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Acute Effects of Dynamic and Static Warm-Up Methods on Soccer Skills and Athletic Performance in 12–14-Year-Old Soccer Players

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ABSTRACT

This study aimed to investigate the acute effects of different warm-up protocols, including no additional warm-up, static warm-up (SWU), and dynamic warm-up (DWU), on changes in soccer-specific technical skills and physical performance parameters between pre- and post-tests in male soccer players aged 12–14 years. Twenty male athletes regularly training in the youth academy of the same soccer club voluntarily participated in the study. Using a randomized within-subject crossover design, all participants completed three warm-up conditions (control/no additional warm-up, SWU, and DWU) on separate testing days with a five-day wash-out period between sessions. Soccer-specific technical performance was evaluated using the Yeagley ball juggling, passing, ball control (slalom), and shooting tests. Physical performance assessments included vertical jump (VJ), standing long jump (SLJ), T-agility, and 20-m sprint tests. Data normality was assessed using the Shapiro–Wilk test, and repeated-measures ANOVA was performed for statistical analysis, with the significance level set at $p<0.05$.

The findings indicated that a statistically significant difference was observed only in the T-agility test results ($p<0.05$), with the DWU protocol showing superior T-agility performance compared with the SWU condition. No significant differences were detected among the warm-up protocols in the remaining physical performance variables or soccer-specific technical skill tests. This study contributes to the literature by jointly evaluating soccer-specific technical skills and physical performance responses to different warm-up protocols in adolescent soccer players.

In conclusion, DWU might acutely improve agility performance in youth soccer players, but appears to not offer short-term benefits for other performance parameters or technical skills. The results might offer coaches some initial guidance in selecting warm-up strategies.

Research Article

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Introduction

Soccer is a complex sport which requires a combination of high physical capacity, technical and tactical thinking (Williams et al., 2003). The success of soccer comes from holistic use of these factors. Success in soccer is the holistic use of these factors (Hughes & Franks, 2004; Williams & Reilly, 2000). In soccer, the use of scientific training principles is essential for enhancing and sustaining athletic performance (Fradkin et al., 2010; Mor et al., 2021). Warm-up protocols are important in preparation of athletes for subsequent exercise by increasing muscle temperature, enhancing neuromuscular activation and improving range of motion (Behm & Chaouachi, 2011). In

addition to the physiological benefits, a well constructed warm-up might also contribute to psychological preparedness, thereby enabling more effective execution of technical skills during performance.

Warm-up stretching practices are also known to influence athletic performance. Literature describes several common stretching methods, including static, dynamic, ballistic and proprioceptive neuromuscular facilitation (PNF) (Zakas, 2005). Most studies have focused on dynamic and static stretching.

Dynamic stretching is a type of stretching that involves sport-specific, controlled movements performed through an active range of motion. This is typically done to increase muscle temperature, stimulate neuromuscular activation, and prepare the athlete for the next physical activity (Behm & Chaouachi, 2011; Fradkin et al., 2010). The increase of motor unit excitability and the positive effect on explosive performance parameters have been shown in previous research by the addition of dynamic stretching to warm-up protocols (Kurak et al., 2024; Mor et al., 2021).

In contrast, static stretching is a form of stretching where a muscle-tendon unit is stretched to a point of slight discomfort and held for a certain duration. While static stretching is often used to improve flexibility and joint range of motion over time, several studies have reported that when performed immediately before exercise, it can cause temporary reductions in strength, power and explosive performance. As a critical note, stretching techniques are just one part of a warm-up protocol that usually includes a broader spectrum of activities that are physiologically and psychologically structured to ready athletes for exercise (Behm & Chaouachi, 2011; Fradkin et al., 2010; Shrier, 2004). Therefore, the effectiveness of different warm-up protocols may depend not only on the type of stretching used but also on the structure, intensity and sequence of the entire warm-up routine.

Technical ability is a key determinant of athletic performance in the game of soccer. Technical skill is the ability to perform sport-specific movements with accuracy, efficiency, and effectiveness in game-related contexts (Klingner et al., 2022; Koopmann et al., 2020). Moreover, technical competence also consists of the execution of these movements with the least energy wasted and under different competitive conditions (Kamar, 2003; Koç, 2005). Previous studies have shown that higher levels of technical proficiency are associated with faster decision making, greater movement accuracy and better overall performance outcomes (Egesoy et al., 1999; Williams, 2000). Thus, technical performance in soccer is seen as a multidimensional construct involving both motor execution and cognitive processing. The overall performance in soccer is affected by the interaction of different physical components like strength, speed, endurance, agility, and coordination, and cognitive components like decision-making and concentration (Özkan et al., 2022). The acquisition of these competences is promoted by the implementation of well-prepared and systematized training programs, particularly in childhood and adolescence. These types of programs are not only supportive in developing motor skills, but also in the basis of long-term athletic performance (Beunen et al., 1992; Çetin & Kaya, 2022). Thus, training interventions should be designed taking into account individual differences and developmental characteristics.

In conclusion, although many studies have been done on the effects of various stretching and warm up techniques on athletic performance, the literature has been mainly focused on adult athletes and on isolated physical performance variables such as strength, sprinting or jumping ability. Few studies on youth soccer players have examined simultaneously the soccer-specific technical skills and physical performance responses to different warm-up protocols. Moreover, the findings on acute effects of static and dynamic warm-up protocols are inconsistent, especially in adolescent populations, which are going through rapid physical and neuromuscular development. Therefore, further investigation is needed to clarify how different warm-up strategies influence both technical and physical performance parameters in young soccer players. Accordingly, the present study aimed to compare the acute effects of no additional warm-up, static warm-up, and dynamic warm-up protocols on selected technical skill and physical performance variables in male soccer players aged 12–14 years. It was hypothesized that the dynamic warm-up protocol would produce more favorable acute performance responses compared with static warm-up and no warm-up conditions.

Methods

Research Model

This study employed a randomized within-subject repeated-measures crossover design to examine the acute effects of static and dynamic warm-up methods on soccer-specific technical skills and athletic performance parameters in male soccer players aged 12–14 years. All participants completed all three experimental conditions (Control/no additional warm-up, SWU, and DWU) on separate testing days, with a five-day wash-out period between sessions to minimize potential carryover effects (Table 1). The order of the protocols was randomized across participants to reduce potential order effects. No separate participant groups were formed, and each participant served as his own control across conditions. The research was conducted in accordance with the principles of the Helsinki Declaration and was approved by the Non-Interventional Clinical Research Ethics Committee of Mardin Artuklu University (approval date and number: 16.04.2024; 2024/4-26).

Table 1. Schematic representation of the randomized within-subject crossover experimental design

Same participants (n=20)	**Session 1** Control condition / No additional warm-up	**5-Day Wash-out**	**Session 2** Static Warm-Up (SWU)	**5-Day Wash-out**	**Session 3** Dynamic Warm-Up (DWU)

Note: All participants completed all three experimental conditions. The same group of participants was tested repeatedly under each condition with a 5-day wash-out period between sessions.

Experimental Protocol: In this study, all participants completed three experimental conditions in a randomized crossover order: (1) control condition (no additional warm-up), (2) static warm-up (SWU), and (3) dynamic warm-up (DWU). Each condition was performed on a separate testing day with a five-day wash-out period between sessions to minimize residual and carryover effects. All testing sessions were conducted at the same time of day (13:00) and followed the same testing sequence.

Before the pre-tests, participants performed a standardized general warm-up consisting of low-intensity running and mobility exercises, and a brief active rest period was provided between the pre-tests. This warm-up was standardized and used in all conditions to ensure participants' safety and standardized physiological preparation before testing.

The experimental conditions were identical except for the inclusion of an additional warm-up intervention after the pre-tests. Therefore the control condition should not be considered a complete 'no warm-up' condition, but rather a condition without any additional static or dynamic warm-up intervention other than the standardized general warm-up.

1- Control condition (no additional warm-up): Following the standardized general warm-up and pre-tests, participants completed a passive rest period matched in duration to the SWU and DWU protocols. Subsequently, post-tests were performed. No additional static or dynamic warm-up protocol was applied in this condition.

2- SWU protocol: After the pre-tests, participants completed 5 minutes of rest followed by the SWU protocol, after which post-tests were performed.

3- DWU protocol: After the pre-tests, participants completed 5 minutes of rest followed by the DWU protocol, after which post-tests were performed.

The research protocol is presented schematically in Figure 1.

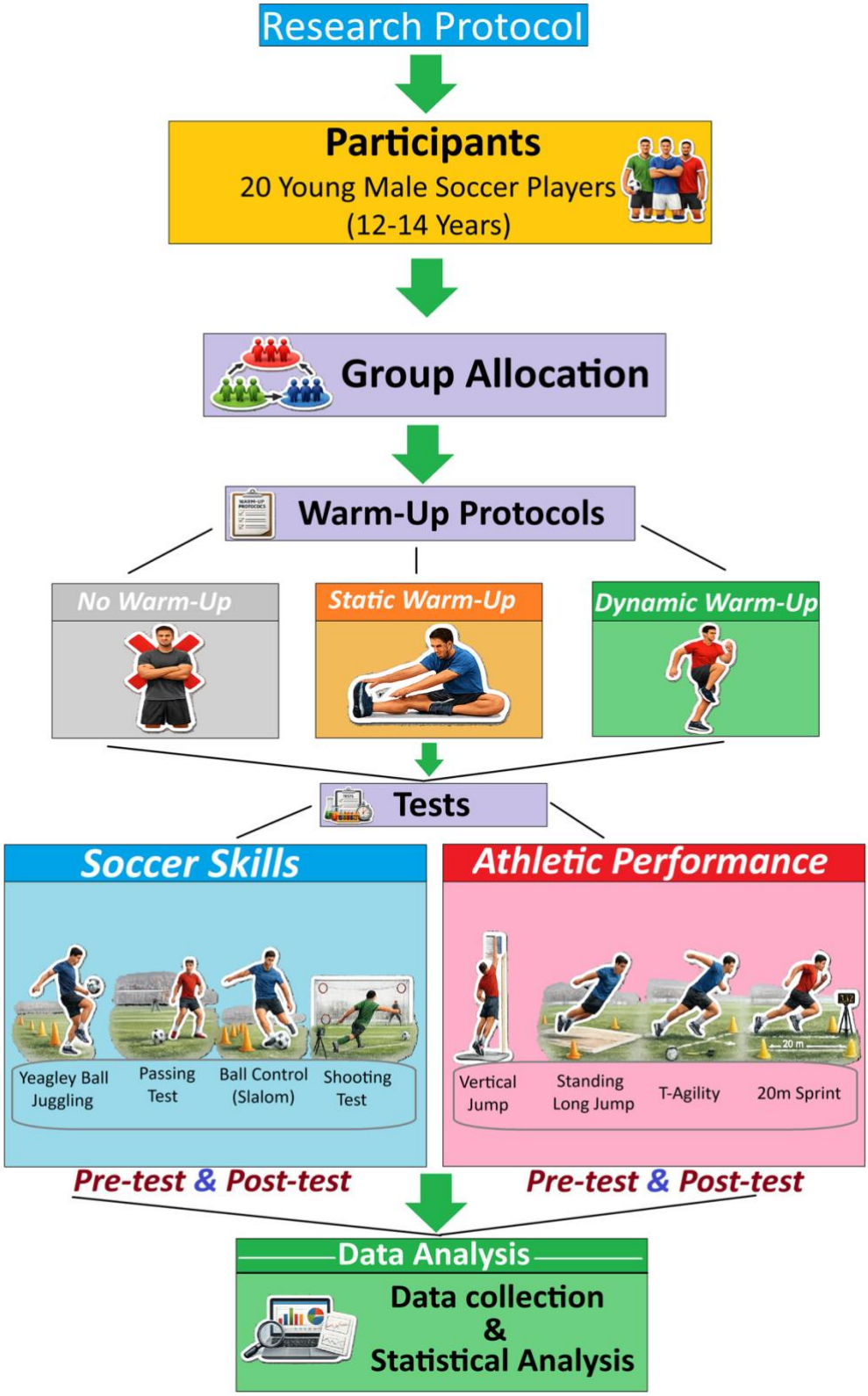

Figure 1. Schematic diagram of the research protocol for 12–14-year-old male soccer players. Participants were randomly assigned to three different warm-up methods. The diagram illustrates the timeline of interventions and pre- and post-test measurements.

Warm-up Protocols: The SWU protocol consisted of 10 exercises covering the upper and lower extremities, according to the Alter (1988) method; each exercise was performed for 20 seconds, followed by 10 seconds of rest, and repeated for 2 repetitions, totaling 10 minutes (Alter, 1988). The exercises targeted the quadriceps, hamstrings, hip flexor, biceps, triceps, and trapezius muscle groups (Ayala et al., 2013; Behm & Chaouachi, 2011; Shrier, 2004; Takeuchi et al., 2021). The DWU protocol consisted of 10 exercises based on the method of Işıkdemir et al. (2020), using the same duration structure (20 seconds of activity, 10 seconds of rest, 2 repetitions; total 10 minutes) (Işıkdemir et al., 2020). Dynamic exercises were performed in a controlled and rhythmic manner through a comfortable and safe range of motion under researcher supervision. The protocol included movements such as high knees, butt kicks, lunge walks, and changes of direction (Behm & Chaouachi, 2011).

Inclusion and Exclusion Criteria: The study included athletes aged 12-14 years who trained regularly and had not experienced an injury in the previous 6 months. Athletes who wished to withdraw from the study, experienced an injury, or did not comply with the protocol were immediately excluded.

Research Group

The study included 20 volunteer male athletes (Age: 13.35±0.65 years; Body weight: 48.6±8.14 kg; Height: 163.25±6.74 cm; BMI: 18.14 ± 2.1 kg/m²) who had been actively playing soccer for at least three years. Sample size was determined using G*Power software (version 3.1.9.4); a minimum of 18 participants was calculated using a moderate effect size (f=0.25), test power (1–05.0.85 and α=0.05. Considering potential losses, the sample size was set at 20. Participants and their families were provided with the necessary research information, and signed written consent was obtained.

Data Collection Tools

Data were collected in three stages: anthropometric measurements, soccer-specific technical skills tests, and athletic performance tests. Height was measured with a stadiometer, body weight with an electronic scale with ±100 g accuracy; BMI was calculated (Gleim & McHugh, 1997; Heyward & Stolarczyk, 2004).

Soccer-Specific Technical Skills Tests: Soccer players were subjected to Yeagley ball juggling test, passing test, ball control (slalom) test, and shooting test (Fig. 1).

- Yeagley ball juggling test: The number of valid juggles performed within 30 seconds was evaluated (Strand & Wilson, 1993).
- Passing test: 12 passes were made from a distance of 13.5 m, and accurate passes were scored (Mor & Christian, 1979; Strand & Wilson, 1993).
- Ball Control (Slalom) test: Time was measured on a 30 m course (Huijgen et al., 2010).
- Shooting test: 16 shots at targets were scored (Mor & Christian, 1979).

Athletic Performance Tests: Athletic performance was assessed using VJ, SLJ, T-agility, and 20 m sprint tests (Arin et al., 2012; Maulder & Cronin, 2005; Raya et al., 2013) (Fig. 1).

Analysis of Data

Data were analyzed using IBM SPSS 26 (Armonk, NY: IBM Corp, USA). The normality of distribution was examined by Shapiro-Wilk test and all variables were normally distributed ($p>0.05$). For each participant and protocol, change scores were calculated by subtracting post-test values from pre-test values (Pre-test − Post-test). Therefore, positive values in the T-agility test indicate improved performance because lower completion time reflects better agility. These change scores were subsequently compared across the three warm-up protocols using one-way repeated-measures ANOVA. The sphericity assumption was examined using the Mauchly's test, and Greenhouse-Geisser correction was applied when violations were detected. Significant pairwise differences were determined using Bonferroni-corrected comparisons, and effect sizes were reported using partial eta-squared (η^2). According to Cohen (1988), η^2 values of 0.01–0.059 were considered small, 0.06–0.139 medium, and ≥0.14 large effects (Cohen, 1988). The significance level was accepted as $p<0.05$. Because change scores were calculated as Pre-test − Post-test values, the interpretation of positive and negative values differed according to the variable type. For time-based variables (e.g., T-agility, sprint, and slalom), positive values indicated improved performance because lower completion times reflect better performance. In contrast, for score- or distance-based variables (e.g.,

VJ, SLJ, passing, shooting, and Yeagley tests), negative values indicated improved performance because higher post-test scores or distances reflect better performance.

Results

The study included 20 soccer players (n=20) with an average age of 13.35±0.65 years, average height of 163.25±6.74 cm, average body weight of 48.6±8.14 kg, and average BMI of 18.14±2.10 kg/m² (Table 2).

Table 2. Participant Descriptive Characteristics.

Variables	n	min.	max.	X̄±SD
Age (years)	20	12	14	13.35±0.65
Height (cm)		150	175	163.25±6.74
Body Weight (kg)		37	64	48.6±8.14
BMI[1] (kg/m²)		14.7	21.5	18.14±2.1

[1] BMI: Body Mass Index

The repeated measures ANOVA results for soccer-specific technical skills and athletic performance tests are presented in detail in Table 3.

Table 3. ANOVA Results of Change Scores (Pre-test − Post-test) for Soccer-Specific Technical Skills and Athletic Performance Variables

Tests	Method (Groups)	n	X̄±SD	95% Confidence Interval		F	p	η^2
				Lower Bound	Upper Bound			
Soccer-Specific Technical Skills Tests								
Yeagley ball juggling (number)	No Additional Warm-up	20	3.80±5.32	1.31	6.29	.121	.818	.006
	Static Warm-up		4.85±13.17	-1.31	11.01			
	Dynamic Warm-up		5.25±9.96	.59	9.91			
Passing test (number)	No Additional Warm-up		1.45±1.76	.626	2.274	1.69	.198	.082
	Static Warm-up		.35±2.11	-.637	1.337			
	Dynamic Warm-up		.60±2.06	-.365	1.565			
Slalom test with ball (sec)	No Additional Warm-up		-.86±.90	-1.276	-.434	.531	.592	.027
	Static Warm-up		-.30±3.38	-1.882	1.284			
	Dynamic Warm-up		-.88±1.85	-1.744	-.011			
Shooting test (number)	No Additional Warm-up		4.90±4.28	2.898	6.902	2.611	.102	.121
	Static Warm-up		13.70±18.5	5.039	22.361			
	Dynamic Warm-up		3.70±20.78	-6.024	13.424			
Athletic Performance Tests								
Vertical jump (cm)	No Additional Warm-up		1.61±3.61	-.08	3.303	2.04	.144	.097
	Static Warm-up		3.2±4.76	1.1	5.462			
	Dynamic Warm-up		.94±4.54	-1.2	3.062			
Standing long jump (cm)	No Additional Warm-up		1.65±11.09	-3.542	6.842	1.962	.168	.094
	Static Warm-up		8.10±21.33	-1.881	18.081			
	Dynamic Warm-up		9.85±10.30	5.028	14.672			
T-agility test (sec)	No Additional Warm-up		-.16±.61	-.449	.122	5.418	**.015***	.222
	Static Warm-up		-.37±.66	-.680	-.058			
	Dynamic Warm-up		.13±.77	-.231	.488			
20m sprint test (sec)	No Additional Warm-up		-.076±.20	-.169	.018	.275	.690	.014
	Static Warm-up		-.13±.17	-.207	-.051			
	Dynamic Warm-up		-.09±.29	-.230	.045			

*: p<0.05, X̄±SD: Arithmetic Mean±Standard Deviation

Note: Note: Change scores were calculated as Pre-test − Post-test values. For time-based variables (slalom, T-agility, and 20 m sprint), positive values indicate improved performance because lower completion times reflect better performance. For score- or distance-based variables (Yeagley, passing, shooting, vertical jump, and standing long jump), negative values indicate improved performance because higher post-test scores or distances reflect better performance.

Table 2 shows that the repeated measures ANOVA results indicated no statistically significant differences in Yeagley ball juggling ($F = 0.121$, $p = 0.818$, $\eta^2 = 0.006$), passing ($F = 1.69$, $p = 0.198$, $\eta^2 = 0.082$), slalom ($F = 0.531$, $p = 0.592$, $\eta^2 = 0.027$), or shooting performance ($F = 2.611$, $p = 0.102$, $\eta^2 = 0.121$) across the three warm-

up protocols ($p > 0.05$). Similarly, no significant differences were observed in VJ ($F = 2.04$, $p = 0.144$, $\eta^2 = 0.097$), SLJ ($F = 1.962$, $p = 0.168$, $\eta^2 = 0.094$), or 20 m sprint performance ($F = 0.275$, $p = 0.690$, $\eta^2 = 0.014$) according to warm-up type ($p > 0.05$).

In contrast, a statistically significant difference was found for T-agility across warm-up protocols. ($F = 5.418$, $p = 0.015$, $\eta^2 = 0.222$). Change scores were calculated as pre-test minus post-test values; therefore, positive values represented improved performance because lower completion times indicate better agility. Since the Mauchly sphericity test was significant ($p < 0.05$), pairwise comparisons were performed using the Greenhouse-Geisser correction (Table 4). Based on partial eta-squared classification criteria, the observed effect size for the T-agility test was considered large ($\eta^2 = 0.222$).

Table 4. Bonferroni-Corrected Pairwise Comparisons for T-Agility Change Scores Across Warm-Up Protocols

(I) Protocol	(J) Protocol	Mean Difference (I-J)	Std. Error	p	95% CI Lower	95% CI Upper
1	2	.205	.150	.558	-.188	.599
	3	-.292	.185	.390	-.776	.192
2	1	-.205	.150	.558	-.599	.188
	3	**-.497***	.113	**.001**	-.794	-.201
3	1	.292	.185	.390	-.192	.776
	2	**.497***	.113	**.001**	.201	.794

*The mean difference is significant at the .05 level.

Note: Protocol codes: 1 = No additional warm-up; 2 = Static warm-up (SWU); 3 = Dynamic warm-up (DWU).

Table 3 shows that Bonferroni-corrected pairwise comparisons revealed a significant difference between the DWU and SWU conditions in the T-agility test ($p = .001$). Change scores were calculated as pre-test minus post-test values; therefore, positive values indicated improved performance because lower completion times reflect better agility performance. Accordingly, the direction of the change scores in the T-agility test indicated relatively better performance following DWU compared with SWU. The mean difference between protocols was approximately 0.5 seconds (95% CI [-0.794, -0.201]). However, although the mean change values differed between protocols, no significant differences were observed between the control condition (no additional warm-up) and the other protocols ($p > 0.05$).

Overall, no statistically significant differences were observed among the warm-up protocols in soccer-specific technical skills or most athletic performance parameters ($p > 0.05$). However, a statistically significant difference was identified between the DWU and SWU conditions in the T-agility test ($p<0.05$).

Discussion

This study investigated the acute effects of three different warm-up protocols (no additional warm-up, SWU, and DWU) on soccer-specific technical skills and athletic performance parameters in 12–14-year-old male soccer players. According to the findings, a statistically significant difference was found only in the T-agility test, whereas no significant differences were detected in the Yeagley ball-juggling, passing, shooting, VJ, SLJ, and 20 m sprint tests. These results suggest that agility performance may be more sensitive to warm-up protocols than other performance measures.

In soccer, technical skills (passing, shooting, ball control, and dribbling) are fundamental determinants of performance (Sarkar et al., 2019), and these parameters are considered as important indicators in match analyses (Harkness-Armstrong et al., 2020; Kelly et al., 2020; Kubayi & Larkin, 2020; Lago-Peñas et al., 2010). However, in this study no significant difference was found in these skills depending on the type of the warm-up. One possible explanation for these findings is that technical skills may be more related to learned neuromotor patterns than to acute changes in warm-up protocols (Ajmol et al., 2007; Little & Williams, 2006).

When evaluated in terms of athletic performance parameters, it is noteworthy that only agility performance showed a significant difference. The findings indicate a significant difference between DWU and SWU in T-agility performance. The estimated mean difference between the two protocols was approximately 0.5 seconds (95% CI: −0.794 to −0.201), suggesting a consistent difference in T-agility performance between conditions. The findings indicated relatively better T-agility performance following DWU compared with SWU. This result is consistent with studies reporting that DWU may enhance reaction time, coordination, and force production speed through

increased neuromuscular activation (Amiri-Khorasani et al., 2010; Faigenbaum et al., 2005; Kilit et al., 2019; McMillian et al., 2006).

Similarly, some previous studies have suggested that static stretching may negatively influence agility performance (Cramer et al., 2005). However, the present findings should be interpreted cautiously, as the underlying mechanisms were not directly assessed in this study. A possible mechanism reported in the literature is that DWU may influence joint range of motion and muscle-tendon properties (Behm & Chaouachi, 2011). In addition, previous literature suggests that static stretching may influence explosive performance through temporary changes in the muscle-tendon unit, although this mechanism was not directly evaluated in the present study (Shrier, 2004).

Previous studies have reported positive effects of dynamic warm-up protocols on technical skill performance (Fradkin et al., 2010; Gelen, 2010). However, no significant differences were observed in the technical performance parameters evaluated in the present study. These inconsistencies may be associated with methodological differences among studies, including variations in participant age, sample size, training background, and the content and duration of the warm-up protocols. In addition, developmental characteristics specific to youth athletes may influence the acute responsiveness of technical skill performance to different warm-up strategies.

Although no statistically significant differences were found, the SLJ mean was highest in DWU, while the VJ mean was highest in SWU. Because of the small sample size and the lack of statistical significance in the results, these findings should be interpreted with caution and do not provide conclusive evidence of a performance-enhancing effect. Findings from earlier studies have been inconsistent regarding the impact of dynamic and static warm-up protocols on jump performance (Akyüz et al., 2017; Arı et al., 2021; Atan, 2019; Carvalho et al., 2012; Faigenbaum et al., 2005), potentially attributable to variations in protocol intensity, duration and participant characteristics. No significant difference was observed in speed performance between the warm-up methods. Some studies have demonstrated the positive effect of DWU on the sprint performance (Akkaya & Çolak, 2020; Akyüz et al., 2017; Fletcher & Jones, 2004; Little & Williams, 2006), and some studies have reported the negative or null effects of SWU on performance (Gelen, 2010; Paradisis et al., 2014). The findings of this study also suggest that the effect of warm-up types on short-distance speed performance may be limited, particularly in child and adolescent athletes.

The positive effects of DWU on soccer-specific technical skills such as shooting and dribbling are frequently highlighted in the literature (Bishop, 2003; Dunsky et al., 2017; Gelen, 2010; Herman & Smith, 2008). However, no significant difference was found in these skills in this study. These findings suggest that technical skill performance may depend not only on short-term physical preparation but also on long-term practice, motor learning, and accumulated playing experience.

The findings of the present study indicate that the DWU showed a significant advantage over SWU for T-agility, but not over the no additional warm-up condition. No significant differences were observed between warm-up conditions in the other athletic performance variables or soccer-specific technical skill parameters. Therefore, the present findings do not support a broad superiority of DWU across all evaluated outcomes.

Altogether, this study adds to the existing literature by examining how different warm-up affect acute performance in young soccer players. Nevertheless, more research with larger sample sizes and across different age groups is needed to further clarify how various warm-up protocols influence performance.

Conclusion

This study examined the acute effects of different warm-up protocols on the performance of male soccer players aged 12–14 years. The findings demonstrated no statistically significant differences among the warm-up protocols in soccer-specific technical skills, SLJ, VJ, or 20 m sprint performance ($p > 0.05$). However, a significant difference was observed in T-agility performance between the DWU and SWU conditions.

The present results suggest that the DWU protocol may provide advantages for agility performance involving rapid changes of direction when compared with the SWU condition. However, because significant differences were not identified for the remaining performance variables, the findings should be interpreted with caution and should not be considered evidence that the warm-up protocols produce equivalent effects.

From a practical perspective, dynamic warm-up exercises may be considered prior to activities emphasizing agility performance in youth soccer players. Nevertheless, further research involving larger and more diverse samples,

additional performance measures, and different warm-up structures is needed to better clarify the acute effects of warm-up protocols on physical and soccer-specific performance outcomes.

Limitations: This study has several limitations that should be considered. The relatively small sample size (n=20) and the inclusion of only male youth soccer players from a single club limit the generalizability of the findings. Additionally, the relatively small sample size may have increased the risk of Type II error, particularly for variables in which no statistically significant differences were detected. The study only investigated the acute effects of warm-up protocols and did not consider long-term adaptations. Performance outcomes may also have been affected by environmental factors and the nature of field-based tests. Also, the absence of physiological measurements limits the ability to explain the underlying mechanisms of the observed results. Future studies are encouraged to look at the effects of warm-up protocols across different age groups and genders, with larger sample sizes and long-term applications. Although the order of the protocols was randomized and a 5-day wash-out period was used between sessions to minimize any potential residual effects, possible order, learning, or carryover effects were not specifically analyzed and should be considered in the interpretation of the findings.

Practical applications: Youth soccer players who participate in activities that stress agility performance may consider dynamic warm-up drills. As the majority of performance and skill variables did not significantly improve, coaches should not depend on warm-up routines alone for performance enhancement and should integrate long-term training strategies. Moreover, warm-up programs should include sport specific dynamic movements and should be designed according to the developmental stage of young athletes.

Author Contributions: MÖ, AÜ, and MŞÖ contributed to the study design. AÜ conducted the literature review. AÜ and MŞÖ performed data collection. MÖ performed data analysis and data computerization. AÜ and MÖ drafted the manuscript. All authors contributed to manuscript revision and approved the final version.

Ethics Approval and Consent to Participate: This study was approved by the Non-Interventional Clinical Research Ethics Committee of Mardin Artuklu University (approval date and number: 16.04.2024; 2024/4-26). All participants gave their written informed consent before taking part in the study, which was approved by the ethics committee of Mardin Artuklu University.

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References

Ajmol, A., Williams, C., Hulse, M., Strudwick, A., Reddin, J., Howarth, L., Eldred, J., Hirst, M., & McGregor, S. (2007). Reliability and validity of two tests of soccer skill. *Journal of Sports Sciences*, *25*(13), 1461-1470. https://doi.org/10.1080/02640410601150470

Akkaya, C. C., & Çolak, S. (2020). Investigation of acute effect of different dynamic warmups applied to U11-U12 years old players on some performance parameters. *Research in Sport Education and Sciences*, *22*(4), 78-89.

Akyüz, M., Özmaden, M., Doğru, Y., Karademir, E., Aydın, Y., & Hayta, Ü. (2017). Genç basketbolcularda statik ve dinamik germe egzersizlerinin bazı fiziksel parametrelere etkisi. *Journal of Human Sciences*, *14*(2), 1492-1500. https://doi.org/10.14687/jhs.v14i2.4560

Alter, M. J. (1988). *Science of stretching*. Human Kinetics.

Amiri-Khorasani, M., Sahebozamani, M., Tabrizi, K. G., & Yusof, A. B. (2010). Acute effect of different stretching methods on Illinois agility test in soccer players. *Journal of Strength and Conditioning Research*, *24*(10), 2698-2704. https://doi.org/10.1519/JSC.0b013e3181bf049c

Arı, Y., Tunçel, A., Sever, O., & Arslangörür, A. (2021). Acute effects of static and dynamic stretching on jump performance of volleyball players. *Education Quarterly Reviews*, *4*(3), 390-398. https://doi.org/10.31014/aior.1993.04.03.347

Arin, A., Jansson, D., & Skarphagen, K. (2012). *Maximal unilateral leg strength correlates with linear sprint and change of direction speed* Göteborgs Universitet].

Atan, T. (2019). Effect of different warm-up protocols on joint range of motion, jumping and sprint performance. *OPUS International Journal of Society Researches*, *13*(19), 621-635. https://doi.org/10.26466/opus.574260

Ayala, F., De Ste Croix, M., Sainz De Baranda, P., & Santonja, F. (2013). Acute effects of static and dynamic stretching on hamstring eccentric isokinetic strength and unilateral hamstring to quadriceps strength ratios. *Journal of Sports Sciences*, *31*(8), 831-839. https://doi.org/10.1080/02640414.2012.751119

Behm, D. G., & Chaouachi, A. (2011). A review of the acute effects of static and dynamic stretching on performance. *European Journal of Applied Physiology*, *111*(11), 2633-2651. https://doi.org/10.1007/s00421-011-1879-2

Beunen, G. P., Malina, R. M., Renson, R., Simons, J., Ostyn, M., & Lefevre, J. (1992). Physical activity and growth, maturation and performance: a longitudinal study. *Medicine Science in Sports Exercise*, *24*(5), 576-585.

Bishop, D. (2003). Warm up I: potential mechanisms and the effects of passive warm up on exercise performance. *Sports Medicine*, *33*(6), 439-454. https://doi.org/10.2165/00007256-200333060-00005

Carvalho, F. L., Carvalho, M. C., Simão, R., Gomes, T. M., Costa, P. B., Neto, L. B., Carvalho, R. L., & Dantas, E. H. (2012). Acute effects of a warm-up including active, passive, and dynamic stretching on vertical jump performance. *The Journal of Strength & Conditioning Research*, *26*(9), 2447-2452. https://doi.org/10.1519/JSC.0b013e31823f2b36

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2 ed.). Academic Press.

Cramer, J., Housh, T., Weir, J., Johnson, G., Coburn, J., & Beck, T. (2005). The acute effects of static stretching on peak torque, mean power output, electromyography, and mechanomyography. *European Journal of Applied Physiology*, *93*(5), 530-539. https://doi.org/10.1007/s00421-004-1199-x

Çetin, O., & Kaya, S. (2022). Mobile applications used in measurement and monitoring of athletic performance: A traditional review. *Nigde University Journal of Physical Education & Sport Sciences*, *16*(1), 1-21.

Dunsky, A., Barzilay, I., & Fox, O. (2017). Effect of a specialized injury prevention program on static balance, dynamic balance and kicking accuracy of young soccer players. *World Journal of Orthopedics*, *8*(4), 317-321. https://doi.org/10.5312/wjo.v8.i4.317

Egesoy, H., Eniseler, N., Çamlıyer, H., & Çamlıyer, H. (1999). Elit ve elit olmayan futbol oyuncularının karar verme performanslarının karar verme hızı ve verilen kararın doğruluğu açısından karşılaştırılması. *CBU Journal of Physical Education and Sports Sciences*, *3*(2), 22-33.

Faigenbaum, A. D., Bellucci, M., Bernieri, A., Bakker, B., & Hoorens, K. (2005). Acute effects of different warm-up protocols on fitness performance in children. *The Journal of Strength Conditioning Research*, *19*(2), 376-381.

Fletcher, I. M., & Jones, B. (2004). The effect of different warm-up stretch protocols on 20 meter sprint performance in trained rugby union players. *The Journal of Strength Conditioning Research*, *18*(4), 885-888.

Fradkin, A. J., Zazryn, T. R., & Smoliga, J. M. (2010). Effects of warming-up on physical performance: a systematic review with meta-analysis. *The Journal of Strength & Conditioning Research*, *24*(1), 140-148. https://doi.org/10.1519/JSC.0b013e3181c643a0

Gelen, E. (2010). Acute effects of different warm-up methods on sprint, slalom dribbling, and penalty kick performance in soccer players. *The Journal of Strength & Conditioning Research*, *24*(4), 950-956. https://doi.org/10.1519/JSC.0b013e3181cb703f

Gleim, G. W., & McHugh, M. P. (1997). Flexibility and its effects on sports injury and performance. *Sports Medicine*, *24*(5), 289-299. https://doi.org/10.2165/00007256-199724050-00001

Harkness-Armstrong, A., Till, K., Datson, N., & Emmonds, S. (2020). Technical characteristics of elite youth female soccer match-play: position and age group comparisons between under 14 and under 16 age groups. *International Journal of Performance Analysis in Sport*, *20*(6), 942-959. https://doi.org/10.1080/24748668.2020.1820173

Herman, S. L., & Smith, D. T. (2008). Four-week dynamic stretching warm-up intervention elicits longer-term performance benefits. *The Journal of Strength & Conditioning Research*, *22*(4), 1286-1297. https://doi.org/10.1519/JSC.0b013e318173da50

Heyward, V. H., & Stolarczyk, L. M. (2004). *Applied body composition assessment* (2 ed.). Human Kineties.

Hughes, M., & Franks, I. M. (2004). *Notational analysis of sport: Systems for better coaching and performance in sport*. Routledge.

Huijgen, B. C., Elferink-Gemser, M. T., Post, W., & Visscher, C. (2010). Development of dribbling in talented youth soccer players aged 12–19 years: A longitudinal study. *Journal of Sports Sciences*, *28*(7), 689-698. https://doi.org/10.1080/02640411003645679

Işıkdemir, E., Uzlaşır, S., & Köklü, Y. (2020). Genç erkek basketbolculardа yapılan farklı isınma yöntemlerinin bazı performans parametreleri üzerine akut etkisi. *Hacettepe Journal of Sport Sciences*, *31*(3), 96-105. https://doi.org/10.17644/sbd.688295

Kamar, A. (2003). *Talent, skill and performance tests in sports* (1 ed.). Nobel Academic.

Kelly, A., Wilson, M. R., Jackson, D. T., & Williams, C. A. (2020). Technical testing and match analysis statistics as part of the talent development process in an English football academy. *International Journal of Performance Analysis in Sport*, *20*(6), 1035-1051. https://doi.org/10.1080/24748668.2020.1824865

Kilit, B., Arslan, E., & Soylu, Y. (2019). Effects of different stretching methods on speed and agility performance in young tennis players. *Science & Sports*, *34*(5), 313-320. https://doi.org/10.1016/j.scispo.2018.10.016

Klingner, F. C., Huijgen, B. C., Den Hartigh, R. J., & Kempe, M. (2022). Technical–tactical skill assessments in small-sided soccer games: A scoping review. *International Journal of Sports Science Coaching*, *17*(4), 885-902. https://doi.org/10.1177/17479541211049532

Koç, S. (2005). *Skill development in physical education and sports*. Morpa Culture Publications.

Koopmann, T., Faber, I., Baker, J., & Schorer, J. (2020). Assessing technical skills in talented youth athletes: a systematic review. *Sports Medicine*, *50*(9), 1593-1611. https://doi.org/10.1007/s40279-020-01299-4

Kubayi, A., & Larkin, P. (2020). Technical performance of soccer teams according to match outcome at the 2019 FIFA Women's World Cup. *International Journal of Performance Analysis in Sport*, *20*(5), 908-916. https://doi.org/10.1080/24748668.2020.1809320

Kurak, K., İlbak, İ., Stojanović, S., Bayer, R., Purenović-Ivanović, T., Pałka, T., Ambroży, T., Kasicki, K., Czarny, W., & Rydzik, Ł. (2024). The effects of different stretching techniques used in warm-up on the triggering of post-activation performance enhancement in soccer players. *Applied Sciences*, *14*(11), 4347. https://doi.org/10.3390/app14114347

Lago-Peñas, C., Lago-Ballesteros, J., Dellal, A., & Gómez, M. (2010). Game-related statistics that discriminated winning, drawing and losing teams from the Spanish soccer league. *Journal of Sports Science & Medicine*, *9*(2), 288-293.

Little, T., & Williams, A. G. (2006). Effects of differential stretching protocols during warm-ups on high-speed motor capacities in professional soccer players. *The Journal of Strength & Conditioning Research*, *20*(1), 203-307.

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

McMillian, D. J., Moore, J. H., Hatler, B. S., & Taylor, D. C. (2006). Dynamic vs. static-stretching warm up: the effect on power and agility performance. *The Journal of Strength & Conditioning Research*, *20*(3), 492-499.

Mor, A., Yurtseven, R., Mor, H., & Acar, K. (2021). The effects of different warm-up protocols on some performance parameters in 11-12 age group football players. *Spormetre The Journal of Physical Education and Sport Sciences*, *7*(2), 72-83. https://doi.org/10.33689/spormetre

Mor, D., & Christian, V. (1979). The development of a skill test battery to measure general soccer ability. *North Carolina Journal of Health and Physical Education*, *15*(1), 30.

Özkan, Z., Şehribanoğlu, S., Adar, E., Demir, R., & Aygün, E. (2022). Determination of variables affecting the motor skills of athletes in different sports branches by decision tree. *Gaziantep University Journalof Sport Science*, *7*(4), 471-481. https://doi.org/10.31680/gaunjss.1201961

Paradisis, G. P., Pappas, P. T., Theodorou, A. S., Zacharogiannis, E. G., Skordilis, E. K., & Smirniotou, A. S. (2014). Effects of static and dynamic stretching on sprint and jump performance in boys and girls. *The Journal of Strength & Conditioning Research*, *28*(1), 154-160.

Raya, M. A., Gailey, R. S., Gaunaurd, I. A., Jayne, D. M., Campbell, S. M., Gagne, E., Manrique, P. G., Muller, D. G., & Tucker, C. (2013). Comparison of three agility tests with male servicemembers: Edgren Side Step Test, T-Test, and Illinois Agility Test. *Journal of Rehabilitation Research and Development*, *50*(7), 951-960. http://doi.org/10.1682/JRRD.2012.05.0096

Sarkar, S., Chakrabarti, A., & Prasad Mukherjee, D. (2019). Generation of ball possession statistics in soccer using minimum-cost flow network. Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition Workshops,

Shrier, I. (2004). Does stretching improve performance? a systematic and critical review of the literature. *Clinical Journal of Sport Medicine*, *14*(5), 267-273.

Strand, B. N., & Wilson, R. (1993). *Assessing sport skills*. Human Kinetics.

Takeuchi, K., Sato, S., Kiyono, R., Yahata, K., Murakami, Y., Sanuki, F., Yoshida, R., & Nakamura, M. (2021). High-intensity static stretching in quadriceps is affected more by its intensity than its duration. *Frontiers in Physiology*, *12*, 709655. https://doi.org/10.3389/fphys.2021.709655

Williams, A. M. (2000). Perceptual skill in soccer: Implications for talent identification and development. *Journal of Sports Sciences*, *18*(9), 737-750. https://doi.org/10.1080/02640410050120113

Williams, A. M., Ford, P., Reilly, T., & Drust, B. (2003). *Science and soccer* (2 ed.). Routledge London, UK. https://doi.org/https://doi.org/10.4324/9780203417553

Williams, A. M., & Reilly, T. (2000). Talent identification and development in soccer. *Journal of Sports Sciences*, *18*(9), 657-667. https://doi.org/10.1080/02640410050120041

Zakas, A. (2005). The effect of stretching duration on the lower-extremity flexibility of adolescent soccer players. *Journal of Bodywork and Movement Therapies*, *9*(3), 220-225. https://doi.org/10.1016/j.jbmt.2004.07.002