Evaluating the Effects of Consecutive Phases of Plyometric Jump Training on Athletic Performance in Male Soccer Players: The Effect of Training Frequency and Volume Manipulations

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ABSTRACT

Purpose: This 14-week, two-phase study aimed to determine the relative effects of 1-day or 2-days of volume-matched plyometric training on athletic performance (10 m and 40 m sprints, change of direction, vertical jump) in male soccer players (Phase 1). The objective of Phase 2 was to determine the relative effects of higher- and lower-volume plyometric training protocols in maintaining any previously attained increases in athletic performance from Phase 1. **Method**: A randomised parallel-group trial design was utilised. In Phase 1, participants (n=24; mean age: 19.5 ± 1.2 yrs; mean height: 179.7 ± 7.1 cm; mean weight: 69.8 ± 6.9 kg) were randomly allocated to one of two groups to receive either 1-day or 2-days of volume- and intensity-matched plyometric training for a 7-week period. For the second 7-week period (Phase 2), half of each group was randomized into either a lower volume or higher volume plyometric training group. **Results**: In Phase 1, both the 1-day group and 2-day groups attained comparably significant ($p<0.001$) increases in performance in all fitness tests ranging from effect sizes (*d*) of 0.4 (95% CI: 0.11 to 0.70) for 10 m sprint to 1.51 (0.42 to 2.60) for vertical jump. There were no significant differences between the performance increases in the two groups. In Phase 2, neither group increased or decreased performance, maintaining all previously attained increases with only trivial effect sizes observed (-0.02 [-0.58 to 0.53] to 0.11 [-0.38 to 0.61]). **Conclusion**: Increases in 10 and 40 m sprint speed, change of direction speed and vertical jump height can be achieved and maintained with as little one plyometric training session per week. Sessions can include 120 jumps to induce increases of the reported magnitudes with 60 jumps to maintain these increases thereafter, in male soccer players.

Key words: Jump, power, stretch-shortening cycling, periodisation, programming

INTRODUCTION

Soccer is a sport characterized by bouts of intermittent dynamic activity that require players to execute sudden accelerations, decelerations, jumps and changes of direction, as well as technical skills (10). A multitude of training methods have been developed to enhance soccer players' performance of such dynamic movements and these include plyometric jump training, which is one of the most common ways of improving the ability to express muscular power (24,25). Plyometric training leverages an athlete's capacity to utilize the stretch shortening cycle which involves a rapid pre-stretch of a muscle and its connective tissue (eccentric action), followed by a concentric or shortening action of those same tissues (8,14). This process utilizes neural mechanisms, as well as the stored elastic energy within the musculotendinous tissue, to produce more force than what could be generated through an isolated concentric action (5,8).

Several previous studies have shown that plyometric training can enhance dynamic athletic performance by underpinning muscular power, linear speed, and change of direction speed through the enhancement of neuromuscular efficiency of the lower limbs (15,17,26,28). However, despite the documented benefits, there is ongoing debate about the optimal frequency and volume of plyometric training programs that should be executed by athletes in different sports, over the medium to long term. Some studies suggest that programs with three sessions, or more, per week can result in relatively larger improvements in physical performance (34) whereas others have implied that fewer weekly sessions were more advantageous (15,18). Furthermore, other studies have suggested that lower volume programs, with only one or two sessions per week, may be just as, or more, effective as higher volume programs at enhancing physical performance (32,35). With such variation in the effects of different frequency and volume configurations of plyometric training, it can be very difficult for coaches to determine the optimal combination of these parameters to enhance the dynamic performance of soccer players, and athletes in general.

Compounding the above issue, a large proportion of intervention studies on plyometric training have been undertaken over just a single short phase of training (i.e. 8 weeks or less) making it very difficult to evaluate the optimal configuration of plyometrics for the achievement of varying goals over consecutive blocks of activity (15,17,19). Because of this, it is difficult for coaches to determine how best to follow up one block of training with another meaning that the longer-term periodization of such activity is often based on the assumptions of traditional models in the literature (13), rather than an evaluation of empirical evidence. Studies of this type are therefore rare but the findings of any that adopt such a design could have important implications for the development of efficient and effective plyometric training programs for athletes.

On the above, it has been demonstrated previously in several studies that lower volumes of plyometric training can be as advantageous as higher volumes (11,32) and that lower training frequencies can be as effective as higher (4,27). Though relatively little empirical evidence exists to support the concept of lower volume maintenance doses of plyometric training to maintain previously attained increases in fitness, one study (30) did examine how the volume of in-season strength-maintenance training impacted the strength, jump height, and 40-meter sprint performance of professional soccer players. During a 10-week pre-season phase, participants executed a strength training program twice per week (Day 1: 3x10RM and Day 2: 3x6RM). However, during the following 12-week in-season phase, the players underwent a dramatically reduced volume of strength training (Day 1: 3x4RM). The results of the study suggested that the application of a lower-volume dose of maintenance training enabled the players to preserve the previously attained levels of strength, sprinting speed, and jumping performance they had achieved in the preceding 10-week preparatory phase. Patterns of adaptation such as this are well-documented in the literature (37) but few training intervention studies have been conducted to verify their presence and potential for improved athletic performance.

Based on the above evidence, the rationale for this 14-week, two-phase study was twofold. The aim of Phase 1 was to determine the relative effects of 1-day or 2-days of volume-matched plyometric training on athletic performance in male soccer players. The objective of Phase 2 was to determine the relative effects of higher- and lower-volume plyometric training protocols in maintaining any previously attained increases in athletic performance from the first phase of the study. On this basis, we established parallel sets of hypotheses. The first was that there would be significant increases in sprint speed, change of direction (COD) speed and vertical jump height in both the 1-day and 2-day training groups; but that there would be no significant differences observed between these groups. In the second phase of the study, it was hypothesised that the low volume training group would be able to maintain the attained increases in speed and power to the same level as the high volume group but, again, there would be no observed statistical differences between these groups at the end of the phase.

Based on the above, the information that can be provided by a study like this is important for coaches to be aware of given that previous investigations have underlined the similar effect of both higher and lower volumes of plyometric training on physical performance (6) and few, if any, have examined the additive effect of consecutive blocks of varying training configuration on physical performance. Indeed, to our knowledge, no previous study has utilised a design with plyometric training programmed over a two-phase intervention to determine how potential adaptations in the first phase could be affected by any accrued in the second.

MATERIALS AND METHODS

Experimental approach to the problem

The study was conducted according to the latest version of the Declaration of Helsinki and the protocol was approved by the university ethics committee. This study employed a randomised parallel-group trial design that was conducted in two phases. In Phase 1, participants were randomly allocated to one of two groups to receive either 1-day or 2-days of volume-matched plyometric training for a 7-week period. For the second 7-week period (Phase 2), half of each group was randomized into either a lower volume or higher volume plyometric training group. In this second phase, each group undertook just one day of training per week with the higher volume group executing twice the number of jumps across the same number of sets as the lower volume group. The training load of the higher volume group was identical to that of the 1-day group from Phase 1 of the study.

Participants

Figure 1 outlines the recruitment process and information on the interventions received. The study included 24 male soccer players (mean age: 19.5 ± 1.2 yrs; mean height: 179.7 ± 7.1 cm; mean weight: 69.8 ± 6.9 kg, mean resistance training experience: 5.3 ± 1.5 yrs; mean soccer experience: 8.5 ± 2.0 yrs). Participants were randomly assigned to either a 1-day or 2-day per week plyometric training program. Both groups trained for seven weeks with matched volumes and intensities meaning both programs were identical in all aspects except the number of days on which they were executed. After the initial 7-week training period, half of the participants of each group (n=6) were then randomized into two new groups which were classified as a high-volume group and a low-volume group. The study design can be seen in Figure 1.

Figure 1. CONSORT (Consolidated Standards of Reporting Trials) diagram

The sample size estimation was computed using G*Power software (version 3.1.9.6). We conducted an *a priori* sample size calculation for the outcome 10 m sprint time. We set a type I error rate of 0.05 and 80% statistical power. The estimated effect size of Cohen's d = 0.78 is based on a similar study from Aloui et al. (1) on the effects of plyometric training on change of direction performance in male soccer athletes. The analysis indicated that seven participants per group would represent a sufficient sample. To account for potential attrition, twelve participants per group were recruited.

Procedures

Players were asked to follow their regular diet on the day of the fitness assessments and to not consume any stimulant drinks. Tests were conducted between 9:30 and 11 o'clock in the morning on four days of the week (Sunday, Tuesday, Thursday and Saturday), with one day of recovery between each testing day. The timetable of each testing stage, and the training protocol, is shown in Table 1. The players wore their usual soccer footwear and performed the tests on a natural grass surface that they were accustomed to playing on. The warm-up for the tests was the FIFA11+ protocol (3), executed with minor changes. All players were fully acquainted with the utilised fitness tests having been familiarized with them through their previous training activities. The order of fitness assessments was as follows: on day one, anthropometric measurements were undertaken and these included height and body mass. On day two, the 5-0-5 (COD) test was executed. On day three, the participants undertook the vertical jump (VJ) test and on day four, the 10 m and 40 m sprints were measured. The rest interval between each effort in each of the various tests was three to five minutes. The same protocol was repeated after Phases 1 and 2.

Table 1. **Schedule of testing and implementation of the protocol**

Anthropometry

Stature and body mass were assessed between 8 am and 10 am on the first day of testing. The assessments were made by the same observer. Stature was assessed using a stadiometer (Seca 217 Stable stadiometer, Hamburg, Germany) and body mass was measured using an accompanying scales.

Sprint tests

To measure sprinting speed, electronic timing gates were used (Newtest Powertimer 300-series testing system, Finland). This test has been shown to be highly reliable in the measurement of linear sprint speed (ICC = 0.89-0.9) in soccer players (7,21). Distances of 10 m and 40 m were used to determine the sprinting speed of the players. Participants started in a split-legged stance with the preferred foot positioned 70 cm behind the first pair of photocells that marked the starting line (20,22,23). Three pairs of photocells were used (starting line, 10 m and 40 m). The photocells were positioned at hip height (90 cm) to enable the capturing of trunk movement, rather than a false trigger from a limb. Players performed two trials with the faster trial used for further data analysis (20,22,23).

Change-of-direction test

As per similar investigations (20,23), the 5-0-5 test protocol was employed to measure the COD performance time of the players. Electronic timing gates were used (Newest Power timer 300-series testing system, Finland) and the test has been shown to be highly reliable in the measurement of COD ability (ICC = 0.93) in soccer players of a similar age (21). From a split-stance starting position, the participants were required to sprint 5 m before touching their foot on the demarcated line and then performing a 180 degree turn, positioning their body to sprint 5 m back through the start point. The players were allowed to use their preferred leg for braking and turning, however, they were asked to use the same leg for each effort. The photocells were positioned at hip height (90 cm) (20,22,23) to enable the capturing of trunk movement rather than a false trigger from a limb. Players performed two trials with the fastest used for further data analysis (20,22,23).

Vertical jump

The Sargent Jump Test was used to gauge VJ performance. A familiarization trial was first carried out along with identification of the key technique aspects of the movement. The VJ was measured using a tape measure attached to the wall. Participants were measured standing side onto this wall whilst reaching upward as high as possible with the tips of their fingers. To execute the jump, participants started in a standing position and descended into a flexed-knee position to a depth angle of their choosing before jumping as high as possible and marking the wall with the chalk. The VJ was measured according to the distance from the aforementioned standing position to the mark made during the jump. When executing the VJ, participants were not allowed to stop the movement during the descent or propulsive phases. Each participant was assessed twice with a passive rest period between efforts. The better performance of these two jumps (cm) was recorded for further analysis (20,22,23). The intra-class coefficient (ICC) for this test has been observed to be 0.99 (31).

Training intervention

The training program was conducted during the competition season for fourteen weeks divided into two 7-week phases (Tables 2 and 3). It was done in addition to the participants' regular training load. Prior to starting the research protocol, all subjects participated in a common pre-season phase for five weeks. This period consisted of five training sessions per week and three practice games spread across the five weeks. One week before the start of the in-season, the intensity and volume of training was reduced to avoid the effects of fatigue on the results of the foethcoming fitness tests. After that, the tests were performed and the training intervention was initiated. In the first phase of training (first 7 weeks), the 2-day group conducted plyometric training on two days of the week before soccer training (Saturday and Tuesday). The 1-day group executed plyometric training on one day of the week (Tuesday) before soccer training and completed general skills (submaximal pass-and-move drills) training when the 2-day group was involved in its second plyometric session. All training occurred between 10 and 12 o'clock in the morning on each day. Prior to each session, the players undertook a FIFA11+ style warm-up program (3), Each group then practiced their allocated plyometric as prescribed, on a grass pitch surface. The average time of each plyometric session was between 10- and 20-mins. After the completion of the first phase, the first post-test was implemented. During this week, the team did not participate in any official game. Participants were then randomly divided into higher-volume and lower-volume training groups, both performing one plyometric training session per week, on Mondays, three days removed from any competitive matches. As in the first phase, the players participated in a common warm-up program, before dividing and executing their own prescribed plyometric exercises. The average time of each plyometric training session for each group in Phase 2 was between eight and ten minutes.

Table 2 Phase 1: Training programs for the 1-Day and 2-Day training groups

Table 3 Phase 2: Training programs for the Lower Volume and Higher Volume training groups

Statistical analyses

Statistical analyses were carried out using JASP (version 10.2, University of Amsterdam). The normality and equality of variances for all data were checked with the Shapiro-Wilk and Levene tests respectively. The independent samples t-test was used to compare groups at baseline. A repeated-measures ANOVA was used to detect statistically significant ($p<0.05$) changes in the dependent variables with Tukey-adjusted post-hoc tests conducted to identify statistically significant comparisons. Cohen's *d* effect sizes (ES) were also computed and were classified as 'trivial' (<0.2) 'small' (>0.2-0.59), 'moderate' (>0.6-1.19), 'large' (>1.2-1.99), or 'very large' (>2) (9).

RESULTS

Prior to each phase of the study, there were no significant differences in performance between any of the groups in any of the measured variables. The performance data of the 1-day and 2-day groups during Phase 1 and the high volume and low volume groups during Phase 2 can be seen in Table 4. Despite both groups achieving significant increases in performance in all tested variables in Phase 1, there was no significant differences between the performance changes of the 1-day and 2-day groups. Similarly, there was no significant differences between the high volume and the low volume groups after Phase 2.

Table 4 Baseline (pre) and follow-up (post) performance data for Phases 1 and 2 of the training intervention

Though no significant differences between groups were found, post-hoc analyses were conducted for both phases 1 and 2 of the intervention to evaluate the statistical significance of any within-group training effects. Figure 2 shows Cohen's d effect sizes and 95% confidence intervals for each of these phases. Both the 1-day and 2-day training groups achieved significant increases in performance in all measured fitness tests ($p<0.05$). For the 10 m sprint and 40 m sprint, both the 1-day and 2-day groups achieved 'small' and 'moderate' effect sizes respectively. For the COD test, the 1-day group achieved a 'moderate' effect size while the 2-day group demonstrated a 'small' effect. In the VJ test, both 1-day and 2-day groups achieved 'large' effect sizes. In contrast to the results seen in Phase 1, neither the higher or lower volume groups achieved any significant increases in performance following the second phase of the program, with each group simply maintaining the previously attained gains from Phase 1, demonstrating only trivial effect sizes for all performance measures.

Figure 2 Graphical trajectories of adaptation for each of the groups across each phase of the study (Effect sizes [Cohen's d and 95% confidence interval] detailed on each graph

DISCUSSION

Previous investigations have revealed that plyometric training can be an effective means to enhance a multitude of measures of athletic performance (17,19,28). However, most studies have focused on the shorter-term effects of plyometric training, with relatively few investigating the optimal configuration of training across consecutive blocks of activity. Accordingly, the dual aims of this investigation were to determine and compare the effects of plyometric training, executed on either one or two days per week, on measures of sprint speed, jump height and change of direction time, as well as to evaluate if a comparatively lower volume of plyometric training could maintain previously attained improvements, if any, in one of the experimental groups. The results of the study indicate that while both groups demonstrated significant improvements in all performance measures after Phase 1 of the study, there were no significant differences between the 1-day and 2-day plyometric training groups. Furthermore, in Phase 2, it appeared that the lower volume training group was able to maintain the gains achieved during the first seven weeks of the program, which supports the hypothesis that a lower volume of training can be just as effective in maintaining previously attained increases in performance compared to a higher volume of training.

The authors of a systematic review (12) on plyometric training in a young population, previously suggested that two sessions per week represented the ideal training frequency with which to improve jumping performance. Another meta-analysis (29) on the effects of plyometric training implied that the frequency of training sessions did not impact training-induced adaptations when the number of jumps per week was equalised across protocols. Similarly, Asadi et al. (2) reported no significant relationship between frequency of training or volume of training with COD ability. These results corroborate those of the current investigation and could hold important practical implications for coaches. In relation to this, the evidence reported in the current study suggests that not only can athletes potentially achieve a similar magnitude of adaptation when they execute volume-matched training on one day instead of two, they may also be able to prospectively maintain the attained adaptations on relatively lower doses of plyometric training that are also executed on just a once-weekly basis. Accordingly, given the logistical challenges that many coaches encounter in planning additional training sessions for athletes during congested times in the seasonal schedule, the current study presents a potential solution to such a dilemma over the medium term.

With regard to training volume specifically, Yanci et al. (36) previously examined the effects of plyometric training on a variety performance measures in soccer players who were divided into two groups that differed in the volume of training they executed. Following a six-week training program, there were no significant pre to post differences, within or between groups, for short sprint, agility or horizontal jumping performance. The authors concluded that doubling the volume of plyometric training had no additive effect on the functional aspects of soccer player's performance. Prior to this, de Villarreal et al. (33) had reported that plyometric training, programmed for around two sessions per week, with about fifty jumps per session, was the most efficient strategy for eliciting significant improvements in jump performance. That recommendation is almost exactly in line with the once (120 jumps) or twice (60 jumps) weekly application of plyometric training in Phase 1 of the current study yet the observed increases in performance were maintained on exactly half that number of total jumps in Phase 2. Accordingly, if coaches can structure plyometric training in a format that enhances athletic performance, it appears that the benefits associated with such training can be preserved, over the short-term at least, on 50% of the initially-prescribed volume.

In further support of the results of the current study, de Villarreal et al. (32) examined both the effect of different plyometric training frequencies and volumes on maximal strength, vertical jump performance and sprint ability in a collegiate population. The researchers randomly allocated participants to a control group or one of three training groups with varying frequencies and volumes of drop jumps from different heights. The researchers reported that short-term plyometric training with a moderate frequency and volume of jumps (2 days per week, 840 total jumps) produced similar increases in jumping performance as high-frequency training (4 days per week, 1680 total jumps). Further to this, similar increases in sprint time, jump-related metrics and maximum strength were observed in the participants who undertook a moderate and low number of training sessions each week compared with high training frequencies, despite the lower number of jumps completed over a 7-week period. The results of that study imply that a moderate volume of plyometric training may be more efficient and practical for athletes. Indeed, this is in line with the results of the current study which suggest that training beyond a certain volume appears to hold no real additional benefit for the trainee. It is therefore reasonable to suggest that there is an upper threshold of plyometric training beyond which additional performance increases may not be worth pursuing, as has previously been reported in older adults (16).

One potential reason for the absence of any significant differences between the 1-day and 2-day training groups during Phase 1 is that the volume- and intensity-matched format of the training protocols may have minimised any potential differences in training adaptation, regardless of training frequency. In other words, by ensuring that both groups performed the same number of total repetitions and exercises, at the same level of intensity, the potential advantages that a 2-day training protocol might have over a 1-day protocol, or vice versa, appear negligible. This phenomenon has been documented elsewhere in the literature with other interventions studies (4,27) reporting no significant differences in performance between 1-day and 2-day training groups as per the current study. Based on our results it is appears that the frequency of training (i.e., 1-day versus 2-days per week) may not be as important a factor in the programming of plyometric training as other prescription variables such as jump training volume and intensity, with volume itself potentially less important if increases in physical performance have already been attained in previous phases of a program.

One limitation of this study is the relatively small sample size, however, the study design itself, which necessitated randomization of participants, both at the outset and the halfway point, enhanced statistical power thus offsetting this weakness to a degree. The addition of a control group could also have added additional insight though the objective of the study did not necessitate one and it also proved difficult to identify a group of players who were willing to abstain from training for an extended period of time.

PRACTICAL APPLICATIONS

The results of this study confirm a number of important practical implications for coaches designing and implementing plyometric training programs for athletes. The findings support those of previous studies in that there appears to be very little difference in short-term improvements in athletic performance between 1-day and 2-day training programs when the volume and intensity of these programs are matched. This can enable coaches to be more flexible in their programming and consider factors such as athletes' competition schedule and recovery status when executing training programs. In addition to the above, the finding that both the higher- and lower-volume training protocols were equally effective in maintaining previously attained increases in speed and power can further support the flexibility that coaches can utilize when programming plyometric training. Accordingly, coaches can use lower volumes of training to maintain performance gains, which may be useful during periods of high training load or when the goal is to preserve current performance, rather than increase it.

To this end, 7-week increases in 10 m sprint speed (2.1%), 40 m sprint speed (2.1%), change of direction speed (2.5%) and vertical jump height (9.7%) can be achieved, and then maintained, with as little one plyometric training session per week. These sessions can include 120 jumps to induce changes of this magnitude, and 60 jumps to maintain them thereafter in soccer players. However, the results can likely be applied in other athletic populations. This study has important implications for coaches planning plyometric training programs, most particularly during congested times in an athlete's annual schedule. The study contributes to our understanding of the optimal configuration of plyometric training over consecutive blocks of activity. By comparing the effects of higher- and lower-volume plyometric training protocols in maintaining previously attained increases in performance, we were able to demonstrate the efficacy of preferential prescription of relatively lower jump volumes to maintain previously attained performance increases. This supports the findings of previous studies which suggest that the training stimulus required to achieve a specific level of performance appears to be less than that which must be applied to reach that level in the first instance. Programming in this way seems to concurrently optimize the efficacy and efficiency of a plyometric training program.

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Figure 1. CONSORT (Consolidated Standards of Reporting Trials) diagram

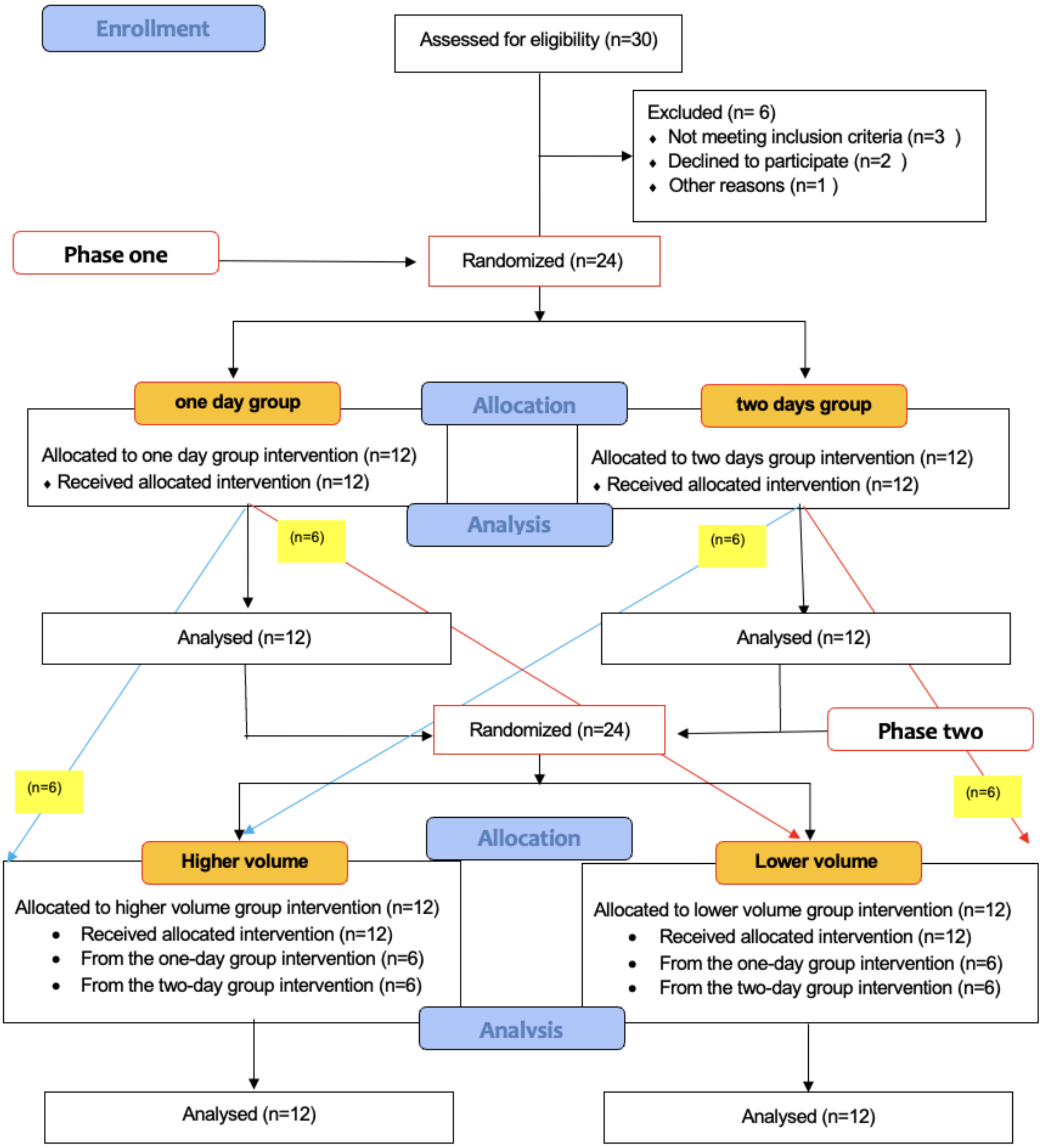

Figure 2 Graphical trajectories of adaptation for each of the groups across each phase of the study (Effect sizes [Cohen's d and 95% confidence interval] detailed on each graph

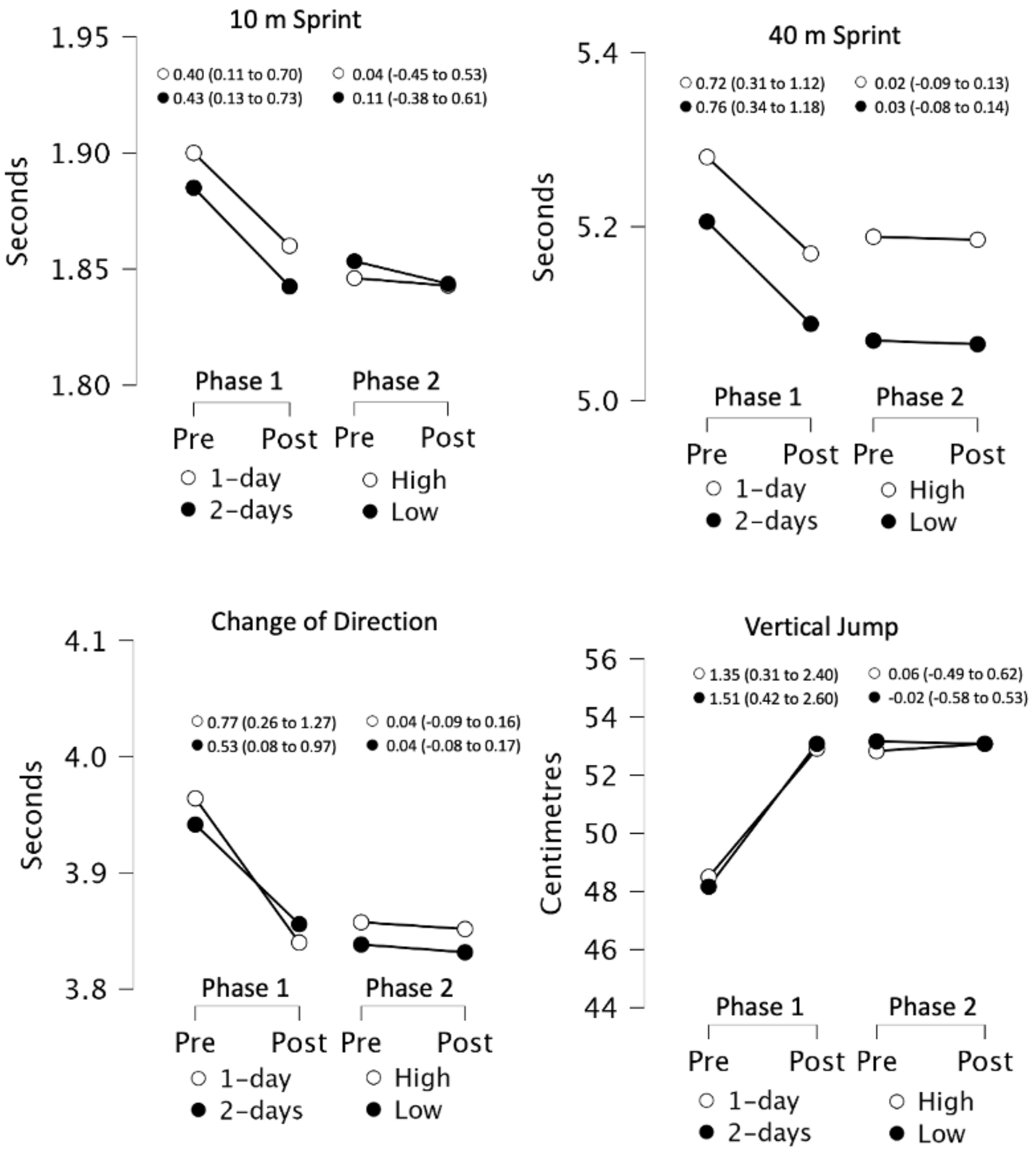

Table 1. Schedule of testing and implementation of the protocol

Pre test	Start of the first phase	End of the first phase	Post test-1		Start of the second phase	End of the second phase	Post test-2
November 15 to 22, 2022	November 24, 2022	January 9, 2023	January 10 to 16, 20023	4 days of rest	January 20, 2023	March 9, 2023	March 10 to 17, 2023
One week	7 weeks		One week		7 weeks		One week

Table 2 Phase 1: Training programs for the 1-Day and 2-Day training groups

Group	Day 1 (sets x repetitions)		Day 2 (sets x repetitions)	
	Two-day group	One-day group	Two-day group	One-day group
Horizontal ankle hops	3×5	3×10	3×5	Skills
Vertical ankle hops	3×5	3×10	3×5	Skills
Horizontal long jumps	3×5	3×10	3×5	Skills
Vertical jumps	3×5	3×10	3×5	Skills
Volume	60	120	60	0

Intensity: exercises were performed with maximal effort (intensity: 100 %), Rest: 1-2 min between sets.

Exercises (all continuous jumps with no pause between reps, 60 to 90 second between sets)

Table 3 Phase 2: Training programs for the Lower Volume and Higher Volume training groups

Group	Day 1 (sets x repetitions)	
	Lower volume group	Higher volume group
Horizontal ankle hops	3×5	3×10
Vertical ankle hops	3×5	3×10
Horizontal long jumps	3×5	3×10
Vertical jumps	3×5	3×10
Volume	60	120

Intensity: exercises were performed with maximal effort (intensity: 100 %), Rest: 1-2 min between sets. Exercises (all continuous jumps with no pause between reps, 60 to 90 second between sets)

Table 4 Baseline (pre) and follow-up (post) performance data for Phases 1 and 2 of the training intervention

Phase 1 Performance data (7 weeks)

	Pre-intervention		Post-intervention	
	1-day group	2-day group	1-day group	2-day group
Test				
10-m sprint (s)	1.90 ± 0.12	1.88 ± 0.09	1.86 ± 0.10*	1.84 ± 0.08*
40-m sprint (s)	5.28 ± 0.16	5.21 ± 0.16	5.17 ± 0.14*	5.09 ± 0.16*
Change of direction (s)	3.96 ± 0.20	3.94 ± 0.14	3.84 ± 0.17*	3.86 ± 0.14*
Vertical jump (cm)	48.50 ± 2.75	48.17 ± 3.35	52.92 ± 3.68*	53.08 ± 3.20*

Phase 2 Performance data (7 weeks)

	Pre-intervention		Post-intervention	
	High group	Low group	High group	Low group
Test				
10-m sprint (s)	1.85 ± 0.09	1.86 ± 0.09	1.84 ± 0.09	1.84 ± 0.08
40-m sprint (s)	5.19 ± 0.13	5.07 ± 0.16	5.18 ± 0.13	5.06 ± 0.16
Change of direction (s)	3.86 ± 0.17	3.84 ± 0.14	3.85 ± 0.16	3.83 ± 0.14
Vertical jump (cm)	52.83 ± 3.30	53.17 ± 3.59	53.08 ± 3.99	53.08 ± 4.68

*Indicates significant pre to post changes