CORPS & PSYCHISME
P-ISSN : 2496-4476 E-ISSN: 2273-1571
Volume 13/ Issue 1/ 2026

The Relationship Between Intermittent Strength Exercises and Physical Development in Soccer Players

Benyamina Mohammed Mehdi[1], Azzem Ahmed[2], Boutobza Nouari[3], Abdeldjelil Chahrazad [4], Gasmi Abdelmalek[5], Sellami Abderrahim[6]. Belabed abderrahim[7]
[1]Laboratory for Expertise and Analysis of Sports Performance « LEAPS »,ISTAPS, University Abdelhamid mehri Constantine 02 (Algeria), E-mail: Mehdi.benyamina@univ-constantine2.dz
[2]Laboratory for Expertise and Analysis of Sports Performance « LEAPS »,ISTAPS, University Abdelhamid mehri Constantine 02 (Algeria), E-mail: ahmed.azzem@univ-constantine2.dz
[3]Laboratory for Expertise and Analysis of Sports Performance « LEAPS », ISTAPS, University Abdelhamid mehri Constantine 02 (Algeria), E-mail: nouari.boutobza@univ-constantine2.dz
[4]Laboratory for Expertise and Analysis of Sports Performance « LEAPS »,ISTAPS, University Abdelhamid mehri Constantine 02 (Algeria), E-mail: Chahrazed.abdeldjelil@univ-constantine2.dz
[5]Laboratory for Expertise and Analysis of Sports Performance « LEAPS »,ISTAPS, University Abdelhamid mehri Constantine 02 (Algeria), E-mail: Abdelmalek.gasmi@univ-constantine2.dz
[6]Laboratory for Expertise and Analysis of Sports Performance « LEAPS », ISTAPS, University Abdelhamid mehri Constantine 02 (Algeria), E-mail: abderrahim.sellami@univ-constantine2.dz
[7]Laboratory for Expertise and Analysis of Sports Performance « LEAPS », ISTAPS, University Abdelhamid mehri Constantine 02 (Algeria), E-mail: abderrahim.belabed@univ-constantine2.dz

Received: 05/03/2026 ; Accepted: 26/05/2026 ; Publish:01/06/2026

Abstract
The aim of this study was to examine the effect of intermittent strength training on improving several performance factors, including maximal aerobic speed (MAS) and muscular power, in U19 football players.
A total of 22 amateur U19 players participated in the study and were divided into two groups of 11 players each. The participants performed the Intermittent Fitness Test (IFT) to assess MAS and estimate VO_2max, in addition to the 5-jump test to evaluate muscular power.
The findings revealed that intermittent strength exercises had a significant positive effect on the development of physical qualities in the players.
Keywords: intermittent strength, physical qualities, U19 players.

1. INTRODUCTION

Modern match analysis using advanced technological tools has shown a clear evolution in the physical demands of football. In 1952, players covered an average distance of approximately 3361 m during a match, whereas current values range between 10,425 m and 11,780 m (Dellal et al., 2011). These efforts correspond to average heart rate values between 80% and 90% of maximum heart rate (Stolon et al., 2005).

Football is considered a multifactorial activity in which performance depends on the interaction of technical, tactical, physical, and psychological abilities. Moreover, each playing position has its own specific characteristics according to tactical requirements and offensive or defensive strategies established by the coaching staff. Therefore, physical preparation occupies a central role in modern football, whether integrated, dissociated, or combined with technical and tactical training (Dellal, 2010).

In addition, muscular power represents a decisive factor in both defensive and offensive actions. It reflects the ability of the neuromuscular system to overcome resistance with the highest possible contraction speed. This quality is particularly important in football because it combines strength and speed, enabling players to perform jumps, shots, accelerations, changes of direction, braking, and repeated short sprints effectively (Weineck, 1996).

Bangsbo (1994a, 1994b) and Verheijen (1997) described football activity as “intermittent” because players continuously alternate between actions such as dribbling, sprinting, and running at varying intensities throughout the match. These intensities differ depending on playing position, competitive level, experience, and tactical role within the team. Consequently, many researchers have focused on intermittent exercises because of their numerous physiological and performance-related benefits.

According to Cometti, intermittent training can take several forms, one of which is intermittent strength training. In football, the performance model requires repeated maximal efforts of short duration, characterized by significant involvement of the anaerobic alactic energy system and type II muscle fibers. Such maximal efforts must be repeated intermittently to reflect the real demands of the game.

Based on these considerations and previous studies, particularly that of Cometti (2010), which highlighted the importance of intermittent strength training in the development of aerobic qualities, the present study aimed to investigate the effect of this training method on improving physical qualities, especially endurance and strength-speed, in football players.

2. Objective of the study:

The objective of the study is to know the impact of the intermittent force method on the performance factors “endurance, strength, speed” in U19 football players.

3. Materials and methods:

22 u19 category players participated in the study. They were divided into 2 groups each containing 11 players. The subjects performed the Yo-Yo test to measure the “MAS” and extrapolate the VO2max and the 5 jump test to measure the strength power , and the following table shows the properties of the research sample.

Table n: 01 shows the morphological characteristics of the study samples.

	lenthg (cm)	weight (kg)	Age (years)
Experimental sample	179.15	69.12	19
Control sample	179.25	69.33	19

4. Presentation of the results: after applying the tests on the samples, we obtain the results shown in the following tables:

Table n : 02 shows the experimental sample results.

	Pre-test		Post-test	
	X	**S**	**X**	**S**
Maximum aerobic speed	14.5	1.45	16.5	1.05
Strentgh power	10.33	1.63	12.24	1.17

X : mean. **S** : standard deviation

Table n: 03 shows the control sample results.

	Pre-test		Post-test	
	X	**S**	**X**	**S**
Maximum aerobic speed	14	1.48	15.5	1.12
Strenthg power	10.29	1.72	11.40	1.28

X : mean. **S** : standard deviation

Table n:(04) shows the post-test comparison results of the study samples

Study parameters	The mean		Value of « T » test	Value of « T » table	The meaning of the results
	Control sample	**Expérimental sample**			
	X	**X**			
Maximum aerobic speed	**15.5**	**16.5**	**3.17**	**1.74**	**significal**
strength power	**11.40**	**12.24**	**4.26**	**2.65**	**significal**

Degree of freedom= 20 **Sig = 0.05** **X: the mean**

5. discussion:

Most studies investigating intermittent exercise have mainly focused on the acute physiological and physical responses induced by this type of training (Clemente et al., 2014a; Halouani et al., 2014b; Hill-Haas et al., 2011). Nevertheless, the long-term effects resulting from structured training programs appear to be more relevant for determining the effectiveness of intermittent training in team sports.

Research conducted in several team sports, including football, futsal, and rugby, demonstrated that intermittent training programs contribute to improving players' aerobic performance and their repeated sprint ability (Berdejo-del-Fresno et al., 2015; Owen et al., 2012; Seitz et al., 2014). Similarly, a study on elite soccer players by Dellal et al. (2008) showed that heart rate responses during the 30–30 intermittent protocol with active recovery were significantly higher than those observed during various small-sided games such as 1 vs 1, 4 vs 4, 8 vs 8, and 10 vs 10.

CORPS & PSYCHISME
P-ISSN : 2496-4476 E-ISSN: 2273-1571
Volume 13/ Issue 1/ 2026
Intermittent exercise has also been associated with delayed fatigue onset and faster recovery between training sessions (Balsom, 1995). These adaptations may be explained by improved muscular buffering capacity (Böning et al., 2007), the recruitment of all muscle fiber types with simultaneous phosphocreatine utilization and oxygen consumption through myoglobin and hemoglobin pathways (Bhambhani, 2004), reduced reliance on anaerobic glycolysis, better glycogen preservation, and lower lactate accumulation (Gaitanos et al., 1993). Moreover, short-duration intermittent formats such as 5–20, 10–10, and 15–15 are considered effective methods for enhancing athletes' anaerobic capacity (Billat, 1998).

The effects of intermittent training have been extensively studied in football, handball, and basketball. Most studies reported significant improvements between pre- and post-training measurements in both aerobic and anaerobic systems as well as physical performance capacities (Buchheit et al., 2009b; Delextrat & Martínez, 2014; Impellizzeri et al., 2006).

Training interventions lasting between 6 and 12 weeks produced notable improvements in aerobic indicators, including VO2max (7–8% increase) (Impellizzeri et al., 2006a; Radziminski et al., 2013; Reilly & White, 2004), VO2 at lactate threshold (8–13% increase) (Impellizzeri et al., 2006a; Radziminski et al., 2013), and 30–15 Intermittent Fitness Test performance (3–6% improvement) (Buchheit et al., 2009b; Delextrat & Martínez, 2014). Significant gains were also observed in sprint performance, including the 5 m sprint (2–3% improvement) (Radziminski et al., 2013), 10 m sprint (1–4% improvement) (Buchheit et al., 2009b; Iacono et al., 2015), 20 m sprint (2–4% improvement) (Iacono et al., 2015), and agility performance (1–2% improvement) (Iacono et al., 2015).

Furthermore, intermittent and combined training methods positively affected muscular power and explosive performance. Improvements were reported in countermovement jump performance (3–10%) (Arcos et al., 2015; Buchheit et al., 2009b; Iacono et al., 2015), peak power output (4–5%) (Jastrzebski et al., 2014; Radziminski et al., 2013), total work capacity (4–5%) (Radziminski et al., 2013), bench press performance (6–12%) (Iacono et al., 2015), upper-body power (1–7%) and lower-body power (1–4%) (Delextrat & Martínez, 2014).

High-intensity intermittent running has also been shown to simultaneously enhance VO2max and anaerobic capacity (MacMahon & Wenger, 1998; Bogdanis et al., 1995). In addition, plyometric and strength training methods play a major role in developing explosive strength. Fukunaga (2002) emphasized the importance of plyometric training in generating high force production, while Bosco (1992) and Cometti (2007) attributed these improvements to enhanced elastic properties of muscles, leading to greater neuromuscular efficiency.

The findings of the present study are consistent with those of Adams (1992), who demonstrated that combining strength and plyometric training results in performance improvements up to three times greater than using either method independently. Likewise, Cometti (2012) reported that resistance training improves explosiveness, while its combination with plyometric exercises contributes to greater training variability and effectiveness.

Several molecular and neuromuscular mechanisms may explain these adaptations. Mackintosh (2004) suggested that increased phosphorylation of actin and myosin chains enhances calcium sensitivity within muscle fibers, thereby improving muscle contraction efficiency. Duchateau (2003) explained that strength improvements may result from increased neural firing frequency and greater motor unit recruitment, leading to enhanced muscular force production.

Moreover, studies conducted by Victor (2013) and Charles (2014) supported the effectiveness of strength training in improving athletic performance and recommended individualized load

prescription to optimize training outcomes. Cometti (2012) also confirmed that maximal strength may increase by 150–200% following plyometric training.
Similarly, Alexandre Hidalgo (2013) demonstrated that combined training significantly improves Squat Jump and Countermovement Jump (CMJ) performance. In contrast, Sofian Hamdi (2012) found that isolated plyometric or strength training performed over six weeks did not significantly improve SJ and CMJ performance. These findings support the conclusions of Jürgen Weineck (1997), who emphasized that combining strength and plyometric training leads to greater improvements in strength, speed, and explosiveness.
Overall, these findings help explain the positive adaptations observed in all variables examined in the present study.

6. Conclusion:

Research has shown that football players cover an average total distance ranging between 9,995 m and 11,233 m during a match (Rampinini et al., 2007a). These findings confirm the importance of endurance and aerobic capacity as essential physical qualities in football performance (Bangsbo, 1994a). Nevertheless, due to the intermittent nature of football activity, training programs must include specific endurance methods adapted to the physiological demands of the game.
Short-duration intermittent exercises are considered highly specific to football because they simultaneously stimulate both anaerobic (Bangsbo, 2008; Gaitanos et al., 1993) and aerobic energy systems (Bangsbo, 2007; Dupont, 2003). Such training methods contribute to the optimization of maximal aerobic speed associated with VO2max (vVO2max) (Billat et al., 2002), enhance the activity of oxidative enzymes (Parolin et al., 1999), and improve peripheral physiological adaptations (Thompson et al., 1999).
The effectiveness of intermittent training in football is widely recognized. However, careful consideration must be given to the manipulation of training variables such as work duration (Balsom, 1995) and recovery intervals (Dupont et al., 2004). In this context, the 30–15 Intermittent Fitness Test (IFT) developed by Martin Buchheit (2008) represents an effective tool for accurately prescribing and monitoring short-duration intermittent training. Moreover, the physiological responses induced by straight-line intermittent exercises differ from those observed in shuttle-running formats (Bisciotti et al., 2000), although both methods remain valuable depending on the objectives and periodization phase of the season (Grosgeorge & Dellal, 2005).

***7. Liste Bibliographique*:**

1. **Balsom, P.D., Gaitanos, G.C., Ekblom, B., and Sjödin, B. (1994)**. Reduced oxygen availability during high intensity intermittent exercise impairs performance. Acta Physiol. Scand. 152, 279–285.
2. **Bangsbo, J. (2014)**. Physiological demands of football. Sports Science ,Exchange, 27(125), 1–6.
3. **Buchheit, M., Allen, A., Poon, T. K., Modonutti, M., Gregson, W., & Di Salvo, V. (2014)**. Integrating different tracking systems in football: Multiple camera semi-automatic system, local position measurement and GPS technologies. Journal of Sports Sciences, 00(00), 1–14.
4. **Buchheit, M., Laursen, P. B., Kuhnle, J., Ruch, D., Renaud, C., &Ahmaidi, S. (2009a)**.Game-based training in young elite handball players. International Journal of Sports Medicine, 30(4), 251–258.

5. **Buchheit, M., Mendez-villanueva, A., Simpson, B. M., & Bourdon, P. C. (2010)**. Repeated-sprint sequences during youth soccer matches. International Journal of Sports Medicine, 31(10), 709–716.

6. **Casamichana, D., Castellano, J., &Castagna, C. (2012)**.Comparing the physical demands of friendly matches and small-sided games in semiprofessional soccer players. Journal of Strength and Conditioning Research, 26(3), 837–843. 22 2 Physiological Demands of the Soccer and Time–Motion Profile

7. **Casamichana, D., Castellano, J., &Dellal, A. (2013).** Influence of different training regimes on physical and physiological demands during small-sided soccer games. Journal of Strength and Conditioning Research, 27(3), 690–697.

8. **Castagna, C., Impellizzeri, F. M., Chaouachi, A., Ben Abdelkrim, N., &Manzi, V. (2011)**.Physiological responses to ball-drills in regional level male basketball players.Journal ofSports Sciences, 29(12), 1329–1336.

9. **Castellano, J., Casamichana, D., &Dellal, A. (2013)**. Influence of game format and number of players on heart rate responses and physical demands in small-sided soccer games. Journal of Strength & Conditioning Research, 27, 1295–1303.

10. **Castellano, J., Casamichana, D., &Dellal, A. (2013)**. Influence of game format and number of players on heart rate responses and physical demands in small-sided soccer games. Journal of Strength & Conditioning Research, 27, 1295–1303.

11. **Chamari, K., Dellal, A., Pintus, A., Girard, O., Cotte, T., & Keller, D.** (2008). Heart rate responses during small-sided games and short intermittent running training in elite soccer players: A comparative study. Journal of Strength and Conditioning Research, 22(5), 1449–1457.

12. **Clemente, F. M., Martins, F. M. L., Kalamaras, D., Wong, D. P., & Mendes, R. S. (2015b).** General network analysis of national soccer teams in FIFA World Cup 2014. International Journal of Performance Analysis in Sport, 15(1), 80–96.

13. **Clemente, F. M., Martins, F. M. L., Wong, D. P., Kalamaras, D., & Mendes, R. S. (2015c).**Midfielder as the prominent participant in the building attack: A network analysis of national teams in FIFA World Cup 2014. International Journal of Performance Analysis in Sport, 15 (2), 704–722.

14. **Clemente, F. M., Wong, D. P., Martins, F. M. L., & Mendes, R. S. (2014c)**. Acute effects of the number of players and scoring method on physiological, physical, and technical performance in small-sided soccer games. Research in Sports Medicine, 22(4), 380–397.

15. **Cometti Gilles. 2005.** La préparation physique en football. Édition Chiron.

16. **Delextrat, A., &Martínez, A. (2014)**. Small-sided game training improves aerobic capacity and technical skills in basketball players. International Journal of Sports Medicine, 35, 385–391.

17. **Dellal, A., Varliette, C., Owen, A., Chirico, E. N., &Pialoux, V. (2012)**. Small-sided games versus interval training in amateur soccer players: Effects on the aerobic capacity and the ability to perform intermittent exercises with changes of direction. Journal of Strength and Conditioning Research, 26(10), 2712–2720.

18. **Impellizzeri et al** :(2008), validity of reptead sprint ability test for foot Ball,

19. **Krustrup, P., Dvorak, J., Junge, A., &Bangsbo, J. (2010)**. Executive summary: the health and fitness benefits of regular participation in small-sided football games. Scandinavian Journal of Medicine and Science in Sports, 20(Suppl 1), 132–135.

20. **Mendez-Villanueva, A., Buchheit, M., Simpson, B., & Bourdon, P**. (2012). Match play intensity distribution in youth soccer. International Journal of Sports Medicine, 34(02), 101–110.

21. **Mohr, M., Krustrup, P., &Bangsbo, J. (2005).**Fatigue in soccer: a brief review.Journal of Sports Sciences, 23(6), 593–599.

22. **Mohr, M., Krustrup, P., Andersson, H., Kirkendal, D., &Bangsbo, J. (2008)**. Match activities of elite women soccer players at different performance levels. Journal of Strength and Conditioning Research, 22(2), 341–349.

23. **Radziminski, L., Rompa, P., Barnat, W., Dargiewicz, R., &Jastrzebski, Z. (2013)**. A comparison of the physiological and technical effects of high-intensity running and small-sided games in young soccer players. International Journal of Sports Science & Coaching, 8(3), 455–465.

24. **Rampinini, E., Impellizzeri, F. M., Castagna, C., Coutts, A. J., &Wisløff, U. (2009)**. Technical performance during soccer matches of the Italian Serie A league: effect of fatigue and competitive level. Journal of Science and Medicine in Sport/Sports Medicine Australia, 12(1), 227–233.