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# Comparison Of The Effectiveness Of Treadmill Vs. Overground Sprint Training

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COMPARISON OF THE EFFECTIVENESS OF TREADMILL VS. OVERGROUND  
SPRINT TRAINING

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Master's Program in Kinesiology

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2016

SPRINT PERFORMANCE: TRAINING METHOD AND PRACTICAL APPLICATIONS

By

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THESIS

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## **Abstract**

Sprint performance is a critical factor in a vast majority of athletic events. Sprint performance is characterized by an athletes' ability to sprint at maximal speeds. Sprint performance has recently been evaluated using various methodological approaches. Research has investigated sprint performance overground as well as with the use of motorized and non-motorized (torque) treadmills. Recently, treadmill research has focused on the non-motorized treadmill. However, the effects of sprint training on a motorized treadmill are still not fully understood. Therefore, the purpose of the proposed research is to investigate: 1) changes in sprint performance between experimental groups; 2) sprint training methods; and 3) determine if treadmill sprinting is replicative of overground sprinting following a 6-week intervention.

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## **Chapter 1: Introduction**

### **An Introduction to Sprint Training**

Most team and individual sports require explosive movements such as jumping, kicking, and sprinting, which all rely heavily on leg muscular power. Being able to rapidly move the body from one location to another is a critical factor in the realm of sports. Recently, coaches and researchers have been investigating optimal training methods to better improve sprint performance. Sprint performance (SP) can be defined as the execution of rapid cyclical movements at top speed in a short period of time. Furthermore, SP can be determined by the muscles' speed of contraction during locomotion. Speed of contraction is influenced by the biochemical and architectural structures of skeletal muscle (Kumagai et al, 2000; Mero, Komi, & Gregor, 1992). Changes in these properties are believed to be directly related to motor recruitment patterns that occur during specific types of training (Abe, Brown, & Brechue, 1999). Specifically, SP can be improved by increasing motor neuron excitability (Ross, Leveritt, & Riek, 2001). Furthermore, previous research has found that high levels of neural activation are required to perform maximal intensity sprint exercises (Johnagen, Ericson, Nemeth, & Eriksson, 1996).

There are many training modalities that cause specific training adaptations to occur, depending on the desired sport's requirements. Therefore, it is important that the training modalities being used are efficiently and effectively improving athletic performance (Hrysomallis, 2012). Sprinting can be described as the fastest natural form of human movement and be used to assess athletic ability (Nesser, Latin, Berg, & Prentice, 1996). Sprinting can occur in multiple forms such as from a static start position as seen in track and field, and when in motion as seen in soccer, rugby, football, and other field sports (Vescovi, & McGuigan, 2007).

Sprint performance is of great importance in field sports as well as track and field. An athlete's SP can determine whether the athlete will compete at the professional level or third division level. Baker and Newton (2008) stated that SP is a critical factor in all sports and that professional athletes tend to be faster than most amateur athletes. Furthermore, measures of SP are used by coaches to identify an athlete's athletic ability. This can be seen in football, determining athletic ability with the 40 yard dash. Coaches believe that testing an athlete's ability to run and jump will be representative of their playing potential (Garstecki, Latin, & Cuppett, 2004).

### **Methodologies of Sprint Training**

Since sprinting is such an important factor for success in many sports that it would be beneficial to employ a regular sprint training regimen for athletes. Two common practices of sprint training are assisted and resisted sprints. Due to speed being considered as the product of stride length and stride frequency, it is believed that improving one or both will result in an improved running speed (Cissik, 2005). Assisted sprints are a common practice amongst coaches to improve athletes' speed by increasing their stride frequency. The main concept of assisted sprinting is to improve foot speed, causing decrease in ground contact time, and an increase in stride frequency that will transfer to non-assisted sprints (Cissik, 2005). Assisted sprinting is executed when the athlete runs while being pulled along by an external device. This type of training can also be executed by enabling the athlete to run at a faster speed by having them run down a declined surface. Assisted sprint training is also referred to as tow training, over speed training, and supramaximal sprint training (Corn & Knudson, 2003). Previous research conducted by Corn and Knudson (2003) examined the kinematics during the acceleration phase of sprinting in free and assisted sprint conditions. They found that performing assisted sprints

with an elastic resistance cord during the acceleration phase of sprinting resulted in an exaggerated stride (increased stride length and increased horizontal distance); however, this method did not increase the stride frequency during the acceleration phase of sprinting.

Resisted sprint training is another form of sprint training that is widely used to improve acceleration and velocity (Upton, 2011). Resisted sprint training makes the movement more difficult to complete. By making the movement more difficult, it is believed that this method will result in the recruitment of more muscle fibers and will require greater neural activation. Furthermore, it is believed that, overtime, the increased motor unit recruitment and neural activation will improve non-resisted sprints and overall sprint speed (Cissik, 2005). Resisted sprinting is executed when an athlete runs against an external force of resistance, often in the form of a weighted object in front of the athlete or by adding an external pulling force behind the athlete. This resistance can take the form of a sled, tire, weighted vest, parachute, or running up hill. This form of training is used to improve athletic performance and enhance power by executing a movement specific to the sport with an added resistance that is not excessive or does not significantly affect the athletes' movement pattern (Hrysomallis, 2012). A study conducted by LeBlanc and Gervais (2004) stated that the use of lighter resistive loads during resisted sprint training could alter sprint kinematics and coordination of muscular activity. Furthermore, resisted sprinting was found to be similar to the acceleration phase of sprinting but not identical, although it is a well-used method to improve an athlete's acceleration and SP. The change in the rate of velocity is defined as the ability to accelerate and is more vital to the end result of a performance than maximal velocity. Upton (2011) stated that the rate of change in velocity (acceleration) is measureable within 5 to 15 yards of a sprint and that velocity is better demonstrated over longer distances such as that of 40 yards.

## **Resistance Training and Sprint Performance**

The use of traditional resistance training is further believed to improve sprint training. Spinks, Murphy, Spinks, and Lockie (2007) stated that increases in muscular strength allow for a greater force development and a decreased ground contact time, resulting in an increased stride frequency. Numerous training modalities such as sprint loading have been used by coaches and trainers to improve athletes' muscular force outputs. Performing traditional resistance training exercises in slow fashion with a heavy amount of resistance is optimal for strength improvements but may not be well suited for power. Power development requires higher velocities throughout the movement (faster rate of force development). Providing resistance during the execution of a sport specific movement may result in improved motor unit recruitment patterns and maximize training adaptations. It's believed the training adaptations will directly crossover to athletic performance (Hrysomallis, 2012).

## **Sprint Training Accessibility**

Sprint training can be executed in both indoor and outdoor environments. While the outdoor environment is most commonly used, it has its drawbacks (weather and turf conditions, access, availability, etc.). Indoor sprint training, therefore, is beneficial to those with access to an indoor track or training facility. However, to those without access to an indoor training facility, treadmill sprinting could possibly be used as an alternative. Previous research has found conflicting evidence when considering athletes' SP overground (on the field) versus on the treadmill. While contradictory, the comparison of athletes' sprint characteristics on treadmill vs. overground appears to be well researched. However, the relevant literature is currently lacking any experimental studies that aim to investigate the effects of sprint training between the two conditions. To date, no study investigated athletes' response to treadmill sprint training

compared to an overground training program over a period of time, thus the applicability of treadmill training is not fully understood. However, research on treadmill sprinting has been abundant and has provided both conflicting evidence but also some consistent evidence, such as the treadmills ability to aid in stride frequency and alter running kinematics. Aside from the numerous treadmill research that has been done there is still a lack of knowledge about its training applicability and its effectiveness against the traditional overground training. Treadmill research has been investigated through the use of both motorized and non-motorized (torque) treadmills and recently more treadmill research is focusing on the non-motorized treadmill, although the effects of sprint training on a motorized treadmill are still not fully understood. Currently, it seems there is a gap within the literature as there have been no experimental studies that have attempted to directly compare the effectiveness of the treadmill vs. the overground training method.

The purpose of the proposed research was to investigate changes in SP (maximum sprinting speed) following a 6-week sprint training intervention either overground or on a treadmill. The primary goal of the proposed research was to quantify the relationship between sprint training method and SP and to explore whether sprint training on a treadmill can produce similar training adaptations to that of overground sprint training. To accomplish the goals of this proposed study, we measured sprint speed pre- and post-training to determine whether sprint training on the treadmill is similarly effective as overground sprinting.



## **Chapter 2: Literature Review**

Sprint performance is critical to athletic success in sports requiring stop and go sprinting as seen in football, soccer, baseball, basketball, and tennis; as well as that of sprinting from an initial static start position as seen in track and field sprinting (Bret, Rahmani, Dufour, Messonnier, & Lacour, 2002). Often, amongst coaches, SP is used as a predictor of power and athletic ability. Sprint performance is believed to be directly related to the sprinter being effective during the three phases of sprinting: a) acceleration phase; b) maintenance of maximal velocity phase; and c) the deceleration phase. Previous research has found that the faster an athlete is sprinting 10 m, the faster they will be at 40 m. This demonstrates the importance of a quick start and rapid acceleration to better improve SP. Furthermore, maintaining maximal sprint speed once attained has been found to result in faster 40 m sprint times (Nesser, Latin, Berg, & Prentice, 1996). Although SP amongst various sports looks different, all sprinting types involve the three phases. The three phases occur differently in field sports as one may be running and rapidly accelerate to maximal sprint speed, or accelerate to maximal sprint speed from a static position as seen in track and field sprinting. Unlike field sport sprinting, track and field sprinting begins from a static start position and the three phases of acceleration, maximum velocity and deceleration are more easily observed (Bret et al., 2002).

### **Phases of Sprinting**

#### **Acceleration.**

Success in sprinting is highly dependent on initially performing a fast start and then achieving and maintaining the fastest possible running speed. The initial phase of acceleration (early acceleration phase) usually occurs within the first 10 m of a sprint (Johnson & Buckley, 2001). This can be seen once the athlete engages in locomotion from a fixed static position to

their initial movement. Once the athlete begins to accelerate both stride length and stride frequency increase. Stride length is simply the distance covered between each consecutive stride, while stride frequency is determined by the frequency of foot to ground contact (Corn & Knudson, 2003; Weynad, Sternlight, Bellizzi, & Wright, 2000). Sprint performance can be determined by the interaction between these two factors. During the first few strides the body's center of gravity (COG) changes in regards to initial ground contact. During the early acceleration phase the body's COG is positioned slightly ahead of the first few ground contact phases. As the acceleration phase progresses to the second phase or late acceleration phase, usually between 10-36 m the body's COG gradually begins to shift behind the ground contact point (Johnson & Buckley, 2001). This initial motion can be considered a ballistic mode of locomotion due to the alternating flight and support phases that occur during acceleration and throughout the sprinting action. The flight phase of sprinting includes recovery and ground preparation. The support phase of sprinting includes eccentric braking and concentric propulsion. These alternating phases are composed of a series of running strides that continuously launch an athlete's body as a projectile in a forward direction at maximal acceleration and maximal velocity. Furthermore, an athlete's ability to accelerate is primarily dependent on their ankle, knee, and hip extensors (Schot & Knutzen, 1992; Spinks, Murphey, Spinks, & Lockie, 2007). Furthermore, the start of the sprint and the acceleration phase are believed to be directly related to the end result of SP. Technique during the acceleration phase is critical as it will determine the efficiency of the sprinters stride length and stride frequency. Komi (1984) stated that force production is increased at sprint start when body mass is centered on the legs rather than the arms. Centering the body mass on the legs allows for an increased pretension of the leg muscles prior to sprint start (Komi, 1984).

### **Maintenance of maximal velocity.**

The maintenance of maximal velocity (the maximum speed maintenance phase) can be maximal or supramaximal and typically occurs between 36-100 m when executing a 100 m sprint (Johnson & Buckley, 2001). The athlete maintains their speed at this point during the sprint. This portion of the sprint phase is determined by running velocity. Running velocity is determined by the athletes stride length and stride frequency (Mero, Komi, & Gregor, 1992). During the initial part of the maintenance phase both stride length and stride frequency increase. The increases seen in stride length and stride frequency have been noted for speeds up to 7 m/sec. At faster speeds there are smaller increases in stride length; however, stride frequency continues to increase with increasing velocity. Therefore, at high speed, runners can maintain or increase their speed by increasing their stride frequency. Furthermore, Markovic, Jukic, Milanovic, and Metikos (2007) stated that the maintenance of maximal velocity is highly dependent on the forward propulsion created by the hip and ankle extensors. During maximal speed sprinting the time before and after the braking phase are crucial to increasing the amount of force/power created during the propulsive phase.

### **Deceleration.**

The deceleration phase occurs toward the end of a race. During deceleration as the athlete begins to slow down, there is a decrease in stride frequency and an increased stride length. Both ground contact time and flight time increase due to the loss of vertical descent of the body's COG and an increase in horizontal braking forces (Mero, Komi, & Gregor, 1992). Furthermore, previous research conducted by Mero, Komi, and Gregor (1992) concluded that SP is further influenced by reaction time, technique, force production, neural factors, and the architectural structure of skeletal muscle.

## **Factors that Influence Sprint Performance**

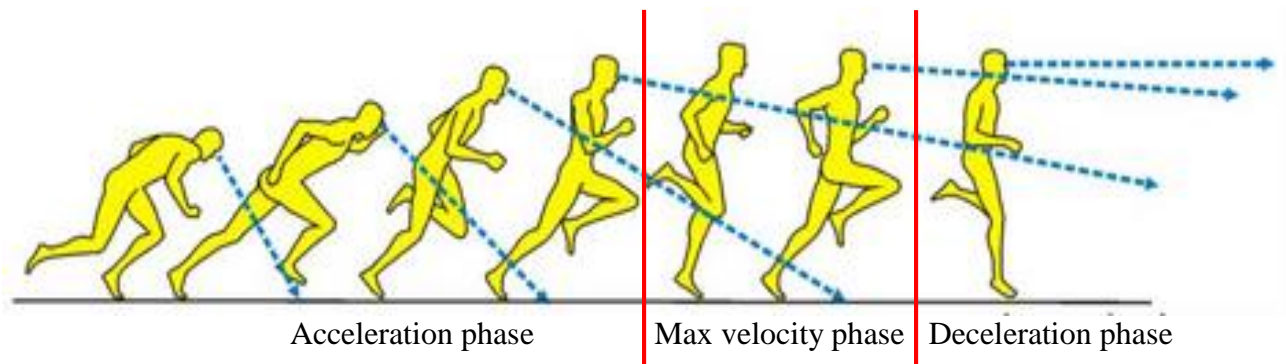
### **Reaction time.**

Reaction time is determined by the time it takes the athlete to respond to an external stimulus such as a verbal command or auditory signal. Skeletal muscle force production occurs when the stimulus is received by the athlete, resulting in bipedal ballistic locomotion. The faster the electrical activity begins in every muscle the faster the athlete is able to maximize neuromuscular performance. Previous research has found that in all sprinting events, reaction times are less than 200msec in professional athletes (Mero, Komi, & Gregor, 1992). Mero, Komi, and Gregor (1992) stated women have slower reaction times compared to men competing in identical events. Although women were found to have slower reaction times than men, previous research has found no correlation between reaction time and SP. Therefore, a faster reaction time does not result in a faster sprint time. Although latent reaction time does not significantly affect SP, sprint start reaction time does. This is the period in which pretension in the muscle occurs and the athlete has to generate a maximal amount of force in the shortest time possible (Coh, Jost, Skof, Tomazin, & Dolenec, 1998). Mero, Komi, and Gregor (1992) believed that other parameters such as acceleration and maximum speed are more important to improving SP rather than reaction time.

### **Technique.**

Technique is a crucial factor for success during the acceleration and maintenance of maximal velocity phases of sprinting. Ground contact time has been reported to decrease significantly as running velocity increases. This demonstrates how important it is for the sprinter to increase their flight time during SP. Furthermore, contact time can be shortened when engaged

in supramaximal sprinting. Mero, Komi, and Gregor (1992) suggested that velocity at toe-off was greater than that at touchdown when running velocity was increased. An increased velocity at toe-off aids in propelling the body forward to increase the stride frequency. However, during deceleration, there is a decrease in stride frequency but an increase in stride length. The three phases of sprint performance can be seen in the figure below.



### **Force production.**

Force production throughout SP can be similar in regards to the braking and propulsion phases. During the acceleration phase of sprinting the average braking forces tend to be smaller than the propulsive forces in both the horizontal and vertical direction. Initial braking forces in both the horizontal direction (-153 N) and vertical direction (148 N) tend to be very small. However, the forces created during the propulsive phases tend to be larger (526 N and 431 N) than that of the initial braking forces (Mero, Komi, & Gregor, 1992). Harland and Steele (1997) stated that amongst sprinters, advanced sprinters are able to generate greater impulses in the horizontal direction (236 N·sec) than novice sprinters (214 N·sec). During the maintenance of maximal velocity there are increases in force production that occurs in both the horizontal and vertical direction. Increases in force production further occur with increased running speeds (Mero & Komi, 1986). Peak forces are believed to be highest during supramaximal sprinting.

### **Architectural structure of skeletal muscle.**

Sprint performance can be determined by the speed of contraction (shortening velocity) of the muscles that initiate locomotion. Muscle shortening velocity is influenced by biochemical and architectural structures of skeletal muscle (Kumagai et al., 2000). Although both biochemical (myosin ATPase activity) and architectural (fiber length; number of sarcomeres) structures influence muscle shortening velocity, it is believed that differences in fiber length is the primary determining factor of muscle shortening velocity. Abe, Kumagai, and Brechu (1999) found that elite sprinters had longer fascicle lengths and lesser pennation angles when compared to distance and marathon runners. Muscle fascicle length may be an important determinant of sprint performance. A previous study conducted by Kumagai et al. (2000) reported that muscle fascicle length of locomotor muscles (vastus lateralis, gastrocnemius medialis, and lateralis muscles) were significantly greater in that of elite sprinters than elite distance runners. Longer fascicle length results in a greater maximal shortening velocity, which results in an improved power output and SP. Muscle shape, like fascicle length is also believed to be associated with sprint performance. Abe, Brown, and Brechue (1999) found that black football players had faster 40 yard dash times compared to white football players. This was believed to be due to a greater muscle thickness in the upper portion of the quadriceps muscle. Sprinters have been found to have greater muscle thickness in the upper portion of the quadriceps compared to distance runners and untrained controls. Abe, Brown and Brechue (1999) further found that even among sprinters muscle thickness of the upper thigh was greater in the best sprinters compared with other trained sprinters. Fascicle length and muscle shape are important variables in determining sprint performance. Fascicle length and muscle thickness are believed to be improved as adaptations to sprint training (Abe, Brown, & Brechue, 1999). Increases in muscle thickness

appear to be related to specific motor unit recruitment patterns that occur during specific types of training.

### **Neural factors.**

Sprint performance can be improved by performing sprint specific movements resulting in more efficient motor unit recruitment patterns. It is believed that neural adaptations can occur after sprint training is conducted. Ross, Leveritt, and Riek (2001) suggested that SP is improved through neural adaptations such as the temporal sequencing of muscle activation to aid in the development of more efficient movements. An increased ability to maintain muscle recruitment is believed to be a result of the increased rate of muscle innervation by neural factors. This also suggests that an increased motor unit firing rate promotes greater force production. Therefore, it has been suggested that increases in motor unit recruitment would be expected to improve SP. A study conducted by Johnagen, Ericson, Nemeth, and Eriksson (1996) found that high levels of neural activation are required to perform maximal intensity sprint exercises. This finding further supports the influence that neural adaptations have on SP.

### **Biomechanics of Sprinting**

Sprinting technique can determine the ability to accelerate to a maximal running speed as quickly as possible. Step length, frequency, and flight time are kinematic variables that affect sprint speed. The kinetics produced when an athlete is in contact with the ground (stance) will also influence sprint speed. Previous research has indicated that many training protocols have placed great emphasis on enhancing an athlete's step kinematics and stance kinetics to improve sprint speed (Lockie, Murphy, Callaghan, & Jeffriess, 2014). Lockie et al. (2014) stated that properly structured sprint training was found to improve sprint performance for both 10 m and 15 m distances. Properly structured sprint training is believed to improve sprinting kinematics

such as increased stride length and a decreased ground contact time. Weyand, Sternlight, Bellizzi, and Wright (2000) found that sprint performance was improved by the ability to generate greater ground reaction forces (GRF). Previous research has found that the biomechanics of sprint acceleration and maximum speed sprinting may differ. Sprints conducted over short distances emphasize acceleration, resulting in a greater leaning of the trunk and a greater posterior foot plant. The biomechanics of sprint acceleration has been shown to greatly influence horizontal force development (Lockie et al., 2014).

Previous research has found both vertical and horizontal ground reaction forces to be vital in sprint performance. Lockie and colleagues (2014) examined the effects of sprinting and plyometric training on field sport acceleration technique. In contrast to the horizontal force development during sprinting, they found that the main adaptations that resulted from sprint training were an increase in step length and a greater emphasis on vertical force production during earlier and later phases of acceleration.

### **Training Method**

To date, two very different training methods are used to improve SP, both of which are designed to improve acceleration and maximum sprint speed. These two commonly used speed training methods are overground sprint training and sprint training conducted with the use of a treadmill. Both methods of training are believed to bring about training adaptations to stride length, stride frequency, acceleration, and maximal sprint speed (Myer, Ford, Brent, Divine, & Hewett, 2007). To improve maximal speed, sprint training must elicit neuromuscular adaptations that result in the increase of stride length or stride frequency.



### **Treadmill sprinting.**

Treadmill sprinting can be described as a form of assisted sprinting. This is because the treadmill belt can be adjusted to a speed greater than the speed attainable by the athlete. Previous research has believed that the sprint kinematics of treadmill sprinting are very similar to that of overground sprinting (Behrens & Simonson, 2011). Furthermore, increases in lower extremity muscle activation have been recorded during inclined treadmill sprinting. Increasing the incline during treadmill sprinting places a greater mechanical load on the hamstrings and produces increases in joint angular velocities. Faccioni (1994) suggested that over-speed training conducted on a treadmill primarily affects the hamstrings muscle group. This is further shown by Swanson and Caldwell (2000) who found that inclined treadmill sprinting resulted in stride frequency training adaptations. This was believed to be due to a heavy reliance on lower extremity muscle activation and an increase in joint angular velocities. However, amongst treadmill studies there have been many contradicting findings within the literature. Nelson et al. (1971) found treadmill sprinting resulted in a decreased stride frequency with an increased support phase. However, Elliot and Blanksby (1976) reported treadmill sprinting to result in an increased stride frequency as a result of a decreased non-support phase.

### **Overground sprinting.**

During overground sprinting, speed constantly changes due to the amount of force applied onto the supporting ground. Morin and Seve (2011) suggested that this would be an important factor when comparing sprint speed overground compared to on a treadmill. Furthermore, McKenna and Riches (2007) suggested that overground sprinting results in shorter ground contact phases. This decrease in ground contact time is seen at faster sprint speeds and is believed to be due to the anterior trunk tilt seen in overground sprinting. This anterior trunk tilt

causes the foot to be behind the center of mass at foot strike and rapidly propel the body forward. Furthermore, Frishberg (1982) suggested that overground sprinting results in a greater energy expenditure due to a greater workload placed on the hip musculature during sprinting.

### **Treadmill sprinting vs. over ground sprinting.**

Previous researchers have found running mechanics to be similar between overground running and treadmill running at low speeds. However multiple studies have found significant differences between overground running and treadmill running. Morin and Seve (2011) stated that when primarily focusing on SP overground sprints and treadmill sprints showed significant biomechanical differences. The biomechanical differences were identified by Kivi, Maraj, and Gervais (2002) who found that stride frequency increased as a result of decreased stance and flight phases seen with increased treadmill speed. Furthermore, it was suggested that training near maximal velocity on a treadmill results in an increased hip extension angular velocity. It was concluded that treadmill sprinting conducted at increasing velocities causes the sprinter to become less consistent in the angular position of the hip at higher speeds (Kivi, Maraj, & Gervais, 2002). McKenna and Riches (2007) stated that conventional motor driven treadmills allow an athlete to attain the same velocity as overground sprinting during the constant velocity phase, but have been found to result in different sprinting kinematics. The kinematic differences can be explained by the differences in sprint acceleration between overground sprinting and sprinting on a conventional motor driven treadmill. McKenna and Riches (2007) suggested that the conventional motor driven treadmill does not allow the subject to have control over sprint acceleration, but that the belt controls the sprint acceleration of the subject. A similar finding was also established by Frishberg (1983) who conducted an analysis of overground and treadmill sprinting. Frishberg (1983) suggested that sprint acceleration between the two conditions was

significantly different due to the lack of rapid acceleration within the treadmill condition. Furthermore, Morin and Seve (2011) found that sprinting on a conventional motor driven treadmill does not reproduce free sprinting as compared to overground sprinting. During overground sprinting, sprint speed constantly changes as a function of the force being applied to the ground throughout the duration of the sprint, which is not seen in treadmill sprinting. Morin and Seve (2011) concluded that SP was lower on a treadmill compared to overground SP after performing a single 100-m sprint. According to Morin and Seve (2011) treadmill SP was found to be significantly slower than overground sprinting by 20% due to force production differences between the two conditions. Although, treadmill SP was found not to be equal to overground SP, it was found to correlate significantly with it.

A study conducted by Botwell, Tan, and Wilson (2009) found that treadmill sprinting allowed for greater sprint repetition without a noticeable change in performance. Treadmill sprinting resulted in less fatigue compared to overground sprinting. This is believed to be due to a lower net external work required by the treadmill. Bowtell et al. (2009) noted that subjects were reaching speeds on the treadmill that they have never experienced during overground sprinting. Greater speeds attained during treadmill sprinting are believed to be due to decreased metabolic demand at the acceleration phase, resulting in less fatigue throughout the sprint. Bowtell et al. (2009) found that no net mechanical work is required on the center of mass during acceleration on a treadmill. The mean kinetic energy of the center of mass remains around zero, resulting in reduced fatigue. According to Bowtell et al. (2009) overground sprinting results in an increased rate of fatigue compared to treadmill sprinting, as well as a decline in muscle power within three seconds. Wind resistance or aerodynamic drag during overground sprinting is further believed to cause a decrease in power and promote increased fatigue (Weyand, Sternlight,

Bellizzi, & Wright, 2000). Furthermore, repeated bouts of overground sprinting are believed to result in greater fatigue compared to that of treadmill sprinting due to an increased metabolic demand (Bowtell, Tan, and Wilson, 2009). Similar findings were reported by Frishberg (1983) who suggested that treadmill sprinting is not as physiologically demanding as overground sprinting and will not result in the same physiological adaptations that can be attainable with overground sprinting. The lesser energy requirements of the treadmill are believed to be due to the treadmill belt. The moving belt aids in propelling the body forward by moving the supporting foot backward promoting a greater range of angular motion displayed by the legs and thighs during the support phase. This is believed to lessen the workload of the hip musculature, allowing for less energy expenditure during treadmill sprinting (Frishberg, 1983).

The number of sprint repetitions has further been identified as a factor resulting in fatigue. Bowtell et al. (2009) investigated the consistency of maximum running speed measurements on treadmills and suggested that there is no advantage to performing more than 5 to 7 overground sprints in one training session. However, they found that treadmill sprinting allows for a greater number of sprints and can be performed without a noticeable decrease in speed. Brown (2002) suggested treadmill sprinting does not show a noticeable decrease in speed because the treadmill will not stop, suggesting the athlete is forced to perform maximally or supramaximally and to maintain power output levels.

## **Hypothesis**

A study conducted by Markovic et al. (2007) suggested that SP in response to sprint training has been neglected within sports science literature, and reported that only a few studies showed improvements in SP as a result of short-term sprint training. However, there is a lack of evidence that SP is improved by neural or muscular adaptations. Therefore, it is hypothesized

that implementing a six week sprint training intervention would be filling this gap in the literature. We believe, based off the literature presented, that it would be beneficial to add the use of a high speed treadmill allowing the athlete to sprint at supramaximal speeds. Furthermore, based off the presented literature, it is our belief that supramaximal sprint speeds may result in greater neural adaptations, in essence greater stride frequency. As such, treadmill sprints may have a superiority over the overground sprints from the neural adaption perspective, while they may be inferior from the force production perspective.

## **Chapter 3: Methods**

### **Approach to the Problem**

Recreationally active college-aged men and women were recruited to participate in this study. All subjects first performed an initial overground (on the track) 50-yard maximal sprint time familiarization sprint test. After performing the initial familiarization sprint test, subjects underwent a 1-week sprint skill/technique familiarization period. After performing the 1-week sprint skill/technique familiarization period, subjects performed another 50-yard maximal sprint time test as well as a maximal sprint speed treadmill pre-test. The faster time between the familiarization test and the pre-test for the 50-yard maximal sprint time test was utilized as the baseline data or the true pre-test.

After completing the pre-test, subjects were randomly assigned to either the overground (track) sprint training (TR) group, or the treadmill sprint training (TM) group. Subjects from both training groups were asked to attend two sprint training sessions every week for 6 weeks. During that time, the subjects performed training specific to their group. The TR group performed their sprint training exclusively on the university's track, and the TM group performed their sprint training exclusively in the Exercise Science Laboratory.

Data collected from the TR and TM training groups was compared on the basis of sprint performance. Assessment data from the TR and TM groups were further analyzed to determine if there was a correlation between maximal sprint speed and training modalities (treadmill versus overground).

## **Subjects**

One-hundred and twenty recreationally-active college-aged (18-30 years of age) males and females were recruited for this study. The potential subjects were selected from the general student population at the University of Texas at El Paso.

Inclusion criteria for the subjects included: 1) that they were free from any underlining medical health conditions (spine deformities, impaired gait, restricted range of motion, heart conditions, musculoskeletal deformations, etc.); 2) had not attained any serious injuries within the past two years (injured ankle, leg, foot, back, head injury, or chronic condition); 3) were recreationally active, at least 2-3 times a week with no physical disability and 4) had to have been between the ages of 18 and 30 years of age. The participants had to have been engaged in activities that were representative of a running motion. Activities such as recreational sports (soccer, basketball, baseball, softball, volleyball, flag football, handball, and racket-ball) or training (running, plyometrics, agility drills, or high intensity interval conditioning) that involved a similar movement patterns to sprinting were acceptable weekly activities for study participation.

Exclusion criteria for the subjects in each group included: 1) chronic medical condition or had been recently diagnosed with medical condition (spine deformities, impaired gait, restricted range of motion, heart conditions, musculoskeletal deformations, etc.); 2) if they sustained any injury within the past two years (broken bones, surgery, injured ankle, leg, foot, back, head injury, or chronic condition, etc.); 3) if they were not recreationally active for at least 2-3 days a week (did not engage in recreational sports such as basketball, soccer, softball, or regular training to include resistance training, swimming, running, cycling, etc.), and 4) were not within the 18-30 year age range.

### **Preparation for recruitment.**

The researcher had already obtained an IRB approval from the University of Texas at El Paso's IRB committee for this study. The approved IRB was amended with the proposed new study methodology. After attaining the IRB approval the researcher met with the Kinesiology departmental professors to speak with their students and informed them of the proposed study. An informed consent form outlining the purpose and details of the proposed study was provided to those students who were interested in participating. Due to the Kinesiology departments enrollment of nearly 1,000 students the researcher had no problem recruiting 120 subjects.

### **Procedures**

#### **Data collection.**

Recruited Subjects first reported to the Fitness Research Facility and were asked to sign a conformed consent and complete a survey on their training history. Subjects then underwent anthropometric measurements of height and weight and performed an initial test for their SP. Collected data included measurements of 50-yard maximal sprint time testing at familiarization test on the track as well as maximal sprint time and maximal sprint speed pre- and post-testing under both track and treadmill conditions (total of 3 time points).

#### **History of physical activity.**

Physically activity was assessed in the form of a questionnaire. The questionnaire determined how active all subjects were before the study. Subjects who had no previous history of physical activity were not accepted in the study. The questionnaire was provided in a checklist format and asked the subjects to check mark the number of times a week they engaged in physical activity. The subject received a questionnaire and filled out their activity level. Subjects



were considered active if they regularly engaged in some type of training (weight training, swimming, running, cycling, etc.) or engaged in any recreational activities (basketball, volleyball, softball, etc.).

### **50-yard maximal sprint time test.**

The maximal sprint time test was conducted over a 50-yard distance and was assessed with a Brower TC Motion Start Timing System. This device allowed us to capture multiple split times as well as record the cumulative 50-yard dash time. This distance was chosen to ensure that we recorded the maximal speed maintenance phase. The maximal speed maintenance phase was recorded based off the time it took the subjects to cover the 20 yard distance between timing gate 1 (30 yard mark) and timing gate 2 (50-yard mark). Subjects were instructed and verbally encouraged to attain their top speed by the 30 yard mark and maintain their top speed throughout the finish line at the 50 yard mark. This distance was also utilized by both Mangine et al (2014) and Markovic, Jukic, Milanovic, and Metikos (2007) for tripod placement to ensure maximal speed was achieved.

Subjects reported to the university's track to conduct their 50-yard maximal sprint time test. They warmed-up by running one lap around the track, followed by dynamic stretching and then engaged in a specific dynamic warm-up. During this time the researcher measured the track using a 100-m measuring tape to ensure timing gates were placed consistently at the 30 and 50 yard marks. When the subjects finished their specific dynamic warm-up they were instructed to perform three 50-yard practice sprints at 50%, 75%, and 85% maximal effort. Following the warm-up sprints, subjects performed a 50% maximal effort practice run through to become familiarized with the testing procedure. Subjects were then allowed to rest for 3-4 minutes before

performing experimental trials. During their rest time subjects were given their previous testing sprint time to motivate and encourage them to beat it.

Prior to starting the testing trials, subjects lined-up in a single file fashion to enable testing to move more efficiently by testing one right after the other. They were instructed to stand behind a line until called fourth by the researcher. They were then instructed to take a standing start position, placing their lead foot forward behind the starting line. The motion start box was then placed at the mid-heel of their rear foot. A double beep from the motion start box signaled the subject that they were free to begin their testing trial. The motion start box started the timer once the subject accelerated from the starting line. Subjects were then verbally encouraged to attain their top speed by the 30 yard mark and maintain their top speed throughout the finish line at the 50 yard mark. Once the subject crossed the finish line sprint time was recorded on a clipboard from the handheld display of the timing system. Subjects were then informed of their sprint time.

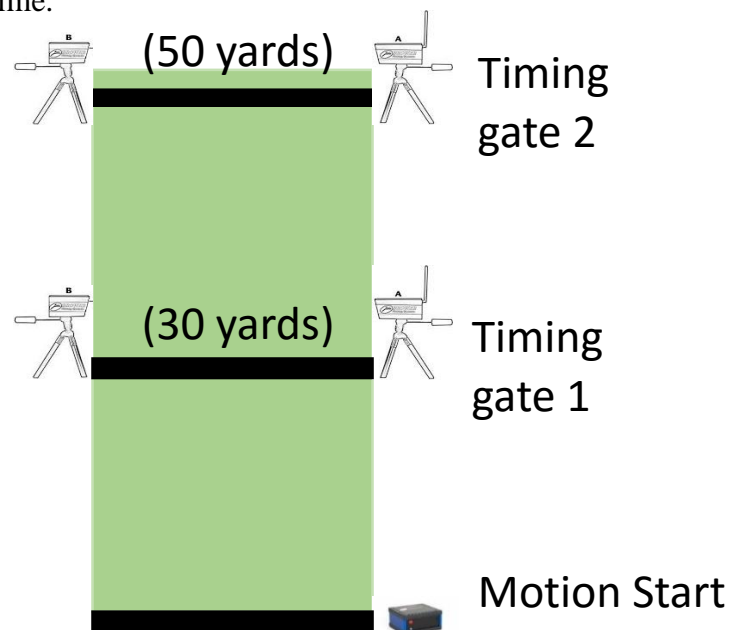


Illustration 1. This illustration displays the testing set-up for the 50-yard maximal sprint time test.

### **Maximal treadmill sprint speed test.**

Subjects reported to the Exercise Science Laboratory. They first performed a five minute jog up and down an accessible hallway. Following the five minute jog they performed dynamic stretches, and then engaged in a more specific dynamic warm-up. They then were instructed to put on a safety harness, and when ready they were instructed to step up onto the treadmill keeping their feet on the sides away from the moving belt and keeping their hands on the railing. They were then anchored to a steel frame by their safety harness. A D-ring on the upper back was attached to a supporting cable suspended from the steel frame. Once the subject was secured they were instructed to sit back in the harness, release the handlebars, and raise their feet to ensure them that they were safe. The treadmill belt speed was then increased and subjects were instructed to perform three practice sprints to become familiarized with transferring their weight onto the moving belt and sprinting on the treadmill. After performing three practice sprints they were detached from the steel frame and given 3-4 minutes rest before attempting the experimental trials. The subjects remained in the safety harness to make the process of attaching and re-attaching them more efficient.

After resting 3-4 minutes subjects were instructed to step back up onto the treadmill and were reattached to the steel frame. They were then verbally given their maximal sprint speed in mph based off their split 2 sprint time from the 50-yard maximal sprint time test. The treadmill speed was set to their top attainable maximal running speed based off their split 2 time. They were verbally instructed to run until failure or until instructed to stop. They were only stopped if they out ran the selected belt speed. After informing them of the procedure the experimental trials began. They gradually shifted their weight onto the moving belt of the treadmill and released the handrails. Treadmill belt speed was instantaneously raised in increments of 0.5 mph

to 1.5 mph depending on subjects' abilities. Belt speed was continuously verbally shouted throughout each testing trail to encourage subjects to remain on the treadmill. Top speed was recorded when subject maintained their top attainable speed for 2-3 seconds before losing their footing and falling. Top speed was recorded on a clipboard and was used as a measure for the next trail. Subjects were then detached from the steel frame and rested 3-4 minutes before attempting their next experimental trial.

A motorized Track Master Treadmill (Full Vision, Inc., Newton, KS, USA) was utilized to perform the maximal treadmill sprint speed test. Treadmill belt speed was accurately assessed by a Model DT-107A Handheld Contact LED Digital Tachometer (NIDEC-SHIMPO, American Corp., Itasca, IL, USA). This was done because the treadmill counsels speed display was not accurately representative of the actual belt speed.



Figure 1. Displays a maximal treadmill sprint speed testing session.



Figure 2. Displays belt speed being assessed during a maximal sprint speed testing session.

## Measurements

Test-retest reliability was established by performing pilot testing on five university students. Each pilot subject performed three measurements of height, weight, and maximal sprint speed performance. A Pearson product-moment correlation coefficient was calculated to determine the test-retest reliability and a minimum  $r$  value of 0.9 was required.

### **Anthropometric measurements.**

Anthropometric measurements included height and weight. Height and weight was determined to ensure that all subjects were within close proximity of each other. Anthropometric variables were recorded on subject's individual data sheets.

### **Height and weight.**

Body weight was assessed using a medical weight scale and was recorded in kilograms (kg). Height was assessed and recorded in centimeters (cm) using a stadiometer.

### **Experimental Design**

Following pre-testing all subjects underwent a week-long sprint skill/technique familiarization period, followed by 6 weeks of specialized training. Subjects that took part in the study all underwent a baseline sprint test prior to the week-long sprint skill/technique familiarization period. Markovic, Jukic, Milanovic, and Metikos (2007) utilized a similar familiarization time period when investigating the effects of sprint and plyometric training on muscle function and athletic performance. Furthermore, this study's familiarization period ended 48 hours before starting the experimental trials. This method of ending a familiarization period 48-72 hours prior to experimental trials was utilized by Highton, Lamb, Twist, and Nicholas (2012) who investigating the reliability and validity of short distance sprint performance on a non-motorized treadmill. After subjects completed the familiarization period, they were randomly assigned to either the TR or TM sprint training groups. After subjects were assigned to their groups, the 6 week specific training intervention began.

## **Experimental Training Protocol**

Following the pre-test, subjects were randomly assigned to one of the experimental groups. Subjects in either experimental group (TR or TM) were instructed to participate in two training sessions weekly. A minimum attendance rate of 66% was required from both experimental groups. Data of non-compliant subjects was removed from the data set.

Each experimental training session was supervised by the researcher. Subjects were asked to perform four maximum speed sprints for 5-6 seconds with 3-4 minutes rest between attempts. This work to rest ratio was well established in the literature to prevent fatigue, as was utilized by Bowtell, Tan, and Wilson (2009) who investigated the consistency of maximum running speed measurements on treadmills, and Brughelli, Cronin, and Chaouachi (2011) who investigated the effects of running velocity on running kinetics and kinematics.

### **Track training protocol.**

TR training subjects reported to the university's track. They conducted their sprint training exclusively on the track. When they arrived to the track they were instructed to run one lap around the track, and perform some dynamic stretches, and then engage in a more specific dynamic warm-up. They then performed three practice sprints at 50%, 75%, and 85% of maximal effort. Following the warm-up protocol they were informed of their predicted 50 yard dash time, which was acquired and calculated from split 2 of the 50-yard maximal sprint time test, more specifically from the time zone between the 30 yard and 50 yard mark. After being informed of their 50-yard dash time they walked to the starting position and waited for the researcher to signal them when to start. The researcher stood at the finish line to read out sprint training times when subjects completed each trail.

Four cones were placed alongside the track to simulate the speed progression of a treadmill. This was done to replicate treadmill conditions. The subjects were informed to start from an upright jog position on the researchers signal and were instructed to progressively increase their speed at each cone (60%, 70%, 80%, and 90%) of their maximal sprint speed and achieve and maintain 100% of their maximal sprint speed throughout the recording zone (5-6 seconds). The cones were placed 10 yards apart from each other over a 50 yard distance. The starting point was 20 yards away from the first cone. The recording zone was a 50 yard distance between two tripods in which subjects maximum sprint effort was recorded and documented after every attempt.

Subjects were encouraged to beat or achieve their predicted 50 yard dash time. Verbal encouragement was provided to motivate each subject during their trials. Once the subject crossed the finish line they were verbally informed of their sprint training time by the researcher from the timing systems handheld display. After the subjects received their sprint training time, they walked around the track (rest time) and returned back to the starting position to repeat the process. They conducted a total of four sprints at each training session. At the conclusion of the each training session the subjects were instructed to perform a 5 minute cool down and then some static stretches.





Figure 3. Displays the gradual progression of speed during a TR training session.

### **Treadmill training protocol.**

TM training subjects reported to the Exercise Science laboratory. They conducted their sprint training exclusively on a high-speed treadmill. When subjects arrived to training sessions they performed a five minute jog up and down an accessible hallway. They then performed dynamic stretches followed by a more specific dynamic warm-up.

Following the warm-up protocol, the subjects were instructed to put on a fall protection safety harness. Subjects were then instructed to grab the handrails of the treadmill and step on the sides to avoid stepping on the moving belt. The subjects' harnesses were then anchored to a steel frame above the treadmill. A D-ring on the upper back of the safety harness was attached to a cable suspended from the steep frame. Once attached the subjects were instructed to perform three practice sprints at gradually increasing speeds. They held onto the handrails and started moving their legs and slowly transferred their weight from the hand rails onto the moving belt of the treadmill. After completing their three practice sprints subjects got off the treadmill and

rested 3-4 minutes before attempting experimental trials. Subjects remained wearing the safety harnesses to ensure training sessions and crowd management moved efficiently.

During their rest time, the treadmill's belt speed was set at 5 mph below the subjects predicted maximal treadmill sprint speed. The subjects' maximal treadmill sprint speed was determined from split 2 of the 50-yard maximal sprint time test. Once the belt speed was set, and the subject was rested, they were reconnected to the steel frame to perform their experimental trials. The researcher stood on the side of the treadmill with a stopwatch in one hand while manipulating the treadmill speed with the other hand. The subjects were then instructed to gradually lower themselves onto the moving belt of the treadmill as they had practiced and remain on the belt for 20 seconds or until they fell. Once the subject removed their hands from the handrails and their full bodyweight was on the treadmill belt, the researcher started the stopwatch and instantaneously increased the treadmill's belt speed to the subject's predicted maximal treadmill sprint speed. Time was counted out loud to encourage the subject to maintain their speed until they achieved their predicted maximal sprint speed or fell due to loss of control.

Each experimental treadmill trial was 20 seconds in duration. This time frame was used because the treadmill took 12-15 seconds to accelerate to the desired maximal speed within a 5 mph range. This ensured that the subjects gradually increased their running speed from an upright jogging position to maintaining their maximal sprint speed for 5-6 seconds.

The researcher monitored each experimental trial closely by recording and documenting the speed and the time spent on treadmill. This was done to ensure each subject was giving a maximal effort. The subjects were encouraged to increase treadmill belt speed by .05 mph at the next training session if they were able to stay on the treadmill for 15-20 seconds for all four

experimental trails. At the conclusion of each training session the subject were instructed to perform a 5-minute cool down and some static stretches.



Figure 4. Displays the maximal speed maintenance phase during a treadmill training session.

## Statistical Analysis

A General Linear Mixed Model Analysis for repeated measures was used to test for a Group effect (TR vs. TM groups), a time effect (baseline vs post-test) and an interaction effect, for each of the continuous response variables with and without the inclusion of any possible covariates (i.e. sex, low vs. high BMI, etc.) in the model. For comparing the attendance rates between the groups, each subject's attendance was used as a continuous response variable and analyzed with the General Linear Mixed Model Analysis for repeated measures. If either a time effect or an interaction term were significant in these analyses, a Tukey's post-hoc procedure was used to further identify where these differences lied over time. The level of significance was set at an alpha level of 0.05 for all analyses. Graphpad Prism version 6.0 (Graphpad Software, Inc., La Jolla, CA) was used for all statistical analysis.

**Test-retest reliability.**

Pilot testing was conducted with five university students to establish test-retest reliability. Each participant was tested three times for height, weight, and maximal sprint speed performance. A Pearson product-moment correlation coefficient was used to calculate and determine test-retest reliability. A minimum  $r$  value of 0.8 was required.

**Group descriptive statistics.**

Descriptive statistics (Mean  $\pm$  Standard Deviation) were reported for each group's anthropometric data (i.e. height, weight, and BMI) and measures of maximal sprint speed performance.

## Chapter 4: Results

One hundred and twenty recreationally-active college-age subjects were initially recruited (agreed to participate) for this study. Out of the initial 120 subjects who agreed to participate, only 41 completed the study. The other 79 subjects did not comply with the study criterion of attending a minimum of 66% of experimental training sessions. These subjects were excluded from the study altogether. Due to the exclusion of the non-compliant subjects, data was only analyzed for the 41 recreationally-active college-age subjects (Age $\pm$ SD: 23.1 $\pm$ 2.6 years; BMI $\pm$ SD: 24.3 $\pm$ 3.8 kg/m<sup>2</sup>) that completed the study.

### Baseline Comparisons

Table 1 displays the physical characteristics of TR and TM subjects. There were no significant between group differences for age ( $p = 0.96$ ), height ( $p = 0.58$ ), weight ( $p = 0.37$ ), or body mass index (BMI) ( $p = 0.55$ ).

Table 1.

*Mean  $\pm$  standard deviation of anthropometric measurements of track and treadmill sprint training subjects.*

Group	N	Age (years)	Height (cm)	Weight (kg)	BMI (kg/m <sup>2</sup> )
Tack	21	23.08 $\pm$ 2.94	166.79 $\pm$ 5.49	66.95 $\pm$ 10.38	24.08 $\pm$ 3.81
Treadmill	20	23.04 $\pm$ 2.32	168.11 $\pm$ 9.42	70.24 $\pm$ 12.35	24.77 $\pm$ 3.46

No significant group differences on the basis of age, height, weight, and BMI ( $p > .05$ ).

Sprint time between familiarization test and pre-test were compared to identify how many subjects improved in either split 2 sprint time or 50-yard sprint time. Ten subjects from the TR group improved split 2 sprint time at pre-test, and 11 improved 50-yard sprint time at pre-test.

Within the TM group, 12 subjects improved split 2 time at pre-test, and 10 improved 50-yard sprint time at pre-test. The better sprint time between the familiarization test and the pre-test was considered the true pre-test sprint time and utilized as a baseline measurement for comparison.

Baseline comparisons compared cumulative 50-yard sprint time, split 2 sprint time and maximum treadmill sprint speed. Figure 5 below illustrates that there were no significant differences in 50-yard sprint time ( $p=0.46$ ) between the TR and TM groups at pre-test. Figure 6 below illustrates that there were no significant differences in Split 2 sprint time ( $p=0.46$ ) between the TR and TM groups at pre-test. Figure 7 below illustrates that there were no significant differences in maximal treadmill speed ( $p=0.37$ ) between the TR and TM groups at pre-test.

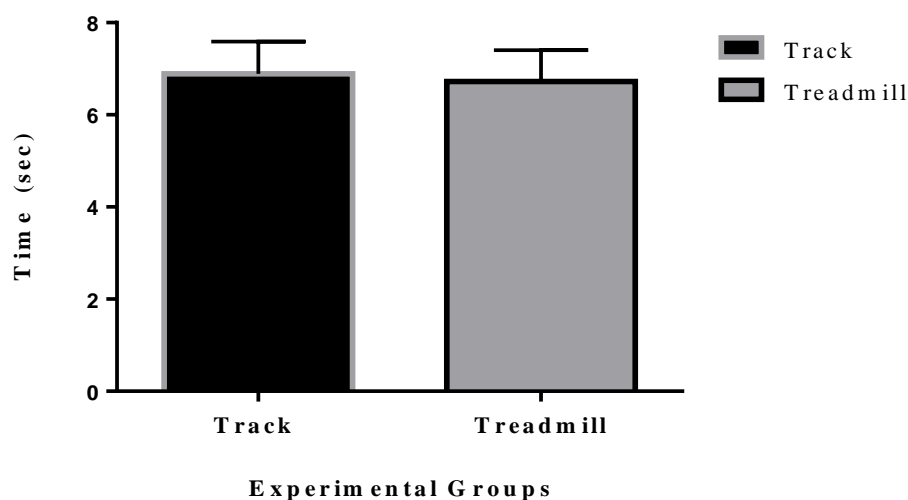


Figure 5. TR and TM group comparison of 50-yard sprint time at pre-test.

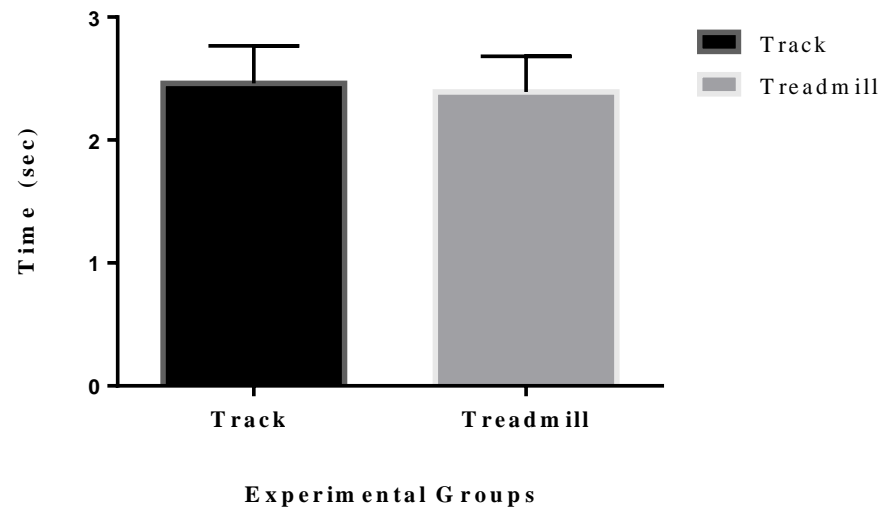


Figure 6. TR and TM comparison of split 2 sprint time at pre-test.

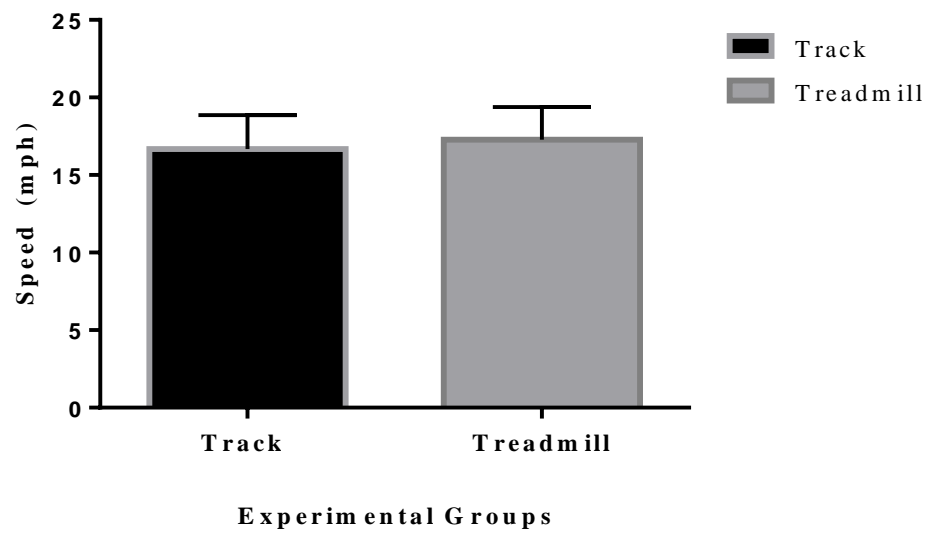


Figure 7. TR and TM group comparison of maximal treadmill sprint speed at pre-test.

## Sprint performance changes due to experimental program

Table 2 displays pre-test and post-testing sprint performance measurements for both TR and TM subjects. The TR group significantly decreased 50-yard sprint time ( $p=0.02$ ), split 2 sprint time ( $p=0.007$ ), and significantly increased maximal treadmill running speed ( $p<0.001$ ). The TM group significantly decreased split 2 sprint time ( $p=0.02$ ), and significantly increased maximal treadmill running speed ( $p<0.001$ ).

Table 2.

*Mean  $\pm$  standard deviation of sprint performance from pre- to post-test of track and treadmill sprint training groups.*

Track Group	Pre-Test	Post-Test
<b>50-yard sprint time (sec)</b>	6.89 $\pm$ 0.70	6.82 $\pm$ 0.69*
<b>Split 2 sprint time (sec)</b>	2.46 $\pm$ 0.30	2.41 $\pm$ 0.29*
<b>Max treadmill speed (mph)</b>	16.68 $\pm$ 2.18	18.11 $\pm$ 2.15*
Treadmill Group	Pre-Test	Post-Test
<b>50-yard sprint time (sec)</b>	6.73 $\pm$ 0.68	6.68 $\pm$ 0.65
<b>Split 2 sprint time (sec)</b>	2.39 $\pm$ 0.29	2.35 $\pm$ 0.27*
<b>Max treadmill speed (mph)</b>	17.29 $\pm$ 2.11	19.16 $\pm$ 2.01*

\*Significantly different from pre-test.

Figure 8 below illustrates that the TR training group significantly decreased their cumulative 50-yard sprint time ( $p=0.02$ ) from pre- to post-test. No difference was seen in cumulative 50-yard sprint time from pre- to post-test for the TM training group. Figure 9 below illustrates that the TR training group significantly decreased split 2 sprint time ( $p=0.007$ ), and that the TM training group significantly decreased split 2 sprint time ( $p=0.02$ ). Figure 10 below



illustrates that both the TR and TM training groups significantly improved maximal treadmill running speed ( $p < 0.001$ ).

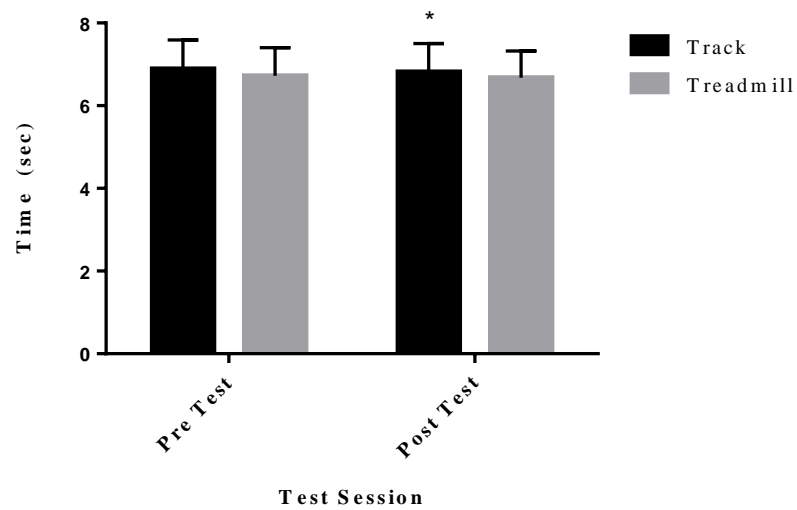


Figure 8. Cumulative 50-yard sprint times for the TR and TM groups between pre-test and post-test.  
\*Significant difference between pre- to post-test.

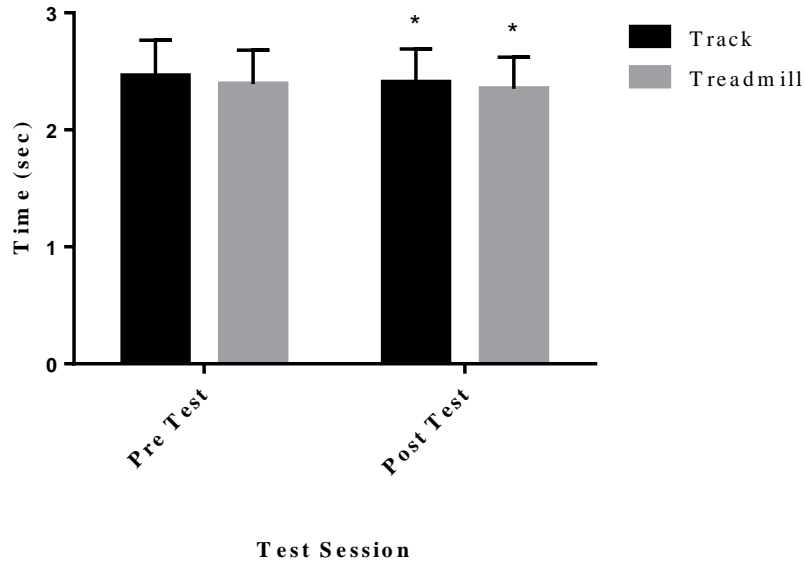


Figure 9. Split 2 sprint times for the TR and TM groups between pre-test and post-test. \*Significant difference between pre- to post-test.

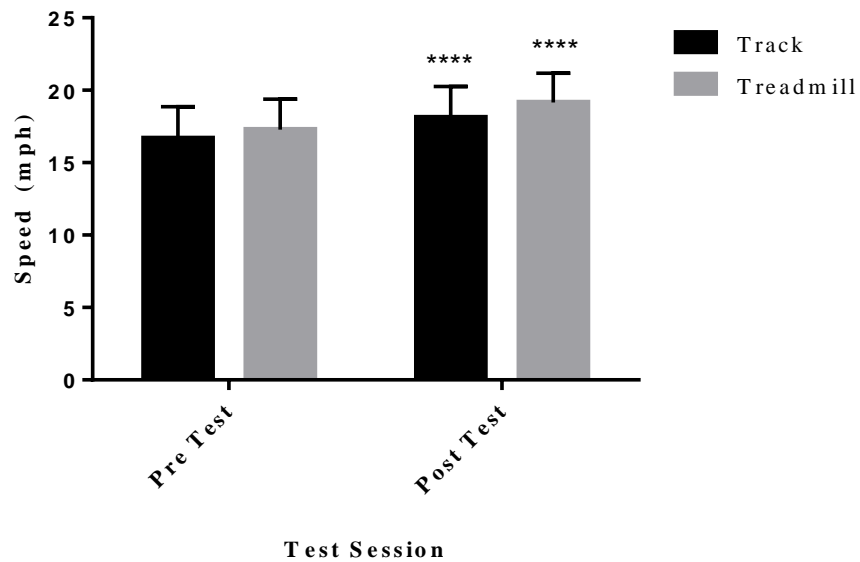


Figure 10. Maximum treadmill sprint speeds for the TR and TM groups between pre-test and post-test. \*\*\*\*Significant difference between pre- to post-test.

## **Chapter 5: Discussion**

### **Summary of Reviewed Literature, Purpose, and Hypothesis**

Sprint training is typically executed outdoors (field, track, etc.), but it has its drawbacks (weather and turf conditions, access, availability, etc.). Sprint training indoors on a high-speed treadmill, therefore, can possibly be used as an alternative. Previous research has found conflicting evidence when considering athletes' SP overground (on the field) versus on the treadmill. Morin and Seve (2011) found that athletes' SP was slower on a treadmill compared to over-ground SP after performing a single 100-m sprint. In contrast, McKenna and Riches (2007) concluded that treadmill sprinting was similar to overground sprinting after four sprinting sessions. They further suggested that maximum speeds attained on the treadmill can be greater than the maximum speeds attained overground.

While contradictory, the comparison of athletes' sprint characteristics on treadmill vs. overground appears to be well researched. Previous research (Frishberg, 1983; Swanson & Caldwell, 2000; McKenna & Riches, 2007; Kivi, Maraj, & Gervais, 2002; Weyand, Sternlight, Bellizzi, & Wright, 2000) has investigated the kinematic and kinetic differences between treadmill and overground conditions. Treadmill research has also been conducted through the use of both motorized and non-motorized (torque) treadmills. Recently more treadmill research (Cheetham & Williams, 1987; Mangine et al., 2014; Ross et al., 2009; Brughelli, Cronin, & Chaouachi, 2011) has been focused on the non-motorized treadmill, although the effects of sprint training on a motorized treadmill are still not fully understood.

Despite of the numerous research studies completed on treadmill running, no previous studies have investigated the training applicability and effectiveness of treadmill sprint training against the traditional overground training. The current study filled important gaps, as the

relevant literature was lacking any experimental studies aiming to investigate the effects of sprint training between the treadmill and overground conditions. Therefore, the purpose of the current study was to examine the effects of a 6-week high-speed treadmill sprint training intervention on sprint performance in comparison to traditional overground sprint training.

It was hypothesized that overground sprint training would result in superior SP than that of treadmill training. The study aimed to determine if differences in SP existed between sprint training groups following a six-week training intervention. The rationale was that sprinting on the ground produces greater ground reaction forces compared to that of the treadmill. Therefore, it was a working hypothesis that traditional overground sprint training would significantly improve SP compared to treadmill training. This was suggested because overground sprinting produces greater ground reaction forces with each foot strike propelling the runner forward.

### **Summary of Results**

Findings of this study do not support the working hypothesis. There were no significant differences in split 2 sprint time or maximal treadmill sprint speed between the two training conditions. Both groups significantly decreased split 2 sprint time, and significantly increased maximal treadmill sprint speed from pre-to post-test. The TR training group significantly decreased 50-yard maximal sprint time from pre-to post-test. There was no difference in 50-yard maximal sprint time from pre-to post-test for the TM training group. Possible confounding variables such as relative sprint speed were taken into consideration and used as matching criteria. Specifically, subjects were successfully matched across groups as there were no significant between-group differences in sprint time or sprint speed at familiarization test.

In summary, this study revealed that high-speed treadmill training can improve sprint performance on the track and could possibly be used as a supplemental method to traditional overground sprint training.

## **Relation of Results to Past Literature**

### **Kinematic and kinetic differences.**

Frishberg (1983) suggested that treadmill sprinting can enable an athlete to attain similar running velocities as overground sprinting during the maximal velocity phase, but results in different sprinting kinematics. A study conducted by McKenna and Riches (2007) reported similar findings, suggesting that conventional motor driven treadmills allowed athletes to attain similar velocities as overground sprinting during the constant velocity phase, and also reported differences in sprinting kinematics between the two conditions. Previous research has suggested that, when primarily focusing on sprint performance, overground sprinting and treadmill sprinting have shown to result in significant biomechanical differences (Morin & Seve, 2011). Kivi, Maraj, and Gervais (2002) identified several biomechanical differences by performing a kinematic analysis of high-speed treadmill sprinting over a range of velocities. These authors found that stride frequency increased as a result of a decreased stance and flight phase seen with increased treadmill speeds. Furthermore, training near maximal velocity on a treadmill resulted in an increased hip extension angular velocity. Kivi et al. (2002) concluded that performing treadmill sprinting at increased velocities causes sprinters to become less consistent in the angular positioning of their hips at high speeds. In comparison, overground sprinting has been suggested to be associated with increased hip extension and hip flexion compared to treadmill sprinting (Sinclair, Richards, Taylor, Edmundson, Brooks, & Hobbs, 2013). According to Kivi et al. (2002), maximizing hip flexion angle resulted in an increased upper-leg angular velocity

before and during ground contact. This is further supported by Markovic, Jukic, Milanovic, and Metikos (2007) who found that the maintenance of maximal velocity is highly dependent on forward propulsion created by the hip and ankle extensors.

Forward propulsion is highly related to the amount of force exerted with each foot strike. Morin and Seve (2011) found that sprinting on a conventional motor driven treadmill does not reproduce free sprinting as compared to overground sprinting. Sprint speed is constantly changing during overground sprinting due to the force being applied to the ground throughout the duration of the sprint, which is not seen in treadmill sprinting. Previous research has found that overground sprinting results in greater reaction forces, which increase at maximal velocities. Brughelli, Cronin, and Chaouachi (2011) found that peak horizontal ground reaction forces significantly increased at higher speeds. Ground reaction forces have been found to be greater in overground sprinting compared to treadmill sprinting. Sprint performance has been found to improve by utilizing greater ground reaction forces. Morin and Seve (2011) suggested that ground reaction forces are greater in overground sprinting but tend to change due to the amount of force exerted with each foot strike. Morin and Seve (2011) concluded that overground sprint performance was significantly faster than that of treadmill sprinting due to greater ground reaction forces. This aligns with Weyand, Sternlight, Bellizzi, and Wright (2000) who found that faster running speeds are achieved with greater ground reaction forces, not more rapid leg movement. However, in regards to sprint performance, the findings within our study suggest that over-speed (more rapid leg movement) treadmill training may possibly improve sprint performance similarly to that of traditional overground sprint training. This finding may be due to an increased stride frequency, as suggested by Elliot and Blanksby (1976) who found that treadmill sprinting increased stride frequency at higher speeds due to a decreased non-support

phase. The current study did not measure stride frequency, therefore this theory cannot be confirmed. Swanson and Caldwell (2000) who investigated kinematic analysis of high-speed incline and level treadmill running also found that treadmill sprinting resulted in stride frequency training adaptations. Mero et al. (1992) suggested that sprinting at maximum speed results in an increased stride frequency restricting the hip range of motion in order to maintain cadence and belt speed. Based on previous literature, it is possible that treadmill sprint performance from the current study improved via stride frequency training adaptations (Swanson & Caldwell, 2000).

### **Treadmill sprint performance.**

Bowtell, Tan and Wilson (2009), who observed the consistency of maximal running speeds on a treadmill, found that greater sprint speeds are attained on a high-speed treadmill compared to overground sprinting due to a lesser metabolic demand. Treadmill sprinting has been found to result in a lesser metabolic demand due to the absence of an acceleration phase (Bowtell, Tan, & Wilson, 2009). Furthermore, previous research has found that treadmill sprinting enables an athlete to perform more successive trials without a noticeable decline in speed (Bowtell, Tan, & Wilson, 2009). However, the same was found not to be true with overground sprinting. Botwtell, Tan and Wilson (2009) found that overground sprinting resulted in a significant decrease in speed after five trails. Brown (2002) who investigated treadmill running on sprint performance suggested treadmill sprinting does not show a noticeable decrease in speed because the treadmill will not stop, suggesting the athlete is forced to perform maximally or supramaximally while maintaining power output requirements. Recently, Ross et al. (2009) observed the effects of treadmill sprint training on maximal running velocity and power and found that treadmill sprint training significantly increased maximal treadmill sprint speed and power. The findings of improved treadmill sprint speed via treadmill sprint training

are further evidenced by Cheetham and Williams (1987) who investigated high intensity training on treadmill sprint performance. They concluded that treadmill sprint training improves attainable peak running speeds.

### **Overground sprint performance.**

Morin and Seve (2011) compared sprint running performance between overground and treadmill conditions and found that sprint performance was lower on a treadmill compared to overground after performing a single 100-m sprint. These authors concluded that treadmill sprint performance was significantly slower than overground sprint performance due to force production differences between the two conditions. According to Morin and Seve (2011) treadmill SP was found to be significantly slower than overground sprinting by 20% due to force production differences between the two conditions. Although, treadmill SP was found not to be equal to overground SP, it was found to correlate significantly with it. The current findings align with that of Morin and Seve (2011) in regards to cumulative sprint time. However, our findings are the first to suggest that high-speed treadmill sprint training improves sprint performance at the maximal speed phase of sprinting similarly to that of overground sprint training.

Sprint performance research between overground and treadmill conditions has not been well researched. Due to the gap within the literature we formulated our hypothesis based off sprinting kinematic research which suggested that treadmill sprinting results in a decreased sprint performance compared to that of overground sprinting. This is evidenced by Mckenna and Riches (2007) who suggested that sprinting kinematics observed on a conventional treadmill, if replicated overground, would result in a reduced sprint performance compared to that of overground sprinting. In the current study, we can only suggest that high-speed treadmill sprint training improves sprint performance at the maximal speed phase similarly to that of overground



sprint training, but we cannot conclude that sprinting kinematics between conditions were the cause. These findings suggest that high-speed treadmill sprint training can be used as a substitution method to improve or maintain the maximal speed phase of sprinting.

## **Limitations, Strengths, and Suggestions for Future Research**

### **Limitations.**

A limitation of this study included weather conditions for the track training group. The track training group performed their training exclusively on the track. Weather conditions such as wind, temperature, and rain could have influenced subjects' 50-yard sprint times. Weyand, Sternlight, Bellizzi, and Wright (2000) suggested that wind resistance and aerodynamic drag during overground sprinting is believed to further cause a decrease in power and promote increased fatigue. Therefore, track training group sprint training times could have possibly been affected by fatigue caused by unwanted weather conditions. Furthermore, time of day may have affected sprint times due to limited access to the track. Track training times could have possibly been at times the subjects were more tired and could have affected their maximal effort.

Limitations within the treadmill group included complications with the treadmill itself, as we experienced reoccurring problems with faulty wiring and error messages. This could have been the result of the treadmill motor being used for extended time period throughout the day. Furthermore, the availability of only a single high-speed treadmill and limited fall protection harnesses made the testing and training procedures challenging. Access to multiple high-speed treadmills and fall protection harness would have made the testing and training procedures more efficient. However, the cost of a high-speed treadmill is only affordable to a limited number of athletic departments.

**Strengths.**

A strength of this study was the successful matching of male and female –recreationally-active subjects across groups. Specifically, through statistical analysis, it was determined that there were no significant differences in sprint performance between the track and treadmill groups at pre-test.

Another strength was ensuring that both groups were treated equally. A conventional motorized treadmill cannot train acceleration. To ensure track conditions simulated that of the treadmill, cones were placed alongside the track to signal the subjects when to progressively increase speed starting from an upright jogging position. This allowed us to eliminate training the acceleration phase of sprinting and exclusively train the speed maintenance phase.

Another strength was utilizing the Brower TC Motion Start Timer System, which allows for accurate and reliable measurements of sprint performance. This device allowed us to record multiple split times, the cumulative sprint time, and the maximal speed phase of sprinting.

The availability of a track allowed us to conduct 50-yard maximal sprint time testing, and enabled us to perform weekly track training sessions. Furthermore, access to a clinical testing laboratory enabled us to utilize a Motorized Track Master Treadmill (Full Vision, Inc., Newton, KS, USA) for the maximal treadmill speed tests and weekly treadmill training sessions.

An additional strength to this study was access to a Model DT-107A Handheld Contact LED Digital Tachometer (NIDEC-SHIMPO, American Corp., Itasca, IL, USA) to accurately assess belt speed during maximal treadmill testing.

**Future research.**

This study suggests that high-speed treadmill sprinting could possibly be used as a supplemental method to overground sprint training. However, we can only speculate that

treadmill sprint performance improved due to stride frequency training adaptations. Given that this could be a possibility to the improvement in treadmill sprint performance, this could be a topic for further investigation. In addition, future research could accurately assess if there are any differences in stride frequency between overground sprinting and treadmill sprinting through the use of video analysis. Electromyography could also be used to assess any changes within muscle recruitment patterns, which could provide further insight into sprint performance differences between track and treadmill conditions. It would also be suggested to implement a longer familiarization period to ensure neuromuscular adaptations are achieved. Possibly implementing a 16-week sprint drill and technique familiarization period to ensure all subjects have truly adapted to the training, and then performing sprint training for 16-weeks exclusively on the track or treadmill. A larger sample size would need to be collected to provide better statistical power. Lastly, an extended familiarization and training period would better identify if high-speed treadmill sprint training could truly replicate traditional overground sprint performance.

## **Conclusions**

The main finding within our study suggests that high-speed treadmill sprint training can possibly replicate and serve as a substitute to the traditional method of overground sprint training. However, a limited 1-week familiarization period, a limitation of this study, might have masked possible significant between-group differences. In addition, future research should include replication of this study with measurement of stride frequency and electromyography.

## **Practical Application**

While overground sprint training is viewed as the superior training method, high-speed treadmill training can be used to maintain and/or improve sprint performance in relation to the maximal speed phase of sprinting. High-speed treadmill training does not seem to affect sprint

acceleration but can be possibly be implemented in a training program to effectively train maximal speed maintenance.

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## **Appendix**

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**University of Texas at El Paso (UTEP) Institutional Review Board**  
**Informed Consent Form for Research Involving Human Subjects**

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**Protocol Title:** Comparison of the effectiveness of treadmill vs. overground sprint training

**Principal Investigator:** Sandor Dorgo; Jeremy J. Perales

**UTEP Department of Kinesiology**

**1. Introduction**

---

You are being asked to take part voluntarily in the research project described below. Please take your time making a decision and feel free to discuss it with your friends and family. Before agreeing to take part in this research study, it is important that you read the consent form that describes the study. Please ask the study researcher or the study staff to explain any words or information that you do not clearly understand.

**2. Why is this study being done?**

---

You have been asked to take part in a research study investigating the comparison of the effectiveness, physiological and psychological benefits of treadmill vs. overground sprint training. The goal is to identify if treadmill sprint training can replicate and produce similar neuromuscular adaptations as overground sprint training. Approximately 60 study subjects will be enrolling in this study at UTEP. Based on your expressed interest you are being asked to part take in the study, as you are between the age of 18 and 30. If you decide to enroll in this study, your active involvement will last approximately eight weeks.

**3. What is involved in the study?**

---

If you agree to take part in this study, you will be asked to complete the following twice:

- Fill out a questionnaire covering basic health information.
- Fill out the Physical Activity Questionnaire that assesses current exercise behavior.
- Fill out a set of questionnaires that assess your exercise confidence.
- Participate in a pre-test procedure of anthropometric measures, including height, weight, upper thigh and body composition measures
- Participate in a maximal sprint speed (sprint performance) testing protocol on the 40 yard dash speed assessment test.
- Participate in a body composition (DEXA) testing protocol.
- Participate in a 8-week intervention program with two meetings a week to include:
  - o A follow up test session every two weeks to assess 40 yard dash sprint performance on turf and treadmill.
  - o Two training sessions weekly to practice skills and techniques of sprinting.

#### **4. What are the risks and discomforts of the study?**

---

There are no known major risks associated with this research. Minor discomfort, including muscle soreness, fatigue, muscle cramps or minor strains, may be resulted from the maximal sprint speed testing, as well as from the experimental training sessions. I understand that the researchers will strive to protect my safety by providing supervision of qualified personnel. There are no known nonphysical risks associated with this study.

I understand that during a single DXA test I will be exposed to approximately 0.03 mrad of radiation. This exposure is less than 1% of the radiation received from a chest x-ray, or 0.5% of a dental x-ray, or less than 25% of the radiation exposure from six hours outdoors.

#### **5. What will happen if I am injured in this study?**

---

The University of Texas at El Paso and its affiliates do not offer to pay for or cover the cost of medical treatment for research related illness or injury. No funds have been set aside to pay or reimburse you in the event of such injury or illness. You will not give up any of your legal rights

by signing this consent form. You should report any such injury to Sandor Dorgo or Jeremy Perales, at 915-549-0004 and to the UTEP Institutional Review Board (IRB) at (915-747-8841) or [irb.orsp@utep.edu](mailto:irb.orsp@utep.edu).

#### **6. Are there benefits to taking part in this study?**

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Potentially, you will experience improvements in sprint speed and running economy. There will be no other direct benefits to you for taking part in this study. This research may help us to understand alternate methods of sprint training modalities.

#### **7. What other options are there?**

---

You have the option not to take part in this study. There will be no penalties involved if you choose not to take part in this study.

#### **8. Who is paying for this study?**

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Internal Funding:

Funding for this study is provided by the UTEP Department of Kinesiology.

Graduate school: Dodson Research Grant

#### **9. What are my costs?**

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There are no direct costs. You will be responsible for travel to and from the research site.

#### **10. Will I be paid to participate in this study?**

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You will not be paid for taking part in this research study. At the conclusion of the study, when

completing the post-test procedures, you will be provided a small value gift card (\$10-\$20)

### **11. What if I want to withdraw, or am asked to withdraw from this study?**

---

Taking part in this study is voluntary. You have the right to choose not to take part in this study. If you do not take part in the study, there will be no penalty. If you choose to take part, you have the right to stop at any time. However, we encourage you to talk to a member of the research group so that they know why you are leaving the study. If there are any new findings during the study that may affect whether you want to continue to take part, you will be told about them. The researcher may decide to stop your participation without your permission, if he thinks that being in the study may cause you harm.

### **12. Who do I call if I have questions or problems?**

---

You may ask any questions you have now. If you have questions later, you may call Jeremy Perales (principal investigator), at 915-549-0004 or by email at [jjperales@miners.utep.edu](mailto:jjperales@miners.utep.edu). If you have questions or concerns about your participation as a research subject, please contact the UTEP Institutional Review Board (IRB) at (915-747-8841) or [irb.orsp@utep.edu](mailto:irb.orsp@utep.edu).

### **13. What about confidentiality?**

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Your part in this study is confidential. Your individual information obtained from the questionnaire and from the tests will be known only by the researcher(s). None of the information will identify you by name. Your name and any details that might identify you will be changed to a subject number in any written reports in order to protect confidentiality. Documents will be kept on the UTEP campus in the researcher's office in a locked cabinet and destroyed three years after completion of the research study. There will be no harmful use of the data collected in this study.

### **14. Mandatory reporting**

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Not applicable.



## 15. Authorization Statement

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I have read each page of this paper about the study (or it was read to me). I know that being in this study is voluntary and I choose to be in this study. I know I can stop being in this study without penalty. I will get a copy of this consent form now and can get information on results of the study later if I wish.

Participant Name: \_\_\_\_\_ Date: \_\_\_\_\_

Participant Signature: \_\_\_\_\_ Time: \_\_\_\_\_

Consent form explained/witnessed by: \_\_\_\_\_

Signature

Printed name: \_\_\_\_\_

Date: \_\_\_\_\_ Time: \_\_\_\_\_

## Health Status and Exercise Background Questionnaire

Please complete the following questions as accurately as possible.

Date of Birth: \_\_\_\_/\_\_\_\_/\_\_\_\_

Age: \_\_\_\_yr.

Weight: \_\_\_\_\_

Height: \_\_\_\_\_

### Medical History

Is there any possibility that you are pregnant? Yes ☐

No ☐

Please mark and date all surgeries you have had:

<input type="checkbox"/> Back	____/____/____	<input type="checkbox"/> Lung	____/____/____
<input type="checkbox"/> Foot	____/____/____	<input type="checkbox"/> Shoulder	____/____/____
<input type="checkbox"/> Joint	____/____/____	<input type="checkbox"/> Neck	____/____/____
<input type="checkbox"/> Knee	____/____/____	<input type="checkbox"/> Heart	____/____/____
<input type="checkbox"/> Ankle	____/____/____	<input type="checkbox"/> abdominal	____/____/____
<input type="checkbox"/> Other	____/____/____		____/____/____

Please mark all of the following for which you have been diagnosed or treated by a physician or health professional:

<input type="checkbox"/> Alcoholism	<input type="checkbox"/> Emphysema	<input type="checkbox"/> Kidney problems
<input type="checkbox"/> Anemia, sickle cell	<input type="checkbox"/> Epilepsy	<input type="checkbox"/> Liver disease
<input type="checkbox"/> Anemia, other	<input type="checkbox"/> Eye problems	<input type="checkbox"/> Lung disease
<input type="checkbox"/> Asthma	<input type="checkbox"/> Gout	<input type="checkbox"/> Mental illness
<input type="checkbox"/> AIDS	<input type="checkbox"/> Hearing loss	<input type="checkbox"/> Neck strain
<input type="checkbox"/> Back Strain	<input type="checkbox"/> Heart problem	<input type="checkbox"/> Obesity
<input type="checkbox"/> Bleeding trait	<input type="checkbox"/> Heart murmur	<input type="checkbox"/> Phlebitis
<input type="checkbox"/> Bronchitis, chronic	<input type="checkbox"/> Hepatitis	<input type="checkbox"/> Rheumatoid arthritis
<input type="checkbox"/> Cancer	<input type="checkbox"/> High blood pressure	<input type="checkbox"/> Stroke
<input type="checkbox"/> Cirrhosis, liver	<input type="checkbox"/> Hypoglycemia	<input type="checkbox"/> Thyroid problem
<input type="checkbox"/> Concussion # ____	<input type="checkbox"/> High Cholesterol	<input type="checkbox"/> Ulcer
<input type="checkbox"/> Congenital defect	<input type="checkbox"/> Infectious mononucleosis	<input type="checkbox"/> Other _____
<input type="checkbox"/> Diabetes	<input type="checkbox"/> Joint problems	
<input type="checkbox"/> Neuromuscular disorders (multiple sclerosis, vertigo, cong. myasthenia, etc.)		

Please mark all medications/supplements taken during the past 6 months:

- |  |   |                                      |
|--|---|--------------------------------------|
| <input type="checkbox"/> Blood thinner | <input type="checkbox"/> Epilepsy medication            | <input type="checkbox"/> Other _____ |
| <input type="checkbox"/> Diabetic      | <input type="checkbox"/> Heart medication               | <input type="checkbox"/> Other _____ |
| <input type="checkbox"/> Diuretic      | <input type="checkbox"/> High blood pressure medication | <input type="checkbox"/> Other _____ |
| <input type="checkbox"/> Insulin       | <input type="checkbox"/> Hormones                       | <input type="checkbox"/> Other _____ |

Please mark any of the following symptoms you have had recently:

- |  |   |
|--|---|
| <input type="checkbox"/> Abdominal pain                  | <input type="checkbox"/> Frequent urination                   |
| <input type="checkbox"/> Arm or shoulder pain            | <input type="checkbox"/> Leg pain/numbness                    |
| <input type="checkbox"/> Breathless with slight exertion | <input type="checkbox"/> Low blood sugar                      |
| <input type="checkbox"/> Blurred vision                  | <input type="checkbox"/> Low-back pain                        |
| <input type="checkbox"/> Blood in urine                  | <input type="checkbox"/> Palpitation or fast heart beat       |
| <input type="checkbox"/> Burning sensations              | <input type="checkbox"/> Shortness of breath                  |
| <input type="checkbox"/> Chest pain                      | <input type="checkbox"/> Significant emotional problem        |
| <input type="checkbox"/> Cough up blood                  | <input type="checkbox"/> Swollen joints                       |
| <input type="checkbox"/> Difficulty walking              | <input type="checkbox"/> Unusual fatigue with normal activity |
| <input type="checkbox"/> Dizziness                       | <input type="checkbox"/> Weakness in arms                     |
| <input type="checkbox"/> Feel faint                      |   |

Have you had any of the following injuries in the past 1 year?

- |                                     |                                     |
|-------------------------------------|-------------------------------------|
| <input type="checkbox"/> Pelvic     | <input type="checkbox"/> Shoulder   |
| <input type="checkbox"/> Elbow      | <input type="checkbox"/> Leg        |
| <input type="checkbox"/> Knee       | <input type="checkbox"/> Ankle      |
| <input type="checkbox"/> Lower back | <input type="checkbox"/> Upper back |
| <input type="checkbox"/> Neck       |                                     |

## Exercise Behavioral Questionnaire

Have you been exercising regularly in the past 6 months? ☐ Yes ☐ No

Do you or have you ever been exposed to sprint training? ☐ Yes ☐ No

What form of exercise do you engage in regularly?

Resistance training (bench press, back squat, deadlift, etc.) ☐

Aerobic training (jogging, swimming, biking, etc.) ☐

Fitness classes (step aerobic, cross fit, kick-boxing, etc.) ☐

Recreational sport activities (basketball, soccer, tennis, baseball etc.) ☐

Other type of activities, please specify: \_\_\_\_\_

Do you engage in any activity that involves running? ☐ Yes ☐ No

And if so please specify the activity: \_\_\_\_\_

How many times a week do you perform an activity that involves some form of running?

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7

How long is your average exercise session? \_\_\_\_\_

Do you consider yourself a very active individual? ☐ Yes ☐ No

Do you engage in agility/speed training exercises? \_\_\_\_\_

What is the average rest time in between your sets? \_\_\_\_\_

Please check ALL exercises from the below list that you practice regularly:

☐ Agility drills

☐ Sprinting

☐ Plyometric (jump training)

☐ Stadiums

☐ High knees

☐ Jump squats

☐ Lunges

☐ Walking knee raises

☐ Walking toe touch

☐ Uphill sprinting

☐ Downhill sprinting

☐ Treadmill running

## **Vita**

Jeremy Perales was born in El Paso, Texas. The second child of Art and Rebecca Perales, he graduated from Burges High School, El Paso, Texas, in the spring of 2008 and enrolled in the University of Texas at El Paso in the spring of 2012. While pursuing a bachelor's degree in Kinesiology, he was accepted into several honors programs and was invited to attend a national conference in Indianapolis. He graduated from his undergraduate degree with academic honors. After earning his bachelor's degree, he entered the University of Texas at El Paso's Kinesiology graduate program in the fall of 2014 and was employed as a teaching assistant. During his graduate studies, he was awarded the Dodson Research Grant which funded his thesis study. In the near future, he plans to pursue a doctoral degree in multi-disciplinary studies with a focus on strength and conditioning.

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