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# Influence of Multidirectional Agility Training on Neuromuscular Efficiency and Match Performance among University-Level Team Sport Athletes

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**ABSTRACT**
Team sports are defined by rapid changes of direction, sudden accelerations and decelerations, and the constant need to respond to an unpredictable game. Success in these sports therefore depends heavily on agility and on the efficiency with which the neuromuscular system produces and controls movement. This study examined the influence of an eight-week programme of multidirectional agility training on the neuromuscular efficiency and the match performance of university-level team sport athletes. A pre-test and post-test experimental design with a control group was employed. Fifty male athletes were randomly assigned to an experimental group, which undertook the agility programme three times a week alongside normal practice, and a control group, which continued its usual practice only. Neuromuscular efficiency was assessed through the reactive strength index, countermovement jump height, the Illinois agility test, the 505 change-of-direction test and a reactive agility test, while match performance was assessed through a coach-rated performance index and objective match indicators. Paired and independent t-tests were used, and effect sizes were calculated. The experimental group improved significantly on every measure of neuromuscular efficiency and match performance, with moderate to large effect sizes, whereas the control group changed little. The findings indicate that structured multidirectional agility training is an effective means of enhancing both the underlying neuromuscular qualities and the on-field performance of university-level team sport athletes.

**Keywords:**Multidirectional agility, neuromuscular efficiency, change of direction, reactive strength, match performance, team sports, university athletes.

## 1. Introduction

Team sports such as football, basketball, handball and kabaddi are characterised by movement that is rarely straight and seldom predictable. Players must accelerate, stop, turn and change direction repeatedly, often in response to the movement of opponents and the run of play. The quality that allows them to do this quickly and effectively is agility, and it is widely regarded as one of the most important attributes a team sport athlete can possess. An athlete who can change direction faster and react more sharply than an opponent gains an advantage that can be decisive at the moment a match is won or lost.

Agility, however, is not a single simple ability. It rests on a foundation of underlying physical qualities, the most important of which is neuromuscular efficiency, that is, the capacity of the nervous and muscular systems to work together to produce, absorb and redirect force rapidly and with control. When an athlete plants a foot to change direction, the muscles must absorb the force of deceleration and then explosively reapply it in a new direction within a fraction of a second. The efficiency of this process determines how quickly and how safely the movement is performed, and it can be measured through tests of reactive strength, jumping ability and change-of-direction speed.

Multidirectional agility training is a method designed to develop precisely these qualities. Rather than training movement in a straight line, it deliberately rehearses the cutting, turning, decelerating and reaccelerating that team sports demand, often progressing from planned drills towards reactive drills in which the athlete must respond to an external stimulus. The aim is to improve not only the mechanics of changing direction but also the perceptual and decision-making components that distinguish true game agility from mere change-of-direction speed.

The ultimate test of any training method, however, is not how an athlete performs in a fitness test but how he or she performs in competition. A programme that improves laboratory measures yet leaves match performance unchanged would be of limited value. It is therefore important to examine the effect of agility training not only on the underlying neuromuscular qualities but also on the athlete's performance during actual matches, where the trained abilities must be applied under pressure, fatigue and the chaos of real play.

University-level team sport athletes form an important group in which to study these questions. They are committed and trainable yet often lack access to the specialised conditioning support available to elite professionals, which means that a well-designed, low-cost agility programme could make a substantial difference to their development. Understanding how such a programme affects both their neuromuscular efficiency and their match performance is therefore of direct practical value.

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The present study accordingly set out to examine the influence of an eight-week multidirectional agility training programme on the neuromuscular efficiency and the match performance of university-level team sport athletes. By assessing both the underlying qualities and the on-field outcomes, it aims to provide a complete account of whether and how such training translates from the practice ground to the match.

## 2. Review of Literature

The concept of agility has been carefully examined in the sports-science literature. Sheppard and Young (2006), in a widely cited review, classified agility and distinguished it from simple change-of-direction speed, emphasising that true agility includes a perceptual and decision-making component, the response to a stimulus, that planned drills do not capture. This distinction was developed further by Young, Dawson and Henry (2015), who presented evidence that agility and change-of-direction speed are largely independent skills, with implications for how each should be trained.

The factors that determine the ability to change direction have been the subject of extensive study. Brughelli and colleagues (2008) reviewed the contribution of resistance training to change-of-direction ability, and Chaabene and colleagues (2018) drew attention to the importance of eccentric muscle action, that is, the capacity to absorb force during deceleration, which lies at the heart of effective turning. Spiteri and colleagues (2014) demonstrated that strength characteristics contribute meaningfully to change-of-direction and agility performance, confirming the neuromuscular foundation of these abilities. Paul, Gabbett and Nassis (2016) provided a comprehensive account of agility in team sports, addressing its testing, its training and the many factors that affect it.

The measurement of the underlying neuromuscular qualities has been refined considerably. Flanagan and Comyns (2008) explained the use of contact time and the reactive strength index to assess and develop the fast stretch-shortening cycle, the rapid sequence of muscle lengthening and shortening that underpins explosive movement. The reactive strength index has since become a standard indicator of neuromuscular efficiency. The validity and reliability of field tests of change-of-direction speed for team sports were established by Lockie and colleagues (2013), making rigorous assessment possible outside the laboratory.

The effectiveness of training interventions has also been documented. Markovic (2007) confirmed through meta-analysis that plyometric training improves vertical jump height, a key expression of neuromuscular power, and Asadi and colleagues (2016) demonstrated through meta-analysis that plyometric and related training improves change-of-direction ability. These syntheses provide strong support for the expectation that structured agility and power training will enhance the neuromuscular qualities relevant to team sport.

Taken together, the literature establishes that agility is a trainable and multifaceted quality resting on a neuromuscular foundation, that the relevant qualities can be reliably measured, and that appropriate training improves them. What is less often examined is the joint effect of a multidirectional agility programme on both neuromuscular efficiency and actual match performance within the same study, particularly among university-level athletes. The present study addresses this gap.

## 3. Significance of the Study

This study is significant because it links the underlying neuromuscular qualities developed through training to the match performance that ultimately matters in competition. By measuring both within the same controlled experiment, it allows the question of transfer, whether improvements in fitness tests carry over to the match, to be addressed directly rather than assumed. The focus on a structured but practical agility programme makes the findings applicable to university-level athletes and to the coaches who prepare them, often with limited resources. The inclusion of effect sizes alongside tests of significance provides a clearer sense of the practical magnitude of the benefits, not merely their statistical reliability. In these ways the study offers evidence of direct value to applied practice while contributing to the wider understanding of how agility training shapes the team sport athlete.

## 4. Objectives of the Study

The study is built around the following two objectives:

1. To examine the influence of an eight-week multidirectional agility training programme on the neuromuscular efficiency of university-level team sport athletes.
2. To examine the influence of the same multidirectional agility training programme on the match performance of university-level team sport athletes.

## 5. Hypotheses of the Study

In support of these objectives, the following null hypotheses were formulated and tested:

H1:There is no significant difference between the pre-test and post-test neuromuscular efficiency of university-level team sport athletes following the multidirectional agility training programme.

H2:There is no significant difference between the pre-test and post-test match performance of university-level team sport athletes following the multidirectional agility training programme.

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## 6. Research Methodology

### 6.1 Research Design

The study employed a pre-test and post-test randomised group experimental design with a control group. This design was appropriate because the aim was to determine the effect of a specific training intervention, which requires the comparison of measurements before and after the programme together with a control group to account for any changes arising from normal practice or the passage of time.

### 6.2 Participants

Fifty male university-level team sport athletes volunteered for the study after being informed of its purpose and procedures. They were randomly assigned in equal numbers to an experimental group and a control group, with twenty-five athletes in each. All participants were free of injury and were regular members of their respective teams. The experimental group undertook the agility programme in addition to their normal team practice, while the control group continued with their normal practice only.

### 6.3 Selection of Variables

Two sets of dependent variables were selected. Neuromuscular efficiency was assessed through the reactive strength index derived from a drop jump, countermovement jump height, the Illinois agility test, the 505 change-of-direction test and a reactive agility test that required a response to a visual stimulus. Match performance was assessed through a coach-rated match performance index and through objective match indicators, namely the number of effective change-of-direction actions and the number of high-intensity efforts performed during a match. Together these variables captured both the underlying qualities and the on-field expression of agility.

### 6.4 The Training Programme

The experimental group undertook multidirectional agility training three times a week for eight weeks. The programme progressed from foundational change-of-direction drills towards reactive, stimulus-based and game-like drills, with the volume and intensity increasing across the weeks. Each session included a thorough warm-up and emphasised correct technique in deceleration and cutting in order to develop efficient movement and reduce the risk of injury. The structure of the programme is summarised in Table 2.

### 6.5 Testing Procedure

All participants were tested before the programme began and again at its conclusion, under similar conditions and at the same time of day. Athletes were familiarised with every test beforehand, and standardised procedures were followed to ensure reliable measurement. The match indicators were recorded from competitive or competitive-standard matches before and after the intervention.

### 6.6 Statistical Techniques

The paired t-test was used to compare pre-test and post-test scores within each group, and the independent t-test was used to compare the groups at the post-test stage. The mean and standard deviation were calculated for every variable, and effect sizes were computed to express the practical magnitude of the changes. A significance level of five per cent was adopted throughout.

## 7. Results and Discussion

### 7.1 Baseline Characteristics of the Groups

Table 1 presents the baseline characteristics of the two groups, which were closely matched and showed no significant differences at the outset, confirming their comparability before the intervention.

**Table 1 Baseline Characteristics of the Experimental and Control Groups (Mean ± SD)**

| Characteristic | Experimental (n=25) | Control (n=25) |
|---|---|---|
| Age (years) | 20.3 ± 1.4 | 20.5 ± 1.3 |
| Height (cm) | 175.2 ± 6.1 | 174.8 ± 5.9 |
| Body mass (kg) | 68.4 ± 6.7 | 69.0 ± 6.3 |
| Playing experience (years) | 4.2 ± 1.3 | 4.1 ± 1.2 |

### 7.2 The Training Programme

The progression of the eight-week agility programme is shown in Table 2. The early weeks built a foundation of sound change-of-direction technique, the middle weeks introduced reactive and plyometric elements, and the final weeks emphasised game-like, stimulus-driven agility at high intensity.

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**Table 2 Structure of the Eight-Week Multidirectional Agility Programme**

| Weeks | Focus | Sample Drills | Volume |
|---|---|---|---|
| 1 – 2 | Foundation and technique | Ladder drills, cone cutting, planned change of direction | Low |
| 3 – 4 | Deceleration and progression | Multidirectional cutting, controlled deceleration, shuttle drills | Moderate |
| 5 – 6 | Reactive and plyometric | Mirror drills, stimulus-based cuts, integrated jumps | Moderate–high |
| 7 – 8 | Sport-specific and game-like | Small-sided reactive games, maximal-intensity agility | High |

### 7.3 Effect on Neuromuscular Efficiency (Objective 1)

The first objective concerned neuromuscular efficiency. Table 3 reports the pre-test and post-test scores of the experimental group, with the results of the paired t-test and the effect size for each variable. For the timed agility tests a lower score indicates better performance.

**Table 3 Pre-Test and Post-Test Neuromuscular Efficiency of the Experimental Group (n = 25)**

| Variable | Pre-test | Post-test | t | p | d |
|---|---|---|---|---|---|
| Reactive strength index | 1.62 ± 0.28 | 1.94 ± 0.26 | 5.94 | 0.000 | 1.18 |
| Countermovement jump (cm) | 38.4 ± 4.6 | 42.7 ± 4.3 | 5.31 | 0.000 | 0.96 |
| Illinois agility test (s) | 16.84 ± 0.92 | 15.91 ± 0.81 | 6.12 | 0.000 | 1.07 |
| 505 change-of-direction test (s) | 2.54 ± 0.18 | 2.38 ± 0.15 | 5.68 | 0.000 | 0.97 |
| Reactive agility test (s) | 1.96 ± 0.21 | 1.78 ± 0.18 | 5.03 | 0.000 | 0.92 |

The experimental group improved significantly on every measure of neuromuscular efficiency, and the effect sizes were moderate to large throughout, indicating that the changes were not only statistically reliable but also practically meaningful. The substantial rise in the reactive strength index is particularly notable, since this measure directly reflects the efficiency of the fast stretch-shortening cycle that underpins rapid changes of direction. The improvement in the reactive agility test, which requires a response to a stimulus, shows that the training enhanced not only the mechanics of movement but also the perceptual and reactive component that distinguishes genuine game agility. The control group, as Table 4 shows, did not achieve comparable gains.

**Table 4 Pre-Test and Post-Test Neuromuscular Efficiency of the Control Group (n = 25)**

| Variable | Pre-test | Post-test | t | p |
|---|---|---|---|---|
| Reactive strength index | 1.60 ± 0.27 | 1.64 ± 0.26 | 1.21 | 0.24 |
| Countermovement jump (cm) | 38.1 ± 4.5 | 38.9 ± 4.4 | 1.36 | 0.19 |
| Illinois agility test (s) | 16.90 ± 0.95 | 16.74 ± 0.90 | 1.42 | 0.17 |
| 505 change-of-direction test (s) | 2.55 ± 0.19 | 2.52 ± 0.18 | 1.09 | 0.29 |

The control group showed only small and non-significant changes, which confirms that the improvements observed in the experimental group were a genuine effect of the agility programme rather than a product of ordinary practice.

### 7.4 Effect on Match Performance (Objective 2)

The second objective concerned match performance. Table 5 reports the pre-test and post-test match scores of the experimental group.

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**Table 5 Pre-Test and Post-Test Match Performance of the Experimental Group (n = 25)**

| Variable | Pre-test | Post-test | t | p |
|---|---|---|---|---|
| Match performance index (0–100) | 64.2 ± 7.1 | 73.6 ± 6.4 | 5.42 | 0.000 |
| Effective change-of-direction actions | 18.6 ± 4.2 | 24.3 ± 4.0 | 5.61 | 0.000 |
| High-intensity efforts per match | 41.3 ± 6.8 | 48.9 ± 6.2 | 4.79 | 0.000 |

The experimental group improved significantly on every measure of match performance. The coach-rated performance index rose substantially, and the objective indicators told the same story: athletes performed more effective changes of direction and sustained more high-intensity efforts during matches after the programme. These results are of central importance, because they demonstrate that the gains in neuromuscular efficiency transferred to the match itself. An improvement in a fitness test is encouraging, but an improvement in the way an athlete moves and competes during play is the outcome that truly matters, and it was clearly achieved. The control group, by contrast, showed only minor and non-significant changes in match performance over the same period.

**7.5 Comparison between the Groups and Testing of Hypotheses**

To confirm the effect of the programme, the post-test scores of the two groups were compared using the independent t-test, with selected results shown in Table 6.

**Table 6 Independent t-Test Comparison of Post-Test Scores between Groups**

| Variable (post-test) | Exp. | Control | t | p |
|---|---|---|---|---|
| Reactive strength index | 1.94 | 1.64 | 4.07 | 0.000 |
| Illinois agility test (s) | 15.91 | 16.74 | 3.42 | 0.001 |
| Match performance index | 73.6 | 65.1 | 4.71 | 0.000 |
| Effective change-of-direction actions | 24.3 | 19.1 | 4.55 | 0.000 |

The experimental group scored significantly better than the control group on every measure compared. The first null hypothesis, that there is no significant difference in neuromuscular efficiency following the programme, was rejected, since the experimental group improved significantly on all such measures while the control group did not. The second null hypothesis, that there is no significant difference in match performance, was likewise rejected. Both objectives were thereby fulfilled, and the evidence shows that the multidirectional agility programme produced significant improvements in both the neuromuscular efficiency and the match performance of the athletes.

**8. Major Findings**

1. The eight-week agility programme produced significant improvements in reactive strength, jumping ability and change-of-direction speed in the experimental group, with moderate to large effect sizes.
2. The programme also significantly improved performance on the reactive agility test, indicating gains in the perceptual and reactive component of game agility.
3. Match performance improved significantly, with higher coach-rated performance and more effective change-of-direction actions and high-intensity efforts per match.
4. The control group, following its usual practice, showed only small and non-significant changes in both domains.
5. The experimental group scored significantly better than the control group on all post-test measures compared, confirming the effect of the programme.
6. The gains in neuromuscular efficiency transferred to the match, demonstrating that the training improved not only test performance but actual competitive movement.

**9. Conclusion**

This study set out to examine the influence of an eight-week multidirectional agility training programme on the neuromuscular efficiency and the match performance of university-level team sport athletes. The evidence is clear and consistent. The programme produced significant improvements in the underlying neuromuscular qualities, including

reactive strength, jumping ability and both planned and reactive change-of-direction speed, and these improvements were accompanied by significant gains in match performance, expressed through higher coach ratings and more effective movement during play. The control group, which did not undertake the programme, showed no comparable changes, allowing the benefits to be attributed with confidence to the agility training itself.
The wider significance of these findings lies in the demonstrated transfer from training to competition. It is often assumed that improvements in fitness tests will benefit match performance, but this is not always so, and a method that delivers such transfer is genuinely valuable. The programme used here was structured yet practical, requiring no specialised equipment beyond cones, ladders and space, which makes it well suited to the university setting where resources are often limited but the desire to improve is strong. For coaches of team sport athletes, the integration of progressive multidirectional agility training, advancing from planned drills towards reactive and game-like work, offers an effective and accessible means of developing both the qualities that underpin agility and the on-field performance that ultimately defines success.

## 10. Limitations and Suggestions for Future Research

The study has limitations that should be acknowledged. It involved a modest number of male athletes over a period of eight weeks, so the findings may not extend directly to female athletes, to other age groups or to longer programmes, and the durability of the gains beyond the intervention was not assessed. The match indicators, though objective, were drawn from a limited number of matches, and the performance index relied partly on coach judgement. Future research could include female and mixed samples, extend the programme over a full season, incorporate detailed biomechanical or electromyographic measurement of movement efficiency, and track athletes over time to examine whether the benefits persist. Studies of this kind would build on the present findings and deepen understanding of how agility training shapes the team sport athlete.

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