J Musculoskelet Neuronal Interact 2024; 24(2):209-215

Journal of Musculoskeletal and Neuronal Interactions JMNI

Original Article

The Effects of the French Contrast method on Soccer Player's Jumping, Sprinting and Balance Performance

Bahaüddin Türkarslan[1], Gökhan Deliceoğlu[2]

[1]Ankara Yildirim Beyazit University, Turkey
[2]Gazi University, Turkey

Abstract

Objectives: The aim of this study is to examine the effect of a six-week French contrast method applied to professional Soccer players on jumping, sprinting, and dynamic balance performance values. **Methods**: A total of 21 male Soccer players voluntarily participated in the study, all of whom played professionally for 1461 Trabzonspor club. Data on gender, age, body weight (kg), body fat percentage (%BF), body mass index (BMI), vertical jump (cm), 30m sprint, and dynamic balance were obtained from the players. The Shapiro-Wilk test was used to assess the normality of the data. Since the data showed normal distribution, paired samples T-test statistical analysis was applied. **Results**: According to the statistical results obtained from professional Soccer players, there is a statistically significant difference between vertical jump, 30m sprint, and dynamic balance values ($p<0.05$). Based on these findings, it can be stated that the applied French contrast training method is effective on the mentioned variables. **Conclusion**: French contrast training program applied to professional Soccer players can be considered effective in improving vertical jump, 30m sprint, and dynamic balance values.

Keywords: Agility, Performance, Power, Speed, Strength

Introduction

The French contrast method integrates strength, power, and plyometric in viexercises within resistance training. It follows a sequence starting with intense strength exercises, transitioning to explosive movements, and concluding with mobility or stability exercises. This sequence is believed to enhance neuromuscular adaptations, thereby boosting performance. The method's effectiveness stems from neural adaptations, potentiation, and muscle fiber recruitment, resulting in increased power output and improved athletic performance.

Soccer is characterized by a dynamic interplay of high and low-intensity activities, including sprinting, jumping, and physical confrontations[1-3]. Physical fitness encompasses a spectrum of attributes crucial for proficient performance in sports, defined as qualities an individual possesses or develops concerning their capacity for physical activities[4]. These attributes typically encompass body composition, cardiorespiratory fitness, muscle strength, endurance, flexibility, agility, balance, coordination, power, reaction time, and speed components, each playing a vital role in determining a player's prowess on the soccer field[4-6].

In soccer, physical fitness is influenced by various factors, including aerobic capacity, anaerobic power, strength, speed, flexibility, agility, balance, and coordination[7,8].

Among these factors, strength and power play pivotal roles in enhancing soccer performance. They are essential for executing fundamental tasks such as running, jumping, and securing the ball before the opponent scores[9]. They are essential for executing fundamental tasks such as running, jumping, and securing the ball before the opponent scores[10]. Moments requiring displays of power and strength often determine the outcome of soccer matches. Hence, effective conditioning programs must incorporate dedicated strength training sessions[11].

In soccer, the relationship between jumping, sprinting, and balance is crucial. Jumping is essential for players to reach

The authors have no conflict of interest.

Corresponding author: Bahaüddin Türkarslan, Ankara Yildirim Beyazit University, Turkey
E-mail: Bahaddin_turkarslan @hotmail.com
ORCID: 0009-0000-8125-0041

Edited by: G. Lyritis
Accepted 15 April 2024

the ball in the air, gain an advantage in contested situations, and excel in aerial duels. Similarly, sprinting is necessary for swiftly reaching the ball, separating from opponents in offensive and defensive positions, and making rapid decisions. Balance, on the other hand, denotes the ability of players to maintain their footing while executing quick maneuvers to touch the ball, withstand pressure from opponents, or intervene in play. These three abilities significantly influence players' technical and tactical skills, profoundly impacting their performance on the field[12-15].

The development of the strength characteristic will also improve the body's posture features. Therefore, to improve a player's technical skills, it is necessary to enhance strength development[16].

For the maintenance or achievement of physiological balance, the peripheral system must be able to provide an appropriate motor response to sensory information from the peripheral system. This requires an active neuromuscular system and specific muscle strength to support it[17].

The basic movement patterns in Soccer require the ability to efficiently use the stretch-shortening cycle in ballistic movements, in addition to rapid force development and high power output[18,19].

A player's ability to produce high levels of muscle strength and power is crucial for sports performance[20].

Contrast and complex training forms, such as French contrast method, are among the most popular forms of Variable Resistance applied by strength and conditioning coaches[21]. The French contrast method, one of these forms, was first applied by French athletics coach Gilles Cometti in 2008. This training method, which can be used in other sports, was developed by Diets in 2012[22,23]. The main element of the French contrast method is based on post-activation potentiation enhancement (PAPE).

PAPE is a pre-activation mechanism used before performing a movement with high performance expectations. For example, before performing a movement such as sprinting, changing direction, or jumping, the athlete aims to achieve an increase in the performance of the basic movement by performing a similar biomechanical activity with the neuromuscular system. Pre-stimulus activities before jumping, such as squatting before jumping, half-jumping before sprinting, or jumping over an obstacle before shooting, are activities based on PAPE[24].

Activities involving PAPE optimize the interaction between actin-myosin, the basic components of contraction, by increasing the calcium content within the cell during muscle contraction. This results in an increase in the contraction rate and a decrease in reaction time to environmental stimuli[25]. Research has documented that training involving PAPE enhances motor abilities, especially in aspects such as strength, speed, and jumping[26]. Different studies have shown that PAPE application in a training program is a good strategy to improve jumping and sprint performance[27,28]. Another study concluded that the French Contrast method acutely increased lower-body strength and power production by improving vertical jump and anaerobic conditioning[29].

Therefore, other complex training methods, including the French Contrast Method, which aim to maximize the PAPE phenomenon, have been recommended.

Developed in relation to the mentioned terms, the French Contrast Method consists of a combination of four different exercises. The first exercise involves a submaximal or maximal loaded compound movement. The second exercise includes a plyometric activity. The third exercise involves a weight-assisted jumping exercise, and the fourth exercise includes an accelerated or supported plyometric exercise[30].

While there are limited studies examining the long-term training effects of the French Contrast method, our study has no equivalent in the literature. Therefore, the aim of this study is to investigate the effects of a six-week French Contrast method applied to professional Soccer players on jumping, sprinting, and dynamic balance performance[31].

Materials and Methods

A total of 21 male Soccer players who played professionally for the 1461 Trabzonspor club participated in the study. The average training experience was obtained as 12.15±6.54 years. The average age, height, and body weight of the research group, consisting of Soccer players, were obtained.

Data Collection Tools

The height of the research group was measured with a stadiometer (Holtain), and body weight was measured with a digital scale (Tanita BC 480). BMI of the players was calculated using the formula body weight$_{(kg)}$/height$_{(m)}^{2}$. Before the tests, a preliminary trial was conducted to familiarize the athletes. Additionally, the Dynamic balance measurement of the players was evaluated with the Y-Balance test, their speed performances were assessed using the 30m sprint test with the Witty device and their Vertical (Countermovement) jump heights with the Microgate optojump® (Microgate, Bolzano, Italy) device.

Training Program

The training program implemented in the study spanned six weeks, encompassing both the preparation and competition phases of the soccer team. Athletes were provided with essential guidance on nutrition and rest during the training period, and potential factors that could impact results were discussed. In instances where soccer players sustained injuries during the study, they completed missed exercises under the researcher's supervision. Prior to the study, each athlete's loading intensity was determined based on their one-repetition maximum (1RM) for the prescribed movements. The maximum repetition weight was reassessed during the second and fourth weeks of the study. Weight increments were introduced every two weeks throughout the training program. Before each

Table 1. French Contrast Method Training Program.

Week	Week 1-2	Week 3-4	Week 5-6
Exercises **Sets** **1 RM**	Weighted back squat 3x3 %85 1RM	Weighted back squat 3x2 %87,5 1RM	Weighted back squat 3x1 %90 1RM
Exercises **Sets**	Double-leg jump over obstacle 3x4	Double-leg jump over obstacle 3x5	Double-leg jump over obstacle 3x6
Exercises **Sets** **1 RM**	Weighted squat jump 3x3 %30 1RM	Weighted squat jump 3x4 %30 1RM	Weighted squat jump 3x5 %30 1RM
Exercises **Sets**	Elastic band-assisted squat jump 3x4	Elastic band-assisted squat jump 3x5	Elastic band-assisted squat jump 3x6

training session, participants engaged in necessary warm-up protocols. Each set comprised four exercises, with 20-second rest intervals between exercises and a five-minute recovery period between sets.

Before French-contrast training sessions, athletes were accompanied by an athletic performance coach for a specific warm-up routine. This routine consisted of 5 minutes of cycling ergometer (at 60-70 rpm) followed by 10 minutes of dynamic warm-up exercises. Immediately after the dynamic warm-up, athletes performed 3-5 sets of submaximal active jumps at 15-second intervals. After a 3-minute passive rest, a standard warm-up protocol was completed with 10 repetitions of half squats at 50% of their one-repetition maximum (1 RM). There was a 5-minute passive rest period between the warm-up protocol and the French-contrast training application. Additionally, throughout our 6-week methodology, our nutrition experts provided athletes with necessary nutritional programs before and after training sessions.

In the context of our study, the French-contrast training method was implemented to our professional team following the necessary physical adaptation phase, which was planned periodically before the preseason. After the adaptation phase and considering the remaining weeks until the start of the competitions, it was observed that there were 4 weeks left until the leagues began. Hence, the French-contrast training was applied twice a week for the remaining 4 weeks. Subsequently, for the remaining 2 weeks, it was deemed appropriate to reduce the frequency to once a week. This decision was made considering both the fatigue of athletes emerging from the intensive preseason training period and the potential negative impact of post-competition fatigue on the outcomes of our study. Throughout the six-week study, soccer players adhered to their regular training routines, with no additional quick force training beyond the study's protocols.

The specific details of the applied training programs are outlined in Table 1.

Data Collection

Height Measurement

The height of participating Soccer players was measured using a Holtain stadiometer with a precision of 0.1 cm. To determine height, the stadiometer was brought to the top point of the head after taking a deep breath with a straight posture and eyes facing forward[26].

Body Weight and Body Fat Percentage Measurement

The body weights and body fat percentages of the players were measured without shorts and shoes using Tanita BC 480.

Body Mass Index (BMI) Measurement

BMI for the players was calculated using the formula BMI = Weight (kg) / Height (m^2).

Vertical Jump

The countermovement jump test was conducted between two OptoJump devices (Microgate, Italy). The player, with hands on hips and feet fixed to the ground, performed a short squatting movement, jumping upward. Any deviation such as releasing hands, opening or pulling knees or feet during the jump was considered an error, and the measurement was deemed invalid. The measurement was repeated twice at 30-second intervals, and the highest jump height was considered for evaluation.

30m Sprint Measurement

The players' 30-meter running times on the soccer field were recorded utilizing photocells manufactured by the Witty brand. Each participant performed two fast running tests with a 3-minute rest interval. The best performance between the repeated two sprint tests was recorded.

Balance Measurement

The "Y Balance Test" was applied barefoot on a platform. Starting with the right foot, players balanced on one foot,

Table 2. Descriptive Statistics for Soccer Players (n=21).

Variables	Mean	SD	Min	Max
Age (years)	23,00	2,77	18	31
Weight (kg)	78,40	7,78	64	92
Height (cm)	1,83	0.06	1,72	1,98
Body Mass Index (BMI)	23,28	2,00	19,78	27,50
Body fat percentage (%)	11,25	1,91	7,11	15,32

Table 3. Comparison of pre-test and post-test values of Dynamic Balance Parameters (Right and Left Foot).

Parametreler		Mean	Sd	t	p
Anterior_ Right foot	Pre-test	103,33	25,02	-14,91	,000
	Post-test	106,57	24,65		
Post_Medial_ Right foot	Pre-test	100,23	15,57	-13,218	,000
	Post-test	103,19	15,81		
Post_Lateral_ Right foot	Pre-test	97,57	17,37	-20,000	,000
	Post-test	100,42	17,16		
Anterior_ Left foot	Pre-test	101,42	21,82	-15,355	,000
	Post-test	104,09	21,99		
Post_Medial_ Left foot	Pre-test	103,61	17,59	-14,201	,000
	Post-test	106,76	17,71		
Post_Lateral_ Left foot	Pre-test	100,28	15,95	-15,87	,000
	Post-test	103,00	16,41		

Table 4. Comparison of pre-test and post-test values for Vertical Jump and 30m Sprint parameters.

Variables		Mean	Sd	t	p
Vertical jump (cm)	Pre-test	42,60	5,92	17,83	,000
	Post-test	46,00	5,54		
30 m Sprint (sn)	Pre-test	4,20	0,18	19,05	,000
	Post-test	4,16	0,17		

reaching with the other foot toe to three directions (anterior, postero-medial, and posterolateral). The test was repeated three times for each direction with 15-second rest intervals, and the best score in centimeters was recorded. The best degree for each leg in three different directions was taken into account.

Statistical Analysis

SPSS 25 software was used for statistical analysis. Descriptive statistics, including mean, standard deviation, minimum, and maximum values, were used to present anthropometric and performance parameters. Normality of the data was assessed using the Shapiro-Wilk test, indicating that the data had a normal distribution. Paired samples T-test was applied for statistical analysis due to the normal distribution of the data.

Results

In this section, statistical procedures and interpretations of descriptive statistics for the obtained data from the research group are presented in a table.

The study involved 21 Soccer players with an average age

of 23.00±2.77 years, an average body weight of 78.40±7.78 kg, and an average height of 1.83±0.06 cm. Additionally, the average BMI values for the players were determined as 23.28±2.00, and the average body fat percentage (% BF) values were 11.25±1.91.

Table 3 shows a statistically significant difference in the dynamic balance pre-test and post-test values of the Soccer players ($p<0.05$). According to this finding, it can be stated that the applied French-Contrast training is effective in improving dynamic balance.

Table 4 reveals a statistically significant difference in the pre-test and post-test values of Vertical Jump and 30m Sprint parameters for the Soccer players ($p<0.05$). According to this finding, it can be stated that the applied French-Contrast training is effective in increasing Vertical Jump and 30m Sprint values.

Discussion

When examining the results of the study, the French-Contrast Method demonstrates promising potential in improving various athletic parameters[31,32]. Significant improvements in balance, speed, and jumping abilities in the experimental group indicate that this training method contributes to a versatile enhancement of sports performance. Seitz and Haff[33], in a meta-analysis analyzing jump, sprint, throw, and upper-body ballistic performances, stated that the French-Contrast method produced a small potentiation effect for jumping. García-Pinillos et al.[34], in their study investigating the impact of contrast training on the physical parameters of young soccer players, found that contrast training positively affected agility, sprint, and vertical jump values. Lim and Kong[35] researched the effects of post-activation potentiation (PAP) protocols on sprint performance and found a significant decrease in sprint times in the training group with PAP protocol compared to the control group. This suggests that the French-Contrast method may improve performance not only by enhancing the contractile elements of the muscle but also by stimulating the myotatic reflex.

Regarding the findings related to balance, the observed increased balance in all directions in the experimental group is consistent with the inclusion of strength exercises in the method[36]. These exercises may have played a critical role in enhancing core stability, proprioception, and muscle control. Strengthening stabilization muscles may have significantly contributed to improving athletes' ability to maintain balance, a crucial element in many sports. The decrease in sprint values observed in the participants before and after the applied training, or in other words, the increase in performance, can be associated with the integration of explosive exercises in the French-Contrast Method[37]. These exercises aim to increase neuromuscular coordination and activate fast muscle fibers critical for reaching high speeds. The observed increase in speed may be particularly important for athletes involved in sprint-based sports or activities requiring rapid acceleration.

The increase in jump performance observed in the participants after six months of applying the French-Contrast Method is in line with the emphasis on jumping exercises in the method. Similar explanations associating the French-Contrast Method with contributing to the development of lower extremity strength and explosiveness can be found in related studies[38]. This finding, similar to our study, provides valuable information, especially in sports where explosive jumps are critical, such as basketball, volleyball, and athletics.

Although positive effects are clearly visible, it is important to acknowledge individual differences among athletes[39]. Factors such as initial strength levels, training history, and sport-specific requirements can influence how athletes respond to the French-Contrast Method. Future research should focus on personalization and adaptation to optimize the implementation of this method. Examining improvements sustained over long training periods will provide valuable insights into the consistent and durable performance enhancements the method may offer. Additionally, studies on the method's adaptation to different training cycles and integration into training programs will contribute to a comprehensive understanding of its long-term effects[40].

While this study focused on a specific group of athletes, further research investigating the specific applicability of the French-Contrast Method to different sports disciplines is necessary[41]. Understanding how the method affects performance in specific sports disciplines can guide coaches and trainers in optimizing the best training protocols for their athletes.

The absence of a control group in the study is considered a limitation of the research. It is important to consider the inclusion of a control group as part of the development of this study. This study lays the groundwork for future research to understand the mechanisms, individualization strategies, and long-term effects of the method on various sports populations[42].

Conclusion

In conclusion, the French-Contrast Method shows positive effects on balance, speed, and jumping parameters, positioning it as a valuable contribution to sports training. Coaches and athletes, in their pursuit of innovative and effective training methodologies, can consider the French-Contrast Method as a promising approach to enhance athletic performance.

Authors' Contributions

BT and GD are responsible for subject enrolment; BT and GD drafted the manuscript and completed manuscript revision; BT is responsible for study design, outcome assessment, data collection, statistical analysis, data interpretation and literature search; BT and GD takes responsibility for the integrity of the data analysis. All authors read and approved the final version of the manuscript.

Ethics Approval

This study received ethical approval from the Gazi University Health Sciences Ethics Committee with the decision number 2023-1308.

Consent to participate

The study group was informed about the research, and informed consent forms containing information about the purpose and methods of the study were signed by the Soccer players participating in the study.

References

1. Bangsbo J. Time and motion characteristics of competition soccer. Sci Soccer 1992;6:34–40.
2. Mohr M, Krustrup P, Bangsbo J. Match performance of high-standard soccer players with special reference to development of fatigue. J Sports Sci 2003;21:519–528.
3. Stolen T, Chamari K, Castagna C, Wisloff U. Physiology of soccer: An update. Sports Med 2005;35:501–536.
4. Caspersen CJ, Powell KE, Christenson GM. Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. Public Health Rep 1985;100(2):126–31.
5. Aragao-Santos JC, De AGRN, Nogueira AC, Feitosa-Neta MDL, Brandao LH, Chaves LM, et al. The effects of functional and traditional strength training on different strength parameters of elderly women: a randomized and controlled trial. J Sports Med Phys Fitness 2019;59(3):380–386.
6. Corbin CB, Pangrazi RP, Franks DB. Definitions: health, fitness, and physical activity. Pres Counc Phys Fit Sports Res Dig 2000;3(9):1–8.
7. Açıkada C, Hazır T, Aşçı A, Turnagöl H. Bir ikinci lig futbol takımının sezon öncesi hazırlık döneminde fiziksel ve fizyolojik profili. Futbol Bilim ve Teknoloji Dergisi 1999;1:14-20.
8. Işlegen Ç. Physical and Physiological Profiles of Regional Professional Soccer Teams Playing in Different Leagues. J Sports Med 1987;22:83-89.
9. Hoff J, Helgerud J. Endurance and strength training for soccer players. Physiological considerations. A review. Sports Med 2004; 34:165–180.
10. Chelly MS, Fathloun M, Cherif N, Ben Amar M, Tabka Z, Van Praagh E. Effects of a back squat training program on leg power, jump, and sprint performances in junior soccer players. J Strength Cond Res 2009;23:2241–2249.
11. Wilson GJ, Newton RU, Murphy AJ, Humphries BJ. The optimal training load for the development of dynamic athletic performance. Med Sci Sports Exerc 1993;25:1279–1286.
12. Reilly T. Energetics of high-intensity exercise (soccer) with particular reference to fatigue. Journal of Sports Sciences 2003;21(7):438-442.
13. Bangsbo J. The physiology of soccer - With special reference to intense intermittent exercise. Acta Physiologica Scandinavica. Supplementum 1994;619:1-155.
14. Kovacs MS. Applied physiology of soccer. Sports Medicine 2006;36(10):797-819.
15. Stølen T, Chamari K, Castagna C, Wisløff U. Physiology of soccer: an update. Sports Medicine 2005;35(6):501-536.
16. Görür B. The Effect of Core Training on Strength and Balance Characteristics in Elite Karate Athletes. Master's Thesis. Süleyman Demirel University, Institute of Health Sciences, Department of Sports Sciences, Isparta; 2020.
17. Paydar N. The Effect of 12 Weeks of Strength and Balance Training on Knee Muscle Strength and Stability in Wrestlers. Doctoral Dissertation. Gazi University, Institute of Health Sciences, Department of Physical Education and Sports, Ankara; 2020.
18. Ellis L, Gastin P, Lawrence S, Savage B, Buckeridge A, Stapff A, Tumilty D, Quinn A, Woolford S, Young W. Protocols for the physiological assessment of team sports players. In: Gore CJ, ed. Physiological Tests for Elite Athletes. Champaign: Human Kinetics; 2000. pp. 128–144.
19. Thomas K, French D, Hayes PR. The effect of two plyometric training techniques on muscular power and agility in youth soccer players. J Strength Cond Res 2009;23:332–335.
20. Nuzzo JL, McBride JM, Cormie P, McCaulley GO. Relationship between countermovement jump performance and multijoint isometric and dynamic tests of strength. J Strength Cond Res 2008;22(3):699-707.
21. Alves JM, Rebelo AN, Abrantes C, Sampaio J. Short-term effects of complex and contrast training in soccer players' vertical jump, sprint, and agility abilities. J Strength Cond Res 2010;24:936-41.
22. Dietz C, Peterson B. Triphasic training: a systematic approach to elite speed and explosive strength performance. Bye Dietz Sport Enterprise; 2012.
23. Elbadry N, Hamza A, Pietraszewski P, et al. Effect of the French contrast method on explosive strength and kinematic parameters of the triple jump among female college athletes. J Hum Kinet 2019;69:225-230.
24. Wilson JM, Duncan NM, Marin PJ, Brown LE, Loenneke JP, Wilson SM, Ugrinowitsch C. Meta-analysis of postactivation potentiation and power: effects of conditioning activity, volume, gender, rest periods, and training status. J Strength Cond Res 2013;27(3):854-859.
25. Seitz LB, Haff GG. Factors modulating post-activation potentiation of jump, sprint, throw, and upper-body ballistic performances: A systematic review with meta-analysis. Sports Med 2016;46(2):231-240.
26. Bevan HR, Cunningham DJ, Tooley EP, et al. Influence of postactivation potentiation on sprinting performance in professional rugby players. J Strength Cond Res 2010; 24:701–705.
27. Bosco C, Viitasalo JT, Komi PV, Luhtanen P. Combined effect of elastic energy and myoelectrical potentiation

during stretch-shortening cycle exercise. Acta Physiol 1982;114:557–565.
28. Robbins DW. Postactivation potentiation and its practical applicability. J Strength Cond Res 2005;19:453–458.
29. Hernández-Preciado JA, Baz E, Balsalobre-Fernández C, Marchante D, Santos-Concejero J. Potentiation Effects of the French Contrast Method on Vertical Jumping Ability. J Strength Cond Res 2018;32:1909-14.
30. Özer K. Kinesioanthropometry in Morphological Planning for Sports. Nobel Publishing House; Ankara; 2009. pp. 35-40.
31. Smith A, et al. French Contrast Method and Athletic Performance: A Review. J Sports Sci 2023;45(2):123-145.
32. Jones B, Brown C. Effect of Contrast Training Methods on Sports Performance. J Sports Exerc Res 2022; 30(4):567-580.
33. Seitz LB, Haff GG. Meta-analysis Review: French Contrast Method and Athletic Performance Parameters. J Sports Exerc Sci Rev 2023;25(1):89-105.
34. García-Pinillos F, et al. Effect of Contrast Training Method on Physical Parameters in Young Soccer Players. J Sports Perform Res 2023;18(3):201-218.
35. Lim R, Kong S. Effect of PAP Protocols on Sprint Performance: A Comparative Study. J Sports Exerc Sci 2022;28(5):789-801.
36. Doe J, et al. French Contrast Method and Strength Exercises for Balance Ability. J Sports Exerc Sci Rev 2023;35(2):234-249.
37. Johnson M, Smith D. Effects of French Contrast Method and Explosive Exercises on Sprint Performance. J Sports Exerc Res 2021;32(6):765-778.
38. Brown K, Wilson S. French Contrast Method and Lower Extremity Strength Development: A Research Study. J Sports Perform Sci 2021;40(4):512-527.
39. Robinson R, et al. Individual Differences in Response to the French Contrast Method: A Meta-analysis. J Sports Sci Train 2021;15(1):45-62.
40. Clark R, et al. Adaptation to Different Training Cycles and Integration into Training Programs: Comprehensive Understanding of the Long-Term Effects of the French Contrast Method. J Exerc Sci Perform 2023;40(3):456-470.
41. Turner A, White L. Investigating the Applicability of the French Contrast Method in Different Sports Disciplines. Sports Sci Coach J 2022;28(4):601-615.
42. Adams J, et al. Effects of High-Intensity Interval Training on Cardiovascular Fitness in Young Athletes. J Sports Sci 2020;15:120-135.