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The Effect of Integrative Training Program on Youth Soccer Players' Power Indexes

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Abstract: Integrative neuromuscular training (INT) is commonly employed for preventing injuries, yet there is a scarcity of studies examining its impact on the physical capabilities of young athletes. This study sought to explore the influence of a brief, in-season INT intervention on the performance of adolescent soccer players. The participants included thirty-one U15 (under 15 years old) soccer players who were randomly assigned to either the control group (CG) (engaged solely in soccer training, n = 14, 14.6 ± 0.6 years) or the exercise group (EG) (where INT was incorporated into traditional soccer training, n = 17, 14.1 ± 0.6 years). Early or late maturers were excluded from the study. The INT program lasted for 5 weeks (two sessions per week) and mainly included single-leg exercises. At the commencement and conclusion of the intervention program, measurements were taken for acceleration (10 m), speed (30 m), jumping ability (squat jump, SJ, and countermovement jump, CMJ), and change of direction ability (COD) (Illinois agility test). The data analysis employed a two-way repeated-measures ANOVA. The INT program resulted in enhanced performance for the EG in SJ (28.4–32.3, $p < 0.001$, $\eta^2 = 0.463$), CMJ (30.6–35.3, $p < 0.001$, $\eta^2 = 0.426$), and COD ability (18.11–17.64, $p = 0.003$, $\eta^2 = 0.545$). No changes in performance were observed in the CG. The results suggest that the addition of a short-duration in-season INT program in U15 soccer players can induce positive adaptations in their performance.

Keywords: functional training; adolescence; physical performance; single-leg strength exercises

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1. Introduction

Soccer is characterized as an interval sport, involving a mix of low-, medium-, and high-intensity activities that alternate throughout the game [1]. The performance of individual players and the overall team performance is significantly influenced by high-intensity actions such as sprints, jumps, and changes of direction [2]. The intermittent nature of the sport also occurs in youth soccer [3]. Previous research has reported that U12–U14 children perform 2–18 sprints every 120 s with an average duration of 2 s [4]. In another study it is reported that U17 soccer players run at a maximum speed (sprint) of 152 ± 72 m [5]. Therefore, it is clear that the anaerobic mechanism of young soccer players is particularly important for their performance, and the foundations for its improvement should begin from adolescence. Anaerobic training plays a pivotal role in enhancing the performance of soccer players, contributing significantly to the demanding nature of the sport [6,7]. As mentioned above, soccer involves a combination of aerobic and anaerobic activities, with players frequently engaging in short bursts of high-intensity sprints, accelerations, decelerations, and changes in direction during a match [6]. Anaerobic training focuses on improving the body's ability to produce energy in the absence of oxygen, crucial for executing explosive movements and maintaining peak performance during intense intervals. A previous study [8] underscores the importance of incorporating anaerobic training in soccer conditioning programs to enhance power, speed, and agility. Training modalities like high-intensity interval training (HIIT), plyometrics, sprint drills, balance, and strength training have been shown to positively impact soccer-specific performance parameters [9–17]. Also, training with small-sided games has positive effects on the physical condition of football players [18].

Coaches at developmental ages devote a lot of time to improving the technical and tactical characteristics of their players, resulting in limited time for training the above necessary physical abilities. The development of integrative neuromuscular training (INT), representing a comprehensive approach to physical performance, prioritizes the improvement of coordination and the functionality of both the nervous system and muscles. This can save time for coaches. This training methodology combines various elements such as strength training, flexibility exercises, balance drills, and proprioceptive activities to improve overall movement patterns and functional capabilities [19,20]. From the above, it is understood that this type of training can save time for trainers as it aims to improve multiple physical abilities simultaneously [21]. Also, another advantage of these programs is that they can be carried out on the soccer field with low-cost equipment. By integrating these diverse components, INT aims to enhance neuromuscular efficiency, reduce the risk of injuries, and optimize athletic performance. Research studies, such as those by Myer et al. [19,20], have demonstrated the effectiveness of integrative neuromuscular training in preventing injuries, particularly in the context of sports-related movements. As a result, integrative neuromuscular training has gained prominence in the fields of sports medicine, physical therapy, and physical training, offering a well-rounded approach to optimizing human movement and performance.

The literature review suggests a scarcity of studies examining the impact of programs like integrative neuromuscular training (INT) on the performance of young soccer players [21,22]. More specifically, Panagoulis et al. [21] conducted an INT program during the season for young U12 soccer players. The program lasted 8 weeks with three workouts per week, and the results showed that speed, strength, and jumping ability improved. In another study, Menezes et al. [23] after applying an INT program to young U9 soccer players for 8 weeks observed an improvement in CMJ performance and change of direction. In contrast, Karydopoulos et al. [22] observed no improvement in the physical performance indicators they assessed. This study was conducted on young U19 soccer players and lasted 8 weeks with two training sessions per week. What sets the current study apart from previous ones is the predominant inclusion of single-leg exercises in the intervention program. Single-leg strength exercises play a pivotal role in enhancing overall lower body strength, stability, and functional performance. These exercises, such as lunges, single-leg squats, and deadlifts, require individuals to engage and stabilize muscles independently on each leg, addressing muscle imbalances and promoting better joint stability. By isolating one leg at a time, these exercises also activate the core muscles, contributing to improved balance and proprioception. Integrating these exercises into a workout routine not only targets specific muscle groups but also translates into functional movements, making sports more manageable and reducing the risk of injury. From the above it becomes clear that the studies that investigated such programs are limited, and their results are conflicting. Thus, the aim of this study was to investigate the effect of a short INT program on developmental age soccer players during the season. We hypothesized that EX will improve its performance in all physical performance tests that will be applied in the study by differing significantly from CG.

2. Materials and Methods

2.1. Participants

Prior to commencing the study, a power analysis was conducted, drawing on previous studies involving athletes in the developmental age range with a comparable research design [17]. An effect size of >0.55 was used, and a probability error of 0.05 and a power of 0.95 for the two groups and time points (pre and post) indicated that 14 subjects was the smallest acceptable number of participants to analyze the interaction between groups and time points of measurements. Initially, thirty-seven players from two local soccer academies wanted to participate. However, only thirty-two of them met the criteria for participation and participated in the study. The criteria for participation were (1) lack of musculoskeletal injury in the last semester, (2) participation in at least 95% of trainings, (3) not participating in external exercise programs other than team and school, (4) not taking any medication, and (5) not being late or early maturers. Participants and their parents received information regarding the potential risks and benefits associated with the study, and parental consent was obtained. The study received approval from the local Institutional Review Board (approval number 168/2023) in accordance with the principles outlined in the Helsinki Declaration. The characteristics of the participants are presented in Table 1.

Table 1. Participants' physical characteristics.

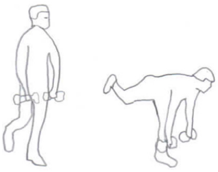
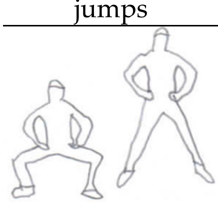
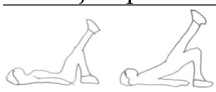
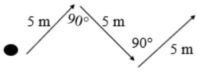
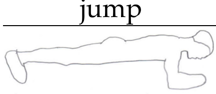
.	CG (n = 14)		EG (n = 17)	
	Pre-Training	**Post-Training**	**Pre-Training**	**Post-Training**
Age (years)	14.6 ± 0.6	14.7 ± 0.6	14.1 ± 0.6	14.2 ± 0.6
Height (cm)	165 ± 7	166 ± 6	162 ± 6	164 ± 6
Weight (kg)	56.7 ± 10.1	57.2 ± 9.2	59.6 ± 10.8	60.0 ± 11.4
Body fat (%)	14.5 ± 2.2	14.7 ± 2.8	15.6 ± 2.7	15.9 ± 3.3
Body mass index	20.8 ± 2.6	20.8 ± 2.4	22.7 ± 3.2	22.3 ± 3.4
Maturity offset	−0.82 ± 0.25		−0.45 ± 0.32	

2.2. Study Design

The independent variables for this study were soccer training (for CG) and the combination of soccer training with the INT program (for EG). The dependent variables included anthropometric measures and physical performance assessments such as counter movement jump (CMJ), squat jump (SJ), speed (10 m and 30 m), and change of direction (Illinois agility test). The research employed a random, two-group repeated measures experimental design.

The study was conducted during the competitive season, with the initial two weeks dedicated to familiarizing the young players with the physical performance tests utilized. The participants in the EG were also familiar with the exercises of the intervention program. For this purpose, a total of four training units were dedicated (two per week). Then, in the first visit after 2 weeks, the physical performance tests were performed in both groups (experimental group, EG, and control group, CG) and repeated 5 weeks later in the same order of execution. The experimental group applied the intervention program for 5 weeks with a frequency of two training units per week that were 48 h apart. It consisted of eight exercises with the volume gradually increasing each week, with the exception of the fifth week when the same volume was maintained as in the fourth week. The exercises included in the program were single-leg squat, single-leg dead lift, side jumps, single-leg glute bridge, change of direction (COD), triple long jump, abdominals, and plank. The program was performed right after the players' warm-up to guarantee complete neuromuscular activation and had a duration of approximately 20–25 min. In contrast, the control group engaged solely in exercises with small-sided games, maintaining an equivalent overall training session duration between the two groups. The exercises followed a progressive structure, with a focus on proper technique. All training sessions took place on the synthetic grass of a soccer field. Throughout the 5-week training program, participants also took part in five matches. Table 2 provides details on the characteristics of the intervention program.

Table 2. Characteristics of the experimental training protocol.

	Weeks				
Exercises	**First**	**Second**	**Third**	**Fourth**	**Fifth**
 Single-leg squat	Three sets of six reps	Three sets of eight reps	Three sets of 10 reps	Three sets of 12 reps	Three sets of 12 reps
 Single-leg dead lifts with two dumbbells, 2.5 kg	Three sets of six reps	Three sets of eight reps	Three sets of 10 reps	Three sets of 12 reps	Three sets of 12 reps
 Single-leg side jumps	Three sets of 15 reps (15 cm hurdle high)	Three sets of 20 reps (15 cm hurdle high)	Three sets of 20 reps (15 cm hurdle high)	Three sets of 25 reps (15 cm hurdle high)	Three sets of 25 reps (15 cm hurdle high)
 Sumo squat and jump	Three sets of four reps	Three sets of six reps	Three sets of eight reps	Three sets of 10 reps	Three sets of 10 reps
 Single-leg glute bridge	Three sets of 10 reps	Three sets of 15 reps	Three sets of 20 reps	Three sets of 25 reps	Three sets of 25 reps
 Change of direction	Three sets of two reps (15 m)	Three sets of three reps (15 m)	Three sets of four reps (15 m)	Three sets of four reps (15 m)	Three sets of four reps (15 m)
 Single-leg triple jump	Three sets of three reps	Jump three sets of four reps	Jump three sets of five reps	Jump three sets of six reps	Jump three sets of six reps
 Plank	Three sets of 15 s	Three sets of 20 s	Three sets of 25 s	Three sets of 30 s	Three sets of 30 s

2.3. Anthropometric Measurements

Body mass was measured with a precision of 0.1 kg (Seca 220e, Hamburg, Germany) while participants were attired in only underwear and without footwear. Height was measured with a precision of 0.1 cm (Seca 220e, Hamburg, Germany). The percentage of body fat was determined through the measurement of four skin folds (biceps, triceps, suprailiac, and subscapular). Each skin fold was measured twice, and the average of these measurements was used for the calculation. Siri's equation [24] was employed to calculate body fat. The measurements were conducted on the right side of the participants using the Lafayette skinfold caliper (Sagamore, Lafayette, Ins. Co., Lafayette, Indiana), and the intra-class correlation coefficient for the measurement was 0.91.

2.4. Assessment Biological Maturity

Biological maturation was estimated using the equation proposed by Moore et al. [25] (Equation (1)). The estimation was performed according to the estimated chronological age at the maximum increase in height. When the occurrence of the maximum height increase was estimated to occur (a) at less than 13 years of age, the children were classified as early biologically matured; (b) when it was estimated to occur at the age of 13 to 15 years, the children were classified as children with normal biological maturation; and (c) when it was estimated to occur at the age of more than 15 years, the children were characterized as children with delayed biological maturation [26].

$$\text{Maturity offset} = -7.999994 + (0.0036124 \times (\text{age} \times \text{height})) \quad \text{Height in centimeters} \tag{1}$$

2.5. Jumping Ability

Two types of jumps were employed to evaluate jumping ability: the SJ and CMJ. For each jump, participants executed two attempts, and the best performance was utilized for statistical analysis. Participants initiated both jumps from a standing position with hands on their waist. In the CMJ, participants began with a swift downward movement by flexing the knees and hips, immediately followed by a rapid leg extension resulting in a maximal vertical jump. In the SJ, participants initiated the jump from a sitting position (knees at 90°), aiming to jump as high as possible without any prior pretension or downward body movement.

The recovery time between attempts was 30 s and 3 min between different jump formats. Chronojump equipment (Chronojump, Boscosystem, Barcelona, Spain) that estimates the jump height from the flight time was used for the evaluation. As previously indicated, participants were acquainted with the jumping technique two weeks before the study commenced. The squat jump (SJ) and countermovement jump (CMJ) exhibited a test–retest coefficient of variation (CV) of 3.4% (ICC = 0.91; 95% CI: 0.73–0.95) and 3.2% (ICC = 0.89; 95% CI: 0.67–0.96), respectively.

2.6. Speed

To evaluate acceleration and speed, the 10 m and 30 m tests, respectively, were used. The participants made two attempts, and the shortest time was used in the statistical analysis. For the measurement of time, three photocell gates were used (Microgate, Bolzano, Italy), which were placed at the start, at 10 m, and at 30 m. Participants started their attempt 0.3 m behind the first gate. Also, the photocells were placed at a height of 0.6 m from the ground to avoid incorrect recordings from hand movement. Between attempts a five-minute recovery time was given to the participants. As mentioned above, the test was performed on synthetic grass of a soccer field with participants wearing soccer shoes. The CV for test–retest trials was 3.8% (ICC = 0.90; 95% CI: 0.81–0.93).

2.7. Agility

The Illinois agility test was employed to evaluate the capacity for changing direction. Following the methodology outlined in a previous study [27], the test measured agility from an upright starting position. Soccer players sprinted from point A to B and then to C. Subsequently, they navigated through a slalom course to reach D and retraced the same path back to C. From there, they sprinted to E and then to F, covering a distance of 60 m.

Photocell gates (Microgate, Bolzano, Italy) were positioned at the start (A) and finish (F) lines to record time. Each participant underwent two attempts, and the shortest time was used for statistical analysis. The CV for test–retest trials was 4.5% (ICC = 0.88; 95% CI: 0.62–0.94). The test configuration is illustrated in Figure 1.

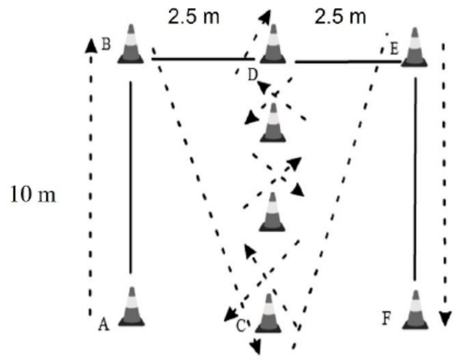


Figure 1. Illinois agility test.

2.8. Statistical Analysis

The data are presented as mean ± standard deviation (SD), and confidence intervals (CIs) (95%) were calculated. To assess the normal distribution of our data, the one-sample Kolmogorov–Smirnov test was employed, indicating that parametric statistical tests could be used. The statistical analysis utilized a two-way (group by time) repeated measures ANOVA. Additionally, partial eta squared values were reported, categorized as small (0.01–0.059), moderate (0.06–0.137), and large (>0.138) [28]. Coefficients of variation (CVs) were employed to evaluate the reliability of the test (CV = (standard deviation/sample mean) × 100). The significance level was set at $p < 0.05$. All analyses were conducted using SPSS version 25.0 (SPSS Inc., Chicago, IL, USA).

3. Results

The results showed that the two groups did not differ on any of the initial measurements. Training also did not affect body mass and body mass index in either group (Table 1). The CIs of all measurements are presented in Table 3.

Table 3. Confidence intervals of physical performance measurements.

	Confidence Interval			
Variable	**EG Pre**	**EG Post**	**CG Pre**	**CG Post**
30 m (s)	4.54–5.92	4.35–5.90	4.50–5.22	4.52–5.35
10 m (s)	1.80–2.35	1.78–2.36	1.94–2.14	1.87–2.24
SJ (cm)	16.0–36.0	18.6–39.5	21.2–36.0	20.8–36.6
CMJ (cm)	17.2–45.0	20.4–43.5	21.7–40.0	22.7–41.4
Illinois test (s)	16.8–18.7	16.3–18.4	17.1–18.5	16.8–18.6

EG, exercise group; CG, control group; SJ, squat jump; CMJ, countermovement jump.

The results for SJ showed that there was a main effect of the repeating factor ($F = 9.086$, $p = 0.006$, $\eta^2 = 0.252$) and interaction ($F = 13.649$, $p < 0.001$, $\eta^2 = 0.336$). More specifically, the EG group improved its performance between the two measurements ($F = 23.308$, $p < 0.001$, $\eta^2 = 0.463$), while the CG performance remained unchanged ($F = 1.224$, $p = 0.640$, $\eta^2 = 0.008$). Also, the two groups differed significantly at the second measurement ($F = 6.345$, $p = 0.038$, $\eta^2 = 0.218$) (Figure 2A).

The results were similar for CMJ where there was a main effect of the repeating factor ($F = 10.659$, $p = 0.003$, $\eta^2 = 0.299$) and interaction ($F = 8.606$, $p = 0.007$, $\eta^2 = 0.256$). The EG group improved its performance between the two measurements (F = 18.524, $p < 0.001$, $\eta^2 = 0.426$), while the CG performance remained unchanged (F = 1.107, $p = 0.813$, $\eta^2 = 0.002$). Also, the two groups differed significantly at the second measurement (F = 4.450, $p = 0.042$, $\eta^2 = 0.198$) (Figure 2B).

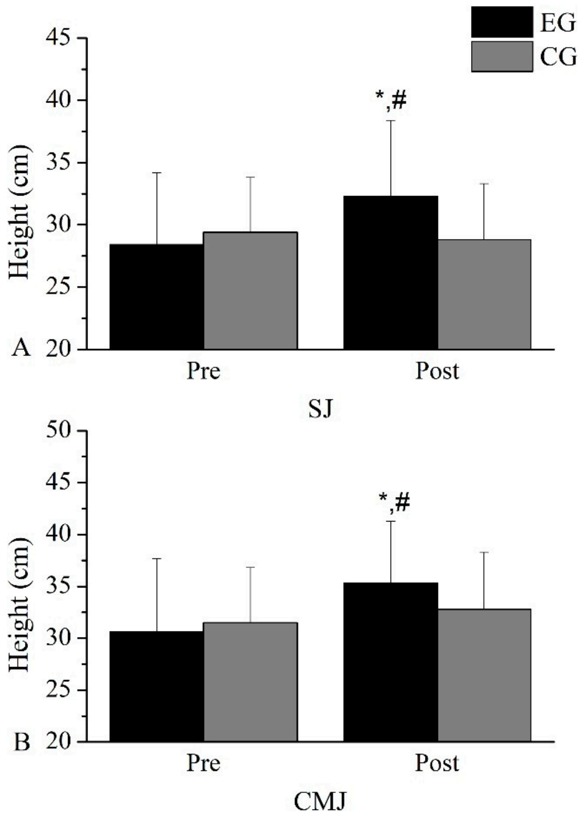


Figure 2. Performance changes in (**A**) SJ and (**B**) CMJ. * denotes a significant difference with Pre ($p < 0.05$). # denotes a significant difference between groups ($p < 0.05$). EG, exercise group; CG, control group; SJ, squat jump; CMJ, countermovement jump.

Regarding the performance in the 10 m, no changes were observed (main effect of repeated factor: F = 0.577, $p = 0.457$, $\eta^2 = 0.031$ and interaction: F = 5.403, $p = 0.132$, $\eta^2 = 0.331$). More specifically, no group showed any changes in its performance (EG: F = 2.448, $p = 0.135$, $\eta^2 = 0.120$ and CG: F = 3.171, $p = 0.092$, $\eta^2 = 0.150$), and no differences were observed between the groups in the post measurement (F = 0.231, $p = 0.637$, $\eta^2 = 0.013$) (Figure 3A).

Similar were the results for the performance in the 30 m where no changes were observed (main effect of repeated factor: F = 0.530, $p = 0.480$, $\eta^2 = 0.042$ and interaction: F = 1.945, $p = 0.188$, $\eta^2 = 0.139$). More specifically, no group showed any changes in its performance (EG: F = 0.311, $p = 0.557$, $\eta^2 = 0.025$ and CG: F = 1.753, $p = 0.210$, $\eta^2 = 0.127$), and no differences were observed between the groups in the post measurement (F = 0.044, $p = 0.838$, $\eta^2 = 0.004$) (Figure 3B).

From the results of the statistical analysis for the Illinois agility test, it was evident that there was a significant main effect of the repeated factor (F = 25.770, $p < 0.001$, $\eta^2 = 0.682$). Performance improvement was observed in the EG group between the two measurements (EG: F = 14.346, $p = 0.003$, $\eta^2 = 0.545$). In the CG group, no changes in their performance were observed (CG: F = 1.502, $p = 0.085$, $\eta^2 = 0.112$). Additionally, there were no significant differences between the two groups (F = 1.633, $p = 0.226$, $\eta^2 = 0.120$) (Figure 3C).

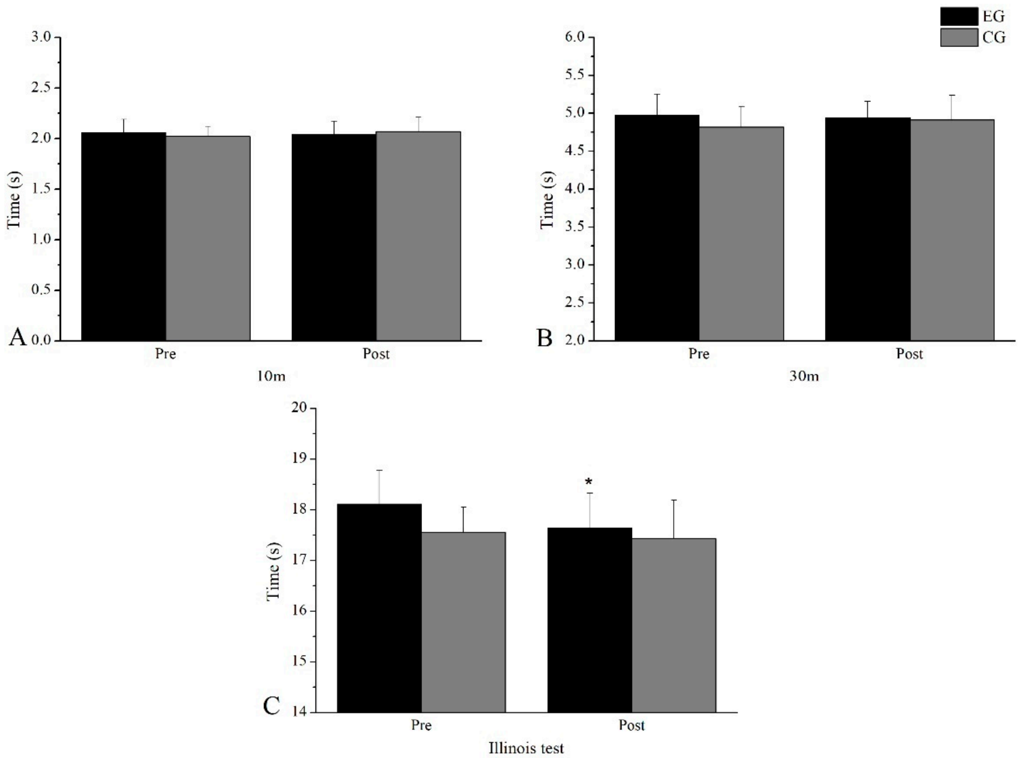


Figure 3. Performance changes in (**A**) 10 m, (**B**) 30 m, and (**C**) Illinois agility test. * denotes a significant difference with Pre ($p < 0.05$). EG, exercise group; CG, control group.

4. Discussion

The purpose of this study was to investigate the effects on anaerobic performance indicators of a brief INT training program in young soccer players (U15). The results showed that the intervention program improved performance in jumps and agility tests but not in speed and acceleration tests. So, the addition of a short-duration in-season INT program in U15 soccer players can induce positive adaptations in their performance.

As previously mentioned, the intervention program improved the players' performance by 13.7% in the SJ and by 15.4% in the CMJ. These results align with earlier research. In particular, Panagoulis et al. [21] implemented an 8-week intervention program, involving three training sessions per week for U12 young soccer players and noted noteworthy enhancements in SJ by approximately 9.8% and in CMJ by ~6.2%. Additionally, Nunes et al. [29] found that a neuromuscular training program applied twice a week for six months to U13 youth athletes improved jump performance. In a recent study, Menezes et al. [23] applied an intervention program twice a week for 12 weeks to U9 soccer players, observing improvement in CMJ at 6 and 12 weeks compared with the initial measurement.

It is known that the stretch–shortening cycle affects jump performance [14,21], and the improvement observed in SJ and CMJ in this study may be attributed to the impact of the INT program on the efficiency of the stretch–shortening cycle of the participants [21]. Previous studies have also reported that SJ performance depends on concentric contraction [30], the myotatic reflex, and the ability of muscle fibers to store elastic energy during the stretch–shortening cycle [31]. Furthermore, improvement in intermuscular and intramuscular coordination and tendon stiffness are factors that can influence jump performance [32,33].

However, there are studies that did not observe changes in jump performance after an 8-week neuromuscular training program. Specifically, the study by Karydopoulos et al. [22] conducted in elite youth soccer players (U19) attributed the lack of adaptations to the low training volume and the high level of the athletes. As mentioned above, the level of participants and the different characteristics of the intervention programs (training volume and intensity, duration, density, and type of exercises) lead to different results and make comparisons of studies more difficult.

In the present study, no significant changes were observed in the acceleration and speed of the soccer players in both groups. The findings of this study are consistent with those of previous research. Specifically, Kobal et al. [34] investigated the impact of a combined strength and plyometric program. The program was applied for 8 weeks to U19 soccer players, and they observed that their performance in the 10 m and 20 m sprints did not improve. Additionally, Karydopoulos et al. [22] did not observe any changes in the performance of players in the 10 m and 30 m sprints. Furthermore, Menezes et al. [23] did not observe changes in sprint performance. In contrast, several studies report improvements in performance [14,21,35]. Michailidis et al. [36] applied a strength/plyometric intervention program, and the results showed improvement in sprint performance in adolescent soccer players. Additionally, Sanders et al. [35], in their study, implemented a strength program to improve power over two years in developmental age soccer players (U15, U17, and U19) and observed improvement in sprint performance. The lack of adjustments in acceleration and speed observed in this study is believed to be due to some factors associated with the intervention program. More specifically, the duration of the program was short, as was the total number of workouts (n = 10). Also, the intensity of the program was low to induce adjustments that would affect speed (e.g., maximum power and rate of force development).

Change of direction is a particularly crucial skill for soccer players [37]. During a match, they perform numerous accelerations, decelerations, and changes of direction [8,38]. In the present study, a significant improvement in Illinois agility test completion time was observed for the EG group (EG: 2.6%) but not for the CG group (CG: 0.7%). Similar findings are reported in other studies. Specifically, Panagoulis et al. [21] observed improvement in the ability to change direction in the arrowhead test following their intervention. Additionally, Hammami et al. (2023) [39] reported improved change of direction ability with a ball in the intervention group. Also, Menezes et al. [23] observed a significant improvement in performance in the EG group after 12 weeks of intervention. However, there are studies where performance did not change after the application of integrative neuromuscular programs. Specifically, Karydopoulos et al. [22] did not observe changes in both the arrowhead test and the Illinois agility test. Change of direction, as mentioned in previous studies, is influenced by the stretch–shortening cycle mechanism. The rapid transition from eccentric contraction to concentric contraction is a fundamental characteristic of the stretch–shortening cycle mechanism. It has been reported that integrative neuromuscular training programs can positively impact the efficiency of this mechanism [21]. Therefore, the improvement in performance in change of direction may be attributed to the positive influence of the intervention program on the stretch–shortening cycle mechanism [40]. Another factor that can influence rapid change of direction is the eccentric strength of muscles. High eccentric strength aids in quick deceleration, proving particularly significant for rapid change of direction [39,41].

From the above, we observe that the number of studies examining the impact of integrative neuromuscular training (INT) programs on physical performance indicators in young soccer players is limited. Additionally, research findings are diverse. The lack of agreement can be attributed to various factors, such as the participants' level, different exercises, varied program volumes, and differences in program intensity, as well as other characteristics of the load, which vary between applied programs. It is important to note that the higher the participants' level, the more challenging it is to observe significant changes in the studied physical performance indicators. Another crucial factor that can influence results is the age of the participants. For this reason, their biological maturity was estimated using the equation of Moore et al. [25], and children in early or delayed biological maturity were excluded. This was done to attempt to limit the effects of biological maturity on the performance of young soccer players as we know that children of the same chronological age at this stage of development may differ in biological maturity, significantly affecting their performances [42].

Single-leg strength exercises must be essential components of a well-rounded fitness routine, targeting stability, balance, and muscle strength. These exercises, such as single-leg squats, jumps, and deadlifts, challenge the body to support itself on one leg, activating various muscle groups including the quadriceps, hamstrings, glutes, and stabilizing muscles. Incorporating single-leg exercises into the workout routine not only helps improve overall strength but also enhances functional performance by mimicking real movements that often require one leg to bear the load. Moreover, these exercises contribute to injury prevention by addressing muscular imbalances and promoting joint stability. In this study, most of the exercises were chosen to be unilateral (six out of eight). Unilateral exercises were used also in recent related studies [21,23,39].

The study has some limitations. The sample size is limited, preventing us from generalizing our results. The observed performance changes were not accompanied by neuromuscular and morphological measurements that would aid in understanding the mechanisms causing these changes. Therefore, imaging methods (electromyography and ultrasound) would provide additional information. Moreover, the intervention duration in this study was particularly limited; however, positive effects were observed. Programs with different durations could emphasize the minimum duration required for effectiveness.

5. Conclusions

In conclusion, implementing a short-term INT program during the competitive season, twice a week for five weeks, may enhance the performance in jumps and change of direction in young soccer players (U15). The program is easy to incorporate into children's training routines as it is brief (~20–25 min) and includes a variety of exercises targeting leg and core strength, muscular power, and change of direction. Last, the versatility of these programs makes them ideal for training young soccer players, where premature specialization should be avoided.

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