



ORIGINAL SCIENTIFIC ARTICLE

EFFECTS OF CONTRAST TRAINING WITH TWO SESSIONS WEEKLY FREQUENCY ON PHYSICAL FITNESS OF UNIVERSITY-LEVEL MALE SOCCER PLAYERS

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Abstract

The purpose of this study was to compare the effects of a six-week contrast training intervention conducted twice per week during the preparatory period on the measures of physical fitness in university-level male soccer players.

Materials and methods. Sixteen players were selected as participants and randomly assigned to an experimental group or an active control group. Data were collected at baseline and after a six-week training intervention period for 15 m and 30 m linear sprint, medicine ball throw (MBT), standing long jump (SLJ), countermovement jump (CMJ), change of direction speed (CODS), peak torque (both legs) during extension and flexion, and running-based anaerobic sprint test (RAST).

Results. The analysis revealed reported significant small to very-large magnitude within-group improvement in all the dependent variables for the experimental group ($p < 0.001-0.028$) but not for the control group ($p = 0.066-1.000$). Further, the analysis of covariance with the pre-test scores as covariates revealed significant differences at post-intervention assessments for all the dependent variables, favoring the contrast training group ($p < 0.001-0.05$).

Conclusions. A six-week contrast training intervention with two weekly sessions during the preparatory period may be sufficient to induce small improvement in the 30 m linear sprint and isokinetic strength of both legs, moderate improvement in the 15 m linear sprint, and MBT, large improvements in SLJ, RAST, and a very large improvement in vertical jump (CMJ) and CODS.

Keywords: football, muscle strength, resistance training, plyometric exercise, human physical conditioning, athletic performance.

Introduction

Soccer is an intermittent sport that requires players to execute different actions demanding explosiveness of the lower limb (Stølen et al., 2005). These explosive actions may range from short sprints to win the ball possession up to kicking to score a goal. Most essential actions in soccer are time-bound and require quick application of force (i.e., high rate of force development) (Taber et al., 2016). Therefore, players need the ability to exert maximal force in a minimal time. Hence, it becomes crucial for soccer players to improve these abilities. Moreover, strength (i.e., the ability to exert maximal force), as well as power (i.e., the ability to exert

maximal force in minimal duration), has been reported to be associated with different physical fitness abilities among soccer players (Arnason et al., 2004; McFarland et al., 2016; Thapa et al., 2019; Wisløff et al., 2004), which are crucial for a soccer game. For example, strength and power are associated with linear sprint, one of the most common soccer actions before scoring a goal (Faude et al., 2012). Indeed, previous studies have reported that strength, aerobic endurance, and other physical fitness abilities can also help discriminate elite players from amateur players (Bangsbo et al., 2008; Cometti et al., 2001). Therefore, training methods to improve these abilities become paramount for soccer players' success.

Different strength training methods are available to improve soccer players' physical fitness. However, traditional resistance training and plyometric training are two commonly used methods. Traditional resistance

training encompasses using external loads (commonly heavier loads). In contrast, plyometric training utilizes the individuals' body mass (sometimes plyometric training may utilize external resistance too [e.g., resistance bands]) (Barrio et al., 2023; Ojeda-Aravena et al., 2023; Ramirez-Campillo et al., 2022; Ramirez-Campillo et al., 2023; Rathi et al., 2023). These distinct differences in the load allow both exercises to be performed with different forces and velocities, putting both at almost opposite ends of the force-velocity spectrum (Kumar, Pandey, Thapa, et al., 2023; Thapa & Kumar, 2023; Thapa et al., 2021; Thapa et al., 2022). Therefore, including only one training method may reduce the overall force-velocity development of a given athlete. Hence, including traditional resistance and plyometric training within a training periodization of soccer players becomes essential.

However, including both training methods on separate days (i.e., compound training) within a congested weekly micro-cycle is often difficult. For example, a coach working with an amateur university-level soccer team may be able to conduct only one session per day, i.e., five training sessions per week. In such a scenario, it becomes difficult to include both traditional resistance training and plyometric training on separate days. A pragmatic approach is to have both traditional resistance training and plyometric training within a single session. Such a training approach is termed complex training (Thapa et al., 2021). Amongst the different possible combinations of both training methods (four combinations are available), complex-contrast training (CT) is done by performing the traditional resistance exercise first, followed by plyometric exercise, in a set-by-set fashion (Kumar, Pandey, Thapa, et al., 2023; Thapa & Kumar, 2023; Thapa et al., 2022). It is suggested that with such a combination, the heavier load performed in the form of traditional resistance exercise activates a larger motor unit pool, thereby enhancing the lower load exercise performance (i.e., plyometric training exercise) (Thapa & Kumar, 2023; Thapa et al., 2021; Thapa et al., 2022).

Moreover, using both traditional resistance exercise and plyometric exercise in such a format may save time while also inducing improvements. Indeed, previous meta-analyses have reported that CT improves sprint, change of direction speed (CODS), and jumps (Thapa et al., 2021) while also enhancing the maximal strength (Thapa et al., 2022) of soccer players. In addition, both meta-analyses (Thapa et al., 2021; Thapa et al., 2022) reported a need for more studies during the pre-season period. According to the authors, only three studies conducted CT during pre-season (Kumar, Pandey, Ramirez-Campillo, et al., 2023; Maio Alves et al., 2010a; Miranda et al., 2022). Furthermore, replication of sports and exercise science studies is needed to increase the rigor of science and advancement of knowledge (Murphy et al., 2023). Therefore, this study aimed to compare the effects of a CT intervention during the preparatory period on soccer players' physical fitness abilities. Based on previous evidence, it was hypothesized that significant improvement would be observed in all the physical fitness abilities after the CT intervention compared to the active control group.

Methods

Participants

Sixteen male amateur soccer players who participated in the University-level competitions were recruited as

participants for this study. A priori sample size estimation suggested this sample size be sufficient to detect a large effect (Cohen $f = 0.4$) within-between interaction in repeated measures design with a power of 0.80. Participants were required to practice regularly (minimum five hours per week) during the preparatory training camp for the inter-university competitions and have a minimum of one year of resistance training experience to be eligible for the study. In addition, participants were excluded if they had any lower-limb injury in the past six months before the start of the study. After that, the participants were allocated randomly to either the experimental training group ($n = 8$) that practiced regular soccer training combined with CT or an active control group ($n = 8$) that practiced soccer training alone. The demographic characteristics of the participants are presented in Table 1. The participants signed informed consent forms after being explained the potential risks and benefits of the study. The study was approved by the University's Internal Review Board and conducted following the declaration of Helsinki.

Table 1. Participant demographics of complex-contrast training (CT) and active control group (CG)

	CT (n = 8)	CG (n = 8)	p-value*
Age (yrs)	20.3 ± 1.8	21.4 ± 1.2	0.233 ^a
Height (cm)	171.4 ± 6.7	174.6 ± 5.0	0.296
Body Mass (kg)	61.7 ± 4.0	68.7 ± 6.3	0.018

Note: * – independent t-tests, ^a – Mann Whitney U Test (non-normal data)

Procedure

Familiarization sessions were conducted for the testing protocols and CT exercises before the start of the study. One repetition-maximum (1RM) assessment for the experimental group (i.e., for training prescription) was done during this period. In addition, demographic data were also collected during the same period. Participants were asked to avoid strenuous activity for 48 hours and eat habitually before the testing day. Two (within-subject, pre- and post-) by two (between subject; experimental and control) randomized controlled design was used to compare the training effects on selected outcome variables. The tests were conducted at identical times during pre- and post-intervention assessments, with the sequence of testing order remaining the same for all the participants. A ten-minute general warm-up procedure was conducted before the testing, with some specific trials before each assessment.

Load measurement and Training intervention

The prescription of load for the experimental group was based on the percentage of 1RM assessed before the start of the study. Furthermore, the contrast pairs of exercises were selected based on previous studies (Kumar, Pandey, Ramirez-Campillo, et al., 2023; Kumar, Pandey, Thapa, et al., 2023; Thapa & Kumar, 2023). Squats were paired with squat jumps, deadlifts were paired with kettlebell swings, barbell lunges were paired with barbell high knees, and bench presses were paired with plyometric push-ups. The

load at the initial two weeks was 65% 1RM for the high-load exercise, followed by 75%1RM for the next two weeks and 85%1RM for the final two weeks. The training sessions' load description is presented in Table 2.

Table 2. Description of training load across a six-week duration

	High-load exercise	Low-load exercise
	Set × repetitions	
Week 1-2	3 × 15	3 × 6/10/15 sec/6*
Week 3-4	3 × 10	3 × 8/10/20 sec/8
Week 5-6	3 × 6	3 × 10/10/25 sec/10

Note: *repetitions are represented as squat jumps/kettlebell swings/barbell high knees/plyometric push-ups

Outcome variables

Linear sprint tests included 15 m and 30 m distances conducted separately to measure acceleration speed and maximal speed on synthetic outdoor track based on protocols used in previous studies (G. Singh et al., 2022; Gaurav Singh et al., 2022). Similarly, the change of direction speed test was conducted on an outdoor natural grass field (participants wore their soccer boots) based on protocols described in previous studies (R. K. Thapa, F. M. Clemente, et al., 2023; Rohit K Thapa et al., 2023). For both the timing-based tests, two experienced timekeepers were recruited who recorded three trials of each test, with a rest period of ~3 minutes between trials. Upper body explosive strength was assessed using a backward medicine ball throw based on methods described in a previous study (Stockbrugger & Haennel, 2001). The vertical jump was evaluated using the countermovement jump test with a valid and reliable inertial measurement unit (S. Kumar et al., 2023), while the standing long jump (SLJ) test was used to assess the horizontal jumps (Gaurav Singh et al., 2022). The peak torque during flexion and extension of both legs was measured using an isokinetic dynamometer (Humac NORM). While the maximal anaerobic power was estimated using a running-based anaerobic sprint test (Zagatto et al., 2009). For all the assessments (except the running-based anaerobic sprint test), three successful trials were conducted with a minimum of ~3 minutes rest between each trial. The interclass correlation coefficient with its 95% confidence interval is presented in Table 3.

Statistical Analysis

The analyses were conducted using SPSS version 24.0.0 (IBM, New York, USA). Data are presented as means and standard deviations. The normal distribution of the data and its homogeneity of variance were verified using the Shapiro-Wilk and Levene's tests for equality of variances, respectively. After that, analysis of covariance (ANCOVA) with baseline scores as a covariate was used to analyze the training-specific effects. Post hoc pairwise comparisons were conducted for significant differences to find which group was favored. Within-group changes were analyzed using a paired t-test. Percentage change scores were also calculated for the dependent variable in each group using the equation in a customized Microsoft Excel sheet:

Table 3. Interclass correlation coefficient (ICC) and their 95% confidence interval (CI)

Variables	ICC	95 % CI
15 m sprint (s)	0.87	0.68 – 0.95
30 m sprint (s)	0.78	0.50 – 0.91
Medicine Ball Overhead Throw (m)	0.95	0.86 – 0.98
Standing Long Jump (m)	0.84	0.62 – 0.94
CMJ height (cm)	0.93	0.82 – 0.97
Modified Agility T-test (s)	0.80	0.54 – 0.92
PT leg extension (right) (Nm)	0.98	0.96 – 0.99
PT leg flexion (right) (Nm)	0.95	0.88 – 0.98
PT leg extension (left) (Nm)	0.98	0.96 – 0.99
PT leg flexion (left) (Nm)	0.95	0.88 – 0.98

$[(\text{meanpost} - \text{meanpre}) / \text{meanpre}] \times 100$. Effects sizes (ES) in the form of partial eta squared (η_p^2) were used from ANCOVA output. Hedge's g were calculated to assess the ES between pre-post measurements testing for each group. The magnitude of effects for η_p^2 was interpreted as small (<0.06), moderate ($\geq 0.06 - 0.13$), and large (≥ 0.14) (Cohen, 1988), while Hedge's g was interpreted as trivial (<0.2), small ($0.2 - 0.6$), moderate ($>0.6 - 1.2$), large ($>1.2 - 2.0$), and very large ($>2.0 - 4.0$) (Hopkins et al., 2009). The interclass-correlation coefficient between trials was interpreted as poor (<0.5), moderate ($0.5 - 0.75$), good ($0.75 - 0.9$), and excellent (>0.9) reliability based on the lower bound of the 95% confidence interval (Koo & Li, 2016). Statistical significance was set at $p \leq 0.05$.

Results

Main outcomes

Table 4 provides comprehensive detail regarding the analysis of the data. The Shapiro-Wilk test results ($p > 0.05$) indicated that all variables were normally distributed. A positive training adaptation was found for the CT group for all the selected dependent variables. The within-group magnitude of improvement after CT intervention across all the variables ranged from small to very large. A substantial improvement (large or very large ES) ($g > 1.20$) was observed in variables such as SLJ ($g = 1.424$, $p = 0.001$), CMJ ($g = 6.660$, $p < 0.001$), CODS ($g = 2.786$, $p = 0.001$), and average power ($g = 1.422$, $p < 0.001$). In the control group, no notable changes were detected for any dependent variables from pre to post-intervention assessments. Further, the percentage change from pre- to post-intervention for both the groups is presented in Figure 1.

The ANCOVA (Table 4) results displayed significant differences in all the selected outcome variables at the post-test after the six-week intervention, favouring the CT group. The ES (η_p^2) derived from the ANCOVA output suggests the magnitude of differences was large (>0.14).

Discussion

The study aimed to find the effects of six-week CT with a weekly frequency of two sessions during the preparatory period on measures of physical fitness among university-

Table 4. Statistical comparisons between complex-contrast training and active control group (CG)

Variables	Complex-contrast training group (n = 8)		Active control group (CG) (n = 8)		ANCOVA p-value
	Pre-test	Post-test	Pre-test	Post-test	
	Mean ± standard deviation		Mean ± standard deviation		
15 m sprint (s)	2.71 ± 0.15	2.61 ± 0.13 ^M	2.69 ± 0.10	2.69 ± 0.12 ^T	0.007 ^L
30 m sprint (s)	4.58 ± 0.22	4.50 ± 0.20 ^S	4.43 ± 0.17	4.48 ± 0.15 ^S	0.015 ^L
MBT (m)	10.50 ± 0.6	11.10 ± 1.0 ^M	11.83 ± 1.17	11.68 ± 1.09 ^T	0.034 ^L
Standing Long Jump (m)	2.40 ± 0.10	2.57 ± 0.13 ^L	2.39 ± 0.15	2.36 ± 0.15 ^S	<0.001 ^L
CMJ height (cm)	36.50 ± 1.9	45.30 ± 3.1 ^{VL}	38.20 ± 4.1	37.00 ± 3.2 ^S	<0.001 ^L
Change of direction speed (s)	6.01 ± 0.18	5.44 ± 0.23 ^S	5.97 ± 0.23	6.01 ± 0.24 ^S	<0.001 ^L
PT leg extension (right) (Nm)	171.10 ± 22.1	181.10 ± 21.7 ^S	187.50 ± 54.9	189.50 ± 53.5 ^T	0.001 ^L
PT leg flexion (right) (Nm)	98.00 ± 8.1	103.80 ± 9.1 ^S	111.60 ± 29.6	113.40 ± 27.0 ^T	0.053 ^L
PT leg extension (left) (Nm)	175.00 ± 23.2	184.40 ± 22.8 ^S	202.50 ± 33.3	204.30 ± 32.5 ^T	0.022 ^L
PT leg flexion (left) (Nm)	102.80 ± 17.9	109.60 ± 18.3 ^S	110.50 ± 25.1	111.90 ± 22.8 ^T	0.009 ^L
Maximum Power – RAST	555.20 ± 41.3	594.40 ± 49.2 ^L	545.80 ± 65.8	530.70 ± 71.0 ^S	0.015 ^L
Average Power – RAST	477.80 ± 36.4	527.10 ± 32.7 ^L	487.60 ± 61.1	476.30 ± 50.5 ^S	<0.001 ^L

Note: CMJ – countermovement jump, g – Hedges’ g, MBT – medicine ball throw, PT – peak torque, ^T – trivial effect size, ^S – small effect size, ^M – medium effect size, ^L – large effect size, ^{VL} – very large effect size, RAST – running-based anaerobic sprint test.

* – significant difference from pre-test

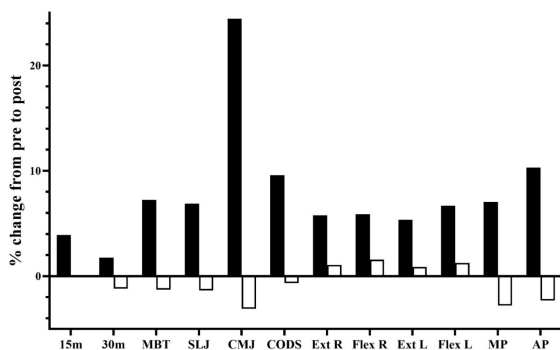


Fig. 1. Relative (%) change in dependent variables between pre- and post-intervention for the complex contrast training (black bars) and control group (white bars). Note: negative bars denote detrimental changes, CODS – change of direction speed, MBT – Medicine Ball Overhead Throw, SLJ – Standing Long Jump distance, CMJ – countermovement jump with arm swing height, Ext – knee extension for maximal torque, Flex – knee flexion for maximal torque, L – left, R – right, MP – Maximum Power, AP – Average Power.

level male soccer players. The findings suggest significant improvements in all the selected dependent variables after six weeks of CT compared to the active control group. Further, the magnitude of improvement from pre- to post-intervention was small for 30 m linear sprint and isokinetic strength (peak torque during knee flexion and extension of both legs), moderate for 15 m sprint and medicine ball throw, large for SLJ, maximum and average power during running-based anaerobic sprint test, and very large for CMJ and CODS.

These significant improvements in physical fitness performance after CT may be attributed to specific

neuromuscular adaptations that enhances the stretch-shortening cycle action. Furthermore, CT may have improved the energy transfer between the eccentric and concentric muscle actions, which allows better coordination as well as synchronization of the active muscle groups and thus improved and enhanced the motor skills (e.g., sprints, jumps, CODS) (Cronin et al., 2001). Moreover, CT has also been linked to hormonal adaptations (i.e., increased free testosterone) (Ali et al., 2019) and maximal strength development (Thapa et al., In press), which may positively enhance the physical fitness performance in soccer players (Wisløff et al., 2004). Other adaptation may have occurred at the cellular level (i.e., muscle fibre adaptations) that favors the strength-power generation (Bottinelli et al., 1996; Harridge et al., 1996; Stasinaki et al., 2015). For example, adding plyometric or power exercise with resistance exercise as in CT may help preserve the type IIx muscle fibres (Stasinaki et al., 2015) compared to resistance training alone (Adams et al., 1993). Although we did not measure the structural adaptations (e.g., leg muscle volume), however, previous studies have reported CT intervention to have increased the leg muscle volume in soccer players (Hammami et al., 2019; Hammami et al., 2017), and studies have shown that these structural adaptations after resistance or plyometric training do not interfere with neuromechanical adaptations (ACSM, 2009; Markovic & Mikulic, 2010). Therefore, it may be possible that the CT intervention may have induced structural adaptations that were not measured in our study.

We observed significant improvements in the 15 m (moderate) and 30 m (small) linear sprint performance favouring the CT intervention. These findings align with previous studies that reported improved linear sprint performance after CT intervention compared to a control condition (i.e., soccer training alone) during the pre-season period (Maio Alves et al., 2010). In addition, although Miranda et al. (2022) did not observe a significant interaction

effect with an active control group, however, within-group significant moderate improvements were reported for 10 m, 20 m (both moderate ES), and 30 m (small ES) linear sprint times from pre- to post-intervention similar to our study. These findings reflect that CT can induce improvements of moderate magnitude for the acceleration speed (15 m linear sprint) and small magnitude for the maximal speed (30 m linear sprint) during the pre-season period. Furthermore, there were large and very large improvements in SLJ and CMJ, respectively. Miranda et al. (2022) reported moderate improvement in CMJ (with a significant interaction effect against an active control group) during the pre-season period. The difference in the magnitude of improvement (moderate vs. very large) between the two studies may be due to the nature of the participants involved. For example, Miranda et al. (2022) included professional soccer players that competed in national-level competitions, whereas participants in our study were amateur university-level soccer players. It is plausible that participants in our study had a window of opportunity for improvement compared to the professional players. In addition, no previous CT study on soccer players reported SLJ making it challenging to compare. However, the SLJ may be an essential attribute in measuring the vertical-horizontal force-power complex of a soccer player. Therefore, CT may induce large to very large ES improvements in vertical and vertical-horizontal force-power complex during the pre-season period among amateur male soccer players.

We also observed a very large magnitude improvement in the CODS, which contrasts with findings from previous studies conducted during the pre-season period (Maio Alves et al., 2010; Miranda et al., 2022). For example, Maio Alves et al. (2010) conducted a six-week CT session with a training frequency of one and two sessions per week and found no improvement in the 5-0-5 agility test among elite soccer players. While Miranda et al. (2022) conducted a four-week CT with a training frequency of two sessions per week and reported no improvement in the Illinois agility test among professional soccer players. In both the previous studies (Maio Alves et al., 2010; Miranda et al., 2022), professional-elite level soccer players were involved, who may have possibly reached the maximum ceiling of improvement for CODS (e.g., playing soccer at the highest level may also have improved the CODS abilities). Furthermore, small ES improvements in the isokinetic strength of both legs' extensor and flexor muscles were reported after the six-week CT. Although previous pre-season CT studies on soccer players did not include isokinetic measurements, our findings align with a previous CT study conducted during the in-season period, which reported small to moderate ES improvements (Brito et al., 2014). Moreover, CT studies conducted on other populations (e.g., physically active participants) also reported small magnitude improvements in the isokinetic strength (G. Kumar, Pandey, Thapa, et al., 2023; Thapa & Kumar, 2023; Thapa, G. Kumar, et al., 2023). In addition, we also observed a moderate ES improvement in upper-body explosiveness (medicine ball throw). Although no previous CT study included assessment for upper-body explosives, Miranda et al. (2022) reported large ES improvement in the upper-body dynamic strength measured by 1RM bench press. Finally, we observed large ES improvements in maximum and average anaerobic power estimated with the running-

based anaerobic sprint test. While no previous CT study assessed anaerobic power using the running-based anaerobic sprint test, improvements in the test were observed with both complex-descending training and resistance training in female team sports athletes (Rathi et al., 2023).

Lastly, a few limitations of the study should be acknowledged. Firstly, stopwatch use to measure the timing-based measurements (e.g., linear sprints, CODS, running-based anaerobic sprint test). Although we obtained moderate test-retest reliability (interclass-correlation coefficient), the timing-based results should be used cautiously. Secondly, the study was conducted on amateur male soccer players during the preparatory period. Therefore, the finding of this study should not be extrapolated to other sex or training period of the competitive season. Thirdly, including biochemical variables (e.g., testosterone) could further help us understand the underlying mechanisms. Lastly, the sample size in the study was low. Although we performed a priori sample size estimation, a larger sample size would have been preferable. However, the results from this study may help generalize findings in the future (e.g., meta-analysis).

Conclusion

In conclusion, a six-week CT intervention with a weekly training frequency of two sessions during the preparatory period may be sufficient to induce small ES improvement in maximal speed (30 m linear sprint) and isokinetic strength of extensor and flexor muscles of both legs, moderate ES improvement in acceleration speed (15 m linear sprint), and upper-body explosiveness (medicine ball throw), large ES improvement in horizontal jump (SLJ), anaerobic power (running-based anaerobic sprint test), and very large ES improvement in vertical jump (CMJ) and CODS.

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ВПЛИВ КОНТРАСТНОГО ТРЕНУВАННЯ З ЧАСТОТОЮ ДВА ЗАНЯТТЯ НА ТИЖДЕНЬ НА РІВЕНЬ ФІЗИЧНОЇ ПІДГОТОВЛЕНОСТІ ЧОЛОВІКІВ-ФУТБОЛІСТІВ УНІВЕРСИТЕТСЬКОГО РІВНЯ

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Авторський вклад: А – дизайн дослідження; В – збір даних; С – статаналіз; D – підготовка рукопису; E – збір коштів

Реферат. Стаття: 8 с., 4 табл., 1 рис., 43 джерела.

Метою цього дослідження було порівняння впливу втручання у формі шеститижневого контрастного тренування, яке проводили двічі на тиждень протягом підготовчого періоду, на показники фізичної підготовленості чоловіків-футболістів університетського рівня.

Матеріали та методи. Для участі в дослідженні були вибрані шістнадцять гравців, яких випадковим чином розподілили до експериментальної групи або до групи активного контролю. Дані збирали на початковому етапі та після шеститижневого періоду тренувального втручання за результатами виконання таких тестів: прямолінійний біг на 15 м і 30 м, кидок медичного м'яча (КММ), стрибок у довжину з місця (СДМ), вертикальний стрибок із зустрічним рухом (ВСЗР), швидкість зміни напрямку (ШЗН), максимальний момент (обидві ноги) під час розгинання та згинання та анаеробний спринт-тест на основі бігу (АСТОБ).

Результати. За результатами аналізу було зареєстровано статистично значуще внутрішньогрупове покращення показників мірою величини від малої до дуже великої за всіма залежними змінними для експериментальної групи ($p < 0,001 - 0,028$), але не для контрольної групи ($p = 0,066 - 1,000$). Крім того, за результатами коваріаційного аналізу з використанням

оцінок попереднього тестування як коваріат було виявлено статистично значущі відмінності в оцінках після втручання для всіх залежних змінних, на користь групи контрастного тренування ($p < 0,001-0,05$).

Висновки. Шеститижневе контрастне тренування з двома щотижневими заняттями протягом підготовчого періоду може бути достатнім для забезпечення невеликого покращення результатів у тестах «прямолінійний біг на 30 м» та «ізо-кінетична сила обох ніг», помірною покращення результатів у тестах «прямолінійний біг на 15 м» і КММ, значного покращення результатів у тестах СДМ, АСТОБ і дуже значного покращення результатів у тестах «вертикальний стрибок» (ВСЗР) і ШЗН.

Ключові слова: футбол, м'язова сила, тренування зі спротивом, пліометрична вправа, кондиційне тренування людей, спортивна результативність.

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