

# Effect of Neuromuscular Training Versus FIFA 11+ Program on Agility Performance in Collegiate Football Players

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## ABSTRACT

**BACKGROUND AND OBJECTIVES:** Football is a dynamic sport that requires frequent sprints, accelerations, decelerations and rapid changes of direction which are all essential aspects of agility. A football player with good agility plays a crucial part for team's success in the game. Neuromuscular training and FIFA 11+ program have been widely used methods shown to enhance agility in football players. However, no study has compared their relative effectiveness in collegiate football players. Therefore, the objective of this study was to evaluate and compare the effects of neuromuscular training and FIFA 11+ training program on agility performance in collegiate football players.

**METHODS:** Quasi experimental study, where 90 subjects were randomly allocated into two groups using systematic random sampling with 45 subjects each group. Group-A received neuromuscular training and Group- B received FIFA 11+ program training with 3 sessions per week for 8 weeks. Agility-T test was the outcome measure used in the study for agility measurement.

**RESULTS:** Independent t-test was used to compare the mean significance difference between groups. Paired t-test was used to assess the statistical difference between pre-test and post-test scores. Statistical analysis of the data revealed that within the group comparison, both groups showed significant improvement in all parameters with p value of 0.001. Whereas, in between the group's comparison, neuromuscular training group ( $9.61 \pm 0.44$ ) showed better agility performance improvement than the FIFA 11+ group ( $10.10 \pm 0.73$ ).

**CONCLUSION:** After eight weeks of training both the groups A & B showed significant improvement. Group-A showed effective results than Group B.

**Keywords:** neuromuscular training, FIFA 11+ training, Agility-T test, agility performance, collegiate football players

## **INTRODUCTION**

Football is the most widely played sport globally, with approximately 270 million subjects across the world (FIFA, 2007).<sup>[1]</sup> Both men and women compete at professional and amateur levels. Football is a physically demanding, high-intensity sport that involves frequent sprints, direction changes, jumps, and physical confrontations throughout the game.<sup>[2]</sup> It requires a wide range of athletic capabilities and overall physical fitness from players.<sup>[3]</sup>

The ability of a professional football player to accelerate, decelerate, change direction, and reach their maximum speed is crucial and depends on shared physiological and biomechanical factors. Enhancing these skills is key to achieving the primary objective of the game: scoring goals against the opposition.<sup>[4]</sup> Football is a team sport with a high injury risk, affecting both professional and amateur players.<sup>[5]</sup> Epidemiological studies suggest that professional footballers experience between 4 and 35 injuries per 1,000 hours of play. Injuries are more frequent during matches, with a 4.1-times greater incidence compared to training sessions.<sup>[6]</sup>

The most common injuries are in the thigh, knee, and ankle, with hamstring strains, ankle sprains, and adductor strains being the most prevalent. Male players typically suffer more from hamstring injuries, followed by ankle, knee, and groin injuries, whereas female players are more likely to sustain knee and ankle injuries, followed by hamstring and thigh issues.<sup>[7]</sup>

Football is a sport requiring high agility, characterized by frequent changes in direction and powerful single-leg movements.<sup>[8]</sup> Success in the game demands a range of physical qualities, including speed, endurance, agility, coordination, strength, balance, as well as perceptual and cognitive abilities.<sup>[9]</sup>

Football players' motions are continuously impacted by the movements of the ball, opponents, and teammates. Therefore, it is anticipated that making decisions more quickly and effectively will help prevent

injuries. A player with higher agility will be able to anticipate potentially dangerous situations and steer clear of needless tackles or collisions with the opponents. A player with a higher agility can also respond quickly and avoid high-intensity motions that could cause injuries, such as sprinting or abrupt breaking.

Agility refers to the ability to change direction quickly while moving at high speed. Specifically, it is the ability to alter one's body movement rapidly and accurately in response to a stimulus. In professional sports, agility is often evaluated based on two key characteristics: (i) reactive agility (RAG), also called non-planned agility, and (ii) change of direction speed (CODS), known as pre-planned agility.

When considering injury risks, it is important to highlight the significance of change of direction speed and reactive agility. Reactive agility refers to an athlete's ability to change direction in response to an external stimulus, such as an opponent, ball, or teammate, while change of direction speed pertains to the ability to alter movement direction and speed according to a predefined pattern. An agile player can sprint quickly with sharp direction changes, enabling them to score against opponents and a lack of agility is shown to cause 1.3 injuries in 1000 hours of training or game where most injury incidence was seen during the game than in the training period.<sup>[10]</sup>

Adolescent sports players are especially vulnerable to both hard- and soft-tissue injuries due to the significant physiological changes they undergo during growth. To help prevent such injuries, it is advised to introduce training programs that emphasize neuromuscular control, proper technique, and balance training, particularly for young athletes who have yet to develop stable movement patterns. These programs must be designed to improve motor skills and overall body control. Typically, they must include sport-specific exercises that can be integrated into warm-up routines to better prepare the neuromuscular system for

athletic movements and for preventing sport specific injuries.<sup>[11]</sup>

Neuromuscular training (NT), conducted by qualified professionals, focuses on correcting improper form, strengthening muscles, and preventing injury, all of which help improve athletic performance.<sup>[12]</sup>

Neuromuscular training combines sport-specific and fundamental movements to enhance sport-specific skills and overall fitness. The primary goal of neuromuscular training is to strengthen and integrate the bio-motor abilities essential for football such as increasing nerve conduction velocity, improving muscle contraction, enhancing sensory feedback for better dynamic joint stability, refining motor patterns and skills, boosting neuromuscular control, and augmenting strength by using a variety of exercises such as resistance, dynamic stability, core strengthening, and plyometrics.<sup>[13]</sup> Studies have shown that neuromuscular training enhances athletic performance by improving motor unit coordination, muscular activation, and the sensitivity of the central nervous system. These improvements lead to better agility, balance, muscular strength, power, and cardiorespiratory endurance.<sup>[14]</sup>

In football players, neuromuscular training programs provide a comprehensive approach by targeting strength, proprioception, explosive power, and neuromuscular control. This can lead to enhanced modulation of ground reaction forces, improved rate of force development (RFD), and more efficient muscle activation timing—key factors for optimal performance in high-intensity movements such as sprinting, jumping, and changing direction.<sup>[15]</sup>

The FIFA 11+ program, developed by the FIFA Medical Assessment and Research Centre, aims to reduce injuries in young football players.<sup>[16]</sup> The program combines aerobic and neuromuscular exercises to improve performance by enhancing hamstring/quadriceps strength ratios, agility, jumping skills, postural stability,

neuromuscular coordination, and body control.<sup>[17]</sup>

FIFA 11+ is divided into three segments: (1) running exercises with stretching and team interactions, (2) exercises focusing on core and leg strength, agility, and plyometrics, and (3) advanced running drills and change of direction speed. The dynamic exercises in FIFA 11+, particularly exercises focusing on core and leg strength, agility, and plyometrics, are designed to optimize the neuromuscular system, enhancing proprioception, muscular activation, and joint stability.<sup>[18]</sup>

FIFA 11+ is a program that improves balance, core stability, and coordination, with evident improvement in change of direction speed. Furthermore, FIFA 11+ emphasizes knee control during cutting and landing, dynamic postural control, leg strength, balance, and joint range of motion. Consistent participation in this program helps athletes produce adaptations in neural drive, activation rates, and inter-muscular control, leading to improved force development and better agility.<sup>[19]</sup> The FIFA 11+ program has been shown to effectively enhance agility performance in adolescent football players. This structured warm-up routine includes exercises that specifically target coordination, balance, and neuromuscular control, all fundamental to agility.

Studies have highlighted that consistent use of the FIFA 11+ leads to notable improvements in movement efficiency, quick changes in direction, and overall agility on the field. Thanks to its simple structure and ease of implementation, the program enjoys high compliance among youth teams. Consequently, the FIFA 11+ serves as a practical, research-backed method for boosting agility and supporting athletic development in adolescent football players.<sup>[20]</sup>

From the available data no studies have shown the effects of FIFA 11+ and neuromuscular training on agility performance in collegiate football players. Therefore, the need of this study is to

identify the most effective program between neuromuscular training and FIFA 11+ to improve agility performance in collegiate football players.

## MATERIALS & METHODS

This is a Quasi Experimental Study approved by the Ethical Committee of GSL Medical College & General Hospital. The study was conducted in the Sports Arena of Physiotherapy College Campus, affiliated to Dr. NTRUHS for a period of one year. (From July 1st 2024 to June 30th 2025). A total of 100 subjects were screened for eligibility through Agility T-test out of which 90 subjects were recruited according to inclusion and exclusion criteria. All the subjects were consecutively randomized through Systematic Random Sampling to either Neuromuscular Training (Group A) or FIFA 11+ training (Group B) groups with 45 subjects in each group. Both the groups received intervention 3 days in a week for 8 weeks.

**Inclusion Criteria:** 18 years and above male subjects, subjects who voluntarily gave consent to participate in the study, Male college students with at least three months of football playing experience, Subjects with less than or equal to average Agility-T test score (10.51-11.50 seconds) were included.

**Exclusion Criteria:** Subjects with musculoskeletal injuries or cardiovascular diseases or who underwent recent surgeries or subjects with neurological deficits, Subjects unable to attend sessions regularly, Subjects involved in another structured training or sports performance program.

**Outcome Measures:** Agility performance was assessed prior to and after the 8-week training period using the Agility T-test. Every subject performed the test three times, and the best score from the three trials was utilized for analysis. The Agility T-Test is a simple running test of agility, involving forward, lateral and backward movements, appropriate to a wide range of sports.<sup>[21]</sup> Subjects begin from a stationary position (cone A) and sprint forward to a

cone 9.14 meters away (cone B), then side shuffle to a cone 4.57 meters to the left (cone C), side shuffle to a cone 9.14 meters to the right (cone D), side shuffle back to the central cone to the left (cone B) and then back-peddle to the start position (cone A). The trial was not counted if the subject crossed one foot in front of the other while shuffling, fails to touch the base of the cones or does not face forward throughout the test.

**INTERVENTION:** This is an 8 weeks study which includes neuromuscular training for Group -A and FIFA 11+ training for Group- B. The outcomes were measured by Agility-T test. All the subjects who are eligible for criteria were allocated randomly into Group-A and Group-B.

## GROUP A - NEUROMUSCULAR TRAINING

Before program, subjects performed warm up (dynamic stretching) and after the training subjects performed cool down (static stretching). In the training program, balance training consisted of double-leg and single-leg balance training with a balance tool.

Gradually, subjects performed ball lifts on the balance tool (bosu ball) (Fig.no 2-i). Plyometric training consisted of box jumps (Fig.no 2-iiia, iib, iic), drop landing and medicine ball throws combined with 1/2 ankle jumps, hopping, lateral bounds and stabilization performed for 2–4 sets with 6–8 repetitions in each set. Each set and repetition had 60 sec and 15 sec of rest period, respectively. Resistance training consisted of exercises such as squats (Fig.no 2-iii), planks (Fig.no 2-vii), lunges (Fig.no 2-v) and side lunges (Fig.no 2-vi), superman and dead-bug (Fig.no 2-vii) which were performed for 2–4 sets with 8–12 repetitions in each set.

The treatment duration was 40 min per session, 3 days a week for 8 weeks. To ensure progressive overload, the exercise program was set differently for every two weeks by systematically adjusting the

resistance load, number of sets, repetitions and speed (tempo) of exercises. Subjects were given proper instructions and the

exercises were performed under the supervision of the physiotherapist only. [22,23]



**Fig. No. 2 – NEUROMUSCULAR TRAINING:** i) Bosu Ball exercises ii) a, b, c Box jumps and drop landing iii) Squats iv) Medicine ball throws with lateral bounds v) Lunges vi) Side Lunges vii) dead Bugs viii) Plank

### GROUP B - FIFA 11+ TRAINING PROGRAM

The program consists of 15 exercises in total divided into three sections, which were performed in sequence. [24]

Part 1: This section includes slow-paced running drills, dynamic active stretching, and controlled partner contacts (Fig.no 3-ia, ib).

Part 2: This section consists of six exercises that focus on strengthening core and leg

strength, balance, and plyometrics or agility. Each exercise includes three degrees of increasing difficulty (Fig.no 3-iaa-iae).

Part 3: This section consists of running drills at moderate / high speed with planting / cutting movements (Fig.no 3-iaa, iaib).

DOSAGE: FIFA 11+ Training will be given for 8 weeks at a frequency of 3 times per week for 40 minutes.



Fig. No. 3 – FIFA 11+ TRAINING: i) PART I Running exercises – a. running across the pitch b. quick forwards ii) PART II Strength, Plyometrics and Balance exercises – a. Plank b. Side Plank c. Hamstrings d. Squats with toe raise e. Vertical jump iii) PART III Running exercises – a. bounding b. Plant and cut

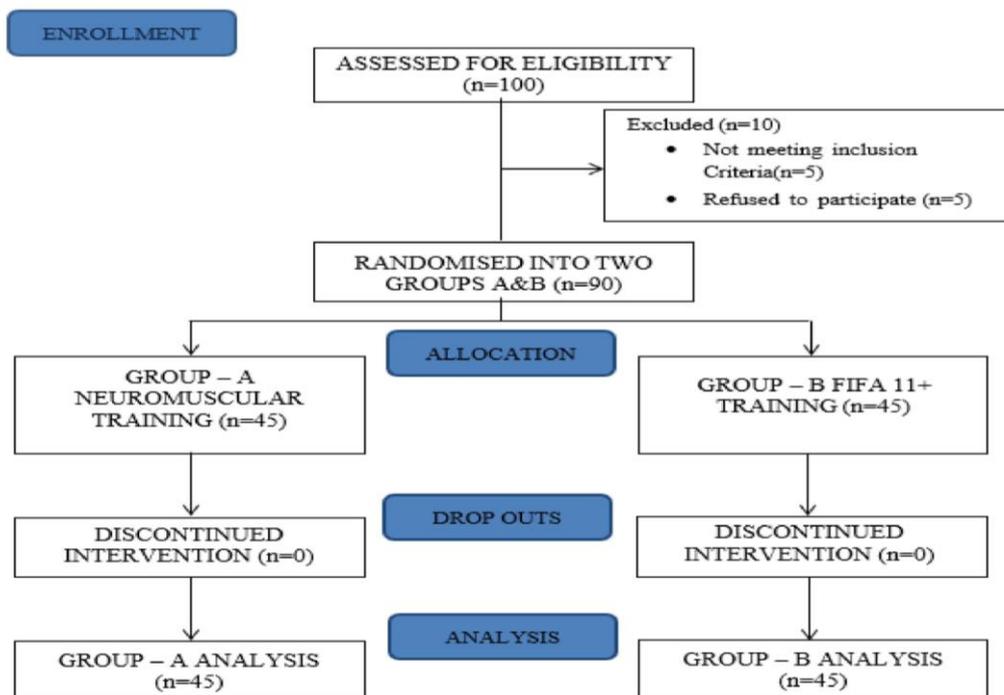


Fig. No. 1 – CONSORT FLOW CHART OF STUDY – FROM ENROLLMENT TO ANALYSIS

### Statistical Analysis

Statistical analysis was done by using SPSS software version 20.0 and Microsoft excel 2019. Between the groups: independent student “t” test was performed to detect the statistically significant difference of mean value between the groups on Agility-T test pretest and post-test values (table 1, table 2). Data was tabulated. For all statistical analyses,  $p < 0.05$  was considered as statistically significant.

### RESULT

The study compared the effect of Neuromuscular Training and FIFA 11+

training program on agility performance in collegiate football players. After eligibility evaluation, 90 subjects in total were recruited based on the inclusion and exclusion criteria. Each subject was randomly allocated to one of two groups, each consisting of 45 subjects, after completing baseline assessments. Training was given three times a week for eight weeks. At the end of the intervention, all 90 subjects—45 in Group A and 45 in Group B—completed the training. At a significance level set at  $p \leq 0.05$ , both the groups demonstrated statistically significant improvements in Agility-T test scores.

**TABLE 1: COMPARISON OF MEAN SCORES OF AGILITY-T TESTS BETWEEN THE GROUPS (PRE-TEST):**

AGILITY-T TEST	MEAN	STANDARD DEVIATION	P VALUE	INFERENCES	
PRE-TEST	GROUP A	11.16	0.44	0.075	INSIGNIFICANT
	GROUP B	11.09	0.47		

The above table 1 shows that the PRE-TEST mean scores of AGILITY-T TESTS between Group A and Group B are statistically insignificant ( $p < 0.05$ ). Group A had a pre-test mean score of  $11.16 \pm 0.44$ ,

while Group B had a pre-test mean score of  $11.09 \pm 0.47$  indicating an insignificant difference of pre-test values between the groups A&B.

**TABLE 2: COMPARISON OF MEAN SCORES OF AGILITY-T TESTS BETWEEN THE GROUPS (POST-TEST):**

AGILITY-T TEST	MEAN	STANDARD DEVIATION	P VALUE	INFERENCES	
POST TEST	GROUP A	9.61	0.44	0.001	HIGHLY SIGNIFICANT
	GROUP B	10.10	1.73		

The above table 2 shows that the post-test mean scores of AGILITY-T TESTS between Group A and Group B are statistically highly significant ( $p < 0.05$ ). Group A had a post-test mean score of  $9.61 \pm 0.44$ , while Group B had a post-test mean score of  $10.10 \pm 1.73$ , indicating a statistically high significant difference in post- test values between the groups A&B.

### DISCUSSION

The aim of the study was to assess the Neuromuscular Training and FIFA 11+ training program and to compare their effect on agility performance in collegiate football players. In this study the subjects were assessed for agility. The following outcome measure is the Agility-T test.

Subjects were assessed for agility at baseline and at the end of the intervention i.e., at the 8th week using Agility-T Test. 90 subjects were assessed for the agility performance (45 subjects in Group-A i.e., Neuromuscular Training And 45 subjects in Group-B i.e., FIFA 11+ Training).

In Group-A (Neuromuscular Training) there was statistically significant improvement seen in agility at the end of 8th week ( $p=0.001$ ). The Neuromuscular Training protocol, which include exercises targeting balance, strength, coordination, and proprioception, contributed significantly to improvements in agility. The possible explanation is that NMT improves nerve-muscle control as well as improves the joint stability, power production of muscles by

increasing muscle activation, targeting, and coordinating the motor units. All these enhancements resulted in significant improvement in agility.

According to the systematic review conducted by the authors Saddam Akbar, Kim Geok Soh et al, On Effects of Neuromuscular Training on Athletes Physical Fitness in Sports, neuromuscular training (NMT) has proven to be an effective method for enhancing various components of athletic performance. The review highlights that NMT protocols, which include exercises targeting balance, strength, coordination, and proprioception, contribute significantly to improvements in agility, jump performance, and muscular endurance across various sports disciplines. The proposed rationale is that NMT activates both central and peripheral neuromuscular pathways, leading to enhanced motor control, joint stability, and movement efficiency. By reinforcing neuromuscular connections and fostering proper movement patterns. The review adds that this type of training improves physical fitness and also plays a crucial role in injury prevention. The findings of this review are consistent with our study outcomes, emphasizing the value of structured, task-oriented interventions that target both sensorimotor and cognitive systems to optimize physical function and overall performance.<sup>[25]</sup>

Previous research by Kwang-Jin Lee et al. on the arrangement order effects of neuromuscular training on physical fitness in youth soccer players demonstrated that strategically sequencing neuromuscular exercises can significantly influence training outcomes. Neuromuscular training, which includes balance, strength, and plyometric components, aims to enhance both muscular coordination and proprioceptive control. When appropriately ordered, such training can maximize muscular activation, reduce fatigue accumulation, and improve biomechanical efficiency.

The study utilized a range of performance tests namely the 20-meter sprint, arrowhead

agility test, vertical jump, and Y balance test to evaluate the effects of exercise sequencing. Results indicated that initiating training sessions with balance-oriented tasks followed by strength and plyometric components may yield superior gains in agility, power, speed, and endurance. By optimizing the sequence, athletes may experience improved motor performance, reduced injury risk, and enhanced adaptation to sport-specific demands. These findings underscore the importance of structured program design to effectively develop physical fitness in youth athletes and promote long-term athletic development.<sup>[26]</sup>

The findings of Zouhal, Abderrahman, Dupont, Truptin, Le Bris, Le Postec, Sghaeir, Brughelli, Granacher, and Bideau demonstrated that neuromuscular training plays a notable role in enhancing agility performance among elite soccer players. Their study revealed that a structured six-week neuromuscular training program, incorporating strength, balance, plyometric, and change-of-direction drills, led to a marked improvement in movement time during agility tasks. Importantly, these improvements were observed in both the slower and faster turning directions, thereby reducing asymmetry between sides, which is crucial for multidirectional demands in soccer. However, reaction time remained unchanged, suggesting that neuromuscular training primarily influences the mechanical and coordinative aspects of movement rather than perceptual or decision-making speed.

The authors attributed the enhanced efficiency to the optimization of the stretch-shortening cycle, where eccentric preloading facilitates greater concentric force output, thereby minimizing ground contact time during rapid directional changes. These results support the notion that agility performance is not solely dependent on muscle strength but also on neuromuscular coordination, balance, and the effective transfer of strength into explosive, sport-specific movements.

Therefore, a progressive training model beginning with the development of fundamental strength and technique, advancing to maximal strength, and finally converting strength into reactive power and agility, is recommended to optimize performance outcomes in elite players.<sup>[27]</sup>

The study by Anbu, Malar, and Maniazhagu (2022) demonstrated that concurrent neuromuscular training combined with football game practice produced significant improvements in agility performance among young football players. Over a six-week period, players who performed neuromuscular training either before or after their football practice sessions showed greater agility gains compared to the control group who continued regular training.

The authors attributed these improvements to the integration of neuromuscular elements such as strength, balance, coordination, and plyometric exercises with sport-specific practice, which enhanced the transfer of physical adaptations to gameplay situations. The mechanism underlying these gains was explained through improved neuromuscular coordination, better efficiency of the stretch-shortening cycle, and reduced ground contact time during changes of direction, all of which are critical determinants of agility.

Furthermore, the study highlighted that the sequencing of neuromuscular training in relation to football practice may influence performance outcomes, suggesting that training structure and timing are important considerations for coaches. Overall, these findings reinforce that the neuromuscular training is an effective strategy to augment agility when combined with regular football practice, particularly in developing players.<sup>[28]</sup>

In Group-B (FIFA11+ Training) the results showed statistically significant improvement in agility at the end of 8th week ( $p=0.001$ ). The FIFA11+ training program incorporates core and leg strength exercises, running drills and plyometrics exercises that challenge the postural control and reaction time. These might have likely

be responsible for the notably decreased agility test times.

The result of the current study aligns with the findings of Batool Mohammed Foqha et al., who conducted a 10-week intervention using the FIFA 11+ program to evaluate its effects on physical performance in elite seven-a-side soccer players. The study assessed key parameters such as short-sprint performance and agility using the modified agility T-test. Participants who underwent the FIFA 11+ training showed statistically significant improvements in both sprint times and agility measures compared to the control group ( $P < 0.05$ ). The structured warm-up protocol, which emphasizes neuromuscular control, core stability, balance, and dynamic strength, likely contributed to these performance gains. The results can be attributed to the progressive and sport-specific nature of the FIFA 11+ program, which not only enhances athletic performance but also reduces injury risk. These findings are consistent with our observations, where targeted, task-specific interventions led to measurable improvements in functional outcomes, supporting the growing evidence that structured training protocols play a critical role in optimizing physical performance.<sup>[29]</sup>

Jorge Aredé et al. suggest that the FIFA 11+ warm-up program plays a pivotal role in enhancing both physical attributes and small-sided game (SSG) performance among youth football players. The study demonstrated that regular implementation of the program led to improvements in key physical components such as agility, sprint capacity, and jump performance, alongside enhanced tactical and technical execution during SSGs. The underlying mechanism is believed to involve improved neuromuscular efficiency and motor control fostered by the program's structured, progressive exercises targeting balance, strength, and dynamic stability. Moreover, repeated exposure to sport-specific movements during warm-ups may reinforce motor patterns and decision-making under game-like conditions. These findings

underscore the importance of integrative warm-up strategies like FIFA 11+ in not only reducing injury risk but also optimizing performance by priming both physical and cognitive systems before play.<sup>[30]</sup>

Impellizzeri, Bizzini, Dvorak, Pellegrini, Schena, and Junge demonstrated that the FIFA 11+ program is effective in enhancing neuromuscular control and selected performance outcomes in soccer players. Their randomized controlled trial reported significant improvements in balance, agility, and joint stabilization, mainly due to the combination of strength, plyometric, balance, and core stability exercises. Performing the FIFA 11+ three times per week for nine weeks was shown to improve neuromuscular control and time-to-stabilisation, which represents a key mechanism explaining its injury prevention effect. Some positive changes in flexor strength were also observed, though their practical significance remains uncertain. Importantly, no meaningful effects were found for other performance measures, indicating that the FIFA 11+ cannot be considered a training strategy for developing muscle power. These findings suggest that the FIFA 11+ should be viewed primarily as an injury prevention program with secondary benefits for neuromuscular control, rather than as a substitute for dedicated power training interventions.<sup>[31]</sup>

The study by Ivan Reis et al highlights the dual role of the FIFA “11+” program in youth futsal, showing benefits not only for injury prevention but also for performance enhancement. Significant improvements were noted in balance, agility, strength, and explosive actions such as sprinting and jumping, all of which are crucial for futsal. The findings are consistent with previous evidence that dynamic warm-up programs incorporating functional strength and balance exercises can improve neuromuscular control, stability, and coordination. The observed gains in agility and explosive performance further indicate that the “11+” can be integrated effectively into training without compromising sport-

specific conditioning. Individual responses varied, with some athletes improving more in strength and others in agility, reflecting differences in baseline fitness and adaptation. Overall, the FIFA “11+” emerges as a practical, low-cost strategy for coaches to enhance both safety and performance in young futsal players.<sup>[32]</sup>

The findings of Daneshjoo et al provide further evidence that structured warm-up programs can influence physical performance in soccer players. Their study compared the FIFA 11+ and HarmoKnee warm-up protocols and found that the 11+ program produced greater improvements in vertical jump, agility, and soccer skill performance compared to HarmoKnee, while both programs enhanced technical measures such as ball control. These results indicate that the specific design of the 11+, which integrates balance, plyometric, and functional strength components, may better facilitate neuromuscular activation and motor control, thereby supporting agility and explosive performance. Interestingly, improvements in sprint speed were less pronounced, suggesting that warm-up interventions alone may not be sufficient to elicit significant gains in acceleration and sprinting capacity, particularly in professional athletes with high baseline fitness levels.

Overall, the study emphasizes the importance of selecting comprehensive warm-up strategies, such as the FIFA 11+, that can simultaneously reduce injury risk and contribute to performance enhancement in competitive soccer.<sup>[33]</sup>

Hwang and Kim demonstrated that 12 weeks of the FIFA 11+ program improved agility, coordination, and functional movement in collegiate male soccer players, as reflected in 30- m sprint, arrowhead agility, and FMS scores. However, no significant changes were observed in 10-m sprint or aerobic endurance, suggesting that the program primarily enhances neuromuscular control and movement efficiency rather than speed or endurance.<sup>[34]</sup>

Trajković et al. (2020) reported that a 4-week FIFA 11+ program significantly enhanced agility and vertical jump performance in young soccer players compared to a control group. Even in a short-term intervention, improvements in explosive leg power and quick change-of-direction ability were evident, highlighting the program's capacity to develop neuromuscular control and functional performance. These results suggest that implementing the FIFA 11+ can produce meaningful gains in key physical attributes relevant to soccer.<sup>[35]</sup>

The results of the present study have shown more improvement in agility in Group-A (neuromuscular training group). This improvement can be attributed to the progressive overload in the training program. This progressive overload drives neuromuscular adaptations like motor unit recruitment, rate of force development more which help shorten ground contact times and improve directional changes - key factors for faster agility.<sup>[36]</sup>

In addition, the Neuromuscular Training (NMT) protocol incorporates balance and proprioceptive drills performed on unstable surfaces such as the Bosu ball, whereas the FIFA 11+ program is largely limited to single-leg stance tasks on stable ground. Training on an unstable surface requires a heightened degree of postural control and neuromuscular recruitment, thereby stimulating greater activation of stabilizing musculature, enhancing intermuscular coordination, and refining sensorimotor integration. These adaptations are particularly beneficial for football players, as they contribute to improved footwork precision, quicker reaction times, and the capacity to execute rapid multidirectional movements with efficiency. Consequently, the results of the present study highlight that NMT not only provides a more comprehensive neuromuscular challenge but also produces superior gains in agility compared to FIFA 11+.<sup>[37]</sup>

However, the study has a few limitations: a) small sample size; b) The participant group

consisted of only male collegiate football players; c) true randomization and blinding were not strictly ensured; d) The intervention lasted 8 weeks, which does not allow to understand long-term adaptations, retention, or sustainability of agility gains. Additionally, it is recommended to investigate if a hybrid program (NMT + FIFA 11+) provides superior results and also to broaden the population like including female athletes, other sports where agility is critical (basketball, hockey, rugby).

## CONCLUSION

In conclusion, the present study compared the effects of Neuromuscular Training and the FIFA 11+ program on agility performance in collegiate football players where both interventions produced significant improvements in agility, highlighting their value in enhancing sport-specific performance. However, Neuromuscular Training demonstrated superior gains compared to the FIFA 11+ program, suggesting its greater effectiveness for agility enhancement in this population. These findings emphasize the importance of incorporating structured neuromuscular training into football conditioning programs to address agility-specific demands.

### *Declaration by Authors*

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