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Enhancing Lower Limb Strength in Amateur Soccer Players: Assessing the Impact of Repeated Sprint Training in Tactical Soccer Drills

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Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection

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Abstract

Background. Soccer is one of the most popular sports worldwide, including among amateur players. However, many training programs still rely on traditional methods that separate physical conditioning, technical skills, and tactical drills, limiting their effectiveness. The limited research on holistic training approaches, especially regarding lower limb strength evaluation, underscores the need for training interventions based on physiological principles.

Objectives. This study aimed to examine the effectiveness of Repeated Sprint Training (RST) in enhancing lower limb strength in amateur soccer players.

Materials and methods. Thirty-six amateur soccer players with an average age of 20 years were randomly assigned to either the intervention group (RST) or the control group (CTRL). The training program lasted four weeks, with three sessions per week. Lower limb strength was assessed using the body weight squat test and the Nordic hamstring curl test. Data analysis included the Shapiro-Wilk test, Paired t-test, and Independent t-test, conducted using SPSS 29.0.

Results. The RST group showed a significant improvement in performance on the body weight squat test (pre-test: 66 ± 8.60; post-test: 76 ± 6.84, $p < 0.001$) and the Nordic hamstring curl test (pre-test: 4 ± 1.18; post-test: 7 ± 1.41, $p < 0.001$). Meanwhile, in the control group, no substantial improvements were observed.

Conclusions. This study concludes that Repeated Sprint Training effectively enhances lower limb strength, particularly in the hamstring muscles. The findings of this study not only contribute to a deeper understanding of soccer player training, but also have implications for the broader field of sports science. This training method can be a practical approach to improving performance and preventing injuries in amateur soccer players, and its effectiveness could potentially be applied to other sports and athletic training programs.

Keywords: repeated sprint training, lower limb strength, amateur soccer players.

Introduction

The advancement of soccer has made it one of the most popular sports across various levels, including amateur players (Griffin et al., 2020; Woods et al., 2023). The number of soccer enthusiasts continues to grow, reflecting the high public interest in the sport (Buyrukoğlu et al., 2023; van Haaften, 2019). However, in the training process, many coaches and sports practitioners still implement traditional training models, especially for amateur players (Bozkurt, 2018; Errama et al., 2024). These training models often focus on separately improving physical conditioning, technical skills, and tactics, limiting their effectiveness in enhancing player performance. Therefore, a holistic training approach is needed to optimize amateur players' physical development and skill acquisition (Kusuma et al., 2024). Despite this, in-depth research on training methods that precisely measure lower limb strength is still lacking. The importance of these physiological assessments, including muscle strength response, ensures that training objectives are effectively met and prevent injuries, which are common among soccer players.

A common issue experienced by soccer players, both amateur and professional, is hamstring injuries (Al Attar & Husain, 2023; Rosado-Portillo et al., 2021). These injuries frequently occur when players perform sprinting and rapid directional changes. Hamstring injuries often result in pro-

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longed absences and increase the risk of re-injury if proper rehabilitation and muscle strengthening are not conducted (Al Attar & Husain, 2023; Javier Raya-González Luis Suarez-Arrones & Villarreal, 2021). Amateur players tend to have a higher risk of hamstring injuries than professionals due to a lack of structured physical training programs and limited injury recovery protocols (Zhou, 2022). Previous studies Madison et al. (2019) and van der Horst et al. (2015) have shown that hamstring muscle weakness is a key risk factor for soccer players. Amateur players frequently experience hamstring injuries during high-intensity training sessions or matches, where muscle fatigue becomes a primary trigger (Huygaerts et al., 2020). Therefore, training programs that focus on strengthening the lower limbs and hamstrings are crucial for reducing injury risk and improving player performance (Al Attar & Husain, 2023; Chebbi et al., 2022). In the current scenario, soccer training requires a speed-strength-based program incorporating eccentric exercises (Alarcón et al., 2021).

This study aims to examine the effectiveness of a training program based on Repeated Sprint Training (RST) in enhancing lower limb strength in amateur soccer players. RST is a training approach that emphasizes repeated short sprints with brief recovery periods, which are expected to improve hamstring strength and optimize player performance during matches. The findings of this study are expected to contribute valuable insights for coaches and sports practitioners in designing more effective training programs for amateur soccer players.

Materials and Methods

Study Participants

This study involved 36 amateur soccer players with an average age of 20 ± 0.86 years, body weight of 68 ± 3.24 kg, height of 171 ± 3.05 cm, and BMI (kg/m^2). The participants were randomly divided into two groups: the first group underwent the repeated sprint training (RST) intervention. In contrast, the second group received only standard training as the control group (CTRL). Participants were assessed using the lower body weight squat test and the Nordic hamstring curl test. Before the intervention, each participant had to complete an informed consent form to indicate their agreement to participate in the study. Data collection in this study was conducted following the Declaration of Helsinki and received approval from the University Ethics Committee.

Study organization

This study employed an experimental two-group pre-test and post-test design. The training program lasted four weeks, with a frequency of three sessions per week (Monday, Wednesday, and Friday). Participants' heart rate (HR) was monitored during each training session using a Polar H-10 device.

The Squat Test. In this study, baseline data collection for all groups was conducted one day before the intervention. Before testing, the researcher explained the purpose and correct execution of the body weight squat test. Participants then performed light stretching and warm-up exercises to prevent injuries. The squat test required participants to stand upright with feet shoulder-width apart, knees slightly bent, and arms extended forward or placed on the waist. They then lowered their body until their thighs were parallel to the ground, maintaining a straight back and distributing their weight evenly on both feet. After reaching the lowest position, they returned to the initial upright stance and repeated the movement continuously until muscle fatigue occurred (Mackenzie, 2008).

The Nordic Hamstring Curl Test. Baseline data collection was also conducted one day before the intervention. The researcher explained the purpose and correct execution of the Nordic hamstring curl test. Participants performed light stretching and warm-up exercises beforehand to prevent injuries. During the test, participants knelt on a mat upright while an assistant secured their ankles. Their arms were crossed in front of the chest, and they slowly lowered their body forward before returning to the starting position in a controlled manner. This movement was repeated as many times as possible until muscle fatigue was reached. Once the participants could no longer maintain the movement, they could release their hands onto the mat to prevent injury (Matthews et al., 2015).

Statistical Analysis

The Shapiro-Wilk test was used to assess data normality. If the data were normally distributed, a paired t-test was conducted to analyze within-group differences over time. A Wilcoxon test was applied to non-normally distributed data. An independent t-test was performed to compare differences between groups. All statistical analyses were conducted using SPSS 29.0.

Results

Table 1 presents the baseline characteristics of all participants (n = 36), divided into two groups: the Repeated-Sprint Training (RST) group (n = 18) and the Control group (n = 18). The participants in both groups had an average age of 20 years. The mean body weight was 67.61 ± 3.12 kg for the RST group and 67.50 ± 3.45 kg for the Control group. The average height recorded was 168 cm for the RST group and 161 cm for the Control group. Additionally, both groups had an average of 7 years of soccer training experience before participating in the study.

Table 1. Characteristics of Participant

Characteristics Participant	All Participant (n = 36)	
	RST (n = 18)	Control (n = 18)
Age (years)	20 ± 0.87	20 ± 0.87
Body Weight (Kg) (mean±SD)	67.61 ± 3.12	67.50 ± 3.45
Body Height (cm)	168 ± 2.59	161 ± 3.51
length of time for soccer practice (years)	7 ± 1.26	7 ± 1.29

Figure 1 above shows the pre-squat results with a mean value of 66 ± 8.60 and the post-squat results with a mean value of 76 ± 6.84 in the experimental group. The pre-squat and post-squat values showed a significant difference in the experimental group, with a significance value of $p < 0.001$. Meanwhile, in the control group, the pre-squat results had

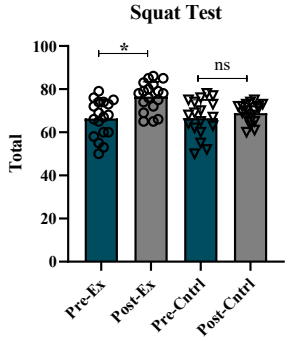

Fig. 1. Result in Paired t-test on the squat test

a mean value of 67 ± 8.47, and the post-squat results had a mean value of 69 ± 4.49. However, no significant difference was observed in this group, with a significance value of p = 0.080.

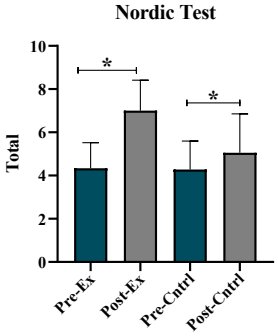

Fig. 2. Result in Paired t-test on Nordic test

Figure 2 above shows that the pre-nordic test had a mean value of 4±1.18, while the post-nordic test had a mean value of 7±1.41 in the experimental group. A significant difference was observed in the experimental group, with a significance value of p<0.001. In the control group, the pre-nordic test had a mean value of 4±1.31, and the post-nordic test had a mean value of 5±1.79, with a significance value of p=0.013.

Table 2. Results of Independent t-test

Variable	Group	T	Sig.
Squat	RST - Control	3.943	<0.001*
Nordic test	RST - Control	3.607	<0.001*

Note: * significant results in Independent t-test

Table 2 presents the results of the Independent t-test, which analyzes the differences in squat and Nordic test performance between groups. The findings indicate a statistically significant difference in both tests. The squat test showed a T value of 3.943 with a p-value < 0.001, while the Nordic test recorded a T value of 3.607 with a p-value < 0.001. These results suggest that the training intervention had a meaningful impact on improving lower limb strength, as reflected in the squat and Nordic test performances.

Discussion

This study examined the impact of repeated sprint training (RST) on lower limb strength in amateur soccer players. The primary findings of this study indicate that RST effectively enhances lower limb strength in amateur soccer players, as evidenced by improvements in body weight, squat test, and Nordic hamstring curl test results.

The present study found a significant increase in strength following this training method, as indicated by the bodyweight squat test results. These findings suggest improved neuromuscular adaptation, as evidenced by the enhanced squat test performance, which allows the muscles to function more efficiently during acceleration and sprint movements. Additionally, increased lower limb strength, as reflected in the body weight squat test, is associated with improved hip and knee stability. Previous research has indicated that players with excellent stability are less prone to injuries during on-field activities (Bliven & Anderson, 2013). Furthermore, an increase in squat repetitions has been linked to a higher rate of force development, a key factor in athletic performance (Martínez-Valencia et al., 2015). Previous studies have also demonstrated that greater propulsion force in the lower limbs is associated with more efficient and rapid acceleration at high speeds during gameplay (Wdowski & Gittoes, 2020).

Beyond improvements in lower limb strength through the bodyweight squat test, a particularly noteworthy finding of this study is that RST enhances hamstring strength in amateur soccer players, as evidenced by the Nordic hamstring curl test. This increase in hamstring strength can be attributed to eccentric contractions throughout the training. These eccentric contractions take place when the muscle undergoes tension during sprinting phases and abrupt stops, enabling rapid knee extension control. Delvaux et al. (2020) also highlighted that eccentric movement-based training improves hamstring flexibility. Similarly, Wan et al. (2021) reported that players with greater flexibility can withstand significant tension without experiencing muscle strain. The benefits of enhanced hamstring strength in amateur soccer players extend beyond injury prevention to improved on-field performance (Aktuğ et al., 2018). Alarcón et al. (2021) further stated that players with greater eccentric strength exhibit more stable sprinting mechanics and optimized movement control during rapid changes in direction. Therefore, integrating this training method into amateur soccer conditioning programs can contribute significantly to hamstring strengthening while reducing the risk of injuries frequently encountered by amateur players.

This study demonstrated that the RST method enhances lower limb strength, as evidenced by improvements in squat and Nordic test results. It significantly increases speed endurance capacity, indirectly contributing to a higher sprint frequency among amateur players. The study also reported a significant correlation between the strength of the quadriceps, hamstrings, and gluteus maximus—key muscle groups involved in the squat and Nordic test performance. Furthermore, neuromuscular adaptations (Behm et al., 2025; Ruas et al., 2018) facilitate faster motor unit recruitment during this training, enabling players to perform more squats with improved movement efficiency. Other studies have shown that squat and Nordic exercises promote hypertrophy in the quadriceps muscles, remarkably increasing the volume of the vastus lateralis (Santos et al., 2020), vastus intermedius, rectus femoris, and vastus medialis, as well as hamstring muscles such as the biceps

femoris, semitendinosus, and semimembranosus. This hypertrophy contributes to the growth of type IIa muscle fibers (EARP et al., 2015; Kubo et al., 2019; Oliver et al., 2024; Ribeiro et al., 2023). Such adaptations occur due to the repetitive concentric and eccentric contractions involved in squat and Nordic movements, which enhance tendon stiffness (Brar et al., 2021). Additionally, squat and Nordic exercises improve quadriceps and hamstring endurance, mitigating fatigue (D'Emanuele et al., 2021; Madison et al., 2019) and enhancing muscle elasticity, connective tissue integrity, and reflex potentiation (Mackey & Kjaer, 2017). Consequently, RST contributes to improved endurance performance in soccer and enhances strength training effectiveness through optimized muscular and neuromuscular adaptations (Behm et al., 2025; Huygaerts et al., 2020; Iga et al., 2012).

Conclusions

This study concludes that repeated sprint training (RST) significantly enhances lower limb strength in amateur soccer players. The eccentric-based training incorporated within RST has been proven effective in promoting neuromuscular adaptations, strengthening the hamstring muscles, and improving hip and knee stability. Furthermore, this training method presents an effective strategy for preventing hamstring injuries, which amateur soccer players frequently experience due to a lack of structured strength training programs.

Conflict of Interest

The authors declare that they have no conflicts interests.

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Підвищення силових якостей нижніх кінцівок у футболістів-аматорів: Оцінка впливу повторних спринтерських тренувань у тактичних футбольних вправах

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Авторський вклад: A – дизайн дослідження; B – збір даних; C – статаналіз; D – підготовка рукопису; E – збір коштів

Реферат. Стаття: 6 с., 2 табл., 2 рис., 34 джерела.

Історія питання. Футбол є одним з найпопулярніших видів спорту в усьому світі, в тому числі серед гравців-аматорів. Однак чимало тренувальних програм досі ґрунтуються на традиційних методах, які відокремлюють фізичну підготовку, технічні навички та тактичні вправи, що обмежує їхню ефективність. Обмеженість досліджень щодо комплексних тренувальних підходів, особливо стосовно оцінки силових якостей нижніх кінцівок, підкреслює необхідність проведення тренувальних інтервенцій, заснованих на фізіологічних принципах.

Мета дослідження. Це дослідження мало на меті вивчити ефективність проведення повторних спринтерських тренувань (ПСТ) щодо підвищення силових якостей нижніх кінцівок у футболістів-аматорів.

Матеріали та методи. Тридцять шість футболістів-аматорів, середній вік яких становив 20 років, було розподілено за методом рандомізації до інтервенційної групи (ІГ) або контрольної групи (КГ). Тренувальна програма тривала чотири тижні і включала три заняття на тиждень. Оцінювання сили нижніх кінцівок проводилося за допомогою тесту на присідання із вагою власного тіла (без використання додаткового обтяження) та скандинавського тесту на згинання підколінного сухожилля. Аналіз даних включав критерій Шапіро-Вілка, t-критерій для парних вибірок та t-критерій для незалежних вибірок, що проводився із використанням програмного забезпечення SPSS 29.0.

Результати. Група ПСТ продемонструвала значне покращення показників у виконанні тесту на присідання із власною вагою (перед початком тестування: 66 ± 8,60; після тестування: 76 ± 6,84, $p < 0,001$) та скандинавському тесті на згинання підколінного сухожилля (перед початком тестування: 4 ± 1,18; після тестування: 7 ± 1,41, $p < 0,001$). Водночас у контрольній групі суттєвих поліпшень не спостерігалося.

Висновки. Дослідження показало, що повторні спринтерські тренування значно покращують силові якості нижніх кінцівок, зокрема, м'язів підколінного сухожилля. Результати цього дослідження не лише сприяють глибшому розумінню тренувального процесу футболістів, але й мають певний вплив на розвиток спортивної науки в ширшому контексті. Запропонований метод тренування може слугувати практичним підходом до поліпшення результативності та запобігання травматизму у футболістів-аматорів, а його ефективність можна потенційно застосовувати до інших видів спорту і програм спортивної підготовки.

Ключові слова: повторне спринтерське тренування, сила нижніх кінцівок, футболісти-аматори.

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