33.88	−8.05
Wall toss (catches)	29.11 ± 2.75	35.39 ± 3.39	+6.29	29.37 ± 4.09	30.99 ± 3.89	+1.63
Orientation (s)	41.29 ± 8.56	34.35 ± 8.59	−6.95	42.58 ± 7.23	40.44 ± 7.84	−2.14
Applied route (s)	56.72 ± 6.53	49.57 ± 7.55	−7.15	53.15 ± 4.78	52.30 ± 4.89	−0.85
Pedaling 75% HRmax (min)	10.34 ± 1.32	12.38 ± 1.46	+2.05	9.75 ± 1.66	10.05 ± 1.76	+0.31
Cadence (rev/min)	96.95 ± 8.24	110.75 ± 10.26	+13.80	93.35 ± 8.96	97.90 ± 8.87	+4.55
Crunches (reps)	19.30 ± 3.71	25.75 ± 3.65	+6.45	19.65 ± 2.66	22.25 ± 3.26	+2.60
Cooper (m)	2190.65 ± 189.59	2470.25 ± 184.42	+279.60	2133.55 ± 159.73	2227.60 ± 180.24	+94.05

Table 3 shows greater pre-post changes in the experimental group for all nine outcomes. Balance errors and reaction time decreased more markedly, while eye-hand coordination increased from 29.11 to 35.39 successful catches in the experimental group compared with 29.37 to 30.99 in the control group. Spatial orientation and applied-route times also decreased more strongly in the experimental group.

Cycling-specific performance improved in both groups, but the experimental group showed the larger changes: pedaling duration at 75% of maximum heart rate increased by 2.05 minutes and cadence by 13.80 revolutions per minute, compared with increases of 0.31 minutes and 4.55 revolutions per minute in the control group.

General physical capacity followed the same pattern. The experimental group increased abdominal crunch performance by 6.45 repetitions and Cooper-test distance by 279.60 meters, compared with increases of 2.60 repetitions and 94.05 meters in the control group.

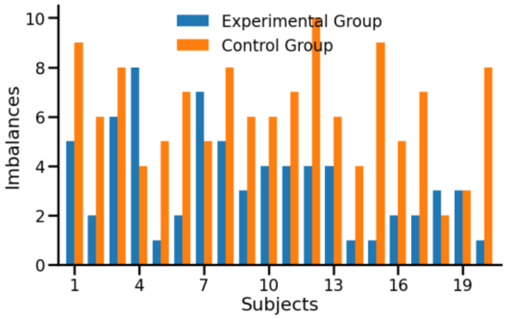

Figure 1. *Results obtained at the final testing (FLAMINGO)*

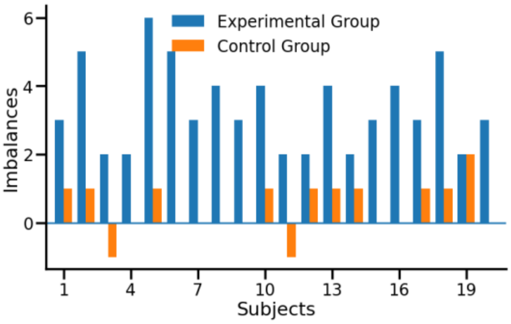

Figure 2. *Differences obtained between the final and initial testing in the FLAMINGO test (both groups)*

Figures 1 and 2 show a consistent reduction in Flamingo balance errors in the experimental group, whereas changes in the control group were smaller and more heterogeneous.

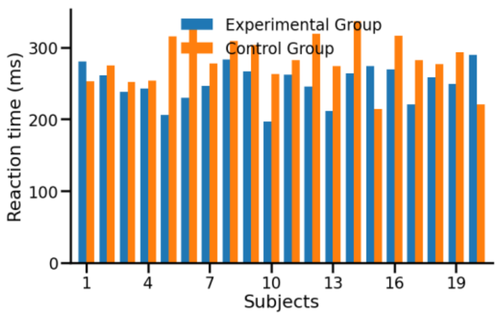

Figure 3. *Results obtained at the final testing (SIMPLE REACTION)*

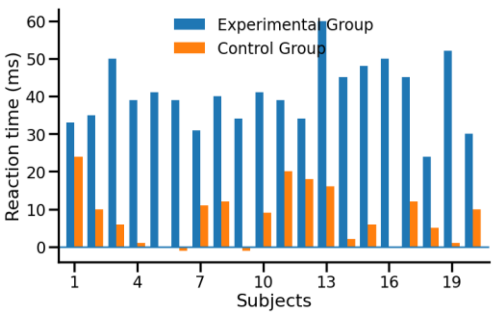

Figure 4. *Differences obtained between the final and initial testing in SIMPLE REACTION (both groups)*

Figures 3 and 4 show that reaction time decreased in all experimental-group participants, with a mean improvement of 40.50 milliseconds compared with 8.05 milliseconds in the control group.

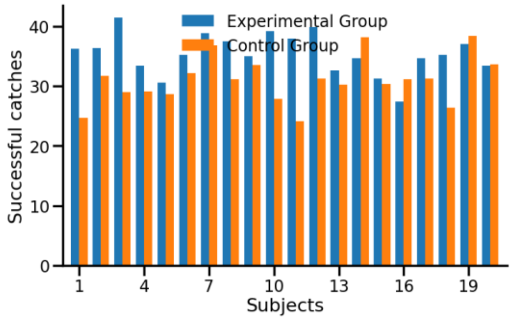

Figure 5. *Results obtained at the final testing (EYE-HAND COORDINATION)*

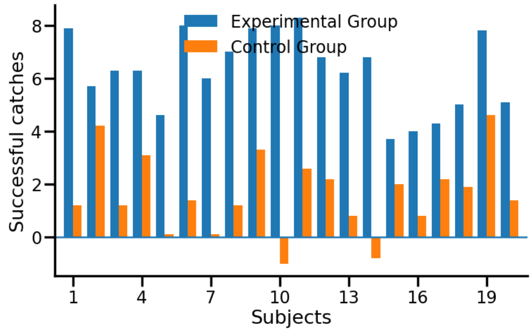

Figure 6. *Differences obtained between the final and initial testing in EYE-HAND COORDINATION (both groups)*

Figures 5 and 6 show improved eye-hand coordination in the experimental group. The mean Alternate-Hand Wall-Toss score increased by 6.29 successful catches, compared with 1.63 catches in the control group.

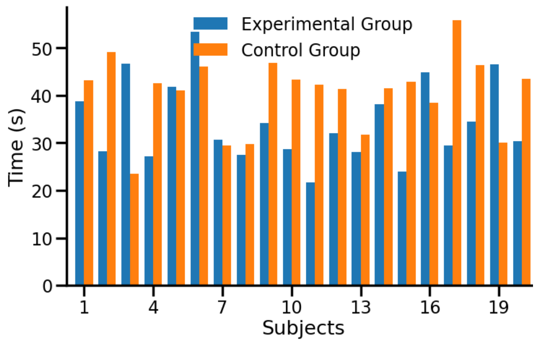

Figure 7. *Results obtained at the final testing (SPATIAL ORIENTATION)*

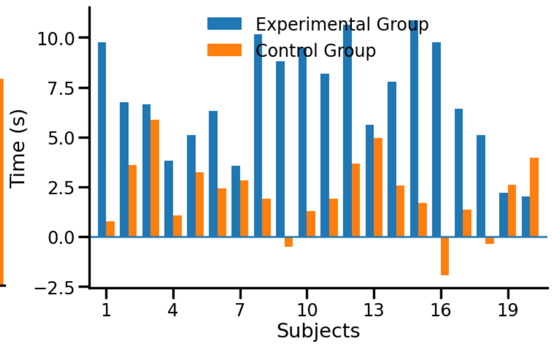

Figure 8. *Differences obtained between the final and initial testing in SPATIAL ORIENTATION (both groups)*

Figures 7 and 8 show greater improvement in spatial orientation in the experimental group, with a mean reduction of 6.95 seconds compared with 2.14 seconds in the control group.

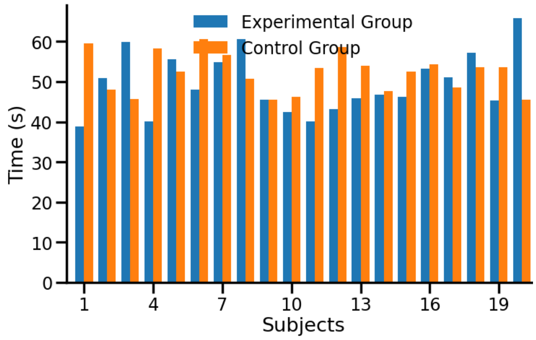

Figure 9. *Results obtained at the final testing (APPLIED ROUTE)*

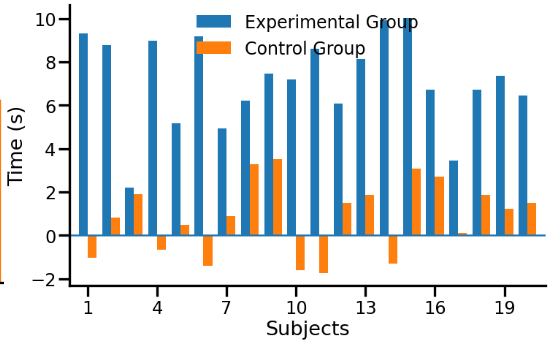

Figure 10. *Differences obtained between the final and initial testing in APPLIED ROUTE (both groups)*

Figures 9 and 10 show a larger reduction in applied-route completion time in the experimental group (7.15 seconds) than in the control group (0.85 seconds), indicating a greater change in agility and complex coordination.

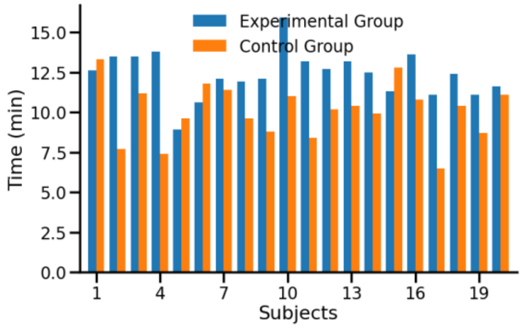

Figure 11. *Results obtained at the final testing (PEDALING)*

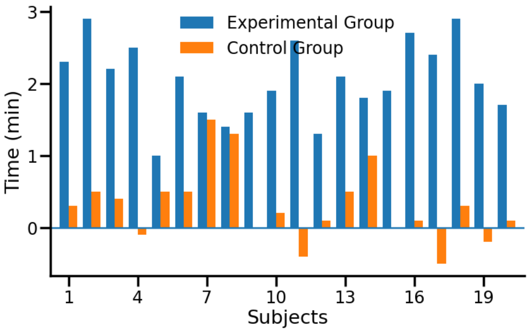

Figure 12. *Differences obtained between the final and initial testing in PEDALING (both groups)*

Figures 11 and 12 show that pedaling endurance increased more in the experimental group, with a mean gain of 2.05 minutes compared with 0.31 minutes in the control group.

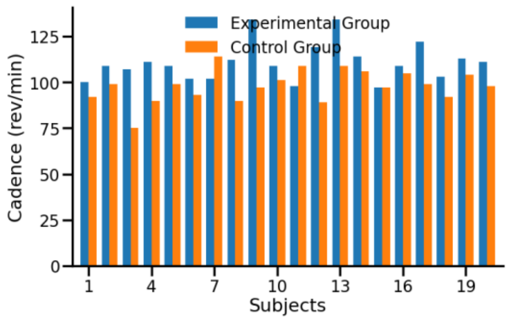

Figure 13. *Results obtained at the final testing (RPM)*

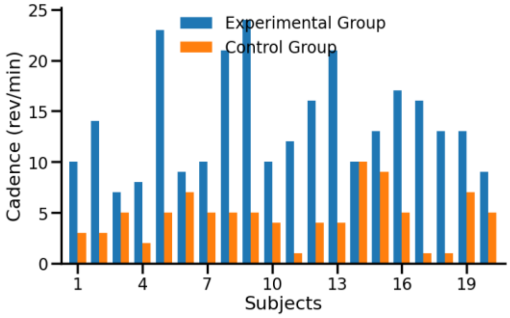

Figure 14. *Differences obtained between the final and initial testing in RPM (both groups)*

Figures 13 and 14 show a mean cadence increase of 13.80 revolutions per minute in the experimental group, compared with 4.55 revolutions per minute in the control group.

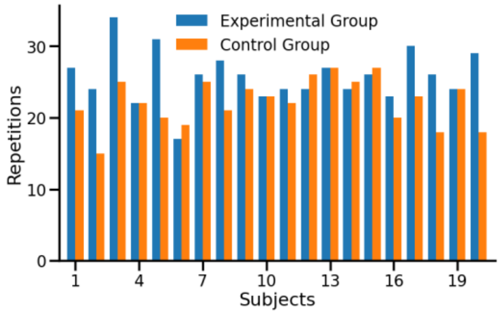

Figure 15. *Results obtained at the final testing (CRUNCHES)*

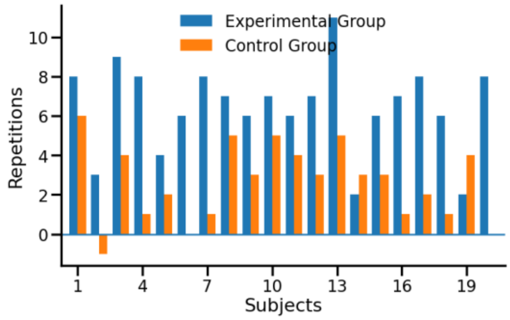

Figure 16. *Differences obtained between the final and initial testing in CRUNCHES (both groups)*

Figures 15 and 16 show that abdominal muscular endurance increased more in the experimental group, with a mean gain of 6.45 crunches compared with 2.60 in the control group.

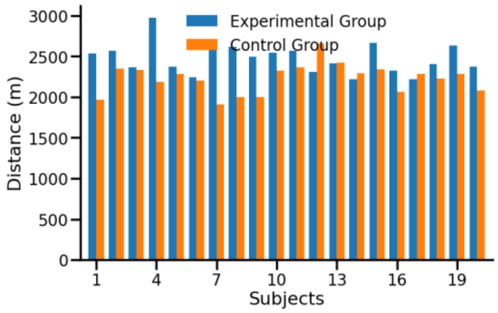

Figure 17. *Results obtained at the final test (COOPER)*

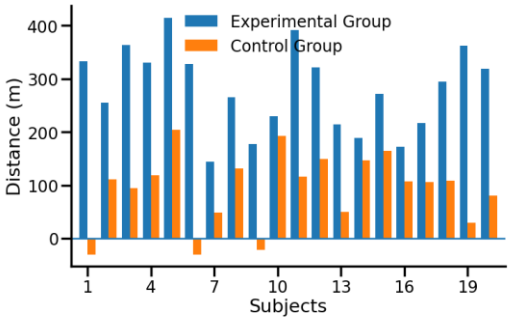

Figure 18. *Differences obtained between the final and initial testing in the COOPER test (both groups)*

Figures 17 and 18 show a larger increase in Cooper-test distance in the experimental group (279.60 meters) than in the control group (94.05 meters), indicating a greater improvement in aerobic endurance.

Discussions

The results indicate a consistent pattern of greater improvement after the indoor cycling intervention, particularly for balance, reaction speed, eye-hand coordination, spatial orientation, agility, cycling endurance, cadence, abdominal endurance, and aerobic performance. This pattern is compatible with the physiological demands of variable-intensity indoor cycling described by Kang et al. (2005) and with training adaptations reported after repeated indoor cycling programs (Bianco et al., 2010). Related work has also reported favorable cardiovascular and exercise-capacity responses to structured spinning (Scheuleac & Vizitiu, 2023; Scheuleac, 2025; Scheuleac & Vizitiu Lakhdari, 2025).

The psychomotor findings are also consistent with evidence that structured physical-education interventions can improve motor and cognitive-motor outcomes (Invernizzi et al., 2022). The increase in eye-hand coordination is methodologically coherent with the Alternate-Hand Wall-Toss Test, which has been examined as a coordination measure in children (Cho et al., 2020). More recently, heart-rate-guided indoor cycling in adolescents has been associated with improvements in balance, coordination, agility, and autonomic recovery (Vicoveanu, Scheuleac, & Vizitiu Lakhdari, 2026). Direct numerical comparison should nevertheless be made cautiously because the protocols, samples, and outcome measures differ across studies.

At the educational level, these findings support the broader rationale for providing varied opportunities for physical activity in schools. Research has linked school-based physical activity and physical fitness with academic or learning-related outcomes (Ciotto & Fede, 2014; El Oirdi et al., 2023; Singh et al., 2012; Van Dusen et al., 2011), although these studies do not establish a spinning-specific academic effect. The present study is limited by its modest sample size, single-site implementation, 12-week duration, and primarily descriptive statistical approach. Future research should use larger samples, randomized allocation where feasible, validated electronic monitoring, and inferential analyses of between-group change.

4. Conclusions

A 12-week indoor cycling program performed twice weekly was associated with greater improvements than circuit-based training across all assessed outcomes in this cohort of eleventh-grade students. The largest differences in mean change favored the experimental group for reaction time, eye-hand coordination, spatial orientation, applied-route performance, pedaling endurance, cadence, abdominal muscular endurance, and Cooper-test distance. Indoor cycling can therefore be considered a complementary option within physical-education programs when appropriate equipment, supervision, and intensity control are available.

Further studies should confirm these findings in larger and more diverse adolescent samples and should include randomization, longer follow-up, and inferential statistical testing. Additional work may also examine how cadence monitoring, visual feedback, posture changes, and resistance adjustments contribute to visuomotor synchronization and other psychomotor adaptations.

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