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EFFECTIVENESS OF A SPECIFIC AND TIME-EFFICIENT WARM-UP PROTOCOL ON STRENGTH PERFORMANCE AMONG TRAINED SOCCER PLAYERS

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ABSTRACT

Resistance training is crucial for soccer players as it enhances their overall physical performance, contributing significantly to strength, power, and injury prevention. A well-structured warm-up enhances physiological readiness, reduces the risk of injury, and optimizes performance during resistance training sessions. The debate between general and specific warm-ups is ongoing, with various studies highlighting the advantages and disadvantages of each approach. Hence, this study investigated the effectiveness of specific and time-efficient warm-up protocols on strength performance, mainly focusing on the one-repetition maximum (1RM) barbell thruster among trained soccer players. Twenty male-trained soccer players aged 17 to 20 (18.99 ± 0.75) were recruited for this study. An experimental crossover study design was conducted with participants undergoing a general or specific warm-up protocol before 1RM testing. The results indicated that the specific warm-up protocol (51.25 ± 8.68 kg) significantly enhanced 1RM barbell thruster performance compared to the general warm-up (42 ± 6.42 kg), demonstrating superior strength outcomes and improved neuromuscular activation ($p = 0.04 < 0.05$). On top of that, there are also significant differences in the time efficiency of the warm-up protocol ($p = 0.00 < 0.05$), which favors a specific warm-up protocol (106.85 ± 8.76 sec). These findings highlight the importance of tailored warm-up strategies in enhancing strength performance and time optimization. The implications of this research are vital for coaches and practitioners in developing effective training regimens for soccer players, contributing to the broader body of knowledge in sports science. Future research should explore the long-term effects of specific warm-up protocols across different athletic populations and examine the underlying physiological mechanisms driving performance improvements.

Keywords: Specific warm-up protocol, time-efficient warm-up, strength performance, soccer players, barbell thruster, one-repetition maximum

INTRODUCTION

The importance of warm-up routines in resistance training cannot be overstated, as they play a crucial role in preparing the body for the physical demands of exercise. A well-structured warm-up enhances physiological readiness, reduces the risk of injury, and optimizes performance during resistance training sessions. The warm-up process increases muscle temperature, enhances blood flow to the muscles, and improves the elasticity of connective tissues, all of which contribute to better performance and reduced injury risk (Neves et al., 2021; A. S. Ribeiro et al., 2014; B. Ribeiro et al., 2020, 2021) Specifically,

warm-up routines can be categorized into general and specific warm-ups, each serving distinct purposes and offering unique benefits to athletes engaged in resistance training.

General warm-up routines typically involve low-intensity aerobic activities that elevate heart rate and increase body temperature. These activities include jogging, cycling, or dynamic stretching, which prepare the body for more intense physical activity by enhancing cardiovascular efficiency and muscle flexibility (Rauseo et al., 2024; Vora, 2019). Research indicates that general warm-ups can improve performance in subsequent resistance training exercises by enhancing muscle activation and neuromuscular coordination (Madarsa & Mohamad, 2022; Neves et al., 2021; A. S. Ribeiro et al., 2014). Furthermore, general warm-ups can serve as a psychological preparation tool, helping athletes mentally transition into training sessions (Afonso et al., 2024).

On the other hand, specific warm-up routines are tailored to the particular movements and muscle groups that will be engaged during resistance training. These routines often include lighter exercises, focusing on the same muscle groups and movement patterns (P. Neves et al., 2021). Specific warm-ups have been shown to enhance performance more effectively than general warm-ups alone, as they directly prepare the muscles and joints for the specific demands of the upcoming exercises. For instance, studies have demonstrated that performing specific warm-up sets before heavy lifts can significantly improve one-repetition maximum (1RM) performance in exercises like bench presses and squats (P. Neves et al., 2021).

When considering the best warm-up for specific exercises, such as the barbell thruster, it is essential to integrate both general and specific warm-up components. A comprehensive warm-up for the barbell thruster might begin with a general warm-up to increase overall body temperature and heart rate, followed by specific movements that mimic the thruster's mechanics, such as bodyweight squats and overhead presses with lighter weights (P. Neves et al., 2021) This combination not only prepares the body physically but also enhances neuromuscular activation, which is critical for maximizing performance during the lift.

Resistance training is crucial for soccer players as it enhances their overall physical performance, contributing significantly to strength, power, and injury prevention. By incorporating resistance training into their training regimens, players can improve their neuromuscular function, which is essential for executing explosive movements such as sprinting, jumping, and changing direction during matches (Anderson et al., 2023; Pareja-Blanco & Loturco, 2022). Studies have shown that increased strength from resistance training correlates with improved sprint performance and agility, which are vital components of soccer (Brahim et al., 2013; Brigatto et al., 2019). Furthermore, targeted strength training can help address muscle imbalances and reduce the risk of injuries, particularly in the lower body, where soccer players are most susceptible (Váczi et al., 2013). Integrating resistance training into a soccer player's program enhances athletic performance and promotes long-term physical resilience, making it an indispensable aspect of modern soccer training (Hosseini Kakhak et al., 2022).

The debate between general and specific warm-ups is ongoing, with various studies highlighting the advantages and disadvantages of each approach. General warm-ups may be more time-efficient and more accessible to implement, especially in settings where time is limited (Iversen et al., 2021). However, specific warm-ups may offer superior performance enhancement and injury prevention benefits, as they directly target the muscles and movements involved in the upcoming resistance training(P. Neves et al., 2021; B. Ribeiro et al., 2021). Therefore, the choice between general and specific warm-ups should be guided by the specific goals of the training session, the time available, and the individual athlete's needs.

Time efficiency is another critical consideration in warm-up routines, particularly for athletes with tight schedules or those participating in multiple daily training sessions. Research suggests a well-structured warm-up can be completed in as little as 10-15 minutes while providing the necessary physiological benefits (Iversen et al., 2021). This emphasizes the importance of designing warm-up protocols that are both effective and time-efficient, allowing athletes to maximize their training time

without compromising performance or safety.

The importance of warm-up routines in resistance training is multifaceted, encompassing physiological, psychological, and performance-related aspects. Both general and specific warm-ups play vital roles in preparing the body for exercise, with specific warm-ups offering targeted benefits for performance enhancement. The best warm-up strategies should consider the specific demands of the exercises, the time available, and the individual athlete's needs. An effective warm-up routine is essential for optimizing performance, reducing injury risk, and ensuring a successful training session. In line with that, this study must be conducted. This study investigates the effect of a specific and time-efficient warm-up routine on one-repetition maximum barbell thruster performance. By exploring the nuances of warm-up protocols, this research seeks to contribute to developing effective training strategies that can optimize performance while minimizing the risk of injury.

MATERIALS AND METHODS

Experimental Approach to the Problem

In this study, as illustrated in Fig. 1, we employed a randomized controlled experimental crossover design to investigate the effects of two distinct warm-up protocols, general and specific, on strength performance. This methodology thereby minimizes inter-subject variability and enhances the reliability of our findings. The participants in this study were subjected to both warm-up protocols in a randomized order, with a sufficient recovery period of one week between sessions to mitigate any residual effects from the previous warm-up. Fig. 2 shows the warm-up routine of the General Warm-up Protocol, which involved five minutes of treadmill running at a speed of six kilometers per hour, followed by 20 rounds of jumping jacks. As depicted in Fig. 3, the Specific Warm-up Protocol followed a designated warm-up regimen comprising 20 repetitions of jumping jacks, ten repetitions of push-ups, five repetitions of bodyweight squats, five repetitions of bodyweight thrusters with calf raises, five repetitions of barbell back squats, and five repetitions of barbell thrusters. Both groups executed the warm-up regimen, necessitating one minute of preparation and a one-repetition maximum barbell thruster assessment.

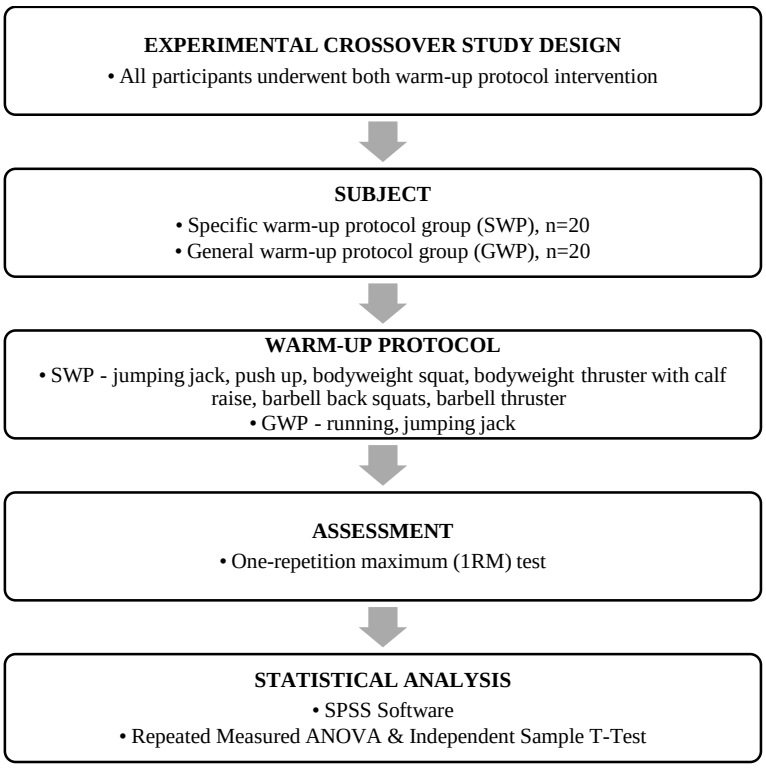

Fig. 1 Overview of research methodology

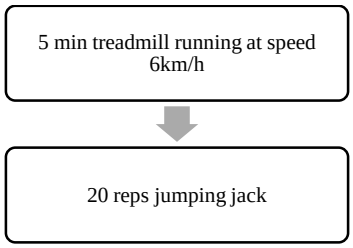

Fig. 2 General warm-up protocol

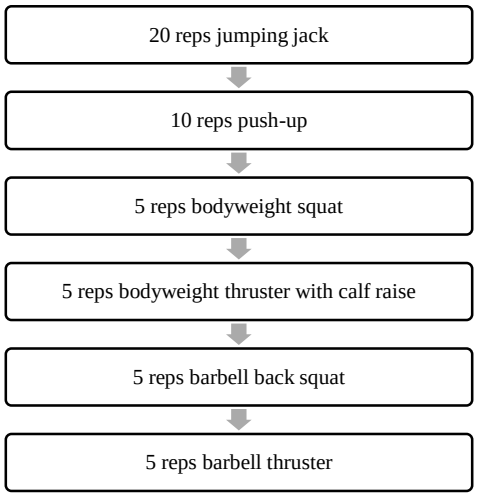

Fig. 3 Specific warm-up protocol

Participants

The participants were trained male soccer players aged between 17 and 20, selected based on their training status and experience. The selection of male participants intentionally maintained homogeneity in the sample, as gender can influence physiological responses and performance outcomes in sports. For inclusion criteria, all participants must actively participate in the Malaysian Football League, meaning they have undergone a structured training program. They must also have a minimum of six months of resistance training experience. This criterion was established to ensure that the participants possessed a foundational level of strength and conditioning, which is crucial for assessing performance metrics in response to the warm-up protocols. In addition to the training experience, participants were screened for any injury history. Only those who were free from injury throughout the study period were included. This was critical to eliminate confounding variables that could skew the results, as injuries can significantly affect performance and recovery. Informed consent was obtained from all participants before their involvement in the study. This process involved providing detailed information about the study's purpose, procedures, potential risks, and benefits, ensuring that participants were fully aware of their rights and the nature of their involvement. Moreover, participants were instructed not to engage in other studies during this research. This stipulation was implemented to avoid potential interference from other interventions affecting the study outcomes. By controlling external variables, it aims to isolate the effects of the warm-up protocols being tested. Lastly, ethical approval for the study was obtained from the Research Ethics Committee of the Sultan Idris Education University (2021-0225-01).

Instruments and Procedures

This study utilized a systematic approach to assess strength performance through one-repetition maximum (1RM) testing, specifically focusing on the barbell thruster exercise. The 1RM testing procedure is a widely accepted method for evaluating maximal strength and is recognized for its practicality and effectiveness in laboratory and field settings (Bianco et al., 2015; Wilk et al., 2020).

The 1RM testing protocol for the barbell thruster involved a structured warm-up followed by incremental loading to determine the maximum weight each participant could lift for a single repetition. The actual 1RM test commenced after the warm-up, where participants attempted to lift the heaviest weight they could manage for one complete repetition, with adequate rest periods provided between attempts to ensure recovery (Fong et al., 2022).

To evaluate the effects of different warm-up protocols on strength performance, participants were randomly assigned to either a general or specific warm-up protocol before undergoing the 1RM barbell thruster test. This randomization was crucial to eliminate bias and ensure that the results could be attributed to the warm-up conditions rather than individual participant differences (Lai et al., 2023). After a one-week recovery period, participants repeated the testing process, switching to the alternate warm-up protocol. This crossover design allowed for a direct comparison of the two warm-up strategies within the same group of participants, thereby enhancing the reliability of the findings (Bertolaccini et al., 2021).

Data collected from the 1RM testing sessions were analyzed using SPSS version 22, a statistical software package widely used for data analysis in research. The analysis focused on comparing the strength performance outcomes between the two warm-up protocols to determine which yielded superior results. Statistical significance was set at $p < 0.05$, and effect sizes were calculated to assess the practical significance of the findings (Macarilla et al., 2022). This rigorous analytical approach ensured that the conclusions drawn from the data were both statistically and practically relevant, contributing valuable insights into the optimal warm-up strategies for enhancing strength performance in trained athletes.

RESULTS

The demographic data's mean and standard deviation (SD) were obtained from descriptive statistics. The Statistical Package for Social Science (SPSS) version 22 (IBM, USA) was utilized for all statistical analyses.

Table 1. Descriptive Statistic of Demographic Data

	n	Mean ± SD	Minimum	Maximum
Age (years)	20	18.99 ± 0.75	17.45	20.17
Height (cm)		171.45 ± 4.25	158	177
Weight (kg)		65.07 ± 5.95	50.20	73.70

The demographic characteristics of the participants were analyzed, and the descriptive statistics are shown in Table 1. The mean age of the participants (n=20) is 18.99 ± 0.75 years, with a minimum of 17.45 years and a maximum of 20.17 years. The average body height was 171.45 ± 4.25 cm, ranging from 158 cm to 177 cm. The participants had a mean weight of 65.07 ± 5.95 kg, with a minimum of 50.20 kg and a high of 73.70 kg.

Table 2. One-repetition Maximum Barbell Thruster Performance Comparison between General and Specific Warm-up Protocol

Group	1RM barbell thruster (kg)	Sig.
	Mean ± SD	
General Warm-up Protocol	42.00 ± 6.42	0.04*
Specific Warm-up Protocol	51.25 ± 8.68	

*A significant level is set at 0.05

Participants underwent general and specific warm-up routines under a randomized, controlled experimental crossover design. An independent-sample t-test was performed to investigate if there is a difference in 1RM barbell thruster performance after adopting the General Warm-up and Specific Warm-up Protocol. The findings in Table 2 demonstrate a notable difference between GWP (42.00 ± 6.42) and SWP (51.25 ± 8.68), with a p-value of 0.04, less than the significance level of 0.05. Therefore, it suggested a significant difference in the effect of GWP and SWP on 1RM barbell thruster performance.

Table 3: Comparison of The Time Efficiency Between Both Warm-Up Protocols

Type of warm-up	Time (second)	Sig.
	Mean ± SD	
General warm-up protocol	318.90 ± 3.55	0.00*
Specific warm-up protocol	106.85 ± 8.76	

*A significant level is set at 0.05

The Independent Sample T-Test analysis in Table 3 reveals a significant difference in time efficacy between the two warm-up methods ($p = 0.00 < 0.05$). The general warm-up approach yielded a completion time of 318.90 ± 3.55 sec, whereas the specific warm-up protocol demonstrated a less completion time of 106.85 ± 8.76 sec. The significant difference in results indicates that the specific warm-up strategy enhances time efficiency during warm-up while simultaneously improving 1RM barbell thruster performance outcomes.

DISCUSSION

This study aimed to investigate the effectiveness of specific and time-efficient warm-up protocols on strength performance, mainly focusing on the one-repetition maximum (1RM) barbell thruster among trained soccer players. The results indicated a significant advantage for the specific warm-up protocol over the general warm-up regarding performance outcomes and time efficiency. Participants who engaged in the specific warm-up demonstrated superior 1RM barbell thruster performance, suggesting that this approach may better prepare athletes for maximal strength efforts (Denadai et al., 2016; Loturco et al., 2023).

The enhanced performance observed after the specific warm-up protocol can be attributed to several physiological mechanisms. Specific warm-ups mimic the movements and demands of the subsequent exercise, activating the relevant muscle groups and neuromuscular pathways more effectively than general warm-ups. This targeted activation likely leads to improved muscle readiness and coordination, critical for executing high-intensity lifts such as the barbell thruster (MICHAILIDIS, 2018; Oliver et al., 2024). Additionally, the specific warm-up may facilitate a more effective increase in muscle temperature and elasticity, further optimizing performance during strength testing (Akagi et al., 2014; Durán-Custodio et al., 2023).

The implications of these findings are significant for coaches, practitioners, and athletes alike. Coaches can utilize the insights from this study to refine their warm-up protocols, ensuring that athletes are adequately prepared for training and competition. By adopting specific warm-up strategies, coaches can enhance athletes' performance while potentially reducing the risk of injury associated with inadequate preparation (Filipovic et al., 2019; Portella et al., 2014). Practitioners can also leverage this knowledge to develop individualized warm-up routines that cater to the specific needs of their athletes, optimizing training outcomes and performance metrics (ÇAĞLAYAN & ERDEMİR, 2019; Parpa & Michaelides, 2022). For athletes, understanding the benefits of specific warm-ups can empower them to take an active role in their preparation, leading to improved performance and greater confidence in their abilities.

This study contributes to the body of knowledge within the sports science industry by providing empirical evidence supporting the efficacy of specific warm-up protocols in enhancing strength performance among soccer players. The findings align with existing literature emphasizing the importance of tailored warm-up strategies in athletic training (Loturco et al., 2023; Souza et al., 2018)(Souza et al., 2018; Veeck, 2023). Furthermore, this research highlights the need for ongoing exploration into the nuances of warm-up protocols, particularly about different sports and performance metrics, thereby paving the way for future studies that can expand on these findings.

Future research should consider the long-term effects of specific warm-up protocols on strength performance across various populations, including age groups and skill levels. Additionally, investigating the physiological responses associated with specific warm-ups, such as muscle activation patterns and metabolic responses, could provide deeper insights into the mechanisms underlying performance improvements (Islamoglu et al., 2023; Madarsa et al., 2021). Furthermore, studies could examine the effectiveness of specific warm-ups in conjunction with other training modalities, such as plyometrics or resistance training, to determine their combined impact on overall athletic performance (González-Fernández et al., 2024; Madarsa et al., 2023; Pardos-Mainer et al., 2020). By addressing these areas, researchers can continue to enhance our understanding of optimal warm-up strategies and their implications for athletic performance.

CONCLUSION

In conclusion, this study effectively demonstrated the advantages of specific warm-up protocols over general warm-ups in enhancing strength performance, particularly in the one-repetition maximum (1RM) barbell thruster among trained soccer players. The findings of this study advocate for a paradigm shift in warm-up practices within the athletic community, emphasizing the need for specificity and efficiency in preparation for strength training and performance. By adopting these evidence-based strategies, athletes can enhance their performance potential while reducing the risk of injury, ultimately contributing to their success in competitive sports.

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