Methodology

SPRINT PERFORMANCE: THE RELIABILITY OF A RUN TO EXHAUSTION

E. M. ROBINSON¹,², L. B. GRAHAM¹, S. A. HEADLEY²

¹Bridgewater State College, Department of Movement Arts, Health Promotion and Leisure Studies and Department of Secondary Education, Bridgewater, MA; ²Springfield College, Department of Exercise Science and Sport Studies, Springfield, MA

ABSTRACT

E. M. ROBINSON, L. B. GRAHAM AND S. A. HEADLEY. Sprint Performance: The Reliability Of A Run To Exhaustion. JEPonline, 2001;4(2):6-9. This investigation was conducted and designed to determine the reliability of a run to exhaustion treadmill protocol; the Robinson protocol. Male subjects from Springfield College (n = 5) participated in three trial runs on the treadmill. The first trial was a modified McConnell maximum oxygen consumption test to determine the aerobic capacity of each subject. The second and third trials were identical run to exhaustion protocols where the subject warmed-up for 15 min at 75% of VO₂max, rested 5 min, and then ran to exhaustion at 100% VO₂max (58.97 ml/kg/min±5.25). No significant difference was found (p>0.05) between the two run to exhaustion trials, and the paired samples correlation (p=0.001) was 0.993. Finding that there was no significant difference between trials enables future researchers to utilize the Robinson protocol with confidence that the trials will consistently be the same.

Key Words: Running, Treadmill, Anaerobic Capacity

INTRODUCTION

The ability to endure throughout an endurance event requires an enormous amount of perseverance, fitness and determination. However, the ability to sprint to the finish line at the end of an endurance event requires available substrates for energy, and the cognitive focus to myopically force the human body into a zone of high demand. Researchers (1-3) have concentrated on the influence of carbohydrate ingestion on sprint performance during short duration (<1-hr) high intensity activity (>75% VO₂max). The studies by Ball et al. (1), Below et al. (4), Coggan and Coyle (5), Davis et al. (6), Dernman et al. (7), and Jarvis (8) all utilized cycling as their method of exercise. Dernman et al. (7) was the partial exception to the rule, and compared cycling to running. Pizza et al. (2), Tsintzas et al. (9), and Wilber and Moffatt (3) utilized running as their mode of exercise. The imbalance of cycling and running research shows that testing subjects on a cycle ergometer is easier than that of a runner on a treadmill. However, it has not been determined if a similar relationship between the metabolism of carbohydrates of cyclists and runners exists (7).
Reliability of a Run to Exhaustion

Sprint performance tests that have been conducted recently include Pizza et al. (2) who tested trained runners, during two trials, in a short term, high-intensity 15-min run at 75% $\text{VO}_2\text{max}$, immediately followed by an exhaustive run to failure at 100% $\text{VO}_2\text{max}$. The two trials were separated one-week apart and followed identical training regimes for the prior week. The 100% $\text{VO}_2\text{max}$ effort at the end of a high-intensity run would closely mimic the environment in which the runner would exist during competitive racing conditions (2). Wilber and Moffatt (3) tested 10 male runners who participated in two randomly ordered experimental trials separated by one week. The runners were supplemented with a carbohydrate-electrolyte (CE) and placebo solution, and the subjects ran on a treadmill at an intensity of 80% $\text{VO}_2\text{max}$ until exhaustion was reached. The researchers used a treadmill protocol of straight high intensity running, instead of intermittent sprinting or switching protocols, to determine the effectiveness of CE supplementation. The protocol used by Wilber and Moffatt (3) was used to simulate consistent high-intensity running, as found in competitive racing environments.

Many performance tests are used in laboratory settings, and the reliability and validity of these tests are unclear, or even unknown. The subsequent variable assessed and measured during the Robinson run to exhaustion was the time to exhaustion.

It was hypothesized that the sprint capacity of runners was well measured using a timed run to exhaustion at 100% $\text{VO}_2\text{max}$, and the Robinson run to exhaustion would be a reliable measurement.

**METHODS**

This independent project was proposed to ascertain the reliability of a run to exhaustion sprint performance treadmill test.

**Participants**

The subjects in this study were 5 trained male runners. The subjects were between 18 and 36 years of age, and were recruited from Springfield College. Subjects were required to adhere to the guidelines set in the testing procedures.

**Testing Apparatus**

Body weight (kg) and height (cm) were measured with a Detecto™ scale. Heart rate was measured with a Polar™ Vantage XL Heart Rate Monitor (Model # 45900, Stamford, CT). Respiratory values of oxygen consumed and expired carbon dioxide were measured with a SensorMedics metabolic cart (2900 System, Yorba Linda, CA). Substrate utilization and oxygen consumption (VO$_2$) were estimated from the gas exchange. The dependent variable time to exhaustion was measured with a stopwatch.

**Procedures**

Subjects were required to participate in three test days. Prior to testing, subjects were given an informed consent document to complete, as well as a medical history questionnaire. Subjects were also asked to record detailed training and diet journals for the week prior to each of the testing sessions. The subjects were then asked to maintain similar dietary and training regimes prior to each trial. Diet analyses were calculated with Mosby’s NutriTrac (Positive Input, Corp., New York, New York).

The first test day consisted of a modified McConnell Protocol maximum oxygen consumption test (10) to assess the maximum oxygen consumption ($\text{VO}_2\text{max}$) of the participant via indirect calorimetry. The McConnell Protocol consisted of a starting pace of 4.0 m/h at 0% grade. Treadmill speed was increased 1 km/h/min to min 6 (9 km/h), and thereafter %grade was increased 1%/min. The establishment of $\text{VO}_2\text{max}$ was met when at least two of the following criteria were met: a plateau, or a decrease in oxygen uptake relative to an increasing workload; an RER value of greater than 1.15; or a heart rate within 10 beats of the age predicted maximum value. The speed and grade that corresponded to $\text{VO}_2\text{max}$ were the values used for setting the speed and grade for the two run to exhaustion trials.
Testing Procedures
Prior to the running time, the treadmill was set at the predetermined and individual maximum speed and grade, which was established during the first trial. The second and third trials were both sub-maximal 15-min runs at 75% VO\textsubscript{2}max followed by a 5-min rest period. These two identical trials were used to compare for reliability. Immediately after the rest, the subjects ran to exhaustion at 100% VO\textsubscript{2}max. Time recorded to exhaustion was the time from when the subject removed his hands from the handrails of the treadmill until he placed them back on the handrails. Both sprint-running trials were spaced at least one week apart.

Statistical Analysis
The results obtained during the two high-intensity running trials were analyzed using the Repeated Measures t-test for the dependent variable time to exhaustion to determine the reliability coefficient and the t-value. The Repeated Measures t-test was statistically analyzed using the Statistical Package for Social Sciences for Windows (SPSS) for Windows (11).

RESULTS
Five male runners were studied to determine the reliability of the Robinson run to exhaustion protocol. The characteristics for subjects are presented in Table 1. No significant (p>0.05) difference was found in the mean time to exhaustion between the two trials, (p=0.279, t = -1.251). The trials were highly correlated (p<0.05) with each other (r=0.993, p=0.001).

DISCUSSION
This research was conducted to determine the reliability of the Robinson run to exhaustion protocol utilizing 100% VO\textsubscript{2}max. The variable that was examined was time to exhaustion. The major finding of this investigation was that the Robinson run to exhaustion protocol is a statistically reliable testing measurement in an exercise physiology laboratory.

Subjects in the present study were adult competitive runners who were very familiar with high intensity running and racing conditions. Using athletes who were accustomed to high intensity running and racing conditions allowed the researcher to investigate the testing instrument while not coaching the runners in treadmill running and high intensity work. A racing environment requires the runner to start immediately at a high intensity and run to the finish at their maximum speed. The Robinson protocol used in this research employed a similar style, where the time to exhaustion was recorded from the time when the runner removed his hands from the handrails until he placed them back on the handrails. This protocol was preferred because no time was lost in setting the treadmill speed or grade at the beginning of the run.

The findings are consistent with those from previous studies that utilized a similar running protocol of high intensity (2, 9). Pizza et al. (2) found that high intensity short duration running is enhanced following a carbohydrate loading protocol. Tsintzas et al. (9) found that during a run to exhaustion running time was longer in the carbohydrate-supplemented trial than in the placebo. However, the reliability of such running protocols was not reported. Measurements that utilize cycling protocols such as the Wingate Anaerobic Test, report the corresponding reliability coefficients, however, no such data has been reported for treadmill running. Therefore, the purpose of this study was to determine the reliability of a high-intensity running protocol to further validate future research studies conducted with the same running protocol. This allows for
further investigation with other various physiological variables, such as glucose, lactate and ammonia, thus researchers will be able to determine with greater confidence and reliability whether a significant difference exists from a protocol of supplementation, and not from variability in the testing protocol itself.

In conclusion, running time to exhaustion is not statistically different from trial to trial when conducting and utilizing the Robinson protocol of 15 minute warm-up at 75% VO$_{2}$max, followed by a run to exhaustion at 100% VO$_{2}$max. Thus, the Robinson run to exhaustion protocol is a reliable protocol to use when comparing trial to trial results of various physiological measurements.

REFERENCES


Address for Correspondence: Ellyn M. Robinson, Bridgewater State College, Department of Movement Arts, Health Promotion and Leisure Studies, Bridgewater, MA 02325; Email: ERobinson@bridgew.edu; Phone: (508) 531-2055; Fax: (508) 531-1717