ISSN: 2146 - 9466
www.ijtase.net
*International Journal of New Trends in Arts, Sports &Science Education – 2025, volume 14, issue 1*

# THE EFFECT OF POWER BAND USAGE IN PRE-MATCH WARM-UP ON SPRINT AND JUMP PERFORMANCE IN U-17 FOOTBALL PLAYERS

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**Received:** December 07, 2024 **Accepted:** January 27, 2025 **Published:** January 31, 2025

**Suggested Citation:**
Isbilir, M., Ispirlidis, I., Chatzinikolaou, A., & Gioftsidou, A. (2025).The effect of power band usage in pre-match warm-up on sprint and jump performance in U-17 football players. *International Journal of New Trends in Arts, Sports &Science Education (IJTASE), 14*(1), 1-7.



**Abstract**

This study aimed to investigate the effects of resistance band exercises applied during warm-up on sprint and jump performance in football players. A total of 20 male football players actively competing in the U-17 Super League participated in the study. Using a cross-over experimental design, two different warm-up methods were compared over two consecutive days. Method 1 consisted of standard warm-up exercises, while Method 2 included jumping and running exercises performed with two power bands of different characteristics. Performance evaluations included the Five Repetition Jump Test (5JT), a 10-meter sprint, and a 30-meter sprint test. Results showed that resistance band exercises significantly improved jump performance ($p < .014$) but negatively affected sprint performance (10m and 30m) ($p < .001$). The decline in sprint performance is thought to result from temporary muscle fatigue induced by resistance band exercises. These findings highlight the importance of carefully planning resistance band exercises to optimize football-specific performance. Further studies are recommended to explore long-term adaptation processes and exercise protocols in more detail.

**Keywords:** Power band, warm-up, sprint performance, jump performance, football.

## INTRODUCTION

Warm-up is a fundamental preparatory process used to enhance performance and minimize the risk of injuries in athletes. From the perspective of motor skills, Davids (2013) emphasized the critical importance of warm-up in optimizing athletes' movement abilities and supporting their rapid adaptation to environmental changes. In dynamic sports such as football, warm-up not only increases muscle temperature but also improves decision-making processes (Reilly, 2005).

Football is a sport that involves various physical demands such as sudden changes of direction, high-speed sprints, and explosive jumping movements. These demands require players to perform at a high level in skills such as explosive strength, speed, and agility (Della & Pinder, 2019). According to Della and Pinder (2019), properly structured warm-up protocols not only enhance physical

preparation but also optimize neuromuscular adaptations, thereby supporting players' success during gameplay.

Owen et al. (2013) stated that football players cover approximately 10–12 km during a match, with 10% of this distance consisting of high-speed runs. Therefore, pre-match warm-up protocols play a critical role in preparing players for such intense physical demands. Bangsbo (1994) emphasized that exercises performed during dynamic warm-up increase muscle temperature and elasticity, positively influencing physical performance.

Another essential aspect of pre-match warm-up protocols is incorporating sport-specific movement patterns. Mallett (2014) highlighted that dynamic movements aligned with the demands of the game during warm-up significantly prepare the neuromuscular system and enhance performance. Additionally, Guzman (2011) and Larsen (2020) underscored that exercises involving various resistance bands improve muscle elasticity, support explosive strength production, and enhance players' sprint and jump performance.

Exercises performed with power bands of varying resistance levels and lengths have recently emerged as innovative practices integrated into sport-specific warm-up protocols. These exercises not only enhance muscle activity but also improve stabilization and balance, thereby optimizing players' performance (Mallo, 2014). Reilly (2007) highlighted that understanding the short-term effects of such exercises is a significant step toward developing sport-specific training programs.

The aim of this study is to investigate the effects of power band exercises, implemented during the final phase of pre-match warm-up, on football players' sprint and jump performance. This study will examine how these exercises, performed using power bands, influence performance indicators requiring explosive strength by enhancing the elastic properties of the muscles. In this context, the potential effects of integrating resistance band exercises into warm-up protocols on football players' performance parameters requiring explosive power will be evaluated.

## METHOD

### Participants

This study involved 20 football players actively competing in the U-17 Super League in Greece. To ensure consistent and reliable results, the research was conducted with a single football team. The participants were selected based on their health status, with only healthy individuals who had no current or past injuries included in the study. Written consent was obtained from the parents of all participants, and each player provided informed consent after being thoroughly briefed about the study.

### Methods

A cross-over experimental design was employed in this study to examine the effects of two different warm-up methods on jump and speed performance in a football context. The experimental sessions were conducted over two consecutive days to systematically compare the effects of each warm-up method. Participants were randomly assigned to two groups, each consisting of 10 football players. On the first day, the first group performed the first method, while the second group performed the second method. On the second day, the groups switched methods, ensuring that each participant experienced both warm-up methods.

The cross-over design allowed each participant to serve as their own control, reducing the influence of confounding variables. This approach minimized the effects of inter-individual differences, thereby enhancing the reliability of the results. Throughout the study, environmental factors such as humidity, temperature, and wind were kept constant to minimize their impact on test outcomes. Additionally, all testing sessions were initiated at the same time each day, and test durations were standardized to prevent time-of-day and day-related effects on physiological performance.

Each warm-up method (Method 1 and Method 2) lasted a total of 30 minutes. Following the completion of the warm-up protocols, a 15-minute interval was implemented to simulate the time between warm-up and match kick-off, in accordance with official match regulations. This interval, commonly used in official football matches, provides players with sufficient time to finalize their preparations after warm-up. To ensure that the study scenarios aligned with real match conditions, two performance tests were conducted immediately after this 15-minute interval.

First, participants performed the Five-Repetition Jump Test (5JT), a widely used assessment tool for evaluating lower limb explosive power and the ability to perform horizontal movements utilizing the stretch-shortening cycle (SSC). The test was conducted using an Optojump platform, with participants instructed to execute five consecutive maximal jumps without arm use. All jumps were performed consecutively, without pauses between repetitions. The best performance achieved by each participant was recorded and utilized for analysis.

Immediately following the jump test, 10-meter and 30-meter sprint tests were conducted. These tests were performed on a grass field using a photocell system (BX700-DFR-T Autonics). Participants began their sprints from a designated starting point located one meter behind the initial photocell. They were instructed to start running whenever they felt ready. Timing commenced as the participant passed through the initial photocell and ended upon crossing the final photocell.

Participants were instructed to sprint with maximum effort. Each participant completed two trials, with one minute of passive rest between sprints. Measurements were recorded with a precision of 1/1000 seconds, and the best times from each participant were used for analysis.

This methodological approach provided an effective framework for thoroughly examining the effects of two different warm-up methods on critical performance metrics in a football context and for collecting comprehensive data. The systematic and controlled implementation enabled a reliable analysis of the methods' impact on jump and sprint performance.

**Method 1**

The 30-minute warm-up program consists of two phases:

**Phase 1 (15 minutes):**

1. Foam Roller Exercises (5 minutes): Relaxation of all major muscle groups using a foam roller.

2. THERABAND™ Exercises (3 minutes): Ankle movements: dorsiflexion, plantar flexion, eversion, inversion. Standing glute kicks 15 repetitions. Lateral band walks: 10 steps to the right, 10 steps to the left. Banded walks: 20 steps to the right, 20 steps to the left.

3. Gym Ball Exercises (3 minutes): Each exercise performed for 15 repetitions: Stability Ball Hamstring Roll-Ins. Back extensions. Abdominal crunches.

4. BOSU Ball Balance Drills (2 minutes): Single-leg balance: 15 seconds on the left leg, 15 seconds on the right leg. BOSU ball skipping: 15 seconds. Lateral skipping on BOSU ball: 15 seconds.

5. Hurdle Drills (2 minutes): Using four hurdles, each 70 cm in height: Forward walking. Backward walking. Whirly birds. Lateral skips (right and left).

**Phase 2 (15 minutes):**

1. Passing Drill (3 minutes): Focused on improving passing accuracy and control through continuous passing routines.

2. 5v5 Possession Game (5 minutes): Conducted in a 20m x 25m area. Two sets of 2-minute games, with 1 minute of rest between sets. Emphasis on maintaining possession under pressure and quick decision-making.

3. Crossing and Shooting Drill (2 minutes): Players practice delivering crosses and finishing with shots on goal.

4. Shooting Drill (2 minutes): Players focus on precision and power during shooting from various distances and angles.

5. Sprints (4 repetitions x 8 meters): Performed at maximum effort. Each sprint is 8 meters in length, emphasizing acceleration and explosive speed.

**Method 2 (Power Band)**

The 30-minute warm-up program consists of three phases:

**Phase 1 (12 minutes):**

1. Foam Roller Exercises (5 minutes): Relaxation of all major muscle groups using a foam roller.

2. THERABAND™ Exercises (3 minutes): Ankle movements: dorsiflexion, plantar flexion, eversion, inversion. Standing glute kicks 15 repetitions. Lateral band walks: 10 steps to the right, 10 steps to the left. Banded walks: 20 steps to the right, 20 steps to the left.

3. BOSU Ball Balance Drills (2 minutes): Single-leg balance: 15 seconds on the left leg, 15 seconds on the right leg. BOSU ball skipping: 15 seconds. Lateral skipping on BOSU ball: 15 seconds.

4. Hurdle Drills (2 minutes): Using four hurdles, each 70 cm in height: Forward walking. Backward walking. Whirly birds. Lateral skips (right and left).

**Phase 2 (12 minutes):**

1. Passing Drill (3 minutes): Focused on improving passing accuracy and control through continuous passing routines.

2. 5v5 Possession Game (5 minutes): Conducted in a 20m x 25m area. Two sets of 2-minute games, with 1 minute of rest between sets. Emphasis on maintaining possession under pressure and quick decision-making.

3. Crossing and Shooting Drill (2 minutes): Players practice delivering crosses and finishing with shots on goal.

4. Shooting Drill (2 minutes): Players focus on precision and power during shooting from various distances and angles.

**Phase 3: Exercises Performed with Two Different Power Bands (6 minutes):**

1. Deceleration and Acceleration Drills with Long Power Band (750 cm): Deceleration: 2 repetitions over a 15-meter distance. Acceleration: 2 repetitions over a 15-meter distance (Figure 1).

2. Jumping Drills with Short Power Band: Performed using a short power band (Figure 2). 5 repetitions of explosive jumping exercises.

3. Sprint Drills: 4 repetitions sprints over an 8-meter distance.

In this study, the AMILA ultra heavy power band was used for fundamental running drills such as acceleration and deceleration, providing appropriate resistance (Figure 1). Three AMILA resistance bands were combined to achieve a total length of 750 cm, capable of delivering up to 40 kg of resistance. This elastic band provided an adequate load for 15-meter acceleration and deceleration drills. The combination was implemented to effectively activate acceleration and deceleration forces.

Additionally, a power band designed to provide resistance during vertical jumping exercises was used (Figure 2). This setup included a belt worn around the waist and adjustable ankle straps connected to the band, increasing resistance during jumps. This configuration effectively enhanced the load applied during jumps, thereby supporting power development exercises.

ISSN: 2146 - 9466
www.ijtase.net
*International Journal of New Trends in Arts, Sports &Science Education – 2025, volume 14, issue 1*

**Figure 1:** AMILA power band and belt system.

**Figure 2:** Power band used for jumping exercises.

## RESULTS

### Data Analysis

The data were analyzed using SPSS 14.0 software. A paired t-test was conducted to compare the effects of the two warm-up methods on sprint and jump performance.

**Table 1.** Descriptive Characteristics of Participants (N=20)

| Variable | Mean (± SD) |
|---|---|
| Age (years) | 16.25 ± 0.43 |
| Height (cm) | 175.1 ± 4.69 |
| Weight (kg) | 64.45 ± 6.14 |
| BMI | 20.99 ± 1.53 |
| Body Fat Percentage (%) | 7.51 ± 2.35 |

**Table 2.** Comparison of Five-Repetition Jump Test (5JT) Between Method 1 and Method 2

| Variables | N | Jump (cm) $\bar{X}$ | SD | *t* | p |
|---|---|---|---|---|---|
| **Method 1** | 20 | 37.675 | 3.96 | -2.701 | .014* |
| **Method 2 (Power Band)** | 20 | 39.275 | 4.09 | | |

*P<.05

When examining the results, the average jump height in the Five-Repetition Jump Test was found to be 37.675 cm for Method 1 and 39.275 cm for Method 2. The difference between these values was statistically significant t(19) = -2.701, p <.014. These results indicate that Method 2 demonstrated better performance in the Five-Repetition Jump Test compared to Method 1.

**Table 3.** Comparison of 10-Meter Sprint Performance Between Method 1 and Method 2

| Variables | N | 10m (sec.) $\bar{X}$ | SD | *t* | p |
|---|---|---|---|---|---|
| **Method 1** | 20 | 1.587 | .052 | -5.857 | .000* |
| **Method 2 (Power Band)** | 20 | 1.686 | .072 | | |

*P<.05

When examining the results, the average 10-meter sprint performance was found to be 1.587 seconds for Method 1 and 1.686 seconds for Method 2. The difference between these values was also

statistically significant t(19) = -5.857, p <.001. These results demonstrate that Method 1 achieved better performance in the 10-meter sprint compared to Method 2.

**Table 4.** Comparison of 30-Meter Sprint Performance Between Method 1 and Method 2

| Variables | N | 30m (sec.) $\bar{X}$ | SD | *t* | p |
|---|---|---|---|---|---|
| **Method 1** | 20 | 4.041 | .123 | -6.633 | .000* |
| **Method 2 (Power Band)** | 20 | 4.201 | .155 | | |

*P<.05

An examination of Table 4 reveals that the average 30-meter sprint performance was 4.041 seconds for Method 1 and 4.201 seconds for Method 2. The difference between these values was statistically significant t(19) = -6.633, p <.001. These findings indicate that Method 1 resulted in superior 30-meter sprint performance compared to Method 2.

## DISCUSSION and CONCLUSIONS

Exercises performed with power bands of varying resistance during warm-up can enhance muscle activation, thereby supporting explosive force production. In this study, Method 2, which incorporated two different power bands during the final phase of the warm-up, led to a statistically significant improvement in Five-Repetition Jump Test (5JT) performance. This finding aligns with existing literature suggesting that power band exercises improve the elastic properties of muscles, thereby enhancing jump performance.

Peng et al. (2021) reported that incorporating 3- and 5-repetition squat exercises with elastic bands as a warm-up activity positively influenced post-activation potentiation (PAP), resulting in improvements in sprint performance, change-of-direction ability, and jump force. Similarly, Gaamouri et al. (2023) observed significant improvements in countermovement jump (CMJ) performance among handball players with an average age of 15.8 ± 0.2 years. After a 10-week elastic band training program, CMJ values increased from 22.8 ± 1.8 cm to 26.8 ± 2.0 cm.

In this study, a statistically significant decrease in 10-meter and 30-meter sprint performance was observed following the warm-up protocol incorporating resistance bands. This outcome has been interpreted as a potential result of temporary muscle fatigue induced by resistance band exercises, which may negatively affect short-distance sprint performance. Morin (2018) and Karaday (2019) emphasized that adaptation processes to resisted sprint training, particularly when using heavy resistance, may take longer and require consideration of individual differences. These findings suggest that while resistance band exercises may impair sprint performance in the short term, they could lead to performance improvements with long-term adaptations.

Similarly, Blazevich (2024), in a study examining the effects of resistance training on sprint and endurance athletes, noted that resistance training triggers morphological and physiological adaptations, contributing to performance enhancements. However, he also highlighted that excessive resistance training is not always necessary for optimal performance and that the specific demands of the individual and sport must be considered.

Atan (2019), in a study investigating the effects of different warm-up protocols on joint range of motion, jump, and sprint performance, reported that the effects of resistance band exercises on sprint performance could be neutral or negative. These findings highlight the importance of tailoring warm-up protocols to the specific needs of athletes to achieve optimal performance outcomes.

In conclusion, the integration of resistance band exercises into warm-up protocols can be beneficial for enhancing jump performance but may have short-term negative effects on sprint performance. Therefore, when designing training programs, it is crucial to consider the timing, intensity, and individual adaptation processes associated with resistance band exercises. Additionally, considering the long-term adaptation processes of resistance training, it is recommended that these exercises be planned strategically during preparatory phases to align with performance goals.

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