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ORIGINAL RESEARCH

A randomized controlled study on the effect of 8-week integrative neuromuscular training on physical performance and technical proficiency in prepubertal badminton players

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Abstract

Background: The effects of Integrative Neuromuscular Training (INT) on injury prevention in young populations are well-established, yet its impact on performance enhancement remains uncertain. **Objective:** This study investigates the effects of an 8-week INT program on physical performance and technical proficiency in prepubertal badminton players aged 9 to 11. **Methods:** Forty-four players were randomly assigned to an experimental group (EXP) or a control group (CON). The EXP performed a specific INT program following a general warm-up, with three sessions per week for 8 weeks. The CON continued their regular training regimen. Both groups followed identical training protocols for the remainder of their sessions. Athletes' vertical jump, 10-m sprint, lateral agility, 20-m shuttle run, and backhand and forehand service performances were observed. **Results:** A significant group × time interaction was detected across all tests conducted: vertical jump (F = 26.23, p < .001, η^2 = .38, large effect), 10-m sprint (F = 20.49, p < .001, η_p^2 = .75, large effect), lateral agility (F = 41.34, p < .001, η_p^2 = .49, large effect), 20-m shuttle run (F = 12.52, p < .001, η_p^2 = .23, large effect), forehand long serve (F = 5.18, p = .02, η_p^2 = .11, medium effect), and backhand short serve (F = 6.08, p = .01, η_p^2 = .12, medium effect). Greater improvements were observed in all performance variables in the EXP compared to the CON. **Conclusions:** Compared to routine training, the 8-week INT program conducted three times per week produced large effects on physical performance and medium effects on technical proficiency in prepubertal badminton players. These findings suggest that INT is an effective training strategy during early developmental stages.

Keywords: comprehensive neuromuscular conditioning, performance enhancement, motor skills development, youth sports training, child athletes, neuromuscular adaptations

Introduction

Badminton is a high-intensity sport involving explosive movements such as jumping, rapid accelerations, decelerations, and directional changes (Wong et al., 2019). Keys to effective performance in badminton are strength and explosive power, which are crucial due to the sport's demanding nature (Paterson et al., 2016). Additionally, aerobic conditioning is vital for sustaining repeated high-intensity efforts and reducing fatigue (Lees, 2003). However, physical attributes alone are insufficient; technical skill also plays a critical role (Pardiwala et al., 2020). Without the ability to execute strokes with proper technique, even the most advanced physical capabilities may not be effectively utilized (Le Mansec et al., 2020). Thus, enhancing both physical conditioning and technical skills is essential for maintaining high performance and gaining a competitive edge.

To address the evolving demands of modern badminton, early implementation of specific training programs is essential (Faude et al., 2007). A solid athletic foundation should be established first, followed by the development of advanced physical abilities and technical skills (Günay et al., 2018). Inadequate physical fitness during this developmental phase can lead to improper movement patterns and hinder neuromuscular development, adversely affecting future performance (Sañudo et al., 2019). Consequently, pediatric researchers advocate for early integration of Integrative Neuromuscular Training (INT) to counter these negative effects and build a foundation for high-intensity training (Faigenbaum et al., 2014; Myer et al., 2011).

INT combines fundamental and skill-specific movements with strength and conditioning exercises (Myer et al., 2011). While often used for injury prevention (DiStefano et al., 2017; Emery et al., 2015), its effectiveness on performance remains debated. Some studies have shown that multi-component INT can enhance physical performance in young athletes (Canlı, 2019; Duncan et al., 2018; Faigenbaum et al., 2014; Nunes et al., 2021), while others have questioned its efficacy (Michailidis et al., 2019; Steffen et al., 2008). These discrepancies may be due to differences in training content or sample characteristics. Recent review

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suggests that a comprehensive INT approach, including all sub-components, may be more effective (Sañudo et al., 2019). Thus, incorporating a holistic INT program that addresses various physical, physiological, and technical aspects could significantly improve the performance and skill levels of young badminton players.

This study aims to evaluate the effects of an 8-week INT program on physical performance and technical proficiency in prepubertal badminton players. Building on previous research that indicates positive outcomes for young athletes (Canlı, 2019; Nunes et al., 2021), we hypothesize that a comprehensive INT program, administered three times a week for 8 weeks, will significantly enhance both physical performance and technical skills compared to routine training.

Methods

Research design

In this study, a matched experimental design with pre-test and post-test measurements and a control group was employed. To ensure initial group homogeneity, participants were stratified by age and gender using stratified random sampling. Following pre-test measurements, participants were randomly assigned to either the experimental group (EXP) or the control group (CON) by an independent researcher who was blind to the participants' identities. Prior to participation, athletes and parents were informed about the study's aims, risks, and benefits, and written consent was obtained. The study received ethical approval from the Non-Interventional Clinical Research Ethics Committee of Niğde Ömer Halisdemir University (protocol number 2022/42) on June 30, 2022, and was conducted in compliance with the Helsinki Declaration.

Participants

Forty-four badminton players, aged 9 to 11 years (16 females and 28 males), participated in the study. Table 1 presents the participants' anthropometric and demographic characteristics. Sample size calculations, based on Canlı (2019), determined a requirement of at least 21 participants per group with a power (1–β) of .80, α of .05, and effect size of 0.33, using the G*Power software (Version 3.1.9.7; Faul et al., 2009). Inclusion criteria were no injuries in the past 6 months, no prior organized INT experience, age between 9 and 11, and right-handedness for racket use. Figure 1 displays the CONSORT flow diagram of the participant selection process.

Procedures

The study was conducted in four stages. In the first stage, participants underwent pre-test measurements on four separate days: Day 1 (10-m sprint), Day 3 (vertical jump), Day 5 (service skill and lateral agility), and Day 7 (20-m shuttle run test). Prior to each test, participants completed a 15-min warm-up, including 5 min of submaximal running, high knee pulls, heel-to-hip strikes, forward-backward-lateral running, lunge steps, multidirectional jumps, general jumps, and 5 min of dynamic stretching. Prior to the badminton skill test, a specific 5-min warm-up was performed. A 1-min rest was provided between trials, and 3–5 min of active rest involving low-intensity activities was allowed between test protocols conducted on the same day (Makhlouf et al., 2018).

In the second stage, the EXP underwent three sessions of adaptation training following the pre-test measurements. This training aimed to familiarize participants with the exercises without increasing the load, focusing on correct technique, error correction, and proper movement form through verbal and visual feedback.

In the third stage, the EXP implemented the INT program, consisting of 3 sessions per week over an 8-week period, while the CON continued their routine training (static stretching, aerobic drills, and moderate-intensity short bursts). Both groups participated in badminton training sessions focused on technical skills (clear, drop, net drop, net kill, drive, and service) under the guidance of a coach. Each session concluded with approximately 5 min of cooling-down exercises targeting major muscle groups. Training sessions lasted about 75 min for both groups.

In the final stage, post-test measurements were conducted starting from the third day after the last training session to minimize fatigue effects. Post-test measurements were performed by the same researchers under similar conditions and procedures as the pre-tests. Participants refrained from any training or strenuous physical activity on rest days during the week of the measurements.

Measurements

Vertical jump

The Smartjump device (Fusion Sport, Brisbane, Australia) was used to measure the explosive power of lower limbs. In the test, participants began from an upright position with their hands on their waist, then quickly squatted and jumped as high as possible to isolate the lower body and prevent arm swing. The highest value from three attempts, with a 1-min rest interval between trials, was recorded in centimeters (Hara et al., 2008).

10-m sprint

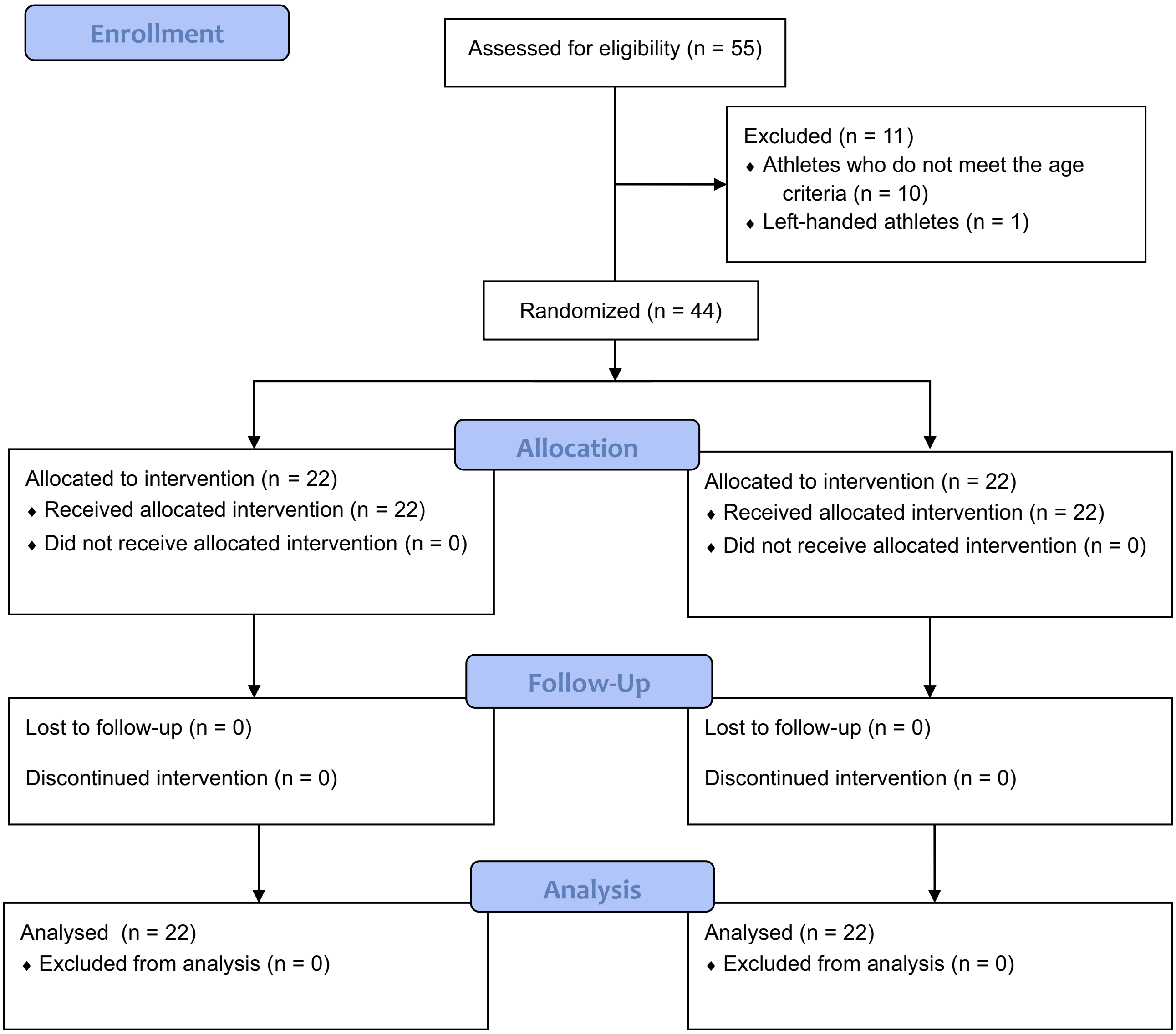
The 10-m sprint performance was measured using Smartspeed (Fusion Sport, Brisbane, Australia) photocell timing gates. Two photocell gates, positioned at the height of 1 m, were set at the 0 and 10 m marks. To ensure maximum speed, a cone was placed 5 m beyond the 10 m finish line, and athletes were instructed to run past it. Participants started 50 cm behind the line, with one foot ahead of the other, and sprinted the distance at full speed. The best time out of three attempts, with a 1-min rest between trials, was recorded in seconds (Makhlouf et al., 2018).

Table 1 Participants' demographic and anthropometric characteristics (mean ± standard deviation)

Variable	EXP (n = 22)	CON (n = 22)	t(42)	p
Age (years)	9.73 ± 0.70	9.73 ± 0.70	0.00	> .99
Body height (cm)	133.59 ± 4.40	133.68 ± 4.55	–0.06	.94
Body weight (kg)	30.74 ± 4.82	31.10 ± 3.70	–0.28	.78

Note. EXP = experimental group; CON = control group.

Figure 1 CONSORT flow diagram



Badminton-specific lateral agility

Athletes' agility was assessed using a badminton-specific lateral agility test involving side-to-side movements on a badminton singles court, as described by Ooi et al. (2009).

20-m shuttle run

To estimate the maximum oxygen consumption (max VO_2) of the athletes, the 20-m shuttle run test was used. Participants ran between two lines 20 m apart, starting at 8.5 km/h and increasing speed by 0.5 km/h each min. They had to cross the line before the second signal sounded and return to the start. If they missed one signal but caught the next, they continued. However, if they missed two signals consecutively, the test ended for them. Progress was tracked with marks made every 20 m, which were then used to evaluate the results (Liu et al., 1992).

Badminton skill test

The athletes' badminton skills were evaluated through high forehand and short backhand serves. Each participant performed 10 short backhand serves and 10 long forehand serves following the protocol outlined by Edwards et al. (2005). The number of successful serves was used to assess the players' serving abilities. All participants used their right hand as the racket hand, and the tests were conducted in the right service area. Prior to the actual test, athletes completed 10 practice serves. The tests utilized a synthetic badminton shuttlecock Yonex Mavis 350 (Yonex, Tokyo, Japan) and participants used their own rackets. Each successful serve, whether forehand or backhand, was scored as 1 point (Edwards et al., 2005).

INT Program

The INT program employed in this study, adapted from previous research (Figure A1), includes plyometric, balance, speed, agility, coordination, strength, fatigue resistance exercises, as well as badminton-specific skill drills (Brown & Ferrigno, 2005; Paterno et al., 2004; Zhao et al., 2021). The INT program was conducted three times per week (Monday, Wednesday, Friday) following a general warm-up, for a duration of 8 weeks. Each INT session lasted an average of 20 min, ranging from 12 to 24 min.

The program consisted of different sub-components for each training day: Monday focused on plyometric exercises and balance, Wednesday on speed, agility, and coordination, and Friday on strength and fatigue resistance. Prior to the INT, athletes completed a 5-min self-perceived low-to-moderate intensity aerobic jog, followed by a 5-min dynamic warm-up, including hip heels, lunge gait and rotation, lateral lunge walking, forward and lateral leg swings, and high knee pulls.

The program followed the principle of progressive overload to enhance effectiveness and prevent overuse injuries, with new exercises introduced to target the same muscle groups and add variety. The scope of the training varied based on exercise type, including repetitions, duration, foot-to-place contacts, or sets. In the 1st and 5th weeks, all exercises were performed in 1 set, increasing to 2–3 sets in subsequent weeks. Rest intervals of 30 to 60 s were provided between sets and exercises, depending on the intensity and complexity of the movements. During INT sessions, an average of 11 athletes was supervised by a coach who continuously monitored movement quality. If an incorrect technique was observed, the exercise was paused, the load reduced, and the movement repeated until performed correctly. After mastering the correct technique, the load was increased, and exercises resumed. Participants were instructed to avoid activities that could affect the study outcomes on non-training days. Coaches received hand cards detailing exercises and the training program.

Statistical analysis

In this study, statistical analysis of the data was conducted using SPSS Statistics (Version 29.0.2.0; IBM, Armonk, NY, USA) software package. The data are presented as mean ± standard deviation. The Shapiro-Wilk test was used to assess whether the data followed a normal distribution, and the results indicated that parametric statistical tests could be applied. At baseline, differences between groups in demographic, anthropometric, and performance variables were examined using independent samples *t*-tests. All measured parameters were compared across two time points (pre × post) and between two groups (EXP × CON) using a two-way analysis of variance. When a significant group × time interaction was detected, Bonferroni-adjusted pairwise comparisons were conducted to examine time-dependent changes within each group. Partial eta squared (η_p^2) values were used to assess effect sizes for simple main and interaction effects, interpreted as small (.01), medium (.06), and large (.14), in line with the guidelines suggested by Cohen (1988). Additionally, percentage change (Δ%) between pre-test and post-test was calculated to facilitate comparisons, using the formula:

$$\Delta\% = (\text{post-test} - \text{pre-test})/\text{pre-test} * 100.$$

Statistical significance was set at $p < .05$.

Results

In the current study, no injuries were reported during training or measurements during the study period. Participants completed the study as allocated and participated in at least 20 training sessions.

Baseline measurements showed no significant differences between the EXP and CON groups in demographic and anthropometric parameters ($p > .05$; Table 1). Similarly, no significant differences were found in performance parameters ($p > .05$).

After the INT program, which was implemented three sessions per week for eight weeks, the EXP group showed significant improvements in all parameters ($p < .05$). In contrast, no significant change was observed in lateral agility performance in the CON group ($p > .05$). The change in 10-m sprint performance in the CON group was borderline significant ($p = .05$), while significant improvements were reported in the other parameters ($p < .05$). Additionally, a significant group × time interaction was observed across all tests: vertical jump ($F = 26.23$, $p < .001$, $\eta_p^2 = .38$), 10-m sprint ($F = 20.49$, $p < .001$, $\eta_p^2 = .75$), lateral agility ($F = 41.34$, $p < .001$, $\eta_p^2 = .49$), 20-m shuttle run ($F = 12.52$, $p < .001$, $\eta_p^2 = .23$), forehand long serve ($F = 5.18$, $p = .02$, $\eta_p^2 = .11$), and backhand short serve ($F = 6.08$, $p = .01$, $\eta_p^2 = .12$), see Table 2. The results demonstrated that performance improvements observed across all parameters in the EXP group were greater compared to the CON group.

Discussion

While numerous studies in the literature have explored the effectiveness of INT in preventing injuries among athletes, there is limited research on its impact on physical performance and specific skills. This study aims to investigate the effects of INT on physical performance and badminton skills in 9–11-year-old badminton players. Our findings indicate that an 8-week training program conducted three times a week resulted in positive outcomes for both groups. However, athletes who underwent INT showed greater improvements in performance and skill levels compared to those engaged in routine training during the same period. These results underscore the superior potential of INT for enhancing physical performance and skill development.

Our study's findings reveal that a comprehensive INT program, when implemented with all its subcomponents, leads to a more pronounced improvement in vertical jump performance compared to routine training. The literature presents both supportive and conflicting findings related to our results. For instance, Trajković and Bogataj (2020) observed a greater improvement in vertical jump performance in 10–12-year-old female volleyball players who underwent the INT program compared to those in a routine training group (12% vs. 6.6%). Likewise, INT resulted in a greater enhancement in vertical jump performance in basketball players of the same age category (5.17% vs. 4.66%; Canlı, 2019). Conversely, DiStefano et al. (2010) demonstrated that two different INT programs significantly enhanced vertical jump performance in 9–10-year-old soccer players compared to control groups (5.19% and 5.93% vs. 1.01 %). However, some studies suggest that INT may yield different effects in adolescents and older

Table 2 Physical performance characteristics (mean ± standard deviation) before and after the 8-week training program

Variable	EXP (n = 22)			CON (n = 22)			Analysis of variance			
	Pre-test	Post-test	Relative change (%)	Pre-test	Post-test	Relative change (%)	Effect	F ratio	p	η_p^2
Vertical jump (cm)	21.89 ± 3.29	25.40 ± 2.89***	16.00	21.92 ± 3.06	22.81 ± 2.42*	4.08	T	76.62	< .001	.64
							G	2.26	.14	.05
							G × T	26.23	< .001	.38
10-m sprint (s)	2.19 ± 0.16	2.00 ± 0.12***	–8.69	2.17 ± 0.11	2.15 ± 0.10*	–0.96	T	201.25	< .001	.82
							G	2.79	.10	.06
							G × T	128.35	< .001	.75
Lateral agility (s)	21.46 ± 1.24	20.47 ± 1.04***	– 4.60	21.41 ± 1.04	21.27 ± 1.02	–0.65	T	71.80	< .001	.63
							G	1.34	.25	.03
							G × T	41.34	< .001	.49
20-m shuttle run (ml·kg^{-1}·min^{-1})	28.22 ± 1.83	32.25 ± 2.51***	14.26	28.40 ± 1.45	30.14 ± 2.32***	6.11	T	79.28	< .001	.65
							G	3.27	.07	.07
							G × T	12.52	< .001	.23
Forehand long serve (10 reps)	3.09 ± 2.95	4.81 ± 1.43***	55.66	2.95 ± 1.21	3.77 ± 1.26**	44.61	T	40.65	< .001	.49
							G	3.32	.07	.07
							G × T	5.18	.02	.11
Backhand short serve (10 reps)	4.36 ± 1.17	6.13 ± 1.52***	40.63	4.27 ± 1.16	5.22 ± 1.47***	38.57	T	67.62	< .001	.61
							G	1.82	.14	.05
							G × T	6.08	.01	.12

Note. EXP = experimental group; CON = control group; T = time; G = group; reps = repetitions. Asterisks indicate a statistically significant difference between pre-test and post-test (*p < .05, **p < .01, ***p < .001).

athletes (Steffen et al., 2008; Vitale et al., 2018). These discrepancies may be attributed to factors such as variations in age groups, sport disciplines, current performance levels, and specific details of the training content. Our program, which includes high-intensity neuromuscular exercises, is believed to positively impact neuromuscular coordination and muscle strength development. Additionally, the high level of neuroplasticity observed in prepubertal children supports the notion that neuromuscular training enhances neural and muscular adaptations (Myer et al., 2011). Therefore, the pronounced improvements observed in the experimental group are closely associated with these neuromuscular adaptations, indicating that the content and intensity of our training program positively influence this adaptation process.

In badminton, one of the fastest racket sports in the world, players must possess the ability to react quickly, accelerate, decelerate, and change direction abruptly. These skills are crucial for gaining an advantage in both offensive and defensive situations and for creating scoring opportunities (Wong et al., 2019). Our study revealed that athletes in the EXP demonstrated greater improvements in 10-m sprint and badminton-specific lateral agility skills compared to those in the CON. These findings align with similar studies in the literature. For instance, Panagoulis et al. (2020) observed a 15.47% improvement in speed performance among early adolescent soccer players following a season-long integrated neuromuscular strength training program, compared to a 4.26% improvement in those continuing with routine soccer training. Similarly, Wang et al. (2022) reported that children aged 7–8 undergoing INT achieved greater speed performance improvements compared to those engaged in regular tennis training. Similar enhancements were also noted in a study involving 6–7-year-old children (Duncan et al., 2018). Improvements in agility performance have also been reported.

A study of male soccer players in the U12 category found that those undergoing INT showed greater gains in agility compared to those following traditional warm-up routines (Pomares-Noguera et al., 2018). Additionally, a study with children from a basketball academy indicated that those who followed a specific INT program had shorter agility completion times compared to those in a regular training program (Latorre Román et al., 2018). These studies support the improvements observed in both speed and agility performance. However, Xiong et al. (2022) reported no significant difference between the pre-test and post-test in speed and agility performance among elite female table tennis players. The lack of significant differences in Xiong et al.'s study may be attributed to the already high physical fitness levels of the participants. Consistent with previous research, it is emphasized that skills such as rapid acceleration, deceleration, and directional changes are closely related to neuromuscular abilities (Aloui et al., 2021). It is suggested that these skills cannot be adequately developed through isolated interventions like speed or agility training alone; rather, a comprehensive approach that includes strength, power, speed, agility, coordination, and balance is recommended (Wang et al., 2022). The more pronounced improvements in speed and agility performance observed in our study may be attributed to the comprehensive nature of the INT program, which addresses all these subcomponents.

One of the fundamental characteristics of badminton is the interruption of high-intensity explosive movements with short rest intervals. The dynamic nature of the game emphasizes both aerobic and anaerobic endurance requirements (Lees, 2003). Increasing aerobic endurance can assist players in sustaining their performance in the game by repeating high-intensity movements and speeding up their recovery between matches (Harrison et al., 2015). Our data show significant improvements in both groups; however, there are greater improvements in the 20-m shuttle run performance in athletes undergoing INT. These findings suggest that while regular badminton training has positive effects on endurance, the INT program may be more effective in increasing aerobic endurance in pre-adolescent badminton players. The scientific training literature indicates that multi-component INT programs incorporating strength, speed, agility, coordination, plyometric, and fatigue resistance exercises enhance both aerobic and anaerobic endurance (Sultana et al., 2019). One reason for the more pronounced results in our EXP athletes could be attributed to the inclusion of intermittent and short-duration high-intensity exercises in the INT program. Studies on the effects of INT on aerobic endurance have shown that athletes undergoing INT demonstrate greater aerobic improvements compared to those who do not, in sports such as handball (9.4% vs. 3.6%; Hammami et al., 2021) and tennis (4.2% vs. 2.4%; Fernandez-Fernandez et al., 2017). These findings are consistent with our own study. However, Michailidis et al. (2019) showed in a study on young soccer players that INT lasting 15–20 min three times a week did not lead to significant differences in endurance performance. This inconsistency can be attributed to the content of the football training program and the nature of football. Therefore, while aerobic endurance development is considered important in prepubescent badminton players, comprehensive INT programs are thought to be potentially more effective in this development.

The prepubescent period represents a critical window for motor learning and skill acquisition, during which frequent and structured practice substantially accelerates the development of sport-specific technical abilities (Faigenbaum et al., 2011). In the present study, regular and repetitive service training integrated within badminton practice contributed to performance improvements in both groups. However, the EXP demonstrated significantly greater gains, which are believed to be associated with the supplementary effects of the INT program.

Neuromuscular exercises, particularly those involving stretch-shortening cycles such as plyometrics, have been shown to enhance neural coordination by increasing motor neuron firing rates and improving intra- and inter-muscular synchronization, thereby facilitating sport-specific skill performance (Cavaco et al., 2014). The high-intensity nature of the INT program implemented in this study is expected to potentiate these neural adaptations, potentially leading to enhanced skill execution. Additionally, Deng et al. (2022) emphasized the significance of physical fitness components in technical strokes, suggesting that improvements in physical fitness following INT may further augment service performance in badminton players.

Although there is limited research directly investigating the influence of INT on skill performance in racquet sports, existing evidence suggests that enhancing underlying physical capacities through integrative training can indirectly facilitate technical development (Lloyd et al., 2016; Myer et al., 2011). Accordingly, the superior performance outcomes observed in the EXP may be attributed not only to regular skill practice but also to neuromuscular adaptations induced by the INT program, supporting its potential to contribute to technical proficiency in young athletes. Supporting this notion, Barber-Westin et al. (2010) reported significant improvements in forehand and backhand scores in tennis players following combined neuromuscular training interventions. Furthermore, while not directly related to racquet sports, Cavaco et al. (2014) demonstrated that adolescent soccer players exhibited significant improvements in shooting efficiency after two different neuromuscular training protocols, with increases of 60% and 266% in scoring performance, respectively. These findings collectively support the premise that INT programs may play a significant role in the development of sport-specific skills.

Conclusions

The results of this study demonstrate that a comprehensive INT program, when combined with skill drills, offers significant advantages for prepubescent badminton players over routine training alone. The INT program effectively enhances power, speed, agility, endurance, and skill performance, highlighting the importance of implementing effective training methods for young athletes.

In conclusion, the findings suggest that INT should be integrated into training programs for prepubescent badminton players. A well-rounded INT approach is shown to be an effective means of improving both fundamental physical abilities and specific skills. Coaches and athletes should consider these results when designing training programs to optimize performance and support long-term athlete development.

Conflict of interest

The authors report no conflict of interest.

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Appendix

Figure A1 Integrative neuromuscular training

Day	Type	Exercises	Week 1	Weeks 2–3	Week 4	Week 5	Weeks 6–7	Week 8
Monday	Plyometric	Ankle hops	1x15 reps	2x15 reps	3x15 reps			
		Double leg line hops (forward and backward)	1x12 reps	2x12 reps	3x12 reps			
		Double leg side hops	1x12 reps	2x12 reps	3x12 reps	–	–	–
		Jump 180° turn on the line	1x10 reps	2x10 reps	3x10 reps			
		Double leg zigzag hops	1x10 reps	2x10 reps	3x10 reps			
		Double leg vertical jump				1x6 reps	2x6 reps	3x6 reps
		Double leg forward and backward cone hops				1x10 reps	2x10 reps	3x10 reps
		Double leg lateral cone hops	–	–	–	1x10 reps	2x10 reps	3x10 reps
		Single leg forward–backward cone hops (each leg)				1x10 reps	2x10 reps	3x8 reps
		Single leg lateral cone hops (each leg)				1x10 reps	2x10 reps	3x8 reps
	Balance	Single leg balance on hard ground (each leg)	1x10 s	2x10 s	3x10 s			
		Single leg balance on hard ground (eyes closed)	1x8 s	2x8 s	3x8 s			
		Tree pose on hard ground (each leg)	1x10 s	2x10 s	3x10 s			
		Tree pose on hard ground (eyes closed)	1x8 s	2x8 s	3x8 s			
		Double leg stance on balance disc	1x10 s	2x10 s	3x10 s	–	–	–
		Double leg stance on balance disc (eyes closed)	1x8 s	2x8 s	3x8 s			
		Single leg stance on balance disc (each leg)	1x8 s	2x8 s	3x8 s			
		Single leg stance on balance disc (eyes closed)	1x5 s	2x5 s	3x5 s			
		Drive stroke with racquet on balance disc	1x10 s	2x10 s	3x10 s			
		Lateral toe taps on balance disc (each leg)				1x5 reps	2x5 reps	3x5 reps
		Reverse lunge on balance disc (each leg)				1x5 reps	2x5 reps	3x5 reps
		Forehand–backhand strokes with racquet on bosuball				1x10 s	2x10 s	3x10 s
		Single leg stance on bosuball (each leg)				1x5 s	2x5 s	3x5 s
		Bosu ball squat	–	–	–	1x8 reps	2x8 reps	3x8 reps
		Bosu ball bird dog				1x8 reps	2x8 reps	3x8 reps
		Bosu ball crunch				1x8 reps	2x8 reps	3x8 reps
		Bosu ball double leg jumps				1x8 reps	2x8 reps	3x8 reps
		Double leg jumps and land on bosuball				1x8 reps	2x8 reps	3x8 reps
Wednesday	Speed+Agility+Coordination	Straigt line sprint (15 m)	1x1 reps	1x2 reps	1x3 reps			
		Z cone speed drill	1x1 reps	1x2 reps	1x3 reps			
		Agility ladder (drill–1)	1x1 reps	1x2 reps	1x3 reps	–	–	–
		Agility square drill	1x1 reps	1x2 reps	1x3 reps			
		Agility ladder (drill–2)	1x1 reps	1x2 reps	1x3 reps			
		Agility ladder (drill–3)	1x1 reps	1x2 reps	1x3 reps			
		X cone speed drill				1x1 reps	1x2 reps	3x1 reps
		Agility ladder (drill–4)				1x1 reps	1x2 reps	3x1 reps
		Y speed cone drill	–	–	–	1x1 reps	1x2 reps	3x1 reps
		Agility ladder (drill–5)				1x1 reps	1x2 reps	3x1 reps
		8 cone speed drill				1x1 reps	1x2 reps	3x1 reps
		Agility ladder (drill–6)				1x1 reps	1x2 reps	3x1 reps
Friday	Strength+Endurance	Knee push–ups						
		Air squats						
		Crunch						
		Jumping Jacks	1 set	2 sets	2 sets	–	–	–
		Push up plank	15–30 s	15–30 s	15–30 s			
		Bird dogs						
		Reverse lunge						
		Mummy kicks						
		Push–ups						
		Crunch						
		Plank jack						
		Jumping Jacks	–	–	–	1 set	2 sets	2 sets
		Jump squat				15–30 s	15–30 s	15–30 s
		Dolphin plank						
		Forward lunge						
		High knees						

Note. reps = repetitions.