

Article

The Effects of FIFA 11+ and Harmoknee Warm-Up Protocols on Flexibility, Vertical Jump and Shooting Speed in Female Football Players: A Comparative Study

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Abstract: Background/Objectives: The aim of this study was to compare the acute effects of the FIFA 11+ and Harmoknee warm-up protocols in female football players on flexibility, vertical jump, and shooting speed performance. Methods: This study involved 17 female football players who volunteered to participate, had no history of medical conditions, maintained regular menstrual cycles (28 ± 2 days, range: 26–33 days) in the three months preceding the study, and consistently engaged in football training. The Harmoknee and FIFA 11+ neuromuscular warm-up protocols were applied to the study group on different days, 48 h apart. After the exercises, athletes were tested for flexibility, vertical jump, and shooting speed. Two trials were allowed for each test, with a 3 min break between trials. The Shapiro–Wilk test was used to check for normality, and an independent sample t-test was used to compare groups. The p -value was set at <0.05 to determine statistical significance. Results: When comparing warm-up protocols, it was established that the FIFA 11+ neuromuscular warm-up protocol positively affects athletes' vertical jump performance compared to other protocols ($p < 0.05$). In conclusion, the FIFA 11+ warm-up protocol resulted in better vertical jump performance in female soccer players compared to the Harmoknee warm-up routine. The FIFA 11+ protocol activates leg muscles, and balance exercises improve the neuromuscular characteristics of the warm-up compared to the Harmoknee protocol.

Keywords: female; football; FIFA 11+ neuromuscular; Harmoknee warm-up; vertical jump; flexibility; shooting speed



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1. Introduction

Football is an anaerobic-based branch characterized by high-intensity, intermittent, and repetitive actions—such as multi-directional sprints, agility maneuvers, jumping, ball striking, and dribbling—arising from the game's dynamic and constantly shifting structure [1–5]. In football, selecting an appropriate and effective warm-up protocol before training or matches is critical to enhancing performance and achieving the desired level of play. Factors such as the warm-up's type, duration, and intensity, and the recovery period between the warm-up and the main activity may affect performance outcomes and, therefore, require careful consideration [6–9]. Athletes from various sports utilize

different warm-up protocols before competitions and training sessions [10,11]. Although pre-training or pre-match preparatory activities are generally referred to as warm-ups, the literature presents diverse definitions of warming up. Accordingly, warmed muscles exhibit greater flexibility and faster and stronger contractions; in contrast, insufficient warm-up increases vulnerability to injuries during intense training or matches [12]. In addition to minimizing injury risk, warming up aims to achieve optimal performance during training and competition, preparing the body for the activity demands [13]. While the necessity of a warm-up protocol before each training and match is widely accepted, there is limited scientific evidence on which type of warm-up is most effective. In the past, coaches primarily relied on trial-and-error and personal experience to devise warm-up routines; however, recent extensive research and technological advancements have introduced new and varied warm-up protocols in this field [14–16]. Consequently, coaches are now integrating novel warm-up strategies into their training and competition preparations. Warm-up programs may include various protocols and sport-specific approaches, emphasizing the importance of selecting effective and purpose-driven strategies [17].

FIFA 11+ [18] and Harmoknee [19] are two distinct training programs designed to reduce injury risks in young football players. Both programs are structured based on scientific evidence and best practices, targeting significant and modifiable risk factors for injury. These programs address deficiencies in strength, power, balance, speed, proprioception, and joint range of motion [20]. Despite their similarities, the FIFA 11+ warm-up protocol includes exercises focusing on core stabilization, dynamic stabilization, and plyometric training [21], whereas Harmoknee aims to achieve an optimized movement pattern that reduces stress on the knee joint [19]. Accordingly, they include running exercises and sport-specific dynamic movements, presenting a comprehensive approach to improving athletes' performance while mitigating injury risks [18,19]. Cluster-randomized controlled trials have shown that FIFA 11+ effectively reduces lower extremity injury rates among young males [22,23] and female players [24–26]. While the evidence base for Harmoknee is more limited compared to FIFA 11+, studies have still documented its effectiveness in lowering the occurrence of lower extremity injuries, especially knee injuries, among young female athletes [19]. Understanding the effects of FIFA 11+ and Harmoknee on physical performance could help identify the potential mechanisms behind the reduced frequency of injuries [27]. Some studies have explored the effects of both programs (particularly FIFA 11+) on specific neuromuscular performance measures, such as lower extremity balance [25,28], core stability [27], knee proprioception [28], knee strength [26–28], and sprint and jump abilities [27–31], which are considered integral to athletic physical performance. However, there are few studies on both programs involving female football players.

FIFA 11+ and Harmoknee warm-up protocols have both injury-preventive and performance-enhancing properties. This study aimed to investigate the acute effects of the FIFA 11+ and Harmoknee warm-up protocols on physical performance.

2. Materials and Methods

2.1. Study Design

This research was conducted on female football players in Türkiye Women's 3rd League at the end of the 2024–2025 football season. Seventeen female football players participated in a two-hour familiarization training to introduce the warm-up programs. During the familiarization process, both warm-up programs were explained in detail (Figure 1). Afterwards, the players practiced these warm-up movements on the football pitch. Players were informed not to train and to avoid stimulant drinks and foods 24 h before the test time. Players were instructed to consume a meal approximately 2–3 h before the training and to arrive well rested. Warm-up protocols and performance tests were

performed simultaneously (17:00–18:30) on the artificial turf football pitch. On the day the FIFA11+ warm-up protocol was applied, the temperature was 17.2 °C, the wind direction was 3.9 km/h Northwest, and the humidity was 62%. On the day the Harmoknee warm-up protocol was applied, the temperature was 16 °C, the wind direction was 3.8 km/h Northwest, and the humidity was 67%. Immediately after the warm-up, flexibility, vertical jump, and shooting speed performance tests were performed. Subjects were motivated during the test period to concentrate on movements. The researchers remained neutral towards the protocols and athletes during the implementation phase, avoiding any emphasis on one of the protocols. The data for the study were collected at 48 h intervals and obtained after being recorded in the test chart.

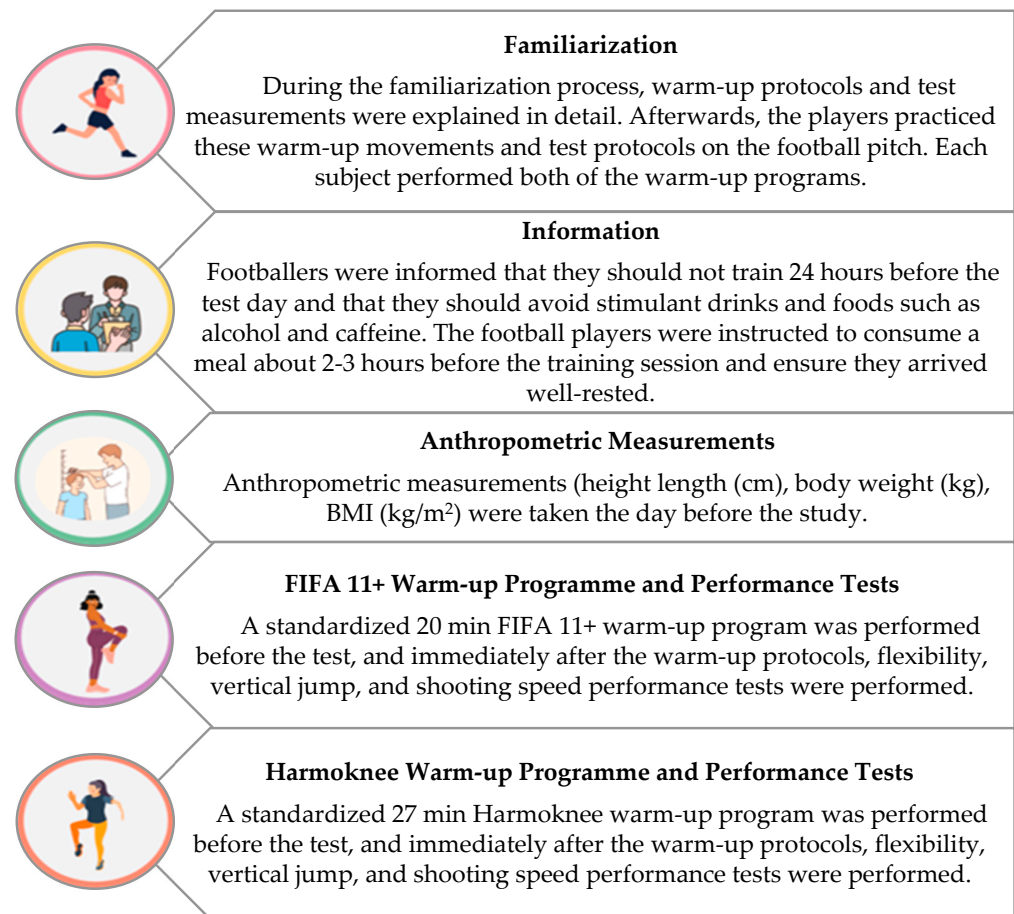


Figure 1. Study design.

For FIFA 11+, 6 pairs of cones were placed 5 m apart and a total distance of 25 m was prepared, spanning from the first to the last set of cones. The FIFA 11+ is divided into three sessions: the first phase involves a dynamic warm-up, the second phase comprises static strength exercises, and the third phase incorporates plyometric movements (Table 1) [14]. The protocol was implemented within a 20 m area. A rest period of 1 min was given between the phases. All stages of the warm-up protocol were allocated as 20 min in total.

Table 1. FIFA 11+ neuromuscular warm-up exercises.

Part 1	Part 2	Part 3
Running Exercises Approximately 8 min (performed approximately 90–120 s for each movement)	Strength, Plyometrics, and Balance Approximately 10 min (performed approximately 90–120 s for each movement)	Running Exercises Approximately 2 min (performed approximately 30–45 s for each movement)
Straight ahead	The bench alternate legs	Across the pitch
Hip out	Sideways bench raise and lower hip 40 s and 3 sets	
Hip in	Hamstring intermediate	Bounding
Circling partner	Single-leg stance throwing ball with partner	Plant and cut
Shoulder contact	Squats walking lunges	
Quick forwards and backwards	Lateral jumps	

The exercises consist of five sections: warm-up, muscle activation, balance, strength, and core stability. The total duration of the Harmoknee protocol for all sections was 27 min (Table 2).

Table 2. Harmoknee warm-up exercises.

Part 1 Warm-up (≥10 min)	Jogging (≥4–6 min), Backward jogging on the toes (Approximately 1 min), High-knee skipping (Approximately 30 s), Defensive pressure technique (Approximately 30 s), One and one (≥2 min)
Part 2 Muscle activation (Approximately 2 min) (6 items, each item 4 s for each leg/side)	Activation of calf muscles, Quadriceps muscles, Hamstring muscles, Hip flexor muscles, Groin muscles,
Part 3 Balance (Approximately 2 min) (4 items each item approximately 30 s)	Hip and lower back muscles Forward and backward double leg jumps, Lateral single leg jumps,
Part 4 Strength (Approximately 4 min) (3 items each item approximately 1 min)	Forward and backward single leg jumps, Double leg jump with or without ball (optional) Forward and backward double leg jumps, Lateral single leg jumps,
Part 5 Core stability (Approximately 3 min) (3 items each item approximately 1 min)	Forward and backward single leg jumps, Double leg jump with or without ball (optional) Sit-ups Plank on elbows and toes Bridging

2.2. Participants

Seventeen healthy female football players who had no history of medical injuries, regularly engaged in football training, and maintained regular menstrual cycles (28 ± 2 days, range: 26–33 days) in the three months preceding the study [32] were included in the study (Table 3). G Power software 3.1 was used to calculate the sample size, and it was concluded that 15 participants were sufficient (0.05 for “ α err prob”, 0.8 for “power (1- β err prob). The subjects were selected from the same football club and had similar prior training load histories to avoid the effects of different training programs. The subjects were enrolled in two programs, the FIFA 11+ and Harmoknee. Each group had an almost equal distribution of playing positions (defenders, mid-fielders, and strikers) without goalkeepers because of different physical and physiological demands [33–35]. The Sinop University Human Research Ethics Committee approved this research.

Table 3. Descriptive characteristics of the participants.

Variables	n	Mean	SD
Height Length (cm)	17	158.17	3.97
Body Weight (kg)		54.42	14.10
Age (year)		16.88	5.74
BMI (kg/m ²)		21.65	4.84
Football Starting Age (years)		12.00	1.45

2.3. Test Procedures

Flexibility tests, vertical jump, and ball speed measurements were performed under standardized environmental conditions (16–17 °C) at the same time. Tests were conducted between 5:00 pm and 6:30 pm. The participants were introduced to the warm-up and test protocols, and the study content was described in detail. Familiarization was applied for the FIFA 11+ and Harmoknee protocols. The same researchers monitored the measurements as part of a standard evaluation. A standardized 27 min Harmoknee warm-up program (five phases) and a 20 min FIFA 11+ warm-up program (three phases) were performed before the tests. The data for the study were collected at 48 h intervals. All participants completed all phases of both warm-up protocols in a counterbalanced and sequential manner.

Anthropometric measurements (height (cm), body weight (kg), BMI (kg/m²)) were taken the day before the study. Immediately after the warm-up protocols, flexibility, vertical jump, and shooting speed performance tests were performed. A 2 min test was given between warm-up and test. Two attempts were given for the tests, and a 3 min rest period was provided between the test repetitions. The best score was determined among the test repetitions.

2.4. Data Collection Tools

2.4.1. Anthropometric Measurements

The heights of the football players participating in the study were measured using the height measurement device from the brand Seca 213 (Germany). Body weights were determined using the Inbody 120 Bioimpedance Body Composition Analyzer and recorded in kilograms. The body mass index of the football players was determined using the formula “BMI (kg/m²) = Body Weight (kg)/Height² (m²)”.

2.4.2. Sit and Reach Flexibility Test

The flexibility test measurements of the football players who participated in the research were performed with a sit-and-reach test table. After the participants were ready, they were asked to flat touch the sole of their bare foot on the test table. They were asked to lean their torsos forward and extend their hands as far as they could in front of their body without bending their knees. In this way, they waited for 1–2 s at the farthest point. Flexibility measurements were applied twice, and the best score was determined in ‘cm’ [36].

2.4.3. Vertical Jump

A digital vertical jump device (Takei Jumpmeter, Figure 2) was used to measure the vertical jump performance of the players. In the vertical jump test, the athlete’s knees were in a squat position at 90° flexion, while the value of their jump from a standing position with hands free was recorded. A 1 min rest period was given between attempts. Players had 2 attempts for the vertical jump, and the best score was recorded [37].



Figure 2. Vertical jump device (Takei Jumpmeter).

2.4.4. Ball Speed Measurement

In the study, a Bushnell radar gun from the USA (Figure 3), capable of measuring speeds in the range of 16–177 km/h with a precision of ± 2 km/h, was used to determine the ball speed after the players kicked the ball. In the study, they kicked the ball from the penalty spot, 11 m from the goal post, using the instep kick technique, after determining the dominant foot. The kicks were made in accordance with FIFA standards. The kickers were asked to make the most powerful kick targeting the goal with the correct kicking technique (position of the supporting foot, movement of the kicking leg, foot strike, contact with the ball, and movement of the upper body). The highest velocity recording device, equipped with a handheld radar, was placed on a 122 cm high fixed tripod, 200 cm behind a standard football goal line, directly opposite the target of the player's kick. Two attempts were made to achieve highest possible rating, and the results were recorded in miles per hour (mph) and then converted to km/h [38].



Figure 3. Bushnell radar gun.

2.5. Data Analysis

In this study, the SPSS 26.0 package program was used for all statistical analyses. Descriptive statistics were used to evaluate the data. The Shapiro–Wilk test was used for normality control and showed normal distribution. An independent sample *t* test was used to compare the effects of different warm-up protocols on flexibility, vertical jump, and shooting speed performance. Cohen's *d* was used as a measure of effect size, with values below 0.5 reflecting a small effect, values between 0.5 and 0.8 reflecting a medium effect, and values above 0.8 reflecting a strong effect [39]. The Pearson correlation was used to analyze the relationship between the two warm-up protocols and physical performance parameters. A *p*-value of less than 0.05 was considered significant.

3. Results

When the performance parameters obtained after the FIFA 11+ and Harmoknee warm-up programs were compared as shown in Tables 4 and 5, there was a statistically significant difference in the scores of the vertical jump tests ($p < 0.05$), while there were no significant differences in shooting speed and flexibility test scores ($p > 0.05$).

Table 4. Acute effects of two warm-up protocols on flexibility, vertical jump, and shooting speed performance.

Variables	FIFA 11+ Warm-Up		Harmoknee Warm-Up		t	p	Cohen's d
	n	Mean $\pm$ SD	Mean $\pm$ SD				
Flexibility (cm)	17	34.79 $\pm$ 6.30	32.17 $\pm$ 8.41	1.02	0.31	0.72	
Vertical Jump (cm)		33.00 $\pm$ 2.87	30.70 $\pm$ 3.45	2.10	0.04		
Shooting Speed (km/h)		68.44 $\pm$ 6.15	67.20 $\pm$ 8.41	0.487	0.62		

Table 5. Pairwise comparison for performance parameters.

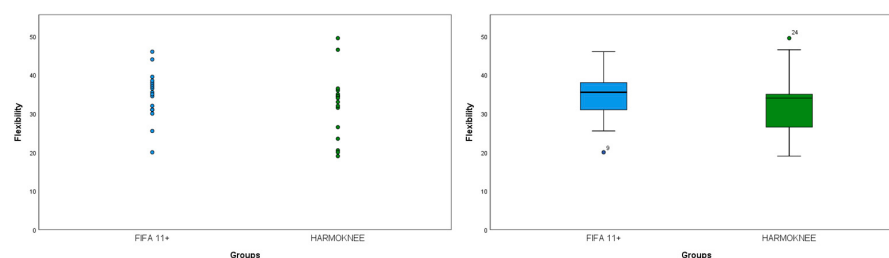
Variables	n	Mean Difference (F-H)	Std. Error	95%CI Lower Bound	95%CI Upper Bound
Flexibility (cm)	17	2.61	2.55	−2.57	7.81
Vertical Jump (cm)		2.29	1.09	0.07	4.51
Shooting Speed (km/h)		1.23	2.52	−3.91	6.38

F: FIFA 11+; H: Harmoknee Warm-up.

When the correlation of performance parameters was obtained after the FIFA 11+ and Harmoknee warm-up programs in Table 6; the relationship between vertical jump and height, height and body weight, and BMI and height were statistically significant ($p < 0.05$). No significance was found in other parameters ($p > 0.05$). In addition, Figures 4–6 illustrate the scatterplots of the variables based on the warm-up protocols.

Table 6. Correlation analysis.

		Flexibility (cm)	Vertical Jump (cm)	Shooting Speed (km/h)	Height (cm)	Weight (kg)	Age (year)	BMI (kg/m ²)
Flexibility (cm)	r	1	0.18	0.25	0.19	−0.09	0.10	−0.12
	p		0.30	0.14	0.26	0.60	0.54	0.48
Vertical Jump (cm)	r	0.18	1	0.22	0.38	0.01	0.04	−0.06
	p	0.30		0.20	0.02	0.92	0.79	0.69
Shooting Speed (km/h)	r	0.25	0.22	1	0.33	0.16	0.07	0.10
	p	0.14	0.20		0.05	0.35	0.66	0.57
Height (cm)	r	0.19	0.38	0.33	1	0.50	0.15	0.35
	p	0.26	0.02	0.05		<0.01	0.38	0.04
Weight (kg)	r	−0.09	0.01	0.16	0.50	1	−0.03	0.98
	p	0.60	0.92	0.35	<0.01		0.82	<0.01
Age (year)	r	0.10	0.04	0.07	0.15	−0.03	1	−0.06
	p	0.54	0.79	0.66	0.38	0.82		0.70
BMI (kg/m ²)	r	−0.12	−0.06	0.10	0.35	0.98	−0.06	1
	p	0.48	0.69	0.57	0.04	<0.01	0.70	

**Figure 4.** Flexibility scatterplots and box-plots of participants according to FIFA 11+ and Harmoknee warm-up protocols.

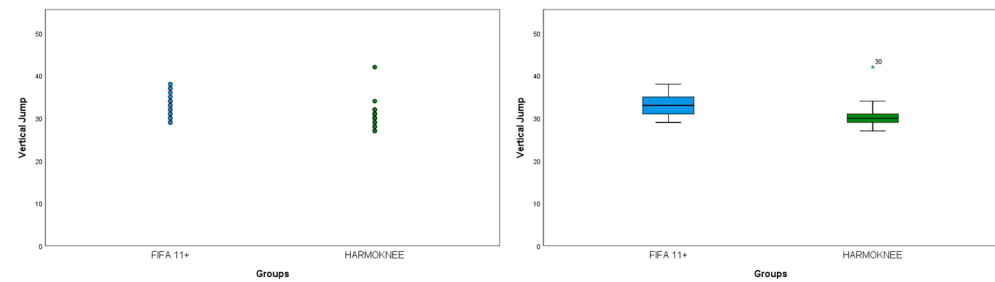


Figure 5. Vertical jump scatterplots and box-plots of participants according to FIFA 11+ and Harmoknee warm-up protocols.

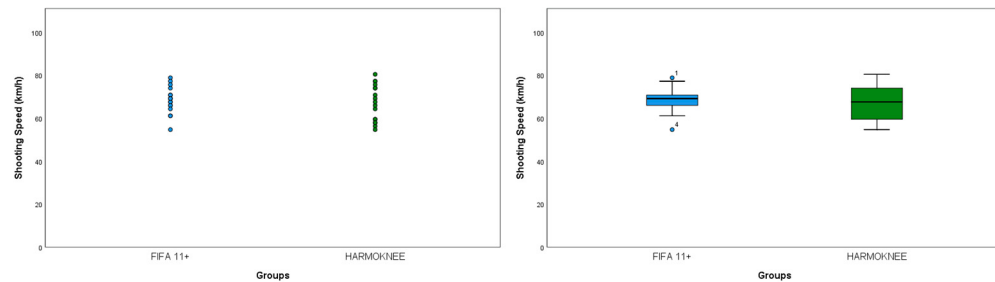


Figure 6. Shooting speed scatterplots and box-plots of participants according to FIFA 11+ and Harmoknee warm-up protocols.

An examination of the box -plots illustrating the variables based on the warm-up protocols in Figure 5 revealed the presence of an outlier in the Harmoknee warm-up group.

4. Discussion

The aim of this study was to investigate the acute effects of the FIFA 11+ and Harmoknee warm-up protocols, known for their injury prevention effects in female football players, on physical performance (flexibility, vertical jump, and shooting speed). To this end, the FIFA 11+ and Harmoknee warm-up protocols were applied to the participants at 48 h intervals, and their acute effects on flexibility, vertical jump, and shooting speed measurements were investigated and compared. When the warm-up protocols were compared, it was observed that the FIFA 11+ warm-up protocol had a statistically significant impact on vertical jump compared to the Harmoknee protocol among female football players ($p = 0.04$). No statistically significant difference was found between the FIFA 11+ and Harmoknee protocols on flexibility and shooting speed test values ($p > 0.05$). When the correlation analysis between physical parameters and performance tests was conducted, it was concluded that the relationship between vertical jump and height, height and body weight, and BMI and height were statistically significant ($p < 0.05$).

An examination of the literature highlights diverse findings regarding the impact of warm-up protocols on flexibility. In a study by Zarei et al. [40], no significant difference in flexibility (sit-and-reach) between the experimental and control groups was found when pre-test and post-test values were compared, where a 10-week FIFA 11+ warm-up program was performed. In their research on young football players, Trajković et al. [41] found that 4 weeks of FIFA 11+ practice improved their flexibility. Mota et al. [42] investigated the acute effects of the FIFA 11+ warm-up protocol and concluded that it had a positive impact on flexibility. In their study, Aktaş et al. [43] found that among child football players of different age groups, the FIFA 11+ and the Harmoknee warm-up had positive acute effects on flexibility. Akodu et al. [44] and Camacho Arcila et al. [45] found that the FIFA 11+ protocol produced a significant difference in flexibility between experimental and control groups. Gatterer et al. [46] reported that the dynamic stretching and plyometric

movements included in the FIFA 11+ protocol aim to develop ROM (range of motion) and flexibility, positively affecting overall athletic performance. In their study on young female football players, Steffen et al. [25] indicated that the FIFA 11+ protocol had no significant effect on flexibility. It is suggested that this finding may be ascribed to the age and gender characteristics of the subjects. The literature presents conflicting results regarding the FIFA 11+ protocol's effect on flexibility, and fewer studies have focused on the Harmoknee protocol, indicating the need for further research in this area.

Silva et al. [17] found positive effects on the vertical jump in 12 male soccer players after 9 weeks of practicing FIFA 11+. In a study by Pomares-Noguera et al. [47], a significant increase in vertical jump and agility was observed in the FIFA 11+ group after 4 weeks of training. In the research conducted by Daneshjoo et al. [48] on 36 elite male football players, the athletes were divided into three groups: FIFA 11+, Harmoknee, and dynamic warm-up programs. As a result of 24 sessions of the warm-up program applied 3 days a week for 8 weeks, a significant increase was observed in athletes' jump heights in the FIFA 11+ and Harmoknee groups. (FIFA 11+: $p = 0.000$, Harmoknee: $p = 0.002$). No similar increase was found in the dynamic warm-up group. Impellizzeri et al. [27] found no statistically significant difference in jump performance between the FIFA 11+ and dynamic warm-up protocols. Ayala et al. [49] investigated the acute effects of the FIFA 11+, Harmoknee, and dynamic warm-up protocols. Sixteen amateur male football players were randomly divided into groups, and their performance parameters, such as jump height, 10 m and 20 m sprint times, and range of motion, were evaluated. No significant change was observed in jump performance in the FIFA 11+, Harmoknee, and dynamic warm-up groups ($p > 0.05$). However, the dynamic warm-up protocol showed higher jump performance than the FIFA 11+, and Harmoknee programs. Akbari et al. [50] conducted a study with 24 male footballers under the age of 19, randomly dividing them into FIFA 11+ and dynamic warm-up groups. Warm-up programs were applied 3 days a week for 8 weeks. Jump heights were evaluated before the study, at the end of 8 weeks, and 1 month after the end of the study. No significant difference was found in the overall findings ($p = 0.076$). However, while jump height increased by 3.27 cm in the FIFA 11+ group, only a 0.41 cm increase was observed in the dynamic warm-up group. Foqha [51] found statistically significant improvements in vertical jump performance in the FIFA 11+ group compared to the traditional dynamic warm-up group in a 10-week study. Soligard et al. [52] investigated the effects of the FIFA 11+ protocol on injury risk reduction and performance enhancement in young footballers. Significant improvements were achieved, especially in vertical jump performance. It was observed that jump height was higher in active jumps performed after the FIFA 11+ programs than in those performed after other warm-up programs. This may be explained because isometric exercises performed before performance increase the stretch-shortening cycle and neuromuscular factors. The number of studies in the literature on Harmoknee, another warm-up protocol evaluated in this study, is much fewer compared to the FIFA 11+, warm-up protocol. Therefore, further research is needed on the effects of the Harmoknee protocol.

In the literature, there is limited research on the effects of warm-up methods on shooting speed performance [53,54]. These studies generally examined how static or dynamic stretching applications and aerobic running affect shooting speed performance. However, there is no study in which neuromuscular warm-up methods and shooting speed performance were evaluated together. In general, existing research has not observed a significant difference in shooting speed performance between warm-up protocols. This may be related to factors such as the population used, resting time, or sufficient pre-activation potential (PAP). Fatigue stands out as one of the elements that negatively affect shooting performance. Because instep striking and shooting performance are integral parts of football, the

warm-up process must not affect the shooting speed of the players [54]. In light of this information, the intensity of warm-up protocols and recovery times needs to be carefully adjusted. Factors affecting shooting speed include technical, biomechanical, physiological, muscular strength, and neuromuscular adaptation [55,56]. Individual characteristics such as athletes' age, gender, playing position, training status, sports experience, and striking technique can also affect shooting speed performance [55,57,58].

The relationship between vertical jump height and athlete height is a complex interaction influenced by biomechanical, physiological, and anthropometric factors. Although studies have shown that there is a correlation between height and vertical jump, increased height does not directly result in higher jumps. Research emphasizes that taller height can improve jumping performance in sports such as volleyball [59] but found a negative relationship between vertical jump and body weight, indicating that other factors may limit the effect of height [60]. Other researchers found that mechanical factors such as peak vertical power and ground reaction force showed a stronger relationship with jump height, suggesting that not only neck but also individual physiological and training factors are important in jump performance [61]. Furthermore, researchers have suggested that body fat percentage negatively affects jump height and that a leaner physique may be advantageous [62]. Height is positively associated with jumping performance but may vary depending on training and athlete-specific factors [63]. This suggests that although height is an important factor, it is not the sole determinant of vertical jump success and that training protocols should consider the athlete's physiological profile.

In order to achieve the desired sporting success in football, warm-up programs should be arranged according to the specific characteristics of the sport. Otherwise, it is not possible to achieve the targeted athletic performance in physical and physiological aspects. The FIFA11+ and Harmoknee warm-up protocols have both injury prevention and performance-enhancing features.

This study has certain limitations that need to be considered. The Harmoknee warm-up protocol was applied 48 h after the FIFA 11+ warm-up protocol. Second, the measurements of flexibility, vertical jump, and shooting speed for performance evaluation were applied in a specific order, and this may affect the final findings. Third, this research was conducted at the end of the general and specific preparation period, meaning that some players were more prepared than others and may have an enhanced baseline fitness level, which could potentially affect changes in performance. Considering this limitation, we selected subjects with a high level of training as demonstrated by their playing history and recommendations from their coaches.

5. Conclusions

Based on the study's findings, the FIFA 11+ warm-up protocol was more effective than the Harmoknee warm-up protocol in improving vertical jump performance. However, there is no statistically significant difference between both protocols in flexibility and shooting speed. The superior performance of the FIFA 11+ protocol in improving vertical jump performance suggests that this protocol may be more effective in dynamic stretching and strength development. This supports the potential of the FIFA 11+ protocol to enhance athletic performance. On the other hand, the results observed in the shooting velocity parameter suggest that both protocols have similar effects in this area. This may be because differences in technical skills specific to different positions are a factor affecting shooting speed.

Considering these findings, it is recommended that future research investigate the effects of warm-up protocols on football players playing different positions, as position-specific technical skills may influence performance parameters such as shooting speed.

Additionally, incorporating supplementary physiological measurements, such as heart rate, ratings of perceived exertion, or electromyography, could provide a more comprehensive understanding of the protocols' impact on athletic performance.

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