

# Improving Running Speed and Acceleration with a Resisted Sprint Ergometer

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## **Abstract**

Sprinting speed is considered an important component of performance in many sports. Full speed in sprinting is not obtained until acceleration has taken place for 30-60m. The majority of sprints in most team sports last for less than that distance, making acceleration more important than full speed. Resisted sprinting is a method commonly employed to improve acceleration and speed. High school football players (n=18) participated in this study during the off-season. There was a control group (CNT) and an experimental group (RES) training 2 times per week for 4 weeks on a commercially available resisted sprint ergometer. Subjects were tested pre and post treatment on 9.1m (10 yd.), 36.6m (40 yd.), and 91.4m (100 yd.) sprints as well as agility (AGL) and vertical jump (VJ) tests. The RES group improves significantly in all performance tests; 9.1m ( $0.1 \pm .23$ ), 36.6m ( $0.27 \pm .41$ ), 91.4m ( $0.65 \pm 2.1$ ), VJ ( $1.89 \pm 7.5$ ), and AGL ( $.18 \pm .49$ ). The CNT group showed no significant changes. There was also a significant difference between the changes in performance between the two groups in every test. This protocol using a resisted sprint ergometer improved speed and acceleration in high school athletes in a short time period.

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## **Introduction**

Sprinting speed is considered an important component of performance in many sports including football, soccer, baseball, and basketball (1,5,6,12). Therefore, methods of enhancing sprinting speed are important to coaches and athletes. There are many methods that have been proposed and employed to improve speed and acceleration. Resisted sprinting is a common method with the resistance added through parachutes, towed sleds, elastic tubing, and partner resistance (1,2,6,7,8).

Resistance during sprinting has been proposed to increase force output in the lower extremity, increase stride length, and increase explosiveness during initial strides (2,3,6,7). Another possible benefit of sprinting under resistance is increased kinesthetic feedback, allowing the athlete to better improve technique (7). It has been documented that full speed in sprinting is not obtained until acceleration has taken place for 30-60m (7,8,11). Since the majority of sprints in these sports last for less than this distance acceleration may be considered the more important factor.

A new commercially available sprint ergometer allows for resisted sprint training in an indoor setting. It also allows training variables such as time, distance, speed, load, and power output to be monitored. If effective, this would be a valuable tool for coaches and athletes.

The purpose of this study was to observe the effects of a resisted treadmill ergometer training protocol on speed, acceleration, and other physical performance variables. It was hypothesized that resisted sprint training would have a positive affect on acceleration and speed.

## **Methods**

### ***Experimental Approach***

The study was designed to compare the changes in performance from resisted sprint training using a pretest-posttest, randomized group design. All subjects were chosen from among a single varsity, high school, football team participating in off-season training to account for the affects of football practice and weight training. The subject pool was pre-screened for precluding injury history and training availability. Throughout the 4-week treatment all subjects continued to participate in normal football practice and a standardized weight-training regimen.

During pilot work it was found that subjects using the resisted sprint ergometer required basic sprint technique instruction. If this basic technique instruction were only given to the experimental group, it would be a confounding factor. To mediate this variable, all athletes were given basic technique instruction after the initial testing session. This included basic instructions and demonstrations on arm action, posture, and leg drive.

### ***Subjects***

Eighteen high school males (means  $\pm$  SD age=16.7  $\pm$  1.04 years, height =176.1  $\pm$  6.88 cm, weight = 86.4  $\pm$  20.07 kg.) participated in the study. All subjects and parents provided informed consent after receiving a complete description of the testing and training procedures. Prior to data collection the subject's health history, height, weight, and age were recorded. Subjects who were available to train during the treatment period were placed into a subject pool from which a resisted sprint training (RES) and control (CNT) were randomly selected.

### ***Measures***

A battery of standard field tests were chosen to measure performance changes. These included in order of performance; vertical jump, 9.1m (10yd), 36.6m (40yd) and 91.4m (100yd) sprints, and agility test. Pre and post testing were performed on the same days for both groups in a team setting. All subjects participated in the same warm-up lasting approximately 20 minutes. The warm-up included a general dynamic warm-up followed by specific warm-up of progressive sprints and jumps.

The vertical jump was a standard countermovement jump and reach test using a Vertec. Each subject performed trials until they could no longer jump higher for 3 attempts. The highest jump was used as their score. Sprints were started from a 3 point stance on the subject's volition and timed electronically using infrared gates (Brower Timing Systems) placed at 9.1m, 36.6m and 91.4m from the starting line. Each subject was given 3 trials with the best times for each split being selected as their score. The agility test was the "5-10-5 pro agility shuttle" and it was timed electronically using infrared gates. The subject started at a cone in the middle of 2 cones 10 yds. apart, on their own volition they

**Table 1: Resisted Sprint Training Protocol**

	<b>Exercise</b>	<b>Repetitions</b>	<b>Resistance</b>
<b>Week 1</b>	60 yard build ups	3	
	60 yard build ups	4	2.5%
	In-Outs	4	2.5%
	40 yard Sprints	6	5.0%
<b>Week 2</b>	60 yard build ups	3	
	60 yard build ups	4	5.0%
	In-Outs	4	5.0%
	40 yard Sprints	6	5.0%
<b>Week 3</b>	100 yard build ups	3	
	100 yard build ups	4	5.0%
	In-Outs	4	5.0%
	60 yard Sprints	6	7.5%
<b>Week 4</b>	100 yard build ups	3	
	100 yard build ups	4	5.0%
	In-Outs	6	5.0%
	60 yard Sprints	6	7.5%

sprinted first to the right, touched past the cone with their hand, sprinted to the other cones and touched past it with their left hand, and finished by sprinting past the starting cone.

### ***Design***

Subjects in the experimental group participated in resisted sprint training 2 times per week for 4 weeks. Training was performed on a FORCE treadmill (Woodway USA, Waukesha, WI). This is a non-motorized treadmill on which the athlete propels the belt while tethered from behind. A constant resistive force from 1 – 150 lbs in 1 lb increments can be applied through a braking mechanism.

Each training session lasted approximately 35 minutes consisting of a standard dynamic warm-up, build-up sprints, in-outs, resisted acceleration sprints, and a stretching cool-down (Table 1). Build-ups were a progressive speed run beginning with a slow run and progressing steadily to full speed. In-Outs were designed to alternate un-resisted (UR) and resisted (RS) sprinting in a single effort. The FORCE treadmill was programmed with the selected load in the following pattern: 5 sec.-UR, 3 sec.-R, 3 sec.-UR, 3 sec.-R, 3 sec.-UR, 3 sec.-R. The resisted acceleration sprints were started from a two-point stance at emphasized accelerating through the entire effort.

### ***Statistical Analysis***

Differences between pre and post performance tests and between the observed changes by group were analyzed through a T-test using Statistics Package for Social Services (Version 9.0.)

### ***Limitations***

This study is limited to effects on relatively untrained high school athletes and cannot be extrapolated to older or more advanced athletes. The duration of 4 weeks and 8 training

sessions was also short and may have limited the magnitude of the effects. The intended duration was to be 6 weeks, but was altered after the first week for practical purposes. The CNT group in this study continued regular off-season football participation, but did not have the additional sprint training that the RES group did. This limitation will be addressed in future studies.

## Results

The experimental group demonstrated a statistically significant improvement in all performance tests. The control group showed no significant improvements (Table 2). There was a significant difference in the changes in performance between the groups (Figure 1). There was a greater improvement in the shorter sprint distances (Table 3). When the respective splits were measured instead of absolute times, the improvement differed more between distances with 5.1%, 4.7%, and 3.8% for the 10, 40, and 100-yard sprints respectively.

**Table 2: Pre, Post Test Results**

		PRE					POST				
		10	40	100	CMJ	Pro Agility	10	40	100	CMJ	Pro Agility
RES	Mean	1.98	5.48	15.53	48.11	5.58	1.88**	5.22**	14.87*	50.00*	5.40**
	SD	0.26	0.53	2.44	7.44	0.47	0.23	0.41	2.10	7.55	0.49
CNT	Mean	1.88	5.25	15.00	51.79	5.52	1.86	5.24	14.92	52.14	5.50
	SD	0.31	0.90	2.59	8.21	0.87	0.33	0.90	2.49	7.77	0.87

\* sig., p. < .01

\*\* sig., p. <.001

## Discussion

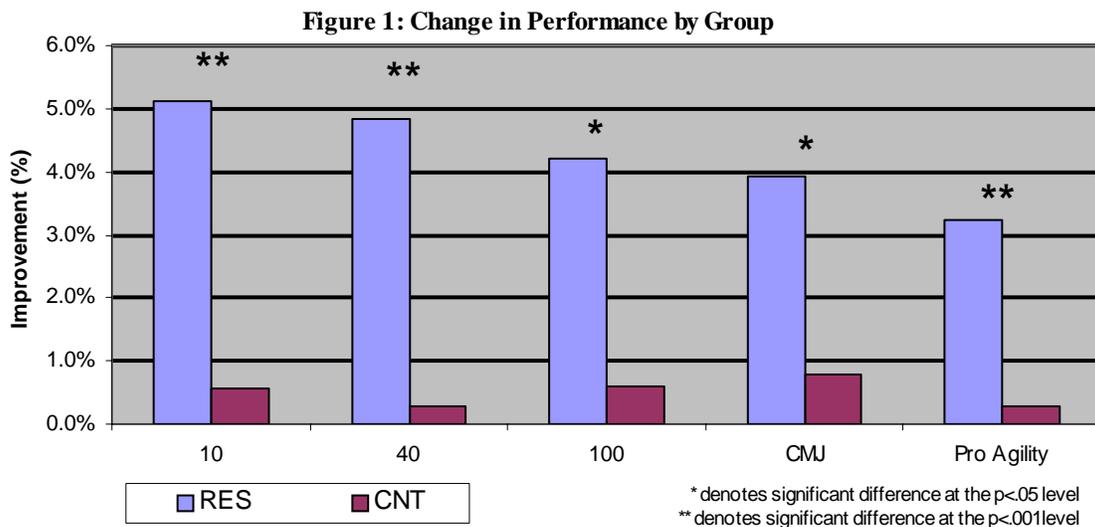
The protocol employed, positively affected sprinting acceleration and speed as hypothesized, as well as agility and vertical jump. The effect was greater for the shorter distances, but it cannot be known whether this was do to the modality of resisted sprinting or the distances used in training.

The improvements occurred during a 4-week treatment period and only 8 training sessions. This is a relatively small volume of training and significant improvements in performance are noteworthy. The shorter training history and level of performance among these high school athletes may have made such improvements in a short time possible. The 2 athletes in the RES group who had times below 5.0 in the 36.6m sprint can be considered above average and still showed improvement of 0.19 and 0.1 seconds. While this change was below the group average it is mildly significant from a performance perspective. It is possible that greater improvements may have been observed in the RES group if a longer duration or higher frequency of training was administered.

Since this study was unable to employ additional strength and power tests or kinematic data, future research will be needed to address what mechanism led to the improvement

in performance. Resisted sprinting is a specific means of strength training. Strength training has been used to improve rate of force development and maximum strength, which are important components of sprint acceleration and speed.

It was hypothesized that the effects from resisted sprinting would be greater for the shorter sprint distances. The results seem to support this since the improvement was greater over the shorter distances. Times improved 5.1%, 4.7%, and 3.8% for the 9.1m, 36.6m, and 91.4m sprints respectively. The magnitude of the load is likely an important factor as several authors have noted that different strength qualities affect different sprint distances (4,13).



## Practical Applications

The idea of resisted sprinting is not new. Many coaches use it as method to improve acceleration technique and to improve driving power. While many methods have been used to create the resistance, the resisted sprint ergometer is closest to a weighted sled in its design.

There are conflicting opinions on the right amount of resistance to use during resisted sprints. Coaches have quoted from 5% - 20% depending on the goal of training. For speed development 5% - 10% are more common. This study used a relatively low load and still produced significant improvements over all distances.

Since acceleration is an important aspect of many team sports and occurs many times during competition, any effective and efficient method of improving acceleration is valuable for coaches and athletes. This resisted sprint ergometer appears to be an effective means. It also has several benefits when compared to traditional methods of resisted sprinting. It can be used in a small space indoors and can measure important training variables. Precise measurement of resistive loads and feedback on performance through times, distances and power output may enhance its effectiveness. Being indoors and stationary can allow a coach to view sprinting technique at a perpendicular angle and give technique cues constantly.

## Applied Performance Research

Several important questions need to be answered in future research including optimal loads and applicability with more advanced athletes. In relatively untrained populations, comparisons with sprint technique training and strength training may be helpful. Additional studies should also address kinetic, kinematic, and physiological changes after resisted sprint training.

### References

1. Arthur, M. and B. Bailey. Complete conditioning for football. Champaign, IL: Human Kinetics, 1998.
2. Costello, F. Training for speed using resisted and assisted methods. *NSCA J.* 7:74-75. 1985.
3. Delecluse, C. Influence of strength training on sprinting performance: Current findings and implications for training. *Sports Med.* 24:147-156. 1997.
4. Delecluse, C. et. al. Influence of high-resistance and high-velocity training on sprint performance. *Med. Sci. Sports Exer.* 27:1203-1209. 1995.
5. Kirkendall, D. The Nature of the Game. In: *Proceedings of 2002 International Football & Sports Medicine Conference*, American Orthopedic Society for Sports Medicine. 2002, Beverly Hills, CA, USA
6. Klinzing, J. Improving sprint speed for all athletes. *NSCA J.*, 6:32-33, 1984.
7. Korchemny, R. A new concept for sprint start and acceleration training. *N. Stud. Athlet.* 7:65-72, 1992.
8. Mann, R. Speed development. *NSCA J.*, 6:12-20, 1984.
9. Mcfarlane, B. Speed...A basic and advanced technical model. *TAC Track and Field Coaching Manual, 2nd Edition*, TAC Development Committee. Champaign, IL: Leisure Press, 1989. pp 14-19.
10. Mero, A., P.V. Komi , H. Rusko, and J. Hirvonen. Neuromuscular and anaerobic performance of sprinters at maximal and supramaximal speed. *Int. J. Sport Biomech.* 8:55-60. 1987.
11. Mero, A., P.V. Komi , and R. Gregor. Biomechanics of sprint running. *Sports Med.* 6:376-392. 1992.
12. Plisk, S.S. Needs Analysis. In: *Training for Speed, Agility and Quickness*, Brown, L.E., V.A Ferrigno and J.C. Santana, ed. Champaign, IL: Human Kinetics, 2000. pp 6-16.
13. Young, W., B. McLean and J. Ardagna. Relationship between strength qualities and sprinting performance. *J Sports Med. Phys. Fit.* 35:13-9. 1995.

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