©Journal of Sports Science and Medicine (2024) **23**, 843-851
http://www.jssm.org DOI: https://doi.org/10.52082/jssm.2024.843

Research article

Elastic Bands During Half-Squats as A Re-Warm-Up Strategy for Youth Soccer Players' Performance

Javier Sanchez-Sanchez [1]✉, Filipe Manuel Clemente [1,2,3,4], Rodrigo Ramirez-Campillo [1,5] and Alejandro Rodríguez-Fernández [1,6]

[1] Research Group PRENDE, Universidad Pontificia de Salamanca, Spain; [2] Escola Superior Desporto e Lazer, Instituto Politécnico de Viana do Castelo, Rua Escola Industrial e Comercial de Nun'Álvares,, Portugal; [3] Sport Physical Activity and Health Research & Innovation Center, Portugal; [4] Gdansk University of Physical Education and Sport, Gdańsk, Poland; [5] Exercise and Rehabilitation Sciences Institute, School of Physical Therapy, Faculty of Rehabilitation Sciences, Universidad Andres Bello, Chile; [6] VALFIS Research Group, Institute of Biomedicine (IBIOMED), Faculty of Physical Activity and Sports Sciences, University of Leon, Leon, Spain

Abstract

The study aimed to assess the immediate effects of re-warm-up strategies using half-squats with elastic looped bands on the performance of youth soccer players. A cross-over study design with repeated measures was implemented in field youth male soccer players (n = 20, age 15.7 ± 0.8 years). Following the first 45-min of match play, players were subjected to one of four re-warm-up (Re-w) interventions of equal duration: no Re-w (PAS), half-squat without elastic looped bands (SQ), half-squat with bands placed on the thighs (SQT), and half-squat with bands placed on the lower legs (SQL). These interventions were compared against a control condition (CON). The Re-w protocols were initiated 10-min after half-time, and players' performance was evaluated through vertical and horizontal jump tests, 20-m linear sprint, and T-agility test. Statistical analysis using ANOVA revealed that the SQT and SQL interventions significantly improved ($p < 0.001$) several performance metrics compared to the PAS and SQ conditions. These improvements were observed in squat jumps, unilateral squat jumps (both dominant and non-dominant legs), countermovement jumps, horizontal jumps, triple horizontal jumps, the 20-m linear sprint, and T-agility performance. In conclusion, SQT and SQL are equally effective to enhance performance as Re-w strategies after the 1st-half of a soccer match. However, the lack of physiological data and 2nd-half assessments suggests the need for further research to confirm the persistence of these effects.

Key words: Human physical conditioning, athletic performance, warm-up exercise.

Introduction

Soccer is played over two consecutive periods separated by a 15-min half-time recovery break (Yanaoka et al., 2018). Traditionally, the recovery period involves passive rest, allowing replenishing of energy stores, hydration, and planification of the game strategy for the 2nd-half of the match (Russell et al., 2015b). However, passive recovery often leads to a significant drop in body temperature, which impairs neuromuscular function and decreases performance in high-intensity actions such as sprinting and jumping (Gonzalez et al., 2023). This cooling effect slows reaction times and reduces muscle power, ultimately contributing to a decline in game-specific sharpness that adversely impacts decision-making and reaction efficiency (Edholm et al., 2014). Such effects can drastically affect performance during the first 15-min of the 2nd-half, a period in which players experience the highest frequency of maximum speed actions, regardless of their position (Oliva-Lozano et al., 2022). Consequently, the drop in body temperature not only compromises performance but also heightens the risk of injuries during this critical phase of the game, which demands significant locomotor effort (Mohr et al., 2004). To mitigate these negative effects, incorporating reactivation exercises during the 15-min half-time break could be beneficial (Towlson et al., 2013). However, despite clear evidence of their effectiveness in counteracting performance decline and reducing injury risk, these exercises are rarely utilized in practice, representing a missed opportunity to enhance both player safety and performance (Gonzalez et al., 2023).

The incorporation of reactivation exercises during the half-time recovery break, commonly known as re-warm-up (Re-w), plays a crucial role in facilitating the transition from rest to activity, effectively preparing players for the physical demands of the 2nd-half (Lovell et al., 2007). Various methods have been effectively employed, including low-intensity exercises (i.e., <70% of maximum heart rate) (Mohr et al., 2004). For example, a study by Ltifi et al. (2023a) demonstrated that a brief 3-minute Re-w using weighted vests at 5% and 10% of body mass significantly improved 20-m sprint performance in U15 elite soccer players, highlighting the effectiveness of shorter, low-load (micro-dose) interventions. Similarly, Re-w involving 7-min of low to moderate-intensity jogging and light calisthenics enhanced sprint and jump performance (Edholm et al., 2014). High-intensity Re-w (i.e., leg-press at 5-repetition maximum) also improved flight-time to contraction-time ratio (9.4%), peak velocity (4%), mean velocity (3%), and acceleration (18%) in soccer players (Zois et al., 2013). Abade et al. (2017) also noted that 6-min Re-w protocols involving plyometrics and repeated changes of direction (COD) improved jump and sprint performance. Another study involving soccer players implemented a Re-w focused on COD exercises, improving agility (T-agility test) and kicking velocity (Matsentides et al., 2023).

However, there is no consensus regarding optimal

Received: 22 August 2024 / Accepted: 30 October 2024 / Published (online): 01 December 2024

Re-w (González-Devesa et al., 2021; Hammami et al., 2018; Miguel Silva et al., 2018). Some Re-w moderators' variables (e.g., volume, intensity, type of exercise) may affect subsequent performance (Abade et al., 2017). Additionally, the limited time available for the Re-w restricts the type of activities that can be implemented (Towlson et al., 2013). Therefore, simple reactivation exercises, such as jogging and dynamic stretches, are desirable as they are familiar to the players, easy to organize, and induce favorable physiological effects, such as increased body temperature (Abade et al., 2017; Lovell et al., 2007). Also, using readily available tools that can be easily transported across different contexts allows for the application of micro-loads that offer substantial benefits. For instance, the recent study by Ltifi et al. (2023b) found that wear light-weighted wearable resistance allowing the application of micro-loads of 0.1%, 0.2%, and 0.3% of body mass was more effective than a control condition (i.e., without external load) for optimizing repeated change-of-direction performance. Similarly, incorporating exercises using elastic looped bands (ELB) can evoke favorable neuromuscular responses, enhancing the overall effectiveness of these reactivation strategies (Nickerson et al., 2018; Sanchez-Sanchez et al., 2024).

Indeed, the use of ELB during squats increased myoelectric activity (Martins et al., 2022), especially when positioned distally compared to proximally along the leg (i.e., thigh vs lower leg vs forefoot) (Foley et al., 2017). The favorable neuromuscular responses induced by ELB includes muscle groups such as the tensor fasciae latae, gluteus maximus, gluteus medius, vastus medialis, vastus lateralis, and biceps femoris (Foley et al., 2017). Moreover, ELB can be equally effective as barbells in enhancing jump power (Buttifant and Hrysomallis, 2015).

Nonetheless, there is a scarcity of research focusing on the applicability of ELB within the context of soccer, particularly in competitive situations. This limitation can be attributed to a historical emphasis on traditional strength training methods in the literature, which has constrained the exploration of ELB and their specific advantages for soccer-related movements, such as sprinting and COD. Additionally, many existing studies have been conducted in laboratory environments where indirect measures of performance were assessed. This underscores the need for more targeted research in this area, especially concerning how ELB could enhance performance in essential actions during matches (Silva et al., 2024).

Therefore, the aim of this study was to assess the immediate effects of Re-w strategies using half-squats with ELB positioned on the performance of youth soccer players. It was hypothesized that i) half-squats with ELB will improve jump and sprint performance compared to half-squats without ELB; ii) larger improvements are expected after SQL compared to SQT.

Methods

Participants

A total of 20 field youth male soccer players (age 15.7 ± 0.8 years, body mass 64.4 ± 5.3 kg and height 165.7 ± 3.2 cm) participated in this study. Players had accumulated 8.5 ± 1.2 years of experience in competitive soccer and belonged to Tier 3 (elite developmental level) (McKay et al., 2022). These athletes regularly compete at the national level, engage in structured and periodized training, and are developing proficiency in key skills required for high-level soccer performance, including biomechanics, ball skills, and acquired decision-making components. Inclusion criteria consisted in i) free of injuries in the last 3-months; ii) had regularly trained and competed in the past 6-months; iii) had a minimum of 2-years of experience in structured resistance training; iv) had at least 5-years of experience of soccer experience; v) each player was required to participate in all four conditions. The field players were 8 defenders, 4 central-midfielders, 4 wide-midfielders and 4 center-forward. Their regular training schedule involved 3 training sessions plus a competitive match per week. Each training session lasted for 2-h, including a 45-min simulation game every 48-h leading up to the competition. The methods and procedures used in this study were approved by the institutional review board for use of human subjects (code: Annex III, Act 13/2/2019), and respected the procedures followed the Declaration of Helsinki. Prior to the beginning, all subjects and their parents completed a health history questionary. A parent signed an informed consent form, and each subject signed an informed assent after receiving a thorough explanation of the study's protocol.

Experimental design

During 4 consecutive microcycles in the 2nd-half of the competitive season, a crossover-controlled and randomized study was conducted. A microcycle, in this context, consists of a training week in which the team trained on Tuesday, Wednesday, and Friday, corresponding to match-day +2, match-day -4, and match-day -2, respectively. Players underwent 4 different Re-w interventions of identical duration, including no Re-w (PAS), half-squat without ELB (SQ), SQT, and SQL. The strategies were implemented across four simulated match scenarios, consistently conducted on the same day of the week and under identical conditions to ensure reproducibility. In these scenarios, players from the same team were divided into 2 teams with a 1-4-4-2 formation and were given the same technical-tactical instructions for all halves. The effects of the different Re-w strategies were assessed using vertical and horizontal jumps, linear 20-m sprint, and T-agility tests. The comparison was made against a controlled setting (CON) after 45-min of match play (1st-half).

Procedures

To replicate realistic match day conditions, we theorized that players would require approximately 10-min after concluding the 1st-half to return from the locker rooms, receive final coaching instructions, and return to the field to perform the Re-w before the start of the 2nd-half (i.e., 15-min after the end of the 1st-half) of the soccer match. Each Re-w intervention lasted for 5-min and was conducted 10-min after the end of the 1st-half. Assessment sessions were performed at the same time of the day (18:00 - 20:00 PM) on artificial turf pitches, under similar environmental conditions (temperature 18 - 24ºC). All Re-w conditions were randomly implemented during a 4-microcycle experimental period with at least 72-h between intervenetions (Figure 1). Players were required to complete 2 familiarization sessions including the Re-w conditions as well as vertical and horizontal jumps bilateral and unilateral, linear and COD sprint time-trial were performed in that exact order. Then, during the subsequent 4 assessment sessions, players were divided into 2 teams, simulating a 45-min match. The teams remained identical across all experimental occasions, and were formed by the coach, aiming to ensure that they were of similar technical-tactical level. Before the start of the 1st-half, players underwent their usual pre-match warm-up, which consisted of 5-min of joint mobility exercises and technical actions focusing on passing and dribbling; 3-min of neuromuscular activity, targeting the extensor and flexor muscles of the knee, as well as the adductor and abductor muscles of the hip; 3-min of a technical drill involving short and long passes, as well as moderate-intensity movements; 4-min of 4vs4 small-sided games with 2 wildcard players, played on a 30x20-m pitch; 3 sprints covering distances of 10, 20, and 30-m, with 30-sec of recovery between each sprint. Immediately after the 1st-half match ended, players underwent physical test assessments randomly, being able to perform one of these groups of tests in each session: bilateral squat jump (SJ), unilateral with the dominant (SJd) and non-dominant (SJnd) leg; bilateral countermovement jump (CMJ), unilateral with the dominant (CMJd) and non-dominant (CMJnd) leg; horizontal jump (HJ) and the 20-m linear sprint (S20); triple horizontal jump (3HJ) and the sprint with COD through the modified T-test (T). In all cases, the assessment lasted approximately 1-min. After completing the assessment, the players rested for 10-min, following the same recovery protocol used during official matches. Next, they performed a randomly assigned Re-w protocol for 5-min. Finally, 2-min after completing the Re-w interventions, players began the physical tests: first, vertical jumps followed by horizontal jumps, with S20 conducted 1-min later and T performed 2-min after the linear sprint.

Measurements

Vertical and horizontal jumps test

Athletes completed the jump tests following previous suggestions (Maulder and Cronin, 2005). In the unilateral vertical jump tests, limb dominance was determined by having the player kick a soccer ball with their preferred leg (Ramirez-Campillo et al., 2018). The vertical jump tests (i.e., SJ, SJd, SJnd, CMJ, CMJd, and CMJnd) were assessed using a contact mat (OptoGait v.1.12.17.0, Microgate, Bolzano, Italy). Meanwhile, in the horizontal jump tests (i.e., HJ and 3HJ), the maximum distance was measured using a measuring tape. This involved recording the minimal distance between the starting point and the last foot on the mat after the jump. In all jumps, the hands were used freely and at the end of each jump attempt, athletes maintained the landing position for a brief moment. The intraclass correlation coefficient (ICC) for SJ, CMJ, HJ and 3HJ were 0.97, 0.98, 0.93 and 0.95 respectively (Markovic et al., 2004).

20-m linear sprint test

To determine the maximal sprint time, athletes complete S20. This assessment comprised single, maximum-effort from a stationary position. Soccer players began the sprint at their own discretion, placing their foots 0.5-m behind the starting line. Performance in the 20-m linear sprint was measured using a photocell system (Polifermo Light Radio, Microgate, Bolzano, Italy) with 0.03-sec standard error of measurement and ~2% CV (Haugen and Buchheit, 2016). The photocells were positioned 90-cm above the ground (approximately at hip height). The ICC for S20 was >0.88 (Turki-Belkhiria et al., 2014).

Change-of-direction sprint test

Following previous instructions (Sassi et al., 2009), soccer players complete a T. Soccer players executed the test following the same guidelines as the traditional version, except for alterations in the total distance covered and inter-cone distances. Timing for the test was conducted using a photocell system (Polifermo Light Radio, Microgate, Bolzano, Italy). The photocells were positioned 90-cm above the ground (approximately at hip height), and participants commenced each trial in a staggered stance with their dominant leg forward. During the COD segment, participants were required to pivot on their preferred leg.

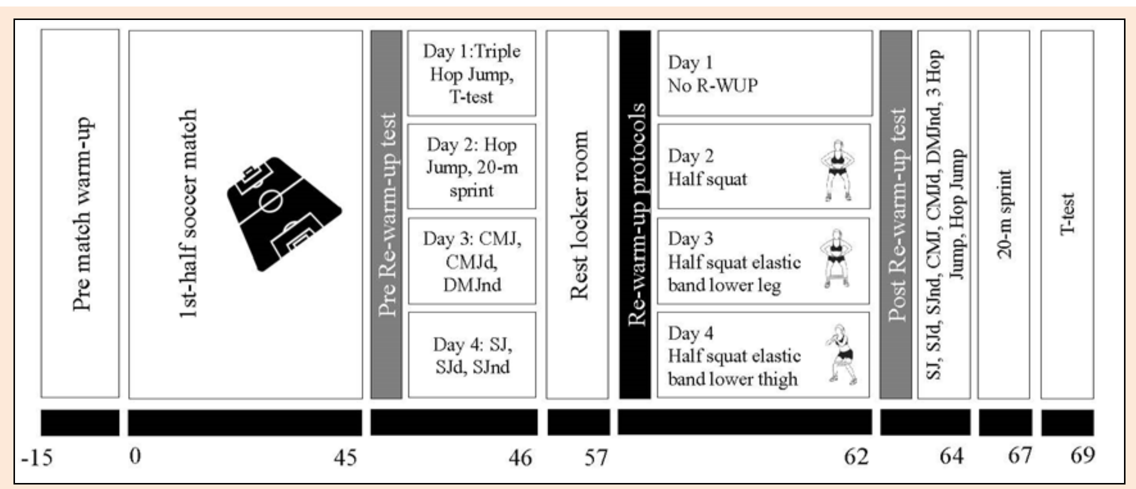

Figure 1. Temporal sequence of the Re-warm-up assessment effects. SJ = squat jump; SJd = squat jump with dominant leg; SJnd=squat jump with non-dominant leg; CMJ = countermovement jump; CMJd = countermovement jump with dominant leg; CMJnd = countermovement jump with non-dominant leg.

Consistency was maintained in the conditions for repeated assessments. The primary outcome measure of the modified T-test was the time taken to complete the task, which was recorded in sec. The ICC for T was 0.82 (Munro and Herrington, 2011).

Re-warm-up protocols

Each Re-w lasted 5-min, following the 10-min standard recovery period used by players during the half-time period. In PAS, players did not engage in any activity (i.e., passive recovery). The Re-w interventions involved 2-min of hip flexion and extension mobility drills, followed by 3-sets of 12-rep of half-squats with 30-sec of passive recovery between sets. While in SQ, the exercise was performed with body weight, in SQT a body weight and ELB (Flexvit Mini Prehab, red: int. 3/6) was used at thigh level, and in SQL at the lower leg level (Flexvit Mini Prehab, red: int. 3/6).

Statistical analysis

Descriptive data are presented as mean ± standard deviation (SD). After verification for data normal distribution via Kolmogorov-Smirnov, parametric statistical analyses were completed. One-way repeated-measure ANOVA was used to evaluate the effects of condition (SQT, SQL, SQ and PAS) in vertical and horizontal jump and linear and COD sprint. If a meaningful F value was found, the Bonferroni post hoc correction was applied. Partial eta squared (η_p^2) was used to estimate effect size for the analysis of variance, while Cohen's d was used to measure effect size in pairwise comparisons. The η_p^2 were interpreted as small (<0.06), moderate (0.06 - 0.13), and large (≥0.14), while Cohens'd were interpreted as trivial (≤0.20), small (0.21 - 0.50), moderate (0.51 - 0.80), and large (>0.80) (Cohen, 2013). Statistical analysis was performed by SPSS software version 25.0 (SPSS, Chicago, IL). Significance was set at $p < 0.05$.

Results

The effects of Re-w protocols on vertical jump are presented in Figure 2. Significant interactions were found for all variables (SJ: F = 41.2, $p < 0.001$, $\eta_p^2 = 0.587$; SJd: F = 31.5, $p < 0.001$, $\eta_p^2 = 0.520$; SJnd: F = 15.7, $p < 0.001$, $\eta_p^2 = 0.351$; CMJ: F = 59.2, $p < 0.001$, $\eta_p^2 = 0.671$; CMJd: F = 118.0, $p < 0.001$, $\eta_p^2 = 0.802$; CMJnd: F = 28.1, $p < 0.001$, $\eta_p^2 = 0.492$).

The results indicated that compared to CON, performance in SJ significantly improved after SQL ($p < 0.001$, d = 7.70) and SQT ($p < 0.001$, d = 0.85). However, when no re-warm-up exercises were performed (i.e., PAS), the soccer players' performance in SJ significantly lower ($p < 0.001$, d = 0.73) compared to that shown at the end of the 1st-half of the match (i.e., CON). On the other hand, SJ was higher after SQL ($p < 0.001$, d = 2.00), SQT ($p < 0.001$, d = 1.82), and SQ ($p < 0.001$, d = 0.80) than after PAS. It was also found that after SQL and SQT, the SJ performance was higher than after SQ ($p < 0.001$, d = 1.20; $p < 0.001$, d = 0.96, respectively). Additionally, the analysis of SJd showed that soccer players reached significantly higher values after SQL and SQT than after SQ ($p < 0.001$, d = 1.50; $p < 0.001$, d = 0.88, respectively), PAS ($p < 0.001$,

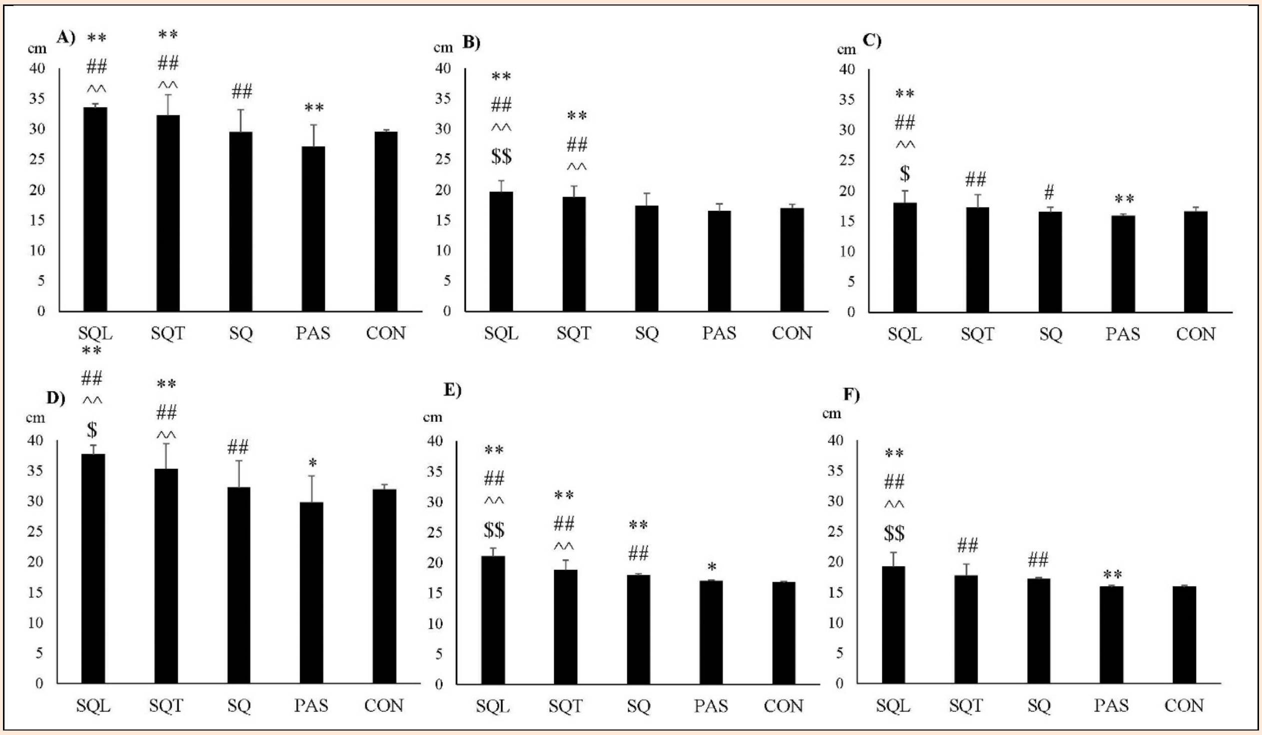

Figure 2. Squat jump height (A), with dominant (B) and non-dominant leg (C), and countermovement jump height (D), with dominant (E) and non-dominant leg (F) after re-warm-up and control protocols. SQL=re-warm-up with half-squat with elastic looped band around the lower leg; SQT=re-warm-up with half-squat with elastic looped band around the thigh; SQ = re-warm-up with half-squat without elastic looped band; PAS = no re-warm-up; CON = performance after 45-min of match play (1st-half). * Significant differences with CON (* $p < 0.05$ and ** $p < 0.001$); # Significant differences with PAS (# $p < 0.05$ and ## $p < 0.001$); ^ Significant differences with SQ (^^ $p < 0.001$); $ Significant differences with SQT ($$ $p < 0.001$).

d = 2.33; p < 0.001, d = 1.66, respectively), and CON (p < 0.001, d = 1.80; p < 0.001, d = 1.20, respectively). Furthermore, SJnd was significantly higher after SQL than after SQT (p < 0.001, d = 0.64), SQ (p < 0.001, d = 1.16), PAS (p < 0.001, d = 1.36), and CON (p < 0.001, d = 1.04). In addition, SJnd was significantly higher after SQT (p < 0.001, d = 0.65) and SQ (p = 0.001, d = 1.00) than PAS. Finally, when no exercise based on Re-w was performed (i.e., PAS), the soccer players' performance in SJnd significantly lower (p < 0.001, d = 1.23) compared to that shown at the end of the 1st-half of the match (i.e., CON).

The CMJ, CMJd and CMJnd analysis (Figure 2) significantly higher values after SQL than after CON (p < 0.001, d = 5.20; p < 0.001, d = 3.30; p < 0.001, d = 1.02, respectively), PAS (p < 0.001, d = 2.26; p < 0.001, d = 3.27; p < 0.001, d = 1.68, respectively), SQ (p < 0.001, d = 1.52; p < 0.001, d = 2.45; p < 0.001, d = 0.92, respectively), and SQT (p = 0.002, d = 0.71; p < 0.001, d = 1.75; p < 0.001, d = 0.85, respectively). In addition, performance in CMJ was significantly higher after SQT than after CON (p < 0.001, d = 0.93), PAS (p < 0.001, d = 1.59), and SQ (p < 0.001, d = 0.88). In the variable CMJd, the values were significantly higher after SQT than after CON (p < 0.001, d = 1.27) and PAS (p < 0.001, d = 1.18). While in CMJnd, the values were significantly higher after SQT than after PAS (p < 0.001, d = 1.10). On the other hand, CMJ, CMJd, and CMJnd were significantly higher after SQ than after PAS (p < 0.001, d = 0.70; p < 0.001, d = 6.35; p < 0.001, d = 2.01, respectively). Additionally, performance in CMJd was significantly higher after SQ than after CON (p < 0.001, d = 8.35). Finally, when no exercise based on Re-w was performed (i.e., PAS), the soccer players' performance in CMJ, CMJd and CMJnd significantly lower (p = 0.04, d = 0.55; p < 0.04, d = 1.36; p < 0.001, d = 2.04, respectively) compared to that shown at the end of the 1st-half of the match (i.e., CON).

Additionally, significant interaction effects were obtained on the HJ (F = 73.6, p < 0.001, η_p^2 = 0.717) (Figure 3A) and 3HJ (F = 22.6, p < 0.001, η_p^2 = 0.437) (Figure 3B). Significantly soccer players reach more HJ after SQL, SQT and SQ than after CON (p < 0.001, d = 2.10; p < 0.001, d = 2.00; p < 0.001, d = 0.96, respectively) and PAS (p < 0.001, d = 2.83; p < 0.001, d = 2.40; p < 0.001, d = 1.85, respectively). In addition, HJ was significantly higher after SQL (p < 0.001, d = 1.16) and SQT (p < 0.001, d = 1.24) than after SQ. Finally, when no exercise based on Re-w was performed (i.e., PAS), the soccer players' performance in HJ significantly lower (p < 0.001, d = 1.17) compared to that shown at the end of the 1st-half of the match (i.e., CON). Regarding performance in 3HJ, the players performed significantly higher after SQL than CON (p < 0.02, d = 0.68), PAS (p < 0.001, d = 1.45), SQ (p < 0.001, d = 1.10) and SQT (p < 0.001, d = 0.57). In addition, 3HJ was significantly better after SQT than after PAS (p < 0.001, d = 0.86) and SQ (p < 0.001, d = 0.50). Also, 3HJ was significantly higher after SQ than after PAS (p = 0.002, d = 0.456) and when no exercise based on Re-w was performed (i.e., PAS), the soccer players' performance significantly lower (p = 0.01, d = 0.80) compared to that shown at the end of the 1st-half of the match (i.e., CON).

Finally, standardized differences of S20 and T between types of Re-w protocols are shown in Figure 4. Significant effects of interactions were obtained on the S20 (F = 10.2, p < 0.001, η_p^2 = 0.261) and T (F = 26.3, p < 0.001, η_p^2 = 0.475) (Figure 4). The performance in S20 and T were significantly better after SQL than after CON (p < 0.001, d = 0.77; p = 0.002, d = 1.55, respectively), PAS (p < 0.001, d = 0.87; p < 0.001, d = 1.63, respectively), SQ (p < 0.001, d = 0.81; p < 0.001, d = 1.21, respectively) and SQT (p < 0.001, d = 0.21; p < 0.001, d = 0.49, respectively). In addition, performance in linear (i.e., S20) and COD (i.e., T) sprint were significantly better after SQT than CON (p < 0.001, d = 0.35; p < 0.001, d = 0.89, respectively) and PAS (p < 0.001, d = 0.51; p < 0.001, d = 1.16, respectively). On the other hand, T was significantly better after SQT than after SQ (p < 0.001, d = 0.70) and after SQ than after PAS (p = 0.01, d = 0.51).

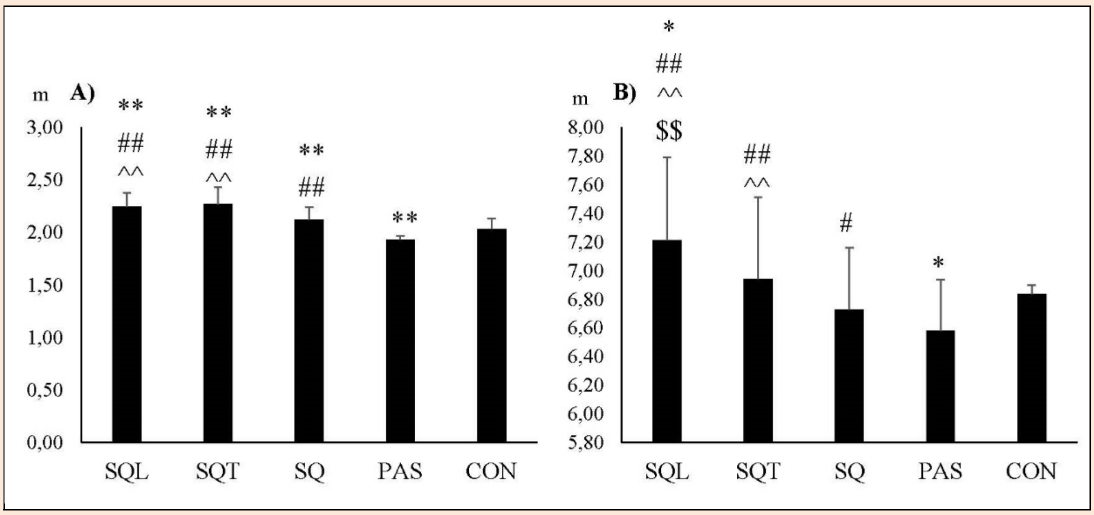

Figure 3. Hop jump distance (A) and triple hop jump distance (B) after re-warm-up and control protocols. SQL = re-warm-up with half-squat with elastic looped band around the lower leg; SQT = re-warm-up with half-squat with elastic looped band around the thigh; SQ = re-warm-up with half-squat without elastic looped band; PAS = no re-warm-up; CON = performance after 45-min of match play (first half). * Significant differences with CON (* p < 0.05 and ** p < 0.001); # Significant differences with PAS (# p < 0.05 and ## p < 0.001); ^ Significant differences with SQ (^^ p < 0.001); $ Significant differences with SQT ($$ p <0.001).

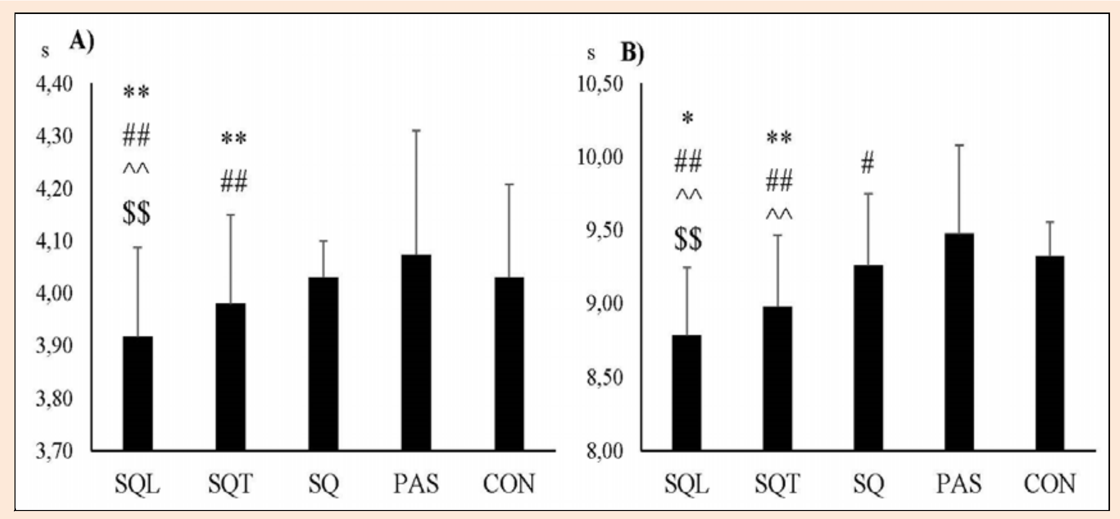

Figure 4. 20-m linear sprint time (A) and T-test change-of-direction sprint time (B) after re-warm-up and control protocols. SQL = re-warm-up with half-squat with elastic looped band around the lower leg; SQT = re-warm-up with half-squat with elastic looped band around the thigh; SQ = re-warm-up with half-squat without elastic looped band; PAS = no re-warm-up; CON = performance after 45-min of match play (1st-half). * Significant differences with CON (* $p < 0.05$ and ** $p < 0.001$); # Significant differences with PAS (# $p < 0.05$ and ## $p < 0.001$); ^ Significant differences with SQ (^^ $p < 0.001$); $ Significant differences with SQT ($$ $p < 0.001$).

Discussion

The aim was to assess the immediate effects of Re-w strategies using half-squats with ELB positioned on the performance of youth soccer players. The main findings indicated that Re-w (i.e., SQL, SQT and SQ) had a more significant impact on performance than PAS across various variables, including vertical and horizontal jumping as well as linear and COD sprinting. Moreover, both SQL and SQT showed a positive effect on performance compared to half-squat without ELB (i.e., SQ). On the other hand, omitting Re-w (i.e., PAS) results in a significant decrease in performance across most variables compared to the assessment conducted at the end of the 45-min simulated match (i.e., CON). To the best of the authors' knowledge, this study is the first to use ELB with Re-w exercise at half-time in soccer.

Explosive actions such as jumping are important contributors to soccer performance (Hoff and Helgerud, 2004; Raya-González et al., 2023). Overall, our findings showed a decrease in both bilateral and unilateral vertical jump performance when comparing the values obtained by players at the end of a 45-min match with a recovery period without Re-w (i.e., CON vs. PAS). This outcome is consistent with prior research suggesting that passive half-time period leads to a reduction in body temperature (Mohr et al., 2004), and meaningful decreases in eccentric hamstring strength (Lovell et al., 2013), so a reactivation before the 2nd-half of a match is recommended to prevent declines in neuromuscular performance. Specifically, the reduction in vertical jump performance at the onset of the 2nd-half should be regarded as a detrimental factor to performance, as it is recognized as a useful index of the muscular ability to generate power (Quagliarella et al., 2010), and more precisely, CMJ has also been established as a determining factor for other attributes like sprinting or change of direction (Köklü et al., 2015). In order to mitigate this performance decline, it is essential to implement Re-w protocols centered around post-activation potentiation (PAP) (Russell et al., 2015a). PAP is a well-described phenomenon by which muscular performance is acutely and temporarily enhanced by increasing myosin light chain phosphorylation (Tillin and Bishop, 2009). While PAP is effective for short-term performance improvements, research indicates that the performance benefits often extend beyond its immediate effects (Boullosa, 2021). This has led to the adoption of the term post-activation performance enhancement (PAPE) to capture the longer-lasting gains observed after conditioning activities, which typically peak 6–10 minutes post-activity (Cuenca-Fernandez et al., 2017). Unlike classical PAP, which diminishes quickly and is influenced by factors such as the intensity and volume of the activity, rest period duration, and training status (Wilson et al., 2013), PAPE incorporates additional factors like muscle temperature and fiber recruitment (Blazevich et al., 2019). This broader perspective provides a more comprehensive framework for understanding and optimizing performance in sports contexts (Cuenca-Fernandez et al., 2017). To achieve the positive effects associated with Re-w strategies, it is crucial to apply activities that adapt these load components to the individual characteristics of the soccer players.

The results of our study have shown that jump performance improves compared to a passive recovery situation (i.e., PAS) when including a half-squat exercise with (i.e., SQL and SQT) and without ELB (i.e., SQ). The meta-analysis presented in a recent systematic review revealed moderate and significant beneficial effects of Re-w protocols on CMJ (Gonzalez et al., 2023). In addition, previous studies have demonstrated positive effects of a Re-w on vertical jump, minimizing loss (Edholm et al., 2014) or enhancing performance (Zois et al., 2013) in a CMJ compared to a situation involving passive recovery. Although PAP using heavy loads seems to offer a superior neuromuscular stimulus for enhancing vertical jump performance (Lum and Chen, 2020), implementing this strategy presents some challenges that are difficult to overcome in the context of soccer competition. Firstly, the absence of gym equipment on the majority of soccer pitches where young soccer players train can hinder its application in real-game settings (Ltifi et al., 2023a). Additionally, time constraints during rest periods necessitate protocols that are simple and ecologically valid (Russell et al., 2015b). In this context, exercises utilizing body weight, along with easily transportable and accessible resistances such as ELB, performed at an optimal volume (i.e., greater than that employed in heavy load training), prove advantageous due to their practicality (Ltifi et al., 2023a). This intervention seems quite effective as it appears to increase the recruitment of higher-order motor units, activate potentiation mechanisms, and/or achieve optimal muscle activation (Suchomel et al., 2016).

Sprinting and COD are physical fitness skills that play a key role in success in the match (Raya-González et al., 2023). Unlike the vertical and horizontal jumping performance, the absence of Re-w did not show any effect on the performance in S20 and T (i.e., PAS vs CON). This contrasts with findings from other studies, which indicated that increased fatigue during the 1st-half, combined with the team's passive behavior during the half-time break, where there is a prolonged period of inactivity that induce a drop in muscle temperature (~1.5°C) (Mohr et al., 2004), may negatively impact sprinting performance at the start of the 2nd-half (Gonzalez et al., 2023). These ambiguous results may be explained from different Re-w strategies and the fitness status of the players (Matsentides et al., 2023), and are also influenced by active behaviors performed during the 15-min rest period between halves (Bishop, 2003). On the other hand, while a recent meta-analysis has revealed a trivial and non-significant beneficial effect of Re-w on sprinting performance (Gonzalez et al., 2023), our results suggest that implementing a protocol that includes half-squats with ELB (i.e., SQL and SQT) predisposes the soccer player to better performance in S20 and T compared to SQ and PAS. In this regard, although the addition of an ELB to the squat resulted in a reduction in myoelectric activity in the biceps femoris compared to the squat without an ELB (Martins et al., 2022), our results show better outcomes in S20 after a Re-w with SQL and SQT than with SQ. The observed enhancement in sprint performance at the end of the break is likely associated with various physiological factors, including elevated heart rate, core and muscle temperature, improved muscle oxygenation, altered blood metabolite response and increased neuromuscular activity (González-Devesa et al., 2021; Ross et al., 2001). Improving the sprinting capacity of soccer players is crucial, particularly those lasting 2 to 4-sec over distances shorter than 20-m, due to their pivotal role in critical moments preceding goal-scoring opportunities (Faude et al., 2012). For this, improving sprint performance at the start of a 2nd-half could have potential benefits for the entire match outcome (Ltifi et al., 2023a). Finally, the improvements in S20 and T were greater when the ELB was placed on the lower leg (i.e., SQL vs SQT). This may be attributed to a higher recruitment of motor units in the hip muscles during lateral stepping exercises (Lewis et al., 2018) and squats (Martins et al., 2022) when the ELB was positioned distally compared to proximally at the hip.

We must acknowledge several methodological limitations in our study. Firstly, our study protocol did not include key physiological measurements such as heart rate, core or muscle temperature, and electromyography, which could provide a more comprehensive understanding of the effects of the Re-w protocols. Secondly, our study did not incorporate a 2nd-half play, leaving uncertainty about whether the positive effects observed in the loaded Re-w experimental conditions would have persisted throughout the entire 45-min duration of the 2nd-half. This aspect warrants investigation in future studies. Lastly, the impact of performing the Re-w in different environmental conditions remains unclear. Additionally, while a minimum of 2 years of experience in resistance training was established for participants, there may be slight variations in strength levels among the players, which could influence the results of the exercises performed with ELB

Conclusion

In conclusion, this study demonstrates that incorporating re-warm-up protocols such as half-squats with elastic looped bands placed on the lower leg (SQL) or thigh (SQT) can significantly enhance key physical performance aspects in youth soccer players, including vertical and horizontal jumps, linear sprinting, and change of direction (COD) speed. These protocols showed greater positive effects compared to both passive rest (PAS) and half-squats without elastic bands (SQ), underscoring the importance of an active re-warm-up to sustain optimal performance during the 2nd-half of play.

Furthermore, omitting re-warm-up activities (i.e., using PAS) resulted in notable declines in physical performance across multiple variables when compared to values assessed at the end of the initial 45 minutes of play, indicating the potential detriment of passive recovery on 2nd-half performance.

This study is among the first to explore the specific application of elastic looped bands within re-warm-up exercises at halftime for soccer players, particularly at the youth level. These findings support the application of re-warm-up protocols with elastic bands for young players, emphasizing their practicality, accessibility, and potential benefits for optimizing performance and reducing injury risk in youth and amateur contexts. Further research could assess the suitability of these protocols for higher-level athletes, such as elite players, to extend the applicability of these findings across broader player levels.

Acknowledgements

The authors express their gratitude to the participating athletes for their involvement in the study. The authors are grateful to research and transfer activities funding for research groups from the Universidad Pontificia de Salamanca. The experiments comply with the current laws of the country in which they were performed. The authors have no conflict of interest to declare. The datasets generated during and/or analyzed during the current study are not publicly available but are available from the corresponding author who was an organizer of the study.

References

Abade, E., Sampaio, J., Gonc, B., Baptista, J. and Alves, A. (2017) Effects of different re-warm up activities in football players' performance. *Plos One* **12(6),** e0180152. https://doi.org/10.1371/journal.pone.0180152

Bishop, D. (2003) Warm up II: performance changes following active warm up and how to structure the warm up. *Sports Medic*ine **33(7),** 483-498. https://doi.org/10.2165/00007256-200333070-00002

Blazevich, A. J. and Babault, N. (2019) Post-activation Potentiation Versus Post-activation Performance Enhancement in Humans: Historical Perspective, Underlying Mechanisms, and Current Issues. *Frontiers in Physiology* **10,** 1359. https://doi.org/10.3389/fphys.2019.01359

Boullosa, D. (2021) Post-activation performance enhancement stragies in sport: a brief review for practitioners. *Human Movement* **22(3),** 101-109. https://doi.org/10.5114/hm.2021.103280

Buttifant, D. and Hrysomallis, C. (2015) Effect of various practical warm-up protocols on acute lower-body power. *Journal of Strength and Conditioning Research* **29(3)**, 656-660. https://doi.org/10.1519/JSC.0000000000000690

Cohen, J. (2013) Statistical power analysis for the behavioral sciences. *Routledge.* https://doi.org/10.4324/9780203771587

Cuenca-Fernandez, F., Smith, I. C., Matthew, J., MacIntosh, B. R., Lopez-Contreras, G., Arellano, R. and Herzog, W. (2017) Non-localized postactivation peformance enhancement (PAPE) effects in trained athletes: a pilot study. *Applied Physiology, Nutrition & Metabolism* **42(10)**, 1122-1125. https://doi.org/10.1139/apnm-2017-0217

Edholm, P., Krustrup, P. and Randers, M. B. (2014) Half-time re-warm up increases performance capacity in male elite soccer players. S*candinavian Journal of Medicine & Science in Sports* **25(1)**, e40-e49. https://doi.org/10.1111/sms.12236

Faude, O., Koch, T. and Meyer, T. (2012) Straight sprinting is the most frequent action in goal situations in professional football. *Journal of Sports Sciences* **30(7)**, 625-631. https://doi.org/10.1080/02640414.2012.665940

Foley, R. C. A., Bulbrook, B. D., Button, D. C. and Holmes, M. W. (2017) Effects of a band loop on lower extremity muscle activity and kinematics during the barbell squat. *International Journal of Sports Physical Therapy* **12(4)**, 550-559.

Gonzalez, T., Sarmento, H., Infantes-Paniagua, A., Ramirez-Campillo, R., González-Víllora, S. and Clemente, F. M. (2023) Effects of re-warm-up protocols on the physical performance of soccer players: A systematic review with meta-analysis. *Biology of Sport* **40(2)**, 335-344. https://doi.org/10.5114/biolsport.2023.116013

González-Devesa, D., Vaquera, A., Suárez-Iglesias, D. and Ayán-Pérez, C. (2021) The efficacy of re-warm-up practices during half-time: A systematic review. *Medicina* **57(9)**, 976. https://doi.org/10.3390/medicina57090976

Hammami, A., Zois, J., Slimani, M., Russel, M. and Bouhlel, E. (2018) The efficacy, and characteristics, of warm-up and re-warm-up practices in soccer players: a systematic review. *The Journal of Sports Medicine and Physical Fitness* **58(1-2)**, 135-149. https://doi.org/10.23736/S0022-4707.16.06806-7

Haugen, T. and Buchheit, M. (2016) Sprint running performance monitoring: methodological and practical considerations. *Sports Medicine* **46(5)**, 641-656. https://doi.org/10.1007/s40279-015-0446-0

Hoff, J. and Helgerud, J. (2004) Endurance and strength training for soccer players: physiological consideration. *Sports Medicine* **34(3)**, 165-180. https://doi.org/10.2165/00007256-200434030-00003

Köklü, Y., Alemdaroğlu, U., Özkan, A., Koz, M. and Ersöz, G. (2015) The relationship between sprint ability, agility and vertical jump performance in young soccer players. *Science & Sports* **30(1)**, 1-5. https://doi.org/10.1016/j.scispo.2013.04.006

Lewis, C. L., Foley, H. D., Lee, T. S. and Berry, J. W. (2018) Hip-muscle activity in men and women during resisted side stepping with different band positions. *Journal of Athletic Training* **53(11)**, 1071-1081. https://doi.org/10.4085/1062-6050-46-16

Lovell, R. J., Kirke, I., Siegler, J., McNaughton, L. R. and Greig, M. P. (2007) Soccer half-time strategy influences thermoregulation and endurance performance. *Journal Sports Medicine and Physical Fitness*, **48(3)**, 279-284.

Lovell, R., Midgley, A., Barrett, S., Carter, D. and Small, K. (2013) Effects of different half-time strategies on second half soccer-specific speed, power and dynamic strength. *Scandinavian Journal of Medicine and Science in Sports* **23(1)**, 105-113. https://doi.org/10.1111/j.1600-0838.2011.01353.x

Ltifi, M. A., Turki, O., Racil, G., Larion, A., Chelly, M. S., Saad, H. Ben, Khalifa, R., Chamari, K. and Padulo, J. (2023a) 3-min weighted vests re-warmups induce sprint performance enhancements at the start of the second half of a soccer match-play. *Frontiers in Physiology* **14**, 1173991. https://doi.org/10.3389/fphys.2023.1173991

Ltifi, M. A., Zouhal, H., Laher, I., Saeidi, A., Govindasamy, K., Granacher, U., Aouadi, R. and Abderrahman, A. ben. (2023b) Lower limbs micro-loading acutely attenuates repeated change-of-direction performance in male youth during small-sided soccer games. *BMC Sports Science, Medicine and Rehabilitation* **15(1)**, 172. https://doi.org/10.1186/s13102-023-00778-1

Lum, D. and Chen, S. E. (2020) Comparison of loaded countermovement jump with different variable resistance intensities on inducing post-activation potentiation. *Journal of Science in Sport and Exercise* **2(2)**, 167-172. https://doi.org/10.1007/s42978-020-00055-4

Markovic, G., Dizdar, D., Jukic, I. and Cardinale, M. (2004) Reliability and factorial validity of squat and countermovement jump test. *Journal of Strength and Conditioning Research* **18(3)**, 551-555. https://doi.org/10.1519/00124278-200408000-00028

Martins, E. C., Steffen, L. B., Gomes, D., Herzog, W., Haupenthal, A. and de Brito Fontana, H. (2022) Looped elastic resistance during Squats: how do band position and stiffness affect hip myoelectric activity? *Journal of Functional Morphology and Kinesiology* **7(3)**, 60. https://doi.org/10.3390/jfmk7030060

Matsentides, D., Christou, M. and Zaras, N. (2023) The effects of different re-warm-up strategies on power, changing of direction and ball shooting velocity in well-trained soccer players. *Sports* **11(9)**, 169. https://doi.org/10.3390/sports11090169

Maulder, P. and Cronin, J. (2005) Horizontal and vertical assessment: reliability, symmetry, discriminative and predictive ability. *Physical Therapy and Sport* **6(2)**, 74-82. https://doi.org/10.1016/j.ptsp.2005.01.001

McKay, A. K., Stellingwerff, T., Smith, E. S., Martin, D. T., Mujika, I., Goosey-Tolfrey, V. L., Sheppard, J. and Burke, L. M. (2022) Defining training and performance caliber: a participant classification framework. *International Journal of Sports Physiology and Performance* **17(2)**, 317-331. https://doi.org/10.1123/ijspp.2021-0451

Miguel Silva, L., Pereira Neiva, H., Cardoso Marques, M., Izquierdo, M. and Almeida Marinho, D. (2018) Effects of warm-up, post-warm-up, and re-warm-up strategies on explosive efforts in team sports: a systematic review key points. *Sports Medicine* **48**, 2285-2299. https://doi.org/10.1007/s40279-018-0958-5

Mohr, M., Krustrup, P., Nybo, L., Nielsen, J. J. and Bangsbo, J. (2004) Muscle temperature and sprint performance during soccer matches- Beneficial effect of re-warm-up at half-time. *Scandinavian Journal of Medicine and Science in Sports* **14(3)**, 156-162. https://doi.org/10.1111/j.1600-0838.2004.00349.x

Munro, A. G. and Herrington, L. C. (2011) Between-session reliability of four hop tests and the agility t-test. *Journal of Strength and Conditioning Research* **25(5)**, 1470-1477. https://doi.org/10.1519/JSC.0b013e3181d83335

Nickerson, B. S., Williams, T. D., Snarr, R. L. and Park, K. S. (2018) Individual and combined effect of inter-repetition rest and elastic bands on jumping potentiation in resistance-trained men. *Journal of Strength & Conditioning Research* **33(8)**, 2087-2093. https://doi.org/ 10.1519/JSC.0000000000002593

Oliva-Lozano, J. M., Fortes, V., López-Del Campo, R., Resta, R. and Muyor, J. M. (2022) When and how do professional soccer players experience maximal intensity sprints in Laliga? *Science and Medicine in Football* **7(3)**, 288-296. https://doi.org/10.1080/24733938.2022.2100462

Quagliarella, L., Sasanelli, N., Belgiovine, G., Moretti, L. and Moretti, B. (2010) Evaluation of standing vertical jump by ankles acceleration measurement. *Journal of Strength and Conditioning Research* **24(5)**, 1229-1236. https://doi.org/10.1519/JSC.0b013e3181cb281a

Ramírez-Campillo, R., Sanchez-Sanchez, J., Gonzalo-Skok, O., Rodríguez-Fernandez, A., Carretero, M. and Nakamura, F. Y. (2018) Specific changes in young soccer player's fitness after traditional bilateral vs. unilateral combined strength and plyometric training. *Frontiers in Physiology* **9**, 265. https://doi.org/10.3389/fphys.2018.00265

Raya-González, J., Torres, L., Beato, M., Rodriguez-Fernández, A. and Sanchez-Sanchez, J. (2023) The effects of training based on Nordic hamstring and sprint exercises on measures of physical fitness and hamstring injury prevention in U19 male soccer players.

Research in Sports Medicine **31(5)**, 588-603. https://doi.org/10.1080/15438627.2021.2010206

Ross, A., Leveritt, M. and Riek, S. (2001) Neural influences on sprint running training adaptations and acute responses. *Sports Medicine* **31(6)**, 409-425. https://doi.org/10.2165/00007256-200131060-00002

Russell, M., West, D. J., Briggs, M. A., Bracken, R. M., Cook, C. J., Giroud, T., Gill, N. and Kilduff, L. P. (2015a) A passive heat maintenance strategy implemented during a simulated half-time improves lower body power output and repeated sprint ability in professional Rugby Union players. *Plos One* **10(3)**, e0119374. https://doi.org/10.1371/journal.pone.0119374

Russell, M., West, D. J., Harper, L. D., Cook, C. J. and Kilduff, L. P. (2015b) Half-Time Strategies to Enhance Second-Half Performance in Team-Sports Players: A Review and Recommendations. *Sports Medicine* **45(3)**, 353-364. https://doi.org/10.1007/s40279-014-0297-0

Sanchez-Sanchez, J., Tocino, P., Ramirez-Campillo, R. and Rodríguez-Fernández, A. (2024) Impacto de una activación mediante ejercicios de autocarga vs bandas elásticas en la capacidad de salto y fuerza dinámica. *E-Balonmano.Com: Revista de Ciencias Del Deporte* **20(1)**, 23-36. https://doi.org/10.17398/1885-7019.20.23

Sassi, R. H., Dardouri, W., Yahmed, M. H., Gmada, N., Mahfoudhi, M. E. and Gharbi, Z. (2009) Relative and absolute reliability of a modified agility T-test and its relationship with vertical jump and straight sprint. *Journal of Strength and Conditioning Research* **23(6)**, 1644-1651. https://doi.org/10.1519/JSC.0b013e3181b425d2

Silva, H., Nakamura, F. Y., Mendez-Villanueva, A., Gomez-Diaz, A., Menezes, P. and Marcelino, R. (2024) Characterizing the sprint threshold (25.2 km/h): a case study analysis on how soccer players reach sprint speeds and what relative intensity the threshold represents. *Sport Sciences for Health*. https://doi.org/10.1007/s11332-024-01185-w

Suchomel, T. J., Nimphius, S. and Stone, M. H. (2016) The Importance of Muscular Strength in Athletic Performance. *Sports Medicine* **46(10)**, 1419-1449. https://doi.org/10.1007/s40279-016-0486-0

Tillin, N. A. and Bishop, D. (2009) Factors modulating post-activation potentiation and its effect on performance of subsequent explosive activities. *Sports Medicine* **39(2)**, 147-166. https://doi.org/10.2165/00007256-200939020-00004

Towlson, C., Midgley, A. W. and Lovell, R. (2013) Warm-up strategies of professional soccer players: Practitioners' perspectives. *Journal of Sports Sciences* **31(13)**, 1393-1401. https://doi.org/10.1080/02640414.2013.792946

Turki-Belkhiria, L., Chaouachi, A., Turki, O., Chtourou, H., Chtara, M., Chamari, K., Amri, M. and Behm, D. G. (2014) Eight weeks of dynamic stretching during warm-ups improves jump power but not repeated or single sprint performance. *European Journal of Sport Science* **14(1)**, 19-27. https://doi.org/10.1080/17461391.2012.726651

Wilson, J. M., Duncan, N. M., Marin, P. J., Brown, L. E., Loenneke, J. P., Wilson, S., Jo, E., Lowery, R. P. and Ugrinowitsch, C. (2013) Meta-Analysis of postactivation potentiation and power: effects of conditioning activity, volume, gender, rest periods, and training status. *Journal of Strength & Conditioning Research* **27(3)**, 854-859. https://doi.org/10.1519/JSC.0b013e31825c2bdb

Yanaoka, T., Hamada, Y., Kashiwabara, K., Kurata, K., Yamamoto, R., Miyashita, M. and Hirose, N. (2018) Very-short-duration, low-intensity half-time re-warm-up increase subsequent intermittent sprint performance. *Journal of Strength and Conditioning Research* **32(11)**, 3258-3266. https://doi.org/10.1519/JSC.0000000000002781

Zois, J., Bishop, D., Fairweather, I., Ball, K. and Aughey, R. (2013) High-Intensity Re-Warm-Ups Enhance Soccer Performance. *International Journal of Sports Medicine* **34(9)**, 800-805. https://doi.org/10.1055/s-0032-1331197

✉ **Javier Sanchez-Sanchez**
Research Group PRENDE, Universidad Pontificia de Salamanca, Salamanca, Spain.

Key points

- Re-warm-up strategies are essential for maintaining and enhancing neuromuscular performance in young soccer players during the halftime period, helping to mitigate declines in physical performance for the 2nd-half of a match.
- The re-warm-up methods employed in this study were short in duration to align with the typical halftime break, designed to be practical within the constraints of match play.
- Elastic looped bands serve as effective tools for improving performance in jumps and sprints during re-warm-up for youth players, providing a practical and accessible solution to increase muscle activation without requiring gym equipment.
- The placement of elastic looped bands impacts performance outcomes: bands positioned on the lower leg have been shown to be more effective for enhancing sprint and agility performance compared to bands positioned on the thigh.
- This study's recommendations are specifically tailored for youth soccer players, potentially applicable to both amateur and competitive youth levels, but further research would be required to determine the effectiveness across different age groups and player levels, such as amateur or elite adult players.

AUTHOR BIOGRAPHY

Javier SANCHEZ-SANCHEZ
Employment
Universidad Pontificia de Salamanca, Spain.
Degree
PhD
Research interests
Strength and conditioning, physical performance in elite sports
E-mail: jsanchezsa@upsa.es

Filipe M. CLEMENTE
Employment
School of Sport and Leisure, Melgaço, Portugal
Degree
PhD
Research interests
Strength and conditioning, physical performance in elite sports
E-mail: filipe.clemente5@gmail.com

Rodrigo RAMIREZ-CAMPILLO
Employment
University of Los Lagos, Chile
Degree
PhD
Research interests
Exercise physiology and physical performance in elite sports
E-mail: ramirezcampillo@gmail.com

Alejandro RODRIGUEZ-FERNANDEZ
Employment
Universidad de León, Spain
Degree
PhD
Research interests
Strength and conditioning, physical performance in elite sports
E-mail: alrof@unileon.es