

# COMPARISON OF A HYDRAULIC RESISTANCE TRAINING SYSTEM AND TYPICAL STRENGTH AND CARDIOVASCULAR PROTOCOLS IN WOMEN

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## ABSTRACT

Many innovative exercise devices are emerging from the traditional treadmill, bike, and weights. Some systems, such as a hydraulic resistance platform (HRP), strive to provide a cardiovascular benefit while adhering to a resistance exercise protocol. It is important to determine if these types of devices can provide the same cardiovascular benefit or caloric expenditure as traditional workouts. **PURPOSE:** The purpose of this investigation is to determine the caloric expenditure and anaerobic demand during a typical 30 minute workout using the HRP compared to a standard strength training session and typical cardiovascular training sessions lasting around 30 minutes. **METHODS:** This study followed a repeated measure design and consisted of 11 physically active women (30 +/- 4yrs; 66.5 +/- 2in; 137.5 +/- 13.5lbs.) Every participant completed four separate exercise protocols at least 48 hours apart. Each protocol lasted 30 minutes and were performed in the following order: treadmill, elliptical, HRP, and weights. Subjects completed a choice reaction time protocol as a warm up and cool down using two reaction time devices. The metabolic data were captured by a portable metabolic cart. The outcomes of interest were the rate of perceived exertion, heart rate, grams of carbohydrates and fat burned per minute, and total calories burned per minute. **RESULTS:** Regarding rate of perceived exertion, HRP (16.3 +/- 1.3) was significantly (p<0.05) higher than treadmill (11.4 +/- 1.0), elliptical (11.5 +/- 1.2) and weights (13.1 +/- 2.3). Heart rate was significantly (p<0.05) higher in HRP (136.8 +/- 15.5 bpm) than weights (107.5 +/- 18.3 bpm), but not significantly different compared to treadmill (132.6 +/- 5.1 bpm) or elliptical (132.2 +/- 4.4 bpm). The average grams of carbohydrate burned were significantly (p<0.05) higher in HRP (1.7 +/- 0.4 g/min), compared to treadmill (1.2 +/- 0.3 g/min) and weights (1.0 +/- 0.3 g/min), but not significantly different than elliptical (1.3 +/- 0.3 g/min). The grams of fat burned per minute were significantly (p<0.05) higher in HRP (0.09 +/- 0.03 g/min) than weights (0.02 +/- 0.01 g/min), but were significantly (p<0.05) lower compared to treadmill (0.3 +/- 0.1 g/min), elliptical (0.3 +/- 0.1 g/min). Total calories burned per minute were significantly (p<0.05) higher in HRP (7.6 +/- 1.4 kcal/min) than weights (4.3 +/- 1.2 kcal/min), but not significantly different compared to treadmill (7.5 +/- 0.8 kcal/min) and elliptical (7.9 +/- 0.8 kcal/min). **CONCLUSIONS:** Though the rate of perceived exertion was increased using an HRP, heart rate, grams of carbohydrates, grams of fat and total calories were not significantly different compared to running or elliptical training lasting around 30 minutes. **PRACTICAL APPLICATIONS:** An exercise protocol using a hydraulic resistance system may provide cardiovascular benefits similar to a typical cardio workout, as well as the skeletal and muscular benefits of a typical weight training protocol.

## INTRODUCTION

The obesity rates in our society are staggering. Almost 41 million women and more than 37 million men aged 20 and over were obese in 2007-2008<sup>1</sup>. Among children and adolescents aged 2–19, more than 5 million girls and approximately 7 million boys were obese<sup>1</sup>. Since the development of many chronic diseases has been linked with obesity and physical inactivity<sup>2</sup>, many organizations are increasingly promoting exercise interventions for public health<sup>3</sup>. However, many individuals do not have a lot of time to spend at the gym. Therefore, there has been a focus on finding exercises or exercise devices that can provide more exercise benefits in less time<sup>4</sup>.

Exercise is often categorized as either cardiovascular exercise or resistance exercise. Both are beneficial and each challenges the body in a specific way. Most training regimens will involve both types of training; however, some exercise devices strive to provide a platform which can provide both types of exercise simultaneously. One such device is the hydraulic resistance platform (HRP). Hydraulic resistance platforms use gravity-free hydraulics, not weights, to create resistance. This is called Omnikinetic Resistance (OMKR). No gravity means no external loading on joints, muscles, and connective tissue, such that an individual can train aggressively without fear of injury. Hydraulic resistance requires a two-way, “push / pull” dynamic vs. the “push and resist” of typical weight-bearing exercise. By combining this device with high intensity interval training protocols, one can effectively train the cardiovascular system while exercising muscles.

Therefore, the purpose of this investigation is to determine the caloric expenditure and anaerobic demand during a typical 30 minute workout using the HRP compared to a standard strength training session and typical cardiovascular training sessions lasting around 30 minutes.

## METHODS

### VARIABLES MEASURED:

- Calories burned
- Average Heart Rate
- Average Ratings of Perceived Exertion (RPE)

### PORTABLE METABOLIC CART

The device used to measure indirect calorimetry and pulmonary gas exchange was the Cosmed Pulmonary Function Equipment K4B<sup>2</sup> unit (Rome, Italy.) Prior to arrival of subjects, 4 calibrations were performed (gas, flow, delay, and room air) to ensure accurate measurements. Upon arrival, the device was placed snugly on the subjects, along with a heart rate monitor (Polar Electro™ Kempele, Finland). The primary variables measured were VO<sub>2</sub>, VCO<sub>2</sub>, heart rate, and respiratory exchange ratio. The device measured the complete work out from 5 minutes before warm up, the 30 minute exercise bout, and after cool down until heart rate fell to resting levels in order to obtain resting, exercise and excess post-exercise oxygen consumption values, respectively.



### 4 Repeated Measurements at least 2 days apart

- 30 minute standard cardio workout on a treadmill
- 30 minute standard cardio workout on an elliptical
- Women=Elliptical

### -30 minute Surge 360 workout

- 30 minute standard lifting session that includes 6 complex exercises
- One-repetition maximum and Surge 360 familiarization were performed on visit one

**SURGE 360**  
32 Minutes total time  
10.6 minutes work/ 21.4 minutes recovery for 20/40 time interval

**LIFTING SESSION:**  
4 sets per exercise  
2 sets in a square stance  
2 sets in a split stance  
20 seconds work, 40 seconds recovery

### CARDIOVASCULAR PROTOCOLS

Women– 30 minute treadmill (Woodway™USA, Inc) running at 70% max heart rate (Moderate as described by the ACSM)  
Women: 30 minute elliptical (PreCor™ Woodinville, Washington) at comfortable RPM at a resistance relative to 70% max heart rate (Moderate as described by the ACSM)



### SURGE 360 PROTOCOL

#### Surge 360 Exercises (Austin, Texas)

1. Chest Press-Push/Pull -Bilateral
2. Circles inside
3. Circles outside
4. 360 Twist
5. Fly's
6. Bent over Shoulder Press/Pull
7. Torso Rotation
8. Power X



### LIFTING PROTOCOL

#### Keiser Machine™ Exercises (Fresno, California)

- Performed to failure at 70% 1RM (Goal of 8-12 reps)
1. Squat
  2. Chest Press
  3. Leg Extension
  4. Shoulder Press
  5. Leg Curl
  6. Seated Row

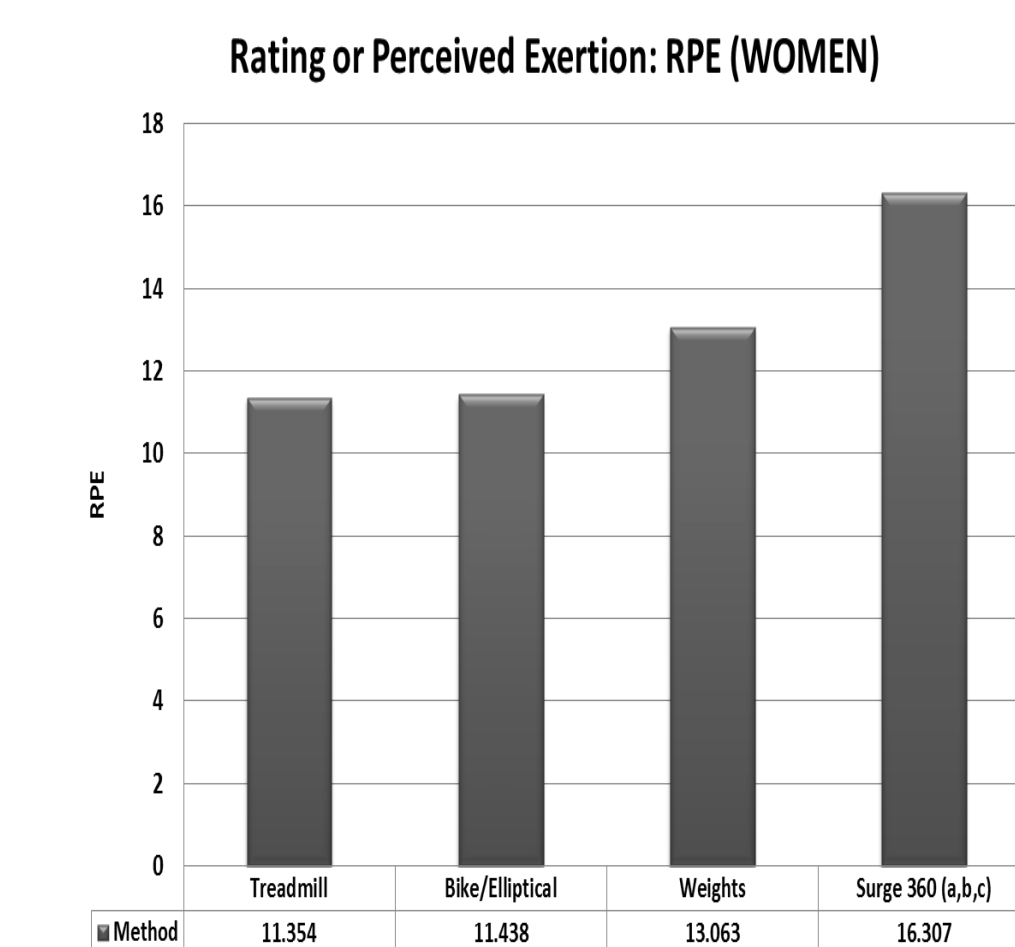


3 sets per exercise  
60 seconds recovery  
≈ 30 Minutes total time

## STUDY PARTICIPANTS

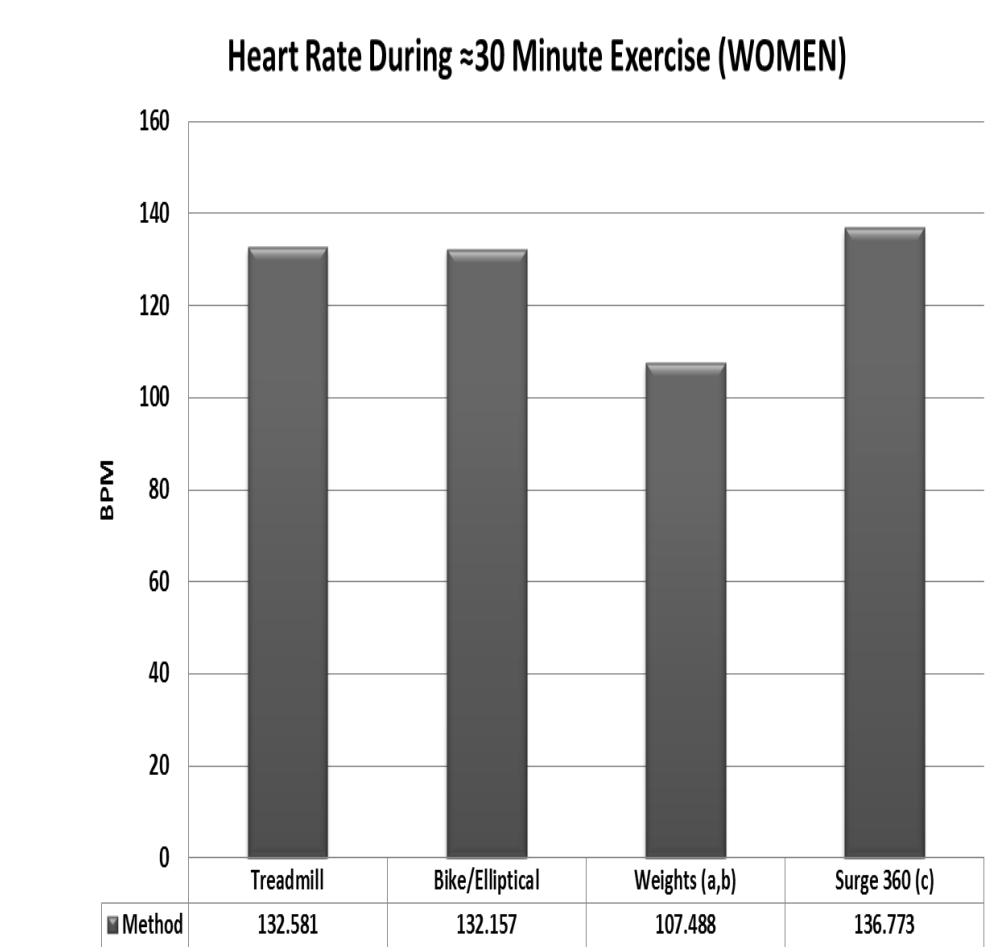
		Age (yrs)	Height (in)	Weight (lbs)	BMI	Training Days/Week	Training Hours/Day
Men	9	25 (7)	71.5 (3)	191 (16.5)	23.79 (2.92)	6 (1)	2 (1)
WOMEN	8	30 (4)	66.5 (2)	137.5 (13.5)	24.68 (3.34)	6 (1)	2 (1)
All	17	27 (6)	69 (4)	166 (31.5)	25.77 (3.16)	6 (1)	2 (1)

## RESULTS



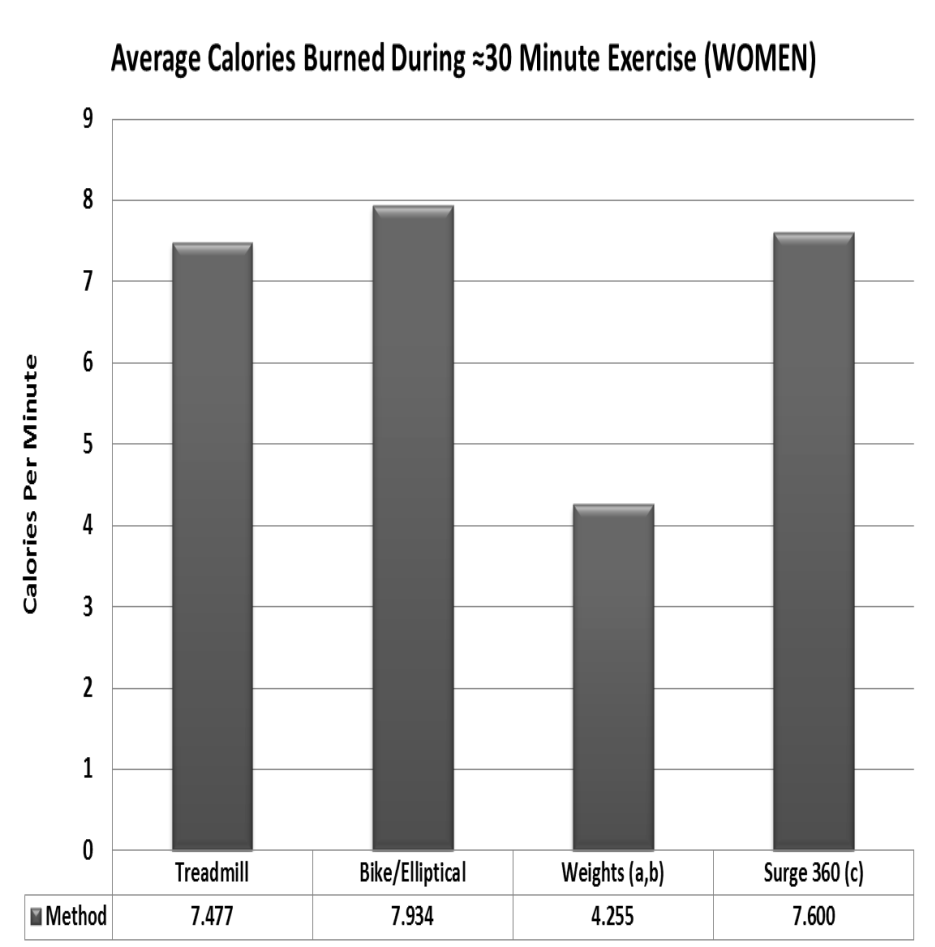
Sig Different from Treadmill: a  
Sig Different from Bike/Elliptical: b  
Sig Different from Weights: c

**WOMEN**  
47% harder than Treadmill  
40% harder than Elliptical  
22% harder than lifting



Sig Different from Treadmill: a  
Sig Different from Bike/Elliptical: b  
Sig Different from Weights: c

**WOMEN**  
3% higher than Treadmill  
4.2% higher than Bike/Elliptical  
28% higher than Lifting



Sig Different from Treadmill: a  
Sig Different from Bike/Elliptical: b  
Sig Different from Weights: c

**WOMEN**  
1.7% more than Treadmill  
4.2% less than Bike/Elliptical  
79% more than Lifting

## CONCLUSIONS

Subjects felt they were working harder (RPE) during the Surge 360 protocol. Women burned more calories, had higher heart rates, and felt more fatigued doing a ~ 30 minute Surge 360 compared to a typical cardio machines and a lifting session lasting the same amount of time.

## PRACTICAL APPLICATIONS

Considering the Surge 360 protocol only has 10.6 minutes of actual “work” subjects essentially burned twice as many calories in half the time compared to cardio machines Future studies can investigate the long term use of the Surge 360 compared to typical cardio machines or lifting protocols to determine if the increased calories burned per session would result in faster improvement in cardiorespiratory fitness as well as body composition and other health parameters.

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