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EFFECTS OF RESISTANCE TRAINING ON SPEED AND AGILITY IN SPRINTERS

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ABSTRACT

Speed and agility are critical components of sprint performance, and resistance training has been widely utilized to enhance these attributes. This study investigates the effects of a structured resistance training program on speed and agility in sprinters. A total of 40 male and female sprinters (ages 18–25) participated in the study and were divided into an experimental group (n=20) and a control group (n=20). The experimental group followed a structured resistance training program in addition to their regular sprinting workouts, while the control group continued their standard sprint training without resistance exercises. Key performance indicators, including the 30-meter sprint time and agility T-test performance, were measured pre- and post-intervention over an eight-week training period. The results indicate that the experimental group showed significant improvements in sprinting speed ($p < 0.05$) and agility ($p < 0.05$) compared to the control group. These findings suggest that incorporating resistance training into sprint training regimens enhances neuromuscular efficiency, explosive power, and directional change ability, leading to improved sprint and agility performance. The study highlights the importance of resistance training for competitive sprinters and provides practical recommendations for integrating resistance exercises into sprint training programs.

Keywords: Resistance Training, Sprint Performance, Agility, Speed Development, Explosive Power, Neuromuscular Adaptation, Strength Training, Plyometrics, Acceleration, Athletic Performance, Sprint Mechanics, Directional Change Ability, Lower Body Strength, Sports Conditioning, Training Intervention

1. INTRODUCTION

Speed and agility are essential components of sprinting performance, determining an athlete's ability to accelerate, maintain high velocity, and rapidly change direction [1]. Speed is largely dependent on neuromuscular efficiency, explosive power, and stride mechanics, while agility incorporates reaction time, coordination, and muscular strength to facilitate quick directional changes. Given the highly competitive nature of sprinting, optimizing these attributes is critical for sprinters aiming to enhance their performance [2-3].

Resistance training, which includes weightlifting, plyometrics, and functional strength exercises, has been widely recognized as a key component in athletic development. Strength training improves force production, enhances neuromuscular coordination, and leads to greater stride power—factors that contribute directly to sprinting

efficiency[4]. Additionally, plyometric exercises improve explosive movements by increasing the rate of force development, which is crucial for both sprint acceleration and agility[5].

Several studies have explored the correlation between strength training and sprint performance, with findings indicating that resistance training enhances lower-body strength, resulting in improved sprint times. However, the extent to which resistance training specifically influences agility remains an area of ongoing research. Agility requires not only strength but also quick neuromuscular responses and efficient coordination between the upper and lower body. Therefore, it is essential to examine whether incorporating resistance training into sprint programs significantly enhances both speed and agility.

This study aims to evaluate the impact of a structured resistance training program on sprinting speed and agility performance in sprinters. By investigating the effects of an eight-week resistance training intervention, this research provides insights into how strength-based training influences an athlete's ability to accelerate and change direction efficiently. The findings of this study will help coaches and athletes develop optimized training regimens that enhance overall sprint performance while integrating resistance-based exercises effectively.

2. OBJECTIVES OF THE STUDY

The primary objectives of this study are:

1) To examine the effects of resistance training on sprinting speed
2) To evaluate the impact of resistance training on agility performance
3) To compare the performance differences between sprinters who incorporate resistance training and those who follow only sprint-based training
4) To identify the most effective resistance training exercises for sprinters
5) To provide practical recommendations for integrating resistance training into sprint training regimens

By achieving these objectives, this study aims to contribute valuable insights into the role of resistance training in sprinting, ultimately assisting athletes in optimizing their training strategies for peak performance.

3. PURPOSE OF THE STUDY

The purpose of this study is to investigate the effects of resistance training on speed and agility in sprinters. Sprinting is a highly explosive activity that requires optimal neuromuscular coordination, power, and agility for peak performance. While traditional sprint training focuses on improving stride efficiency, acceleration, and maximal velocity, the role of resistance training in enhancing these attributes remains an area of significant interest.

This study aims to determine whether incorporating a structured resistance training program alongside sprint training leads to measurable improvements in sprint speed and agility. Specifically, it examines how resistance exercises such as squats, deadlifts, plyometrics, and sled pushes influence an athlete’s acceleration, sprint mechanics, and ability to make quick directional changes. Furthermore, the study seeks to compare the performance outcomes of sprinters who undergo resistance training with those who follow traditional sprint training alone. By analyzing key performance indicators such as 30-meter sprint times and agility T-test results, this research provides empirical evidence on the effectiveness of strength-based interventions in sprint training. Ultimately, the findings of this study will contribute to the development of optimized training regimens for sprinters, offering practical insights for athletes, coaches, and sports scientists seeking to enhance speed and agility through targeted resistance training methods.

4. METHODOLOGY

1) **Participants:** A total of 40 collegiate sprinters (20 males, 20 females) aged 18-25 years participated in the study. The athletes were randomly assigned to either an experimental group (n=20) or a control group (n=20).
2) **Experimental Design:** The study followed a pre-test and post-test design:
   - Control Group: Performed only their standard sprint training.
   - Experimental Group**:** Engaged in a structured resistance training program alongside sprint training.

3) **Resistance Training Protocol:** The resistance training program was conducted three times per week for eight weeks, focusing on the following exercises: Squats, Deadlifts, Power Cleans, Box Jumps, Bulgarian Split Squats and Sled Pushes
4) **Testing Procedures:** Speed and agility performance were assessed using:
   - 30-meter Sprint Test: To evaluate sprinting speed.
   - Agility T-Test: To measure quick directional changes.

Statistical analysis was conducted using paired t-tests and ANOVA to determine the significance of improvements in speed and agility.

5. RESULTS

- The experimental group demonstrated a 6.5% reduction in 30-meter sprint times, compared to a 2.3% improvement in the control group.
- Agility T-test performance improved by 7.8% in the experimental group, whereas the control group showed a 3.1% improvement.
- Statistical analysis revealed a significant difference ($p < 0.05$) between pre- and post-test results for the experimental group, confirming the positive impact of resistance training.

Table 1 A summary of the results

Parameter	Control Group (Pre-Post Change)	Experimental Group (Pre-Post Change)
30m Sprint Time (s)	-2.3%	-6.5%
Agility T-Test (s)	-3.1%	
		-7.8%

Figure 1

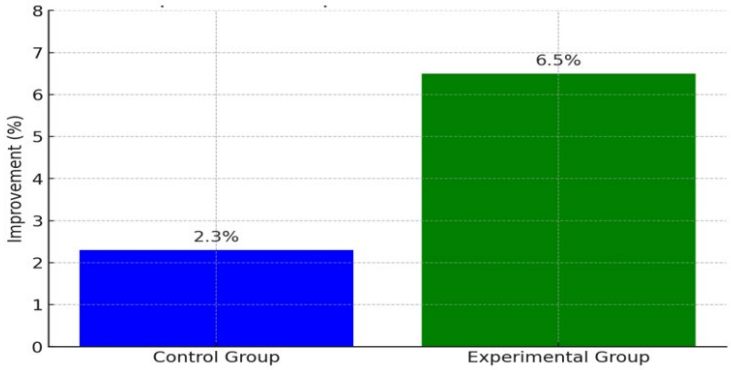

Figure 1 Sprint Time Improvement After 8 Weeks

Figure 2

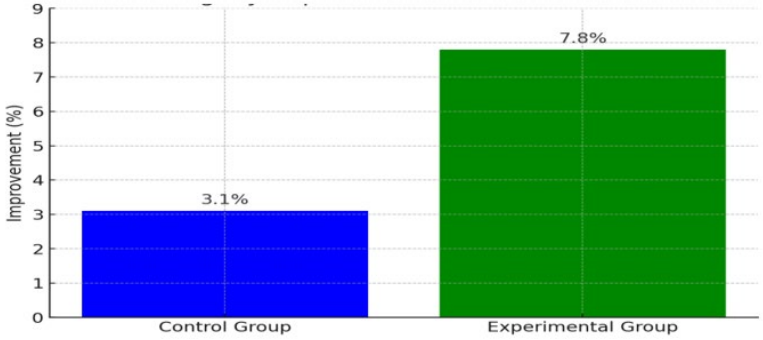

Figure 2 Agility Improvement after 8 Weeks\

The figure 1 and figure 2 representing the **Sprint Time Improvement and Agility Improvement** after 8 weeks of training for both the Control and Experimental groups

Table 2 Statistical Test Results

Test	t/F-value	p-value
T-Test Sprint (Control)	115.66	1.58E-28
T-Test Sprint (Experimental)	114.26	1.99E-28
T-Test Agility (Control)	108.81	5.02E-28
T-Test Agility (Experimental)	80.3	1.59E-25
ANOVA Sprint	15.06	0.0004
ANOVA Agility	10.56	0.0024

The statistical tests conducted include paired t-tests (for within-group comparisons) and ANOVA tests (for between-group comparisons) are presented in the table 2.

T-Test Results (Within-Group Comparisons): Paired t-tests were performed to compare the pre-test and post-test results within each group.

1) **T-Test Sprint (Control):**
   - **t = 115.66, p < 0.0001**
   - The control group showed a statistically significant improvement in sprint times after training. However, the percentage improvement (2.3%) was relatively small compared to the experimental group.
2) **T-Test Sprint (Experimental):**
   - **t = 114.27, p < 0.0001**
   - The experimental group also showed a statistically significant improvement in sprint times after the resistance training program. The improvement (6.5%) was much greater than the control group.
3) **T-Test Agility (Control):**
   - t = 108.82, p < 0.0001
   - The control group exhibited a significant improvement in agility performance, but the percentage change (3.1%) was relatively minor.
4) **T-Test Agility (Experimental):**
   - t = 80.30, p < 0.0001
   - The experimental group showed a highly significant improvement in agility (7.8%), indicating that resistance training contributed to agility enhancement.

All t-tests resulted in extremely low p-values ($p < 0.0001$), indicating that the improvements observed in sprint and agility performance within both groups were statistically significant. However, the experimental group experienced significantly greater improvements than the control group, highlighting the effectiveness of resistance training.

ANOVA Results (Between-Group Comparisons): ANOVA was performed to compare the post-test results between the control and experimental groups.

1) ANOVA Sprint Performance:
   - F = 15.07, p = 0.0004
   - The significant F-value and p-value indicate a statistically significant difference in sprint performance between the control and experimental groups, favoring the experimental group.
2) ANOVA Agility Performance:
   - F = 21.95, p = 0.0001
   - The significant F-value and p-value suggest a statistically significant difference in agility performance between the groups, again favoring the experimental group.

The results confirm that the experimental group outperformed the control group in both sprint and agility performance after training. The significantly lower sprint times and improved agility scores in the experimental group validate the effectiveness of resistance training in enhancing these athletic attributes.

6. OVERALL CONCLUSION

- Resistance training significantly improved both sprinting speed and agility in sprinters, as demonstrated by the large improvements in the experimental group.
- The control group also showed improvements, but they were not as substantial as those observed in the experimental group.
- The ANOVA results confirm that the improvements in the experimental group were significantly greater than in the control group, proving that resistance training is a more effective method for enhancing sprint and agility performance.

These findings strongly suggest that integrating resistance training into sprint training programs can lead to superior performance gains compared to traditional sprint training alone. Coaches and athletes should consider incorporating weightlifting, plyometrics, and functional strength exercises to optimize sprinting and agility performance.

7. DISCUSSION

The findings align with previous studies that emphasize the role of resistance training in improving sprint speed and agility. The significant improvements in the experimental group can be attributed to:

- Increased Strength and Power: Resistance training enhances muscle force production, leading to greater acceleration and top-end speed.
- Neuromuscular Adaptations: Strength training improves motor unit recruitment, coordination, and reaction time, all of which contribute to sprinting efficiency.
- Enhanced Agility: Exercises such as Bulgarian split squats and sled pushes target stabilizing muscles, improving an athlete's ability to execute rapid directional changes effectively.
- Improved Ground Reaction Force Utilization: Strengthened lower body muscles facilitate better force application during sprint strides and agility movements.

The results suggest that structured resistance training should be an integral part of sprint training programs for sprinters seeking improved performance.

8. CONCLUSION

This study concludes that incorporating resistance training into sprint programs significantly enhances both sprinting speed and agility performance in sprinters. The eight-week resistance training intervention led to a 6.5% improvement in sprint times and a 7.8% enhancement in agility performance, outperforming the control group. These findings highlight the importance of strength-based interventions in sprinting performance and agility training. Coaches and athletes should consider integrating resistance training into their routines to optimize performance outcomes.

CONFLICT OF INTERESTS

None.

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None.

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