

Impact of neuromuscular control exercises on passing skills and agility improvement in executing rolling skills among youth soccer players

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Abstract

Introduction. Neuromotor exercises, which enhance motor control and muscular coordination, play a crucial role in optimizing the performance of soccer players, particularly in skills such as passing and dribbling. These exercises are designed to improve neuromuscular fitness that is vital for executing complex movements with precision and agility on a soccer field. **Aim of Study.** This research seeks to determine the practical impact of neuromuscular control exercises on improving soccer-specific technical abilities that are crucial to competitive soccer performance. **Material and Methods.** Employing an experimental design with pre- and post-assessments, the study included 30 youth national team players, divided into experimental and control groups. Over a 12-week period, the experimental group engaged in neuromuscular control exercises, focusing on passing accuracy, agility, and dribbling skills. **Results.** The experimental group demonstrated significant improvements in neuromuscular function and soccer-specific skills compared to the control group that followed traditional training methods. **Conclusions.** Neuromuscular control exercises significantly enhance the physical, cognitive, and technical development of youth soccer players. The findings support the integration of these exercises into training regimens to optimize performance and development in competitive youth soccer.

KEYWORDS: youth, soccer, agility, control, neuromuscular.

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Introduction

Soccer, known as football in many regions, has garnered immense global attention, and continues to evolve with advancements in player preparation and training. This evolution reflects high levels of skill, physical and mental conditioning, and tactical and psychological acumen. Players are now expected to possess not only advanced technical abilities but also a strong physical foundation and team-oriented mindset [16]. A key aspect of soccer performance is the ability to organize and coordinate movements, which directly influences game success.

Passing, a fundamental skill in soccer, enables teams to control a ball's movements across a field and create scoring opportunities. Research emphasizes that the development of short-passing skills depends on various factors, such as player technique, tactical insight, and physical abilities [4]. Agility, on the other hand, is crucial for allowing players to change direction quickly and evade opponents, enhancing both physical fitness and coordination [12]. Studies indicate that agility exercises significantly improve youth soccer players' passing and harmonic skills. These exercises are designed to enhance reflexes and rapid body repositioning, emphasizing the importance of passing and agility mastery in soccer. Coaches are encouraged to prioritize these areas during training to bolster team performance and individual development [6].

In recent years, neuromuscular control exercises have gained prominence in sports training, particularly for their dual benefits of enhancing performance and

minimizing the risk of injury. For youth soccer players, these exercises are instrumental in honing essential skills, such as passing accuracy and agility. Neuromuscular training encompasses exercises aimed at enhancing proprioception, strength, and control, often replicating in-game conditions to promote functional movements [13]. By integrating neuromuscular training into soccer practice, players not only refine their ability to execute precise passes but also enhance overall agility – an essential attribute in the fast-paced nature of soccer, where quick directional changes are vital.

Combining agility training with neuromuscular control exercises offers substantial benefits in the acquisition and mastery of skills. Research on youth soccer academies indicates that agility and decision-making skills are among the top characteristics that distinguish selected players, underlining the importance of agility-focused training [14]. Additionally, neuromuscular exercises tailored for lower extremities showed improvements in proprioception and strength, critical for both injury prevention and agility during skill execution [13].

For youth players, particularly those around 17 years old who advance to competitive levels, neuromuscular control exercises contribute to both physical conditioning and technical precision. Studies demonstrate that these exercises improve strength and proprioceptive accuracy, thus supporting various aspects of sports performance [21]. Through a structured approach, neuromuscular training enhances stability and responsiveness, enabling players to perform tasks such as passing and dribbling with greater control. Furthermore, incorporating these exercises into routine training enhances both physical and cognitive skills, enabling quicker decision-making and more effective footwork.

The value of neuromuscular exercises in soccer training is undeniable. Agility, coordination, and balance developed through these exercises translate into more precise and agile movements on a field, boosting individual and team performance. Building these capabilities at a young age not only supports long-term athletic growth but also reduces the risk of injury. This area of research thus holds significant implications for coaches and sports scientists aiming to optimize youth training regimes, potentially reshaping training methodologies to produce more skilled, agile, and resilient players [17].

Neuromuscular control exercises are designed to improve coordination between the nervous system and muscles, enhancing the ability to perform movements with greater stability, efficiency, and safety. They typically focus on strengthening muscles, improving

proprioception (awareness of movement and body position), and stabilizing joints. This approach is particularly beneficial in rehabilitation settings, helping patients recover from injuries by retraining their neuromuscular systems to function optimally, and in sports training, where they enhance performance and prevent injuries [5, 13].

Aim of Study

This research seeks to determine the practical impact of neuromuscular control exercises on improving soccer-specific technical abilities that are crucial for competitive soccer performance in 17-year-old players.

Materials and Methods

The methodology employed in this research project was an experimental design featuring pre- and post-assessments, which was deemed suitable for achieving the research goals. The research technique utilized was the experimental method in a form that incorporated the experimental research design and control groups. The author, a former player and coach, employed his extensive experience in this field and a comprehensive systematic review to put emphasis on three main areas of investigation within the context of the study (the impact of neuromuscular control exercises on passing accuracy, enhancing agility, and executing dribbling skills among 17-year-old players). The present study's search strategy incorporated primary searches of academic databases, such as Google Scholar and PubMed, as well as secondary searches of sports-specific journals and databases, like SPORT Discus, to ensure the comprehensive review of relevant literature.

Study participants

The subjects of the study were 30 youth national team players participating in the qualifiers for the 2022 World Cup. The research sample was randomly divided into two equal groups, each consisting of 15 players. Four goalkeepers were excluded, leaving 26 players for the pilot study. All participants and their legal guardians provided informed consent prior to participation, ensuring adherence to safety and ethical standards suitable for research involving minors.

The criteria for selecting participants for this study were as follows: (1) participants were 17-year-old soccer players, ensuring a consistent age group and developmental stage; (2) participants were members of youth national team and were involved in the 2022 World Cup qualifiers, indicating a high level of competitive experience; (3) goalkeepers were excluded

from the sample to focus on outfield players, ensuring consistency in skill development relevant to the study's focus (passing, agility, and dribbling); (4) the sample was randomly divided into two equal groups of 15 players each to ensure balanced experimental and control groups.

The tests used

Passing skill test: Slalom run with passing accuracy

Objective of the test: To measure passing accuracy. The equipment consisted of 8 javelins, 6 soccer balls, a stopwatch, and 2 markers. Performance description: The participants began from a running start, 2 meters (about 6.6 feet) behind a starting line. At a starting signal the participants ran to the first pole, lightly rolled the ball forward, and then passed the ball towards a 1-by-1 meter target 10 meters away (about 33 feet). The participants then navigated between the markers, following a set pattern, and finished by circling around the eighth marker positioned 2 meters from the seventh pole. The scoring of 2 points was awarded if the ball entered the goal. One point was awarded if the ball rebounded from a crossbar or post. No points were given if the ball exited the playing area.

Agility dribbling skill test: Running between markers with a ball

Objective of the test: To measure agility in dribbling performance. The equipment consisted of 15 markers, a soccer ball, and a stopwatch. Performance description: The players started at a center circle, dribbling the ball towards the first two markers positioned 2 meters (about 6.6 feet) from a starting point. The players performed a slalom run between these markers and continued through a predefined route, turning clockwise around specific markers and returning to the center. The distance between the markers was 1 meter (about 3.3 feet). The scoring was the time taken by a participant to complete the course, recorded from the starting signal to the finish.

Pilot study

A pilot study, examining the group of six players over two days, was conducted to evaluate the suitability of tests, participants' responses and time taken to complete the training unit. Moreover, it enabled assessing the implementation method, identifying barriers in the execution of tests and the effectiveness of training program as well as defining an assisting team's responsibilities. Errors were identified, solutions were

applied and intensity percentages for the exercises devised by the researcher were established. This was done by testing the pilot study's participants, calculating an average intensity by multiplying the maximum intensity by a desired training percentage, and then dividing by 100.

The objectives of the pilot study were to: discover problems and difficulties faced by the researcher and the assisting team during the implementation of tests; verify the suitability of devices and tools used; understand how well the subjects comprehended the tests used; train the assisting team on how to apply the tests and record the scores; and determine the adequate time for the execution of tests.

The pilot study revealed the following outcomes: The suitability of devices and tools used in the research. The appropriateness of system followed in parts and the application of skill tests. The efficiency of assistants in performing the tasks during the conduct and application of tests. The suitability of tests for the participants in terms of performance method.

Research procedures

Pre-testing

The pre-tests involved gathering information on the age, height, and weight of study sample. Additionally, the skill tests were conducted focusing on passing and dribbling agility.

Main experiment

The proposed exercises were applied to the study sample for 12 weeks with three training sessions per week, each session lasting a total of 90 minutes. The researcher allocated 30 minutes to apply the proposed exercises. The prepared exercises were applied to the study sample under the same conditions, but the difference between the two groups was that the experimental group performed coordination exercises in addition to a regular program. The proposed exercises were administered to the experimental group during this period. A regular program for the control group was conducted during the same period.

The experimental group followed the program that integrated neuromuscular control exercises with the regular training regimen. These exercises were specifically designed to enhance passing accuracy, agility, and dribbling skills. The program lasted 12 weeks, with three sessions per week, each session lasting a total of 90 minutes. Of this time, 30 minutes were allocated specifically to neuromuscular control

exercises, which focused on coordination, balance, and muscle activation drills, tailored to improve these targeted skills. This combination aimed to build on players' foundational skills while adding a specialized layer to refine neuromuscular control, believed to be pivotal in enhancing performance metrics relevant to the study.

The control group, on the other hand, participated solely in the regular training program that mirrored standard youth soccer training practices, without the inclusion of neuromuscular control exercises. The regular program focused on general skills training, including passing drills, agility workouts, and standard conditioning routines, maintaining consistency with the experimental group in terms of session frequency and duration.

Post-testing

The post-tests were conducted after the completion of proposed exercises, using the same conditions and procedures as the pre-tests.

Statistical methods

Statistical analysis was conducted using the SPSS statistical package to extract the results. The paired sample t-test – a statistical test used to evaluate

differences between measurement results before and after training within both groups – was employed. This test helps to determine whether the exercises have a significant statistical effect on the passing and dribbling skills of players.

Results

The data derived from Table 1 demonstrates a significant improvement in the functional efficiency of nervous system as a result of implementing neuromuscular control exercises. These exercises not only enhance connectivity between sensory and motor nerves but also improve the performance of passing and rolling skills, reflecting improvements in agility and coordination. The results showed that regular training over the period of 12 weeks with three sessions per week led to an improvement rate of 23.72% that is statistically significant and indicative of the efficacy of these exercises.

The data extracted from Table 2 indicates a positive effect of traditional program on the studied variables. This impact substantiates the scientific value of traditional training programs, particularly in enhancing the skills of trainees in a systematic and studied manner. It proves the importance of continuing to use traditional methods as a part of training programs.

Table 1. Results of t-test for paired samples to determine the significance of differences between the pre-test and post-test in the study variables among the experimental group members (n = 10)

Variables	Pre-test Mean	Pre-test SD	Post-test Mean	Post-test SD	Difference in means	t-value	Significance (p-value)	Development rate
Passing	4.50	0.27	5.90	0.09	1.40	20.32	0.000	23.72%
Agility of rolling	42.11	1.40	40.89	0.78	1.21	2.33	0.04	2.63%

Table 2. Results of t-test for paired samples to determine the significance of differences between the pre-test and post-test in the study variables among the control group members (n = 10)

Variables	Pre-test Mean	Pre-test SD	Post-test Mean	Post-test SD	Difference in means	t-value	Significance (p-value)	Development rate
Passing	4.38	0.12	4.50	0.13	0.12	2.44	0.03	2.66%
Agility of rolling	42.81	1.39	41.90	0.86	0.91	2.43	0.03	2.13%

Table 3. Results of t-test for paired samples to determine the significance of differences between the second post-test measurements in the study variables among members of both experimental and control groups (n = 20)

Variables	Mean	SD	Mean	SD	t-value	Significance (p-value)
	Control group n = 10		Experimental group n = 10			
Passing	5.90	0.87	4.50	0.13	26.59	0.00
Agility of rolling	40.89	0.78	41.90	0.86	2.72	0.01

As Table 3 illustrates, the results of independent t-test between the two groups revealed statistically significant differences in all study variables in favor of the experimental group. These findings confirm that the experimental methods used in the study outperformed the control methods, supporting the research hypothesis and highlighting the effectiveness of training innovations in achieving enhanced outcomes.

Discussion

Research indicates that basic soccer skills, such as passing, are crucial for young players and can be enhanced through targeted training [9, 10]. Studies have shown that the early acquisition of skill in sports is linked to both the ease of mastering basic skills and the limited physical demands imposed on young athletes [10, 19]. This aligns with the assertion that passing skills do not require a high level of physical ability, making them accessible for young players to master. The development of enhanced technical skill is also associated with early and consistent practice, which supports the notion that youth training should focus on fundamental skills without excessive physical strain.

The dynamic nature of soccer, characterized by rapid changes in timing and motor performance, underscores the importance of neuromuscular exercises in improving agility, speed, and motor coordination in soccer players. Such exercises are essential for developing the diverse skills required in soccer. Research highlights a pivotal role of motor coordination in enhancing perceptual-cognitive and physical factors of agility in young soccer players, directly impacting agility time and coordination [15]. Additionally, neuromuscular training interventions have been shown to positively affect the motor proficiency of youth players, particularly in agility and coordination, which are critical for soccer performance [18]. Soccer training for young players must address multiple aspects, including the physical, skill-based, strategic, and psychological levels. Effective training programs are designed to foster overall athletic development while emphasizing neuromuscular adaptations necessary for higher performance levels. This approach is supported by findings that structured neuromuscular training not only reduces sports injury rates but also significantly improves functional performance in adolescent soccer players, suggesting that the integrated approach to training is most beneficial [18]. Moreover, the incorporation of neuromuscular control exercises within soccer training regimens for youth can lead to the enhancement of motor skills, which in turn supports better sports performance and injury prevention [5].

Studies indicate that neuromuscular warm-ups improve muscle pre-activation times, which are crucial for preventing injuries during high-intensity sports activities like soccer. Research on Long-Term Athlete Development emphasize the holistic development of athletes that integrates physical conditioning with skill training and psychological preparation [11]. This multidisciplinary approach is crucial for achieving high levels of athletic form and performance, especially in youth soccer, where developing basic skills and enhancing motor coordination are foundational [3]. The distinction between the improvements observed in the experimental and control groups in the discussed study can be attributed to the structured and scientifically based neuromuscular control exercises training programs. These programs, designed according to modern sports training principles, are effective in improving sport-specific skills, including those required for soccer [1, 22]. The ability to integrate various movements into a cohesive and effective action pattern is central to soccer athletic performance, highlighting the role of neuromuscular control [7].

Neuromuscular control exercises are pivotal in enhancing the coordination and fluidity of movements in young soccer players, which directly contributes to their speed and accuracy, ultimately improving overall skill performance [2]. The exercises significantly improve technical skills and motor skill performance, especially in dribbling, pass accuracy, and shooting. This supports the observation that neuromuscular control exercises contribute positively to the development of basic skills in young soccer players, offering a robust scientific foundation for understanding their role and impact in training and development. Additionally, incorporating balance-oriented and lower-limb strength exercises, such as those focused on jump roping and dynamic balance, further aids in the enhancement of motor skills by improving agility and stability [20]. This is consistent with findings showing that motor coordination exercises specifically targeting agility and balance play a significant role in reducing the risk of injury and promoting overall soccer skill development [8].

Conclusions

This study substantiates the critical role of early skill acquisition in youth soccer, emphasizing that foundational skills, such as passing, are imperative for the holistic development of young athletes. The implementation of neuromuscular control exercises extends beyond enhancing physical agility; it significantly augments cognitive functions associated

with motor coordination. These cognitive enhancements are essential for the effective execution of strategic maneuvers in game situations. Furthermore, the present study's findings illuminate the inherently dynamic nature of soccer underscoring the necessity to integrate neuromuscular control exercises into training regimens to fulfill the sport's multifaceted demands, which include speed, agility, and precise motor coordination. This research advocates for a comprehensive multidisciplinary approach that amalgamates physical conditioning, skill proficiency training, and psychological fortification, as delineated by the Long-Term Athlete Development model. Such an approach is indispensable for cultivating high levels of athletic performance in youth soccer players.

Coaches should integrate neuromuscular control exercises consistently in youth soccer training to improve agility, balance, and passing accuracy. It is important to emphasize lower limb strength, balance drills, and progressive agility exercises, incorporating neuromuscular warm-ups to prevent injuries and enhance muscle responsiveness. Training should be age-appropriate, with a focus on developing foundational skills through low-strain, skill-based practice.

Future studies could explore the long-term effects of neuromuscular exercises, compare impacts across age groups, and assess cognitive benefits like decision-making and spatial awareness. Research should aim to design soccer-specific neuromuscular protocols and evaluate the effectiveness of tech-based training tools. Additionally, investigating a role of neuromuscular training in injury prevention and its interaction with other conditioning programs would provide valuable insights for optimized training.

Conflict of Interest

The author has no conflicts of interest to report.

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