

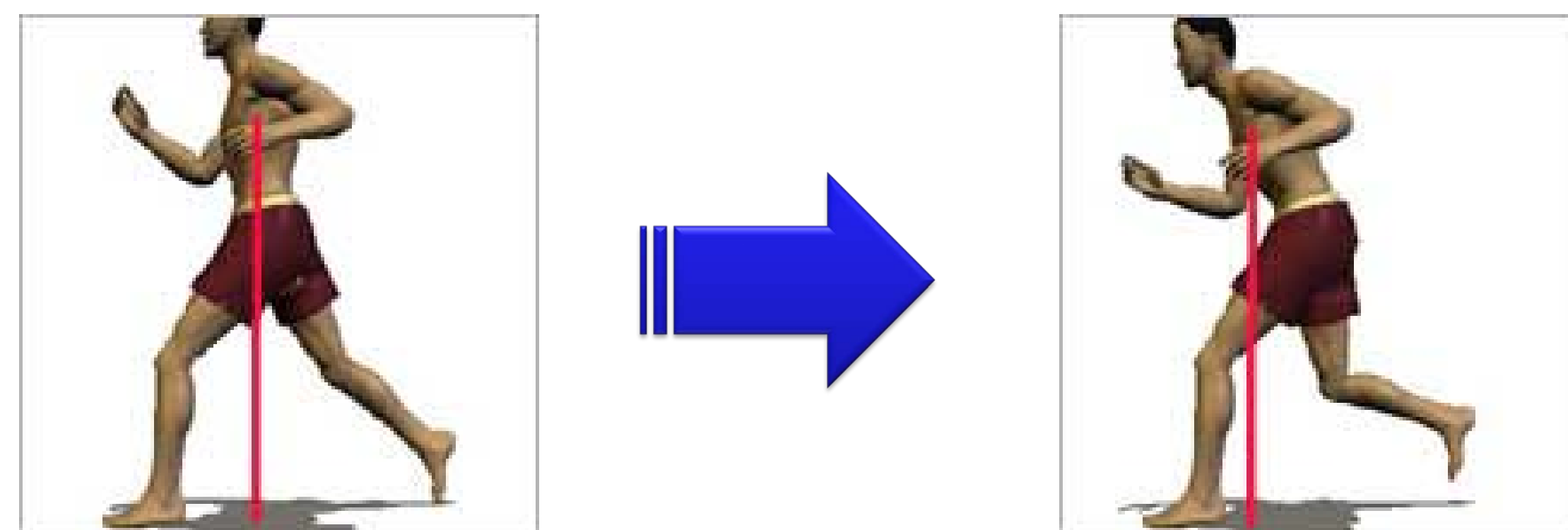
Effects of Core Endurance Training on Running Economy

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ABSTRACT

The core musculature helps stabilize the body and align the spine. Poor core-endurance may result in back injury and inefficient body mechanics. Improving core-endurance may produce favorable changes in body posture and stability that could improve health and exercise performance. With respect to exercise performance, previous studies have demonstrated conflicting data on the potential benefits of core-endurance training on running performance. **Purpose:** The aim of the study was to determine if four-weeks of core-endurance training improves running economy in healthy young adults. **Methods:** Sixteen subjects (3 male, 13 female) between the ages of 18-25 years participated in a thirty-minute (3 days per week) core stability program for four weeks, which consisted of a total of twelve exercise sessions. Pre and post testing consisted of anthropometric measurements, core stability, and a treadmill running economy test at self-selected speeds. **Results:** Core endurance significantly increased in the 16 subjects after the 4 week training program. Interestingly, despite a significant increase in core endurance, running economy was reduced. This rejects the hypothesis (null hypothesis is accepted) and may mean that an increase in core endurance is more harmful than beneficial to one's ability to uptake oxygen when running at a sub-maximal speed. The study suggests the need for further research on this topic and the impact of total body endurance resistance training on running economy and the impact of core endurance improvements on energy expenditure.



BACKGROUND

- The core, including the abdominal, lower back, buttocks and hip flexor muscles, help stabilize the body, align the spine, and helps to promote proper posture.
- Poor core- endurance may result in back injury and inefficient body mechanics. Research shows that increases in core endurance and stability correlate with decreased incidence of injury.
- Running economy (RE) is defined as the oxygen consumption (VO_2) at a submaximal running velocity. Utilizing less oxygen to perform a sub-maximal running workload indicates that RE is good, whereas utilizing more oxygen at the same workload suggest poorer RE.
- Exercises to recruit core musculature should mimic that of running. Research suggests a high intensity, time-based program is needed to induce proper overload on core musculature to improve RE.
- While there has been research showing RE can be influenced by a variety of factors, including total body strength, aerobic, plyometric, and isolated resistance training, there is insufficient research on the influence of core endurance training specifically.
- Accordingly we designed the present study to better understand the influence of core stability training on running performance.

EXPERIMENTAL AIM AND HYPOTHESIS

The aim of the study was to determine if four-weeks of core-endurance training improves running economy in healthy young adults. The hypothesis of this study was that improvements in core endurance will improve running economy.

METHODS

Subjects

- 16 apparently healthy young adults (13 female, 3 male) between the ages of 18-25 years participated in the study.
- Volunteers were recruited from the University of Wisconsin- Eau Claire.
- All subjects provided written informed consent according to the guidelines of the University of Wisconsin – Eau Claire.

Screening and Testing Procedures

- A pre-participation questionnaire was used to determine subject eligibility.
- Body composition (including height, weight, waist circumference, and abdominal skinfolds) was measured before and after program completion.
- Core musculature endurance was assessed using a side bridge, back extensor, and abdominal fatigue test.
- A pre- and post-program treadmill running test was administered to measure oxygen consumption (VO_2) at a self selected speed to assess RE ($mLO_2/kg/meter$).

Selected core exercises



Core Endurance Circuit	Reps	Time (s)
Bird Dog*	4	15
Flutter Kick	1	30
Walking Plank	1	60
Pilates Bridge	2	30
Donkey Kicks	2	15
Mountain Climbers on Bosu	1	30
T-stand with Leg Raise	2	30
Alternate Leg Bridge	6	10
Bosu Isometric Crunch w/ MB* Toss	1	60
Abdominal Roll-out	1	60
Isometric Side Extension	4	15
Back Extension	1	30
Stir the Pot*	4	15
REST	-	120

*MB = Medicine Ball
 * = Stir The Pot Replaced the Bird Dog exercise half-way through study (start of 3rd week)



STATISTICAL ANALYSIS

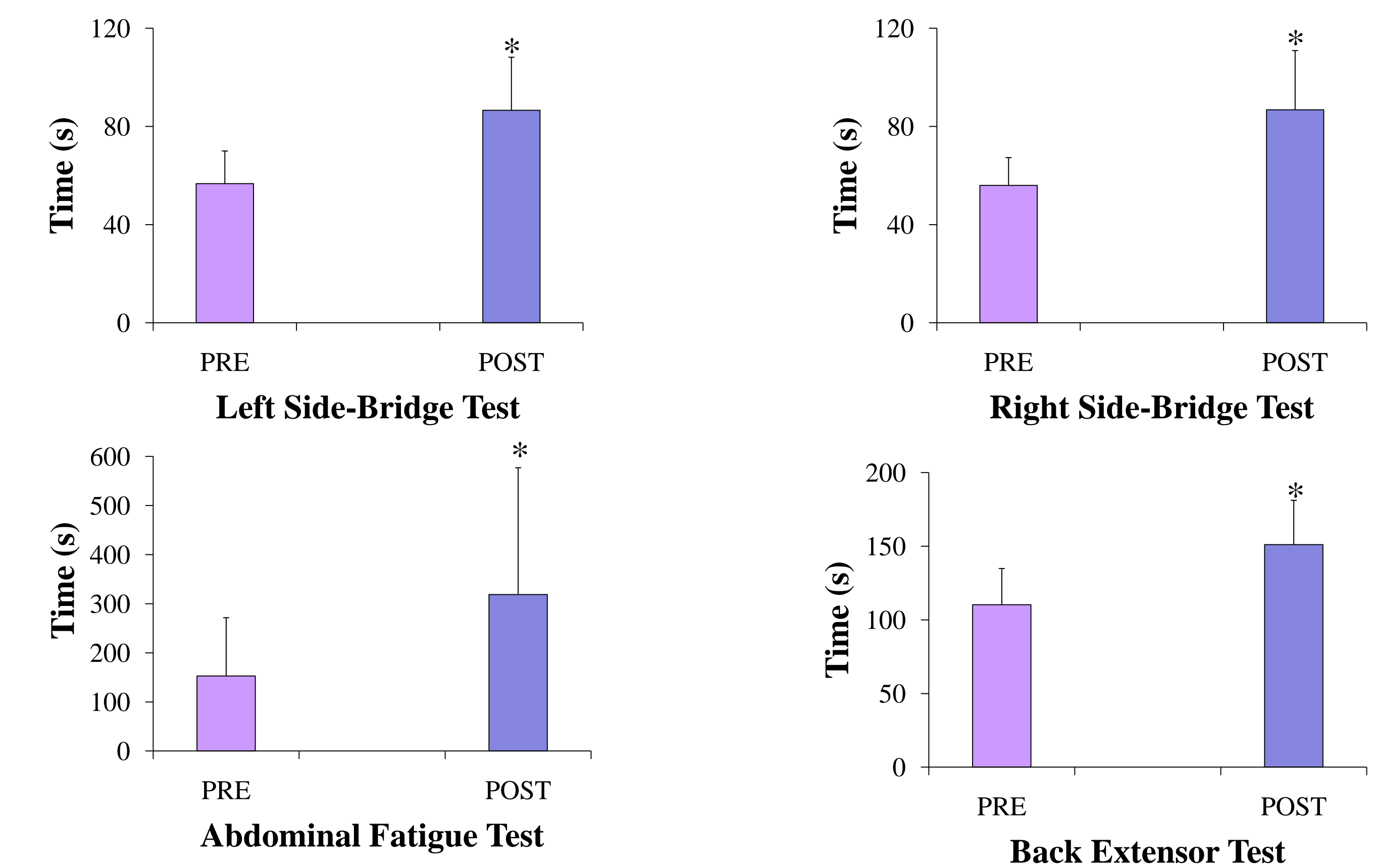
The primary dependent variables were core musculature endurance and RE. The independent variable included the 30-minute core endurance exercise routine administered 3 times per week for 4 weeks. Subject characteristic data was analyzed by descriptive statistics. Changes in core-muscle endurance and RE after the 4-week training program were determined by Repeated Measures Analysis of Variance with Bonferroni adjustment for multiple comparisons. Statistical significance was set at $P < 0.05$. Analyses were performed using SPSS version 17.0 statistical software.

RESULTS

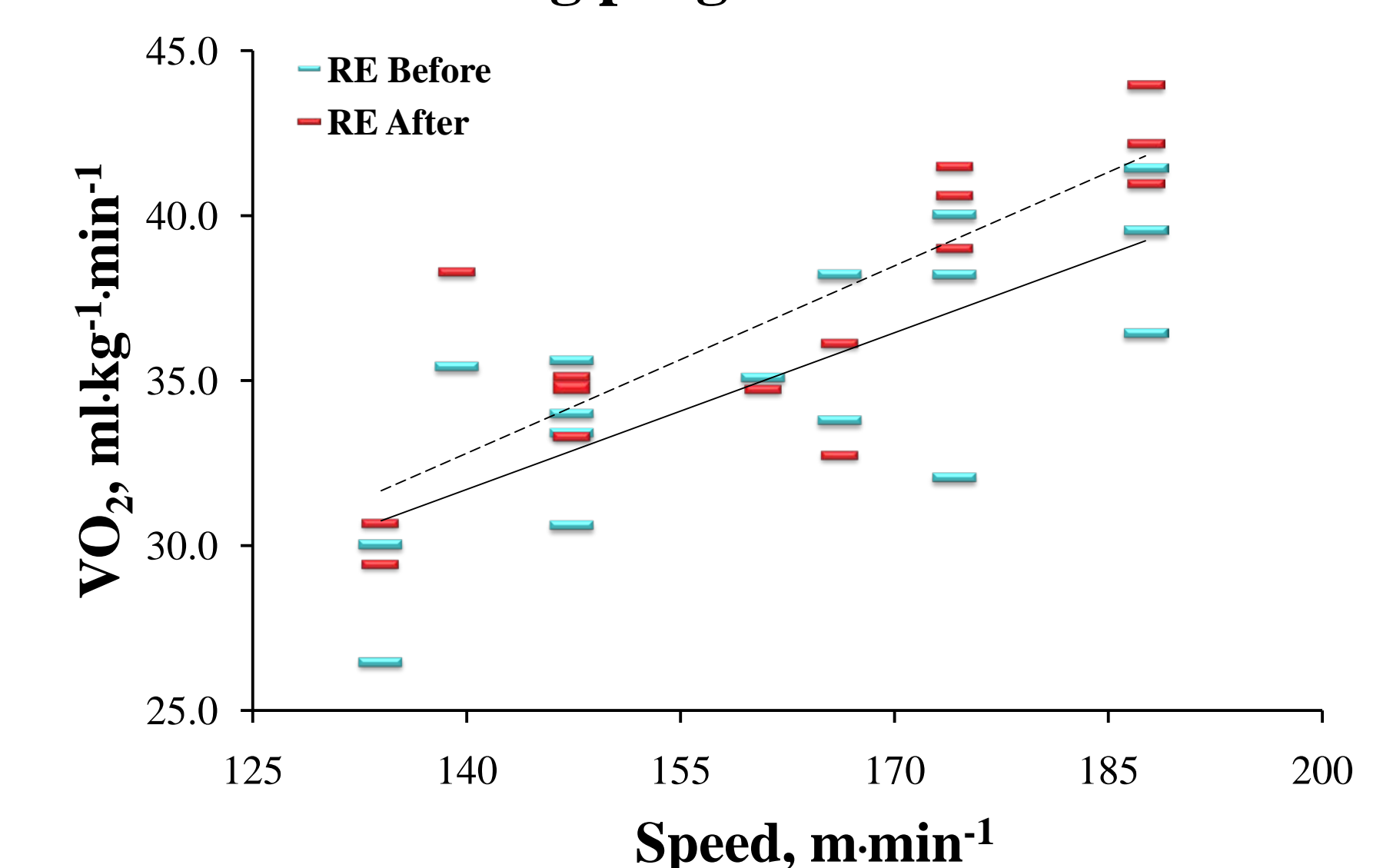
I. Subject Characteristics

Variable (N = 16)	Before Training	After Training
Age, yrs	20.4 ± 1.1	20.4 ± 1.1
Height, cm	168.5 ± 5.8	168.5 ± 5.8
Weight, kg	65.7 ± 10.1	66.4 ± 10.3
BMI, kg/m ²	23.1 ± 2.7	23.3 ± 2.9
Abdominal Skinfolds, mm	18.6 ± 5.1	19.1 ± 5.4
Waist Circumference, cm	73.7 ± 6.9	73.0 ± 7.5

II. Core Endurance Testing. All tests indicated statistically significant increases in core endurance after the 4 week training program ($*P < 0.05$ vs. PRE). Core endurance increased up to 108.5% from pre to post-program.



III. RE decreased (PRE: 0.22±0.2 $mLO_2/kg/meter$; Post: 0.23±0.2 $mLO_2/kg/meter$) after the 4-week core-endurance training program.



SUMMARY AND CONCLUSIONS

- Core endurance significantly increased in the 16 subjects after the 4 week training program. This shows that the core routine was successful in improving one's core endurance and may be a valid and beneficial program for other healthy individuals and studies to utilize when investigating core endurance.
- Interestingly, although a significant increase in core endurance was observed, running economy was reduced. This rejects the hypothesis and may mean that an increase in core endurance is more harmful than beneficial to one's ability to uptake oxygen when running at a sub-maximal speed.
- VO_2 averages were found to be significantly higher during post-testing, which may mean that there was an increase in energy expenditure. This would mean that the subjects were able to expend more calories during their post-test than during their pre-test at the same treadmill speed.
- Further research could include full body strength training with core and full body strength training without core to investigate improvements in running economy.
- The need to further investigate energy expenditure and core endurance in apparently healthy young adults is also warranted.

ACKNOWLEDGMENTS

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