

# The effects of a single serving slow absorption carbohydrate source on fuel utilization and performance in response to a sustained submaximal endurance run

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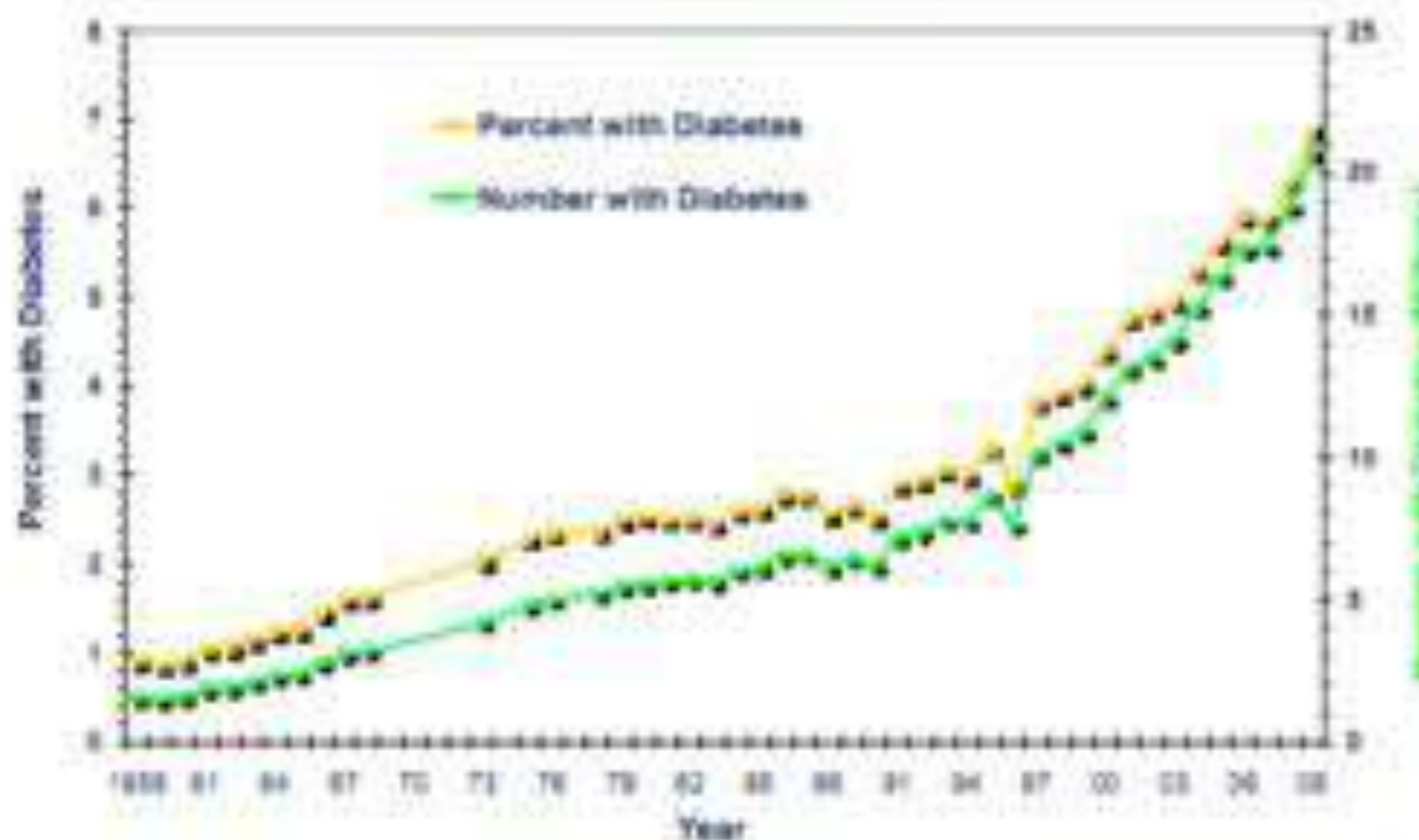
# CARBOHYDRATE FOR SUSTAINED FUEL

- Carbohydrate (CHO) is used for sustained energy availability and blood glucose during prolonged endurance.
- Dietary CHO contributes to supplying fuel and maintaining blood glucose
  - Dietary CHO = Exogenous CHO (*stable isotope tracers*)
- Reliance on CHO for continued fuel requires a lot of total and frequent consumption
- This becomes relevant for slower runners or insulin resistant
  - This is particularly important when considering ultra distance
    - 2006: 160 races globally on Run Ultra website\*
    - 2018: 1,800 races listed

# DIABETES AND HYPERGLYCEMIA

- ~10% of US have diabetes
- 33% have prediabetes

Number and Percentage of U.S. Population with Diagnosed Diabetes, 1958-2009



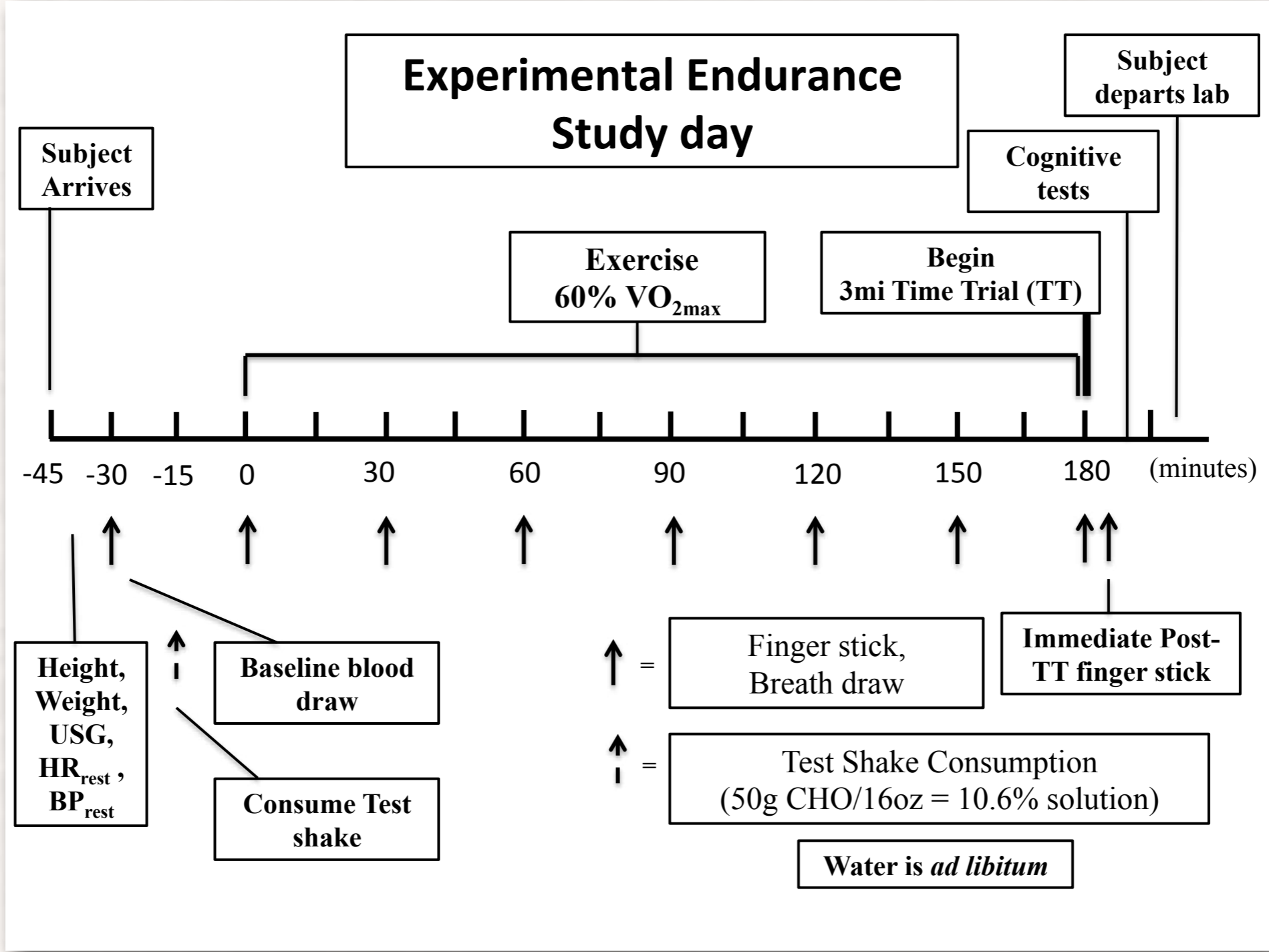
Graph source: Long-term Trends in Diabetes, CDC, October 2010

# PURPOSE

- To examine energy metabolism, total and exogenous CHO utilization, blood glucose and performance after consuming fast or slow absorption, isocaloric glucose beverages before a sustained treadmill run.

# METHODS

- Randomized cross-over design
  - (10 male subjects; experienced distance runners)
- Pre-exercise baseline measurement:  $VO_2$ , body weight, blood markers, RPE, HR
- Consume 1 of 3 drinks: 16oz water + 50g Maltodextrin (MD), 50g Superstarch (SS), no carbohydrate (W)
- 15 min post-drink, start 180-min treadmill run @ 60%  $VO_{2max}$ 
  - Serial data collection measurements (see layout on next slide)
- Immediately at 180-min, stop, 1-2 min post-ex begin Time Trial
  - Time Trial set @ 110%  $VO_{2max}$  speed (time to exhaustion and volitional termination)
  - Post Time-Trial data collection measurements (no breath @ Post-TT measurement)



Height,  
Weight,  
USG,  
HR<sub>rest</sub>,  
BP<sub>rest</sub>

Baseline blood  
draw

Consume Test  
shake

↑ =  
Finger stick,  
Breath draw

↑ =  
Test Shake Consumption  
(50g CHO/16oz = 10.6% solution)

Immediate Post-  
TT finger stick

**Water is ad libitum**

# DEMOGRAPHICS

## Averages:

Age:  $32.4 \pm 6.02$  y

Height:  $68.0 \pm 1.55$  in

Weight:  $161.3 \pm 20.32$  lb

BMI:  $24.6 \pm 3.2$

Body fat%:  $15.3 \pm 6.5$

$VO_{2max}$ :  $55.9 \pm 4.76$  mL/kg/min

Sleep:  $6.1 \pm 0.3$  hr

Temp:  $21.7 \pm$  F

Humidity:  $54 \pm 0.05\%$

## Trial

Avg Speed: 6.1 mph @1% grade  
(min:5.2; max:7.0mph)

Avg  $VO_2$ : 57.2%  $VO_{2max}$

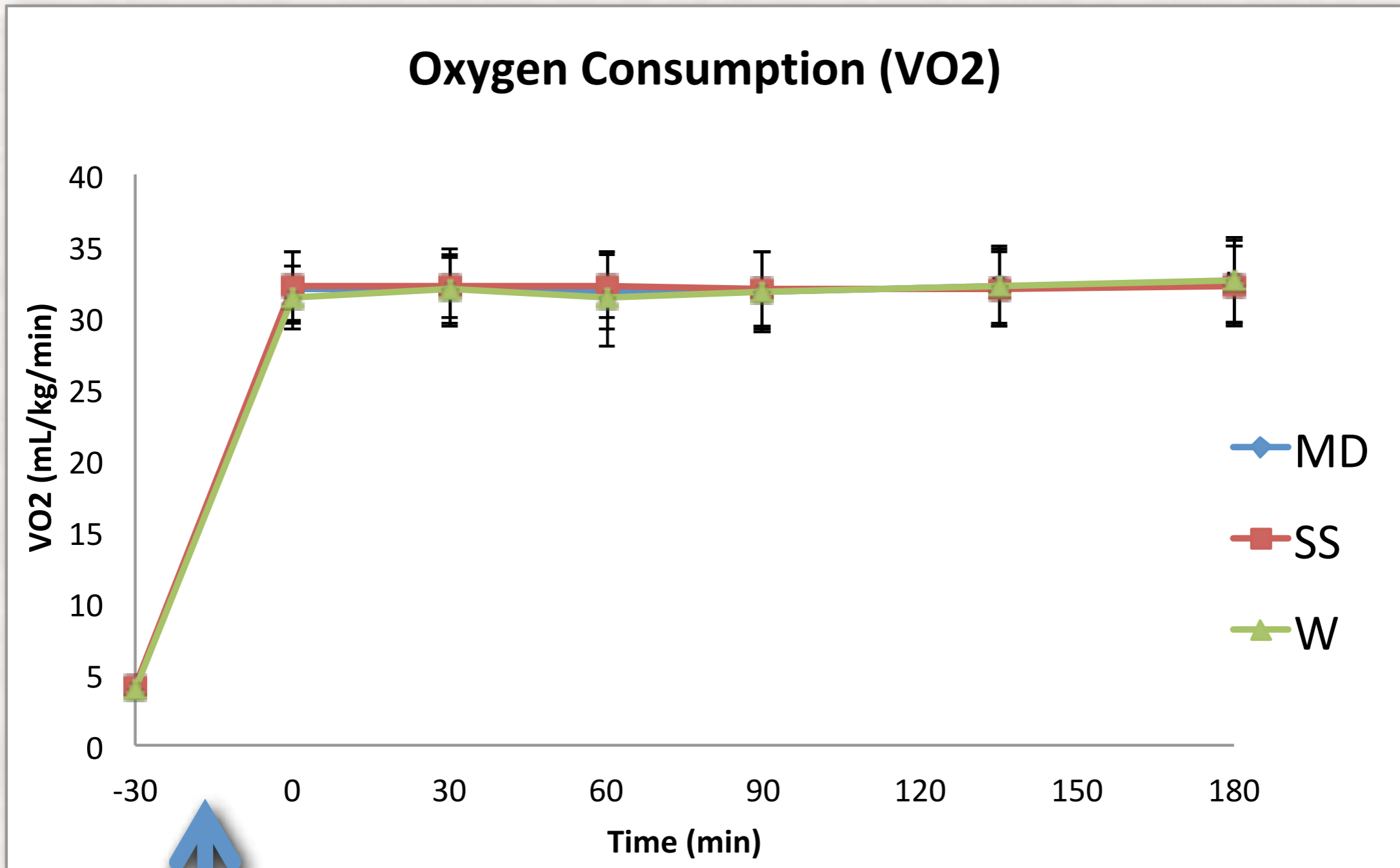
Avg kcal total: 2,030.5 kcal

Avg distance/3hr: 18.3 mi

Avg weight lost:  $4.5 \pm 0.5$  lb

# RESULTS

## Oxygen Consumption (VO<sub>2</sub>)

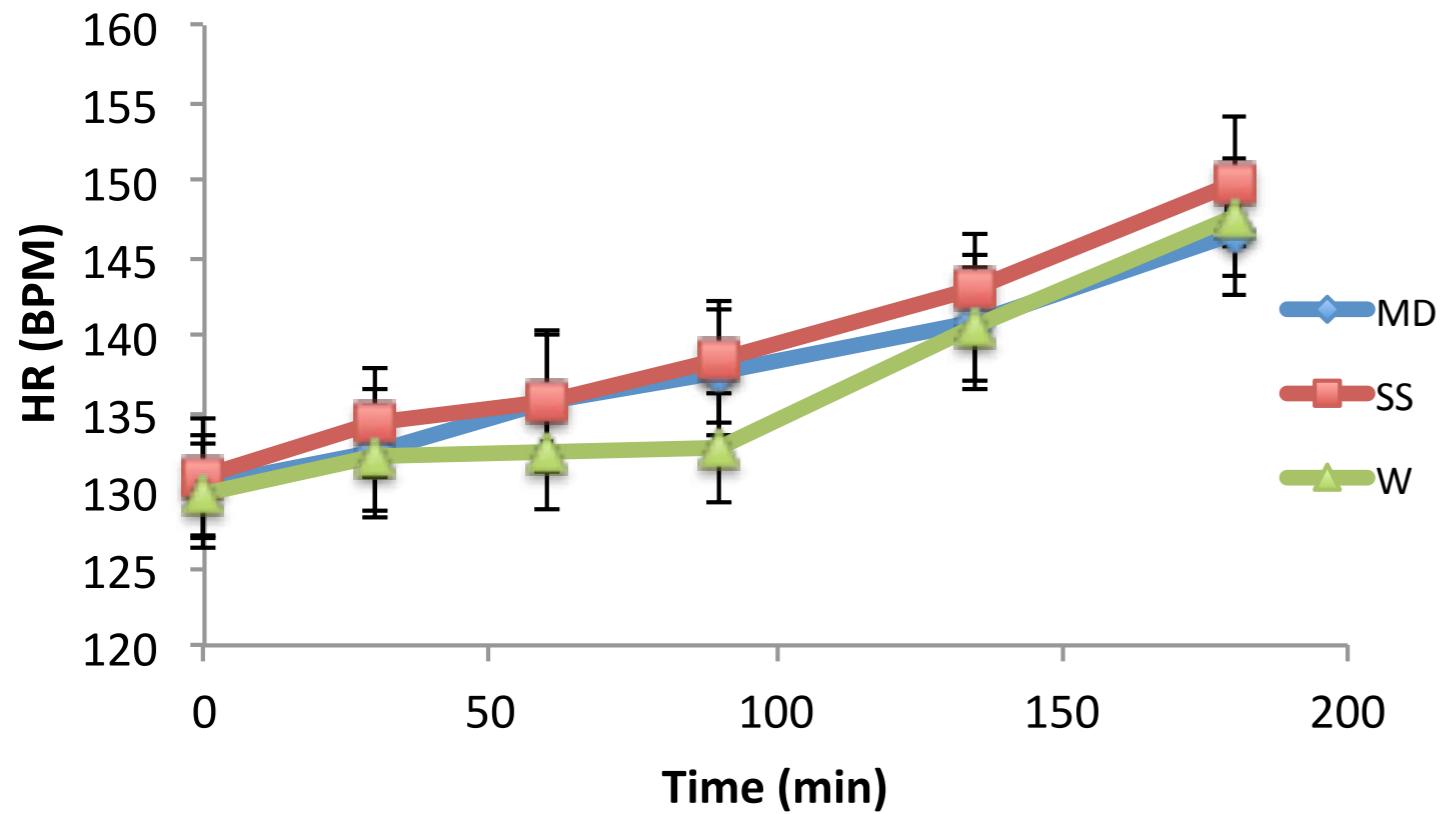


Consumed Drink

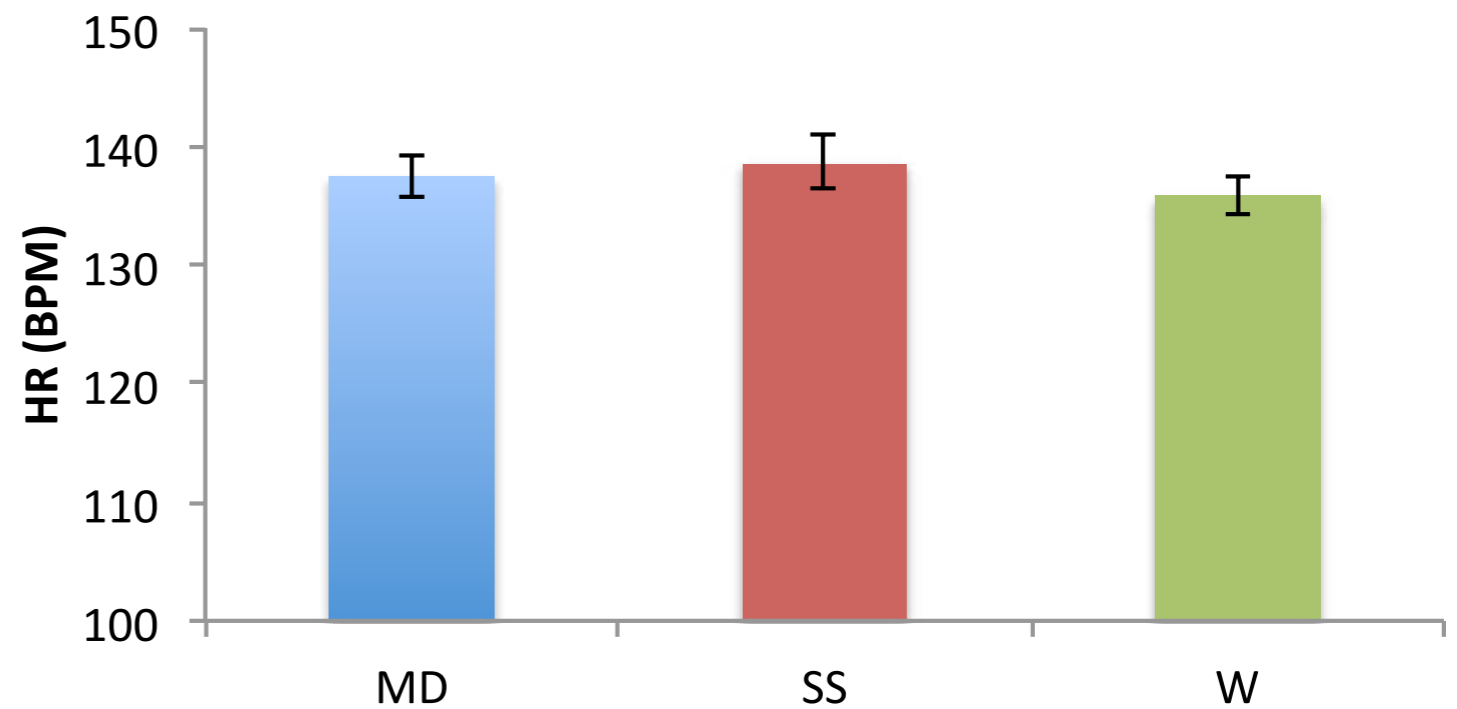
Run start



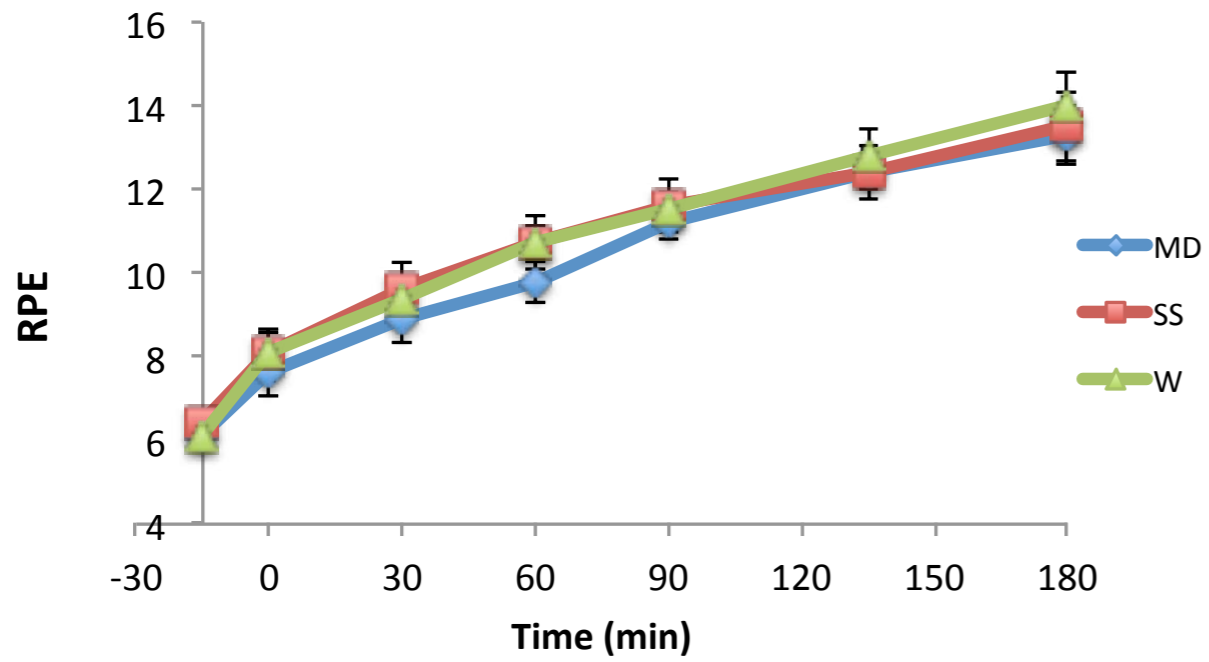
## Heart Rate During Run



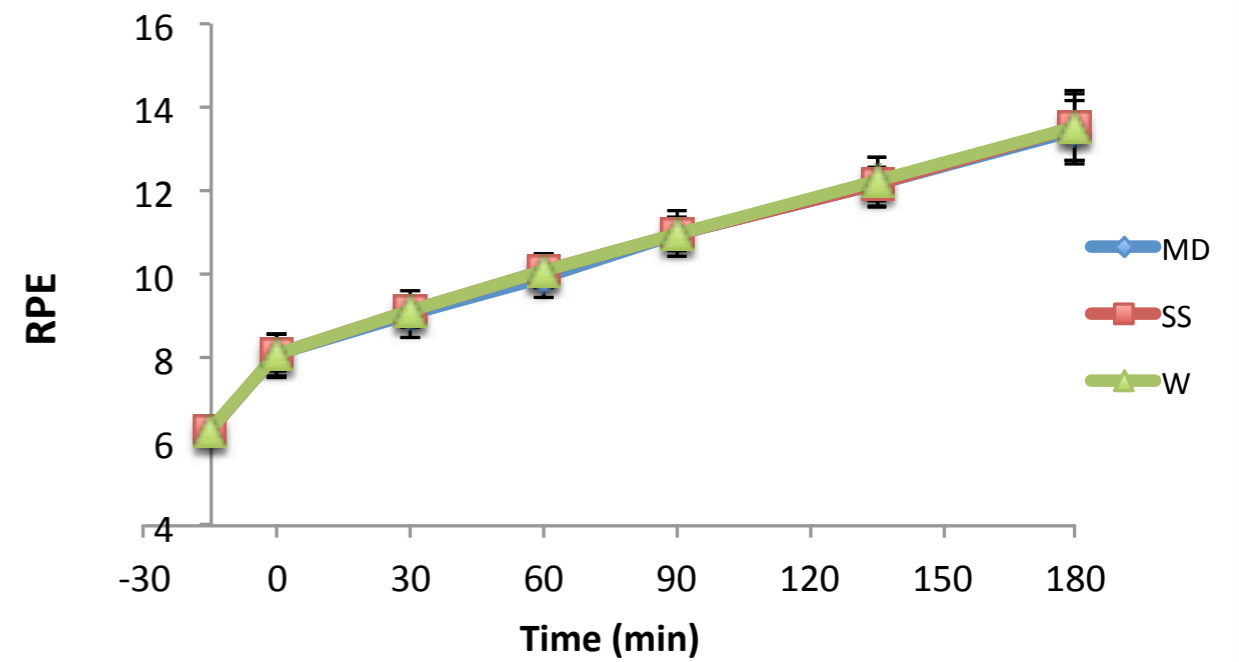
## Average Heart Rate



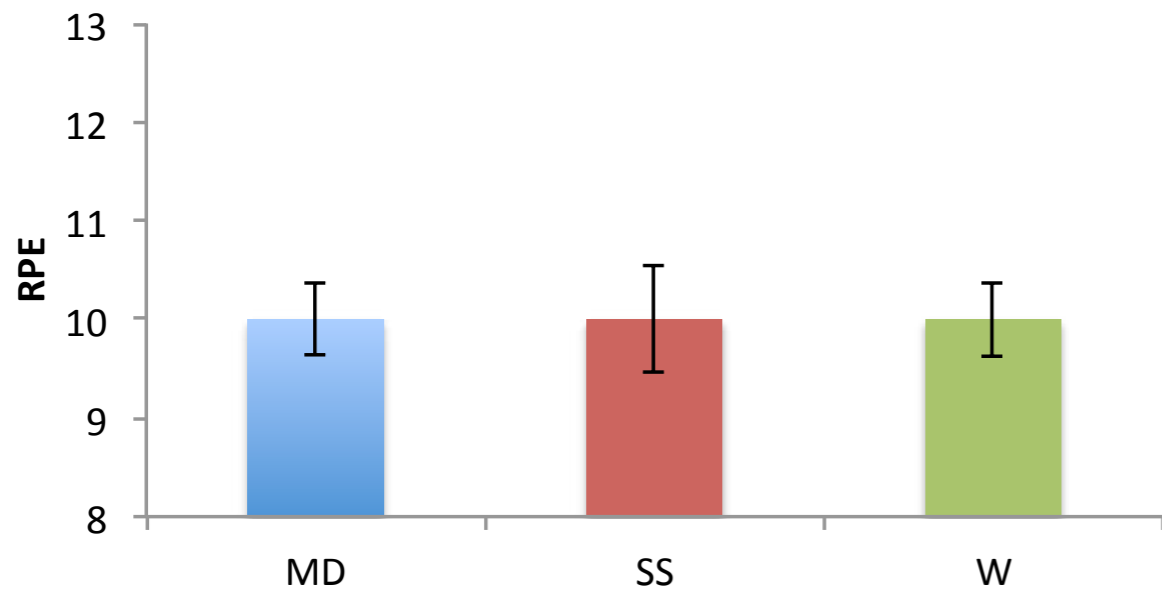
### RPE - Whole Body



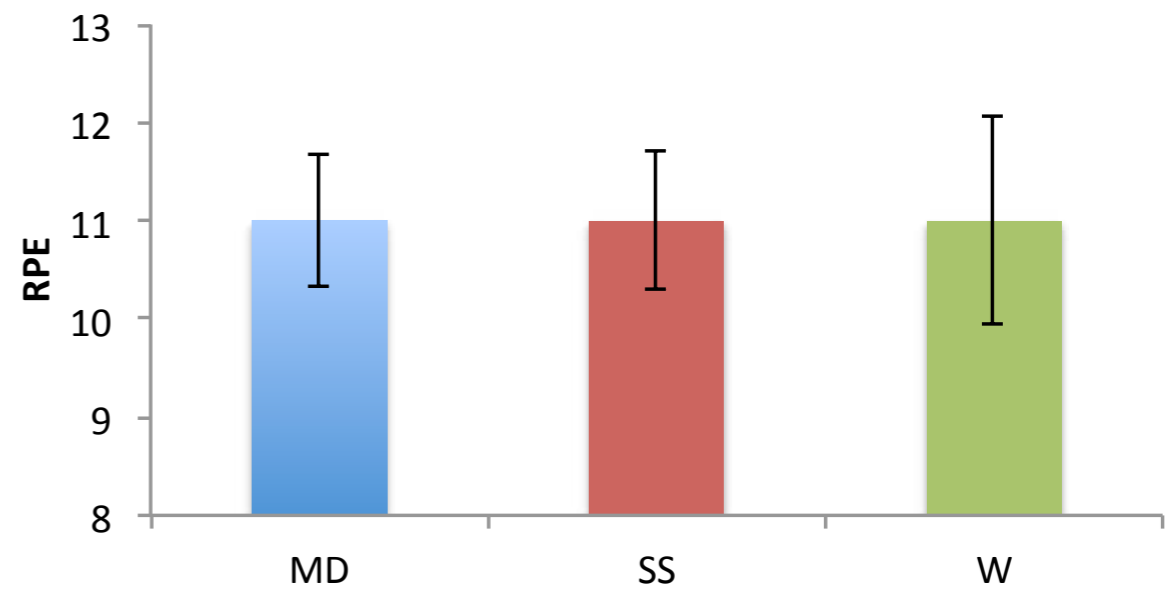
### RPE - Legs

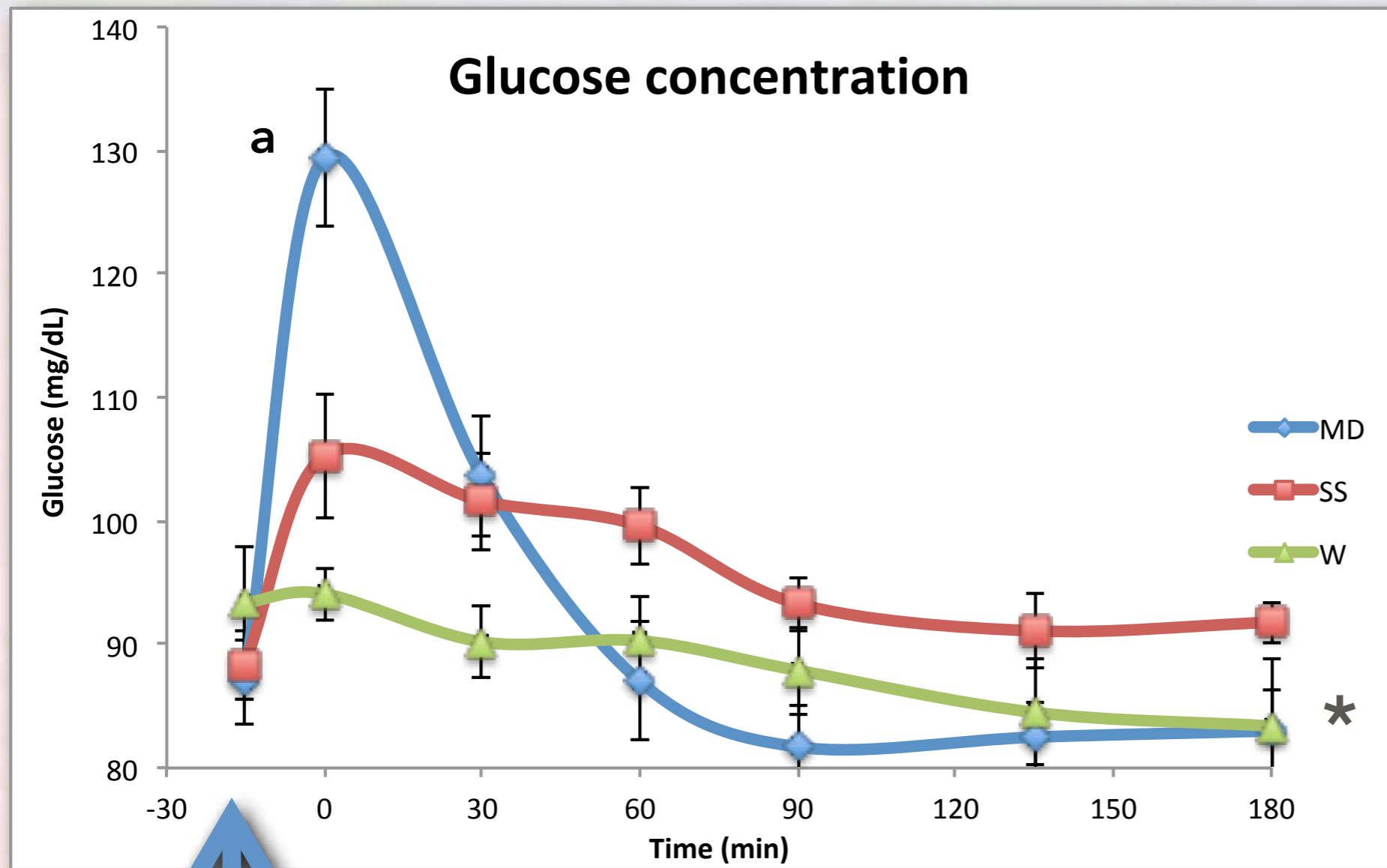


### RPE - Whole Body



### RPE - Legs

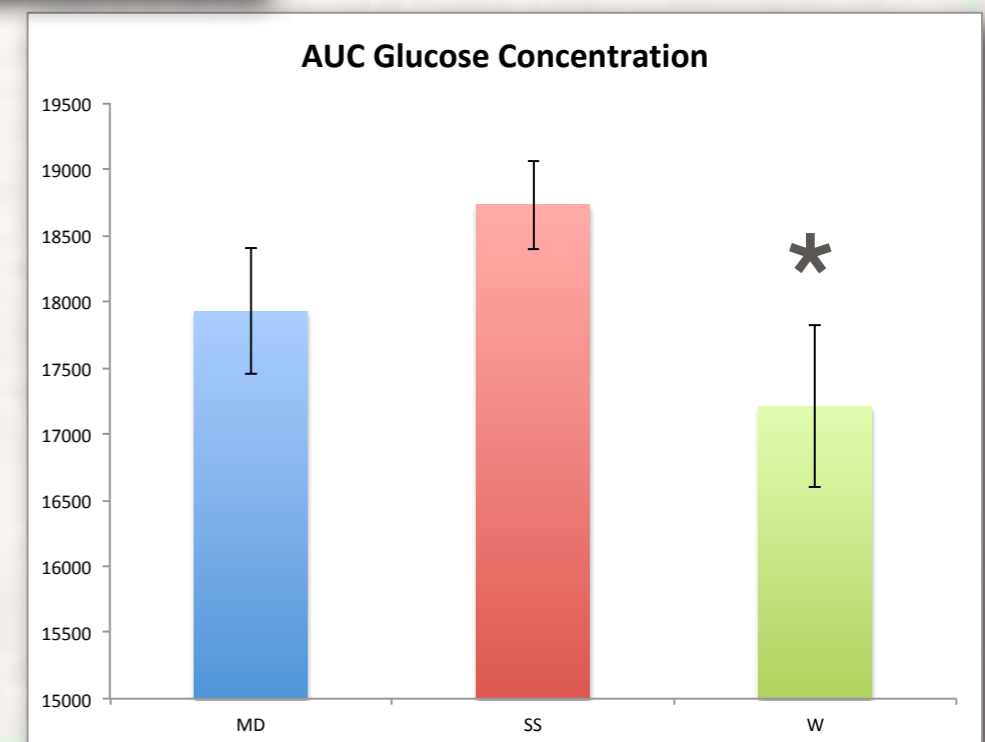


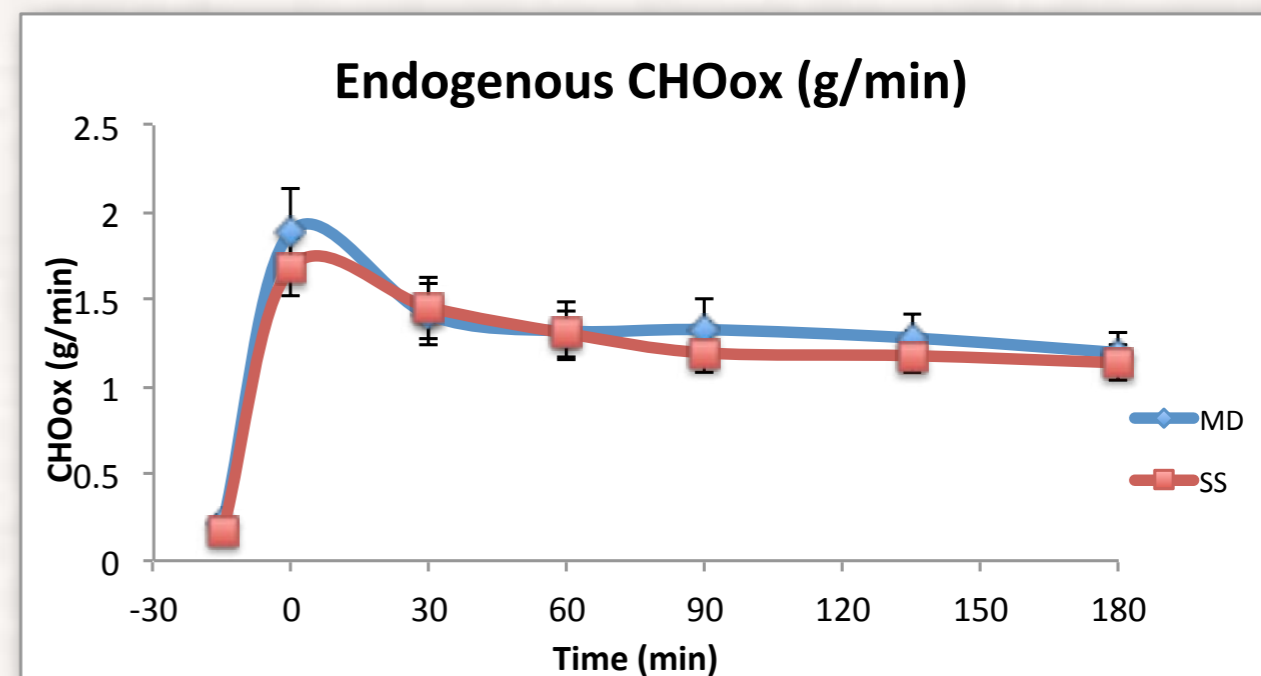
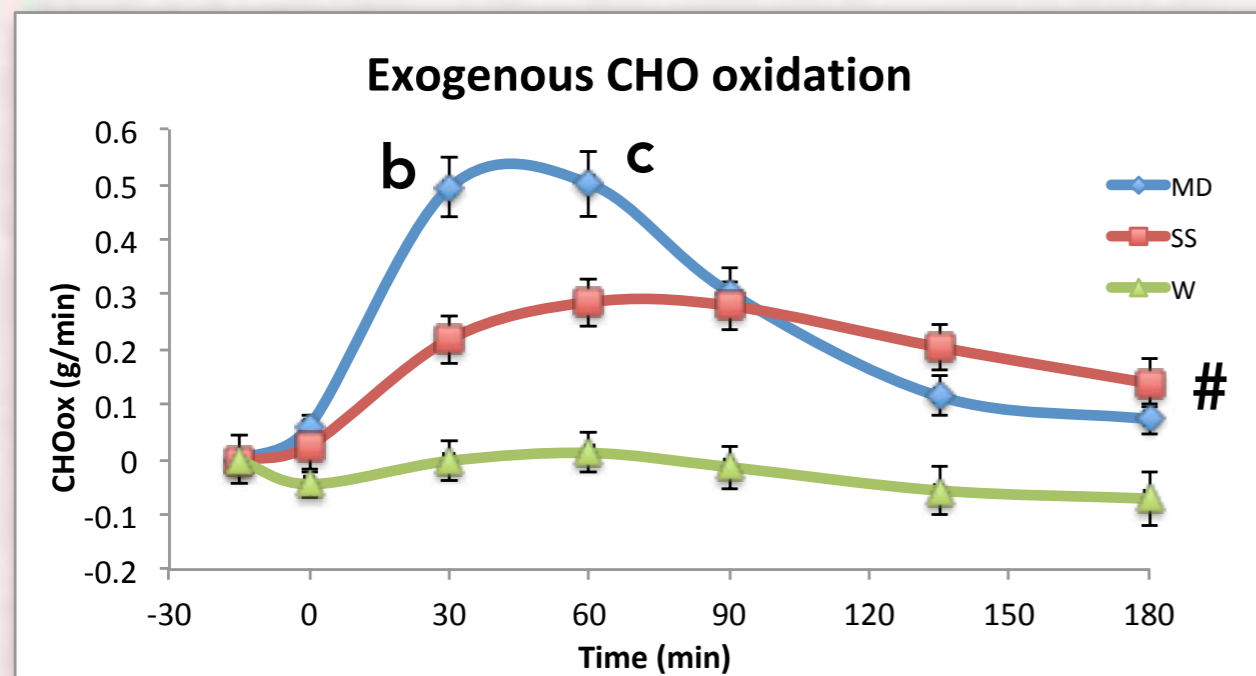
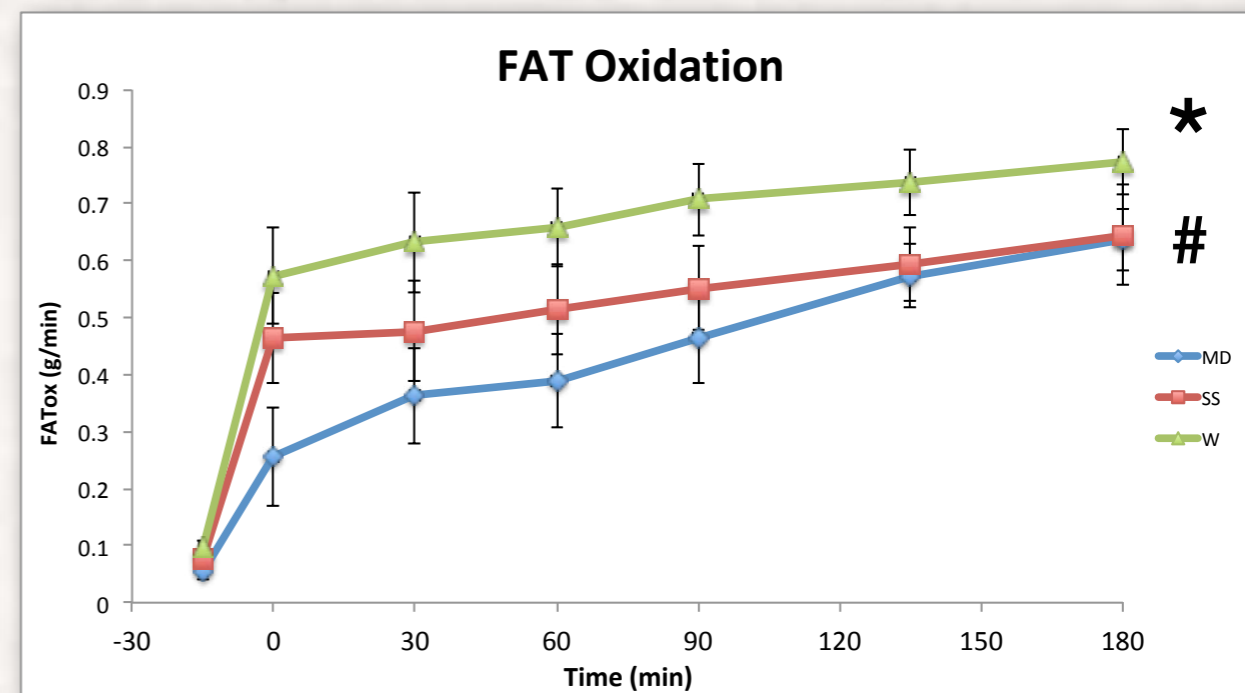
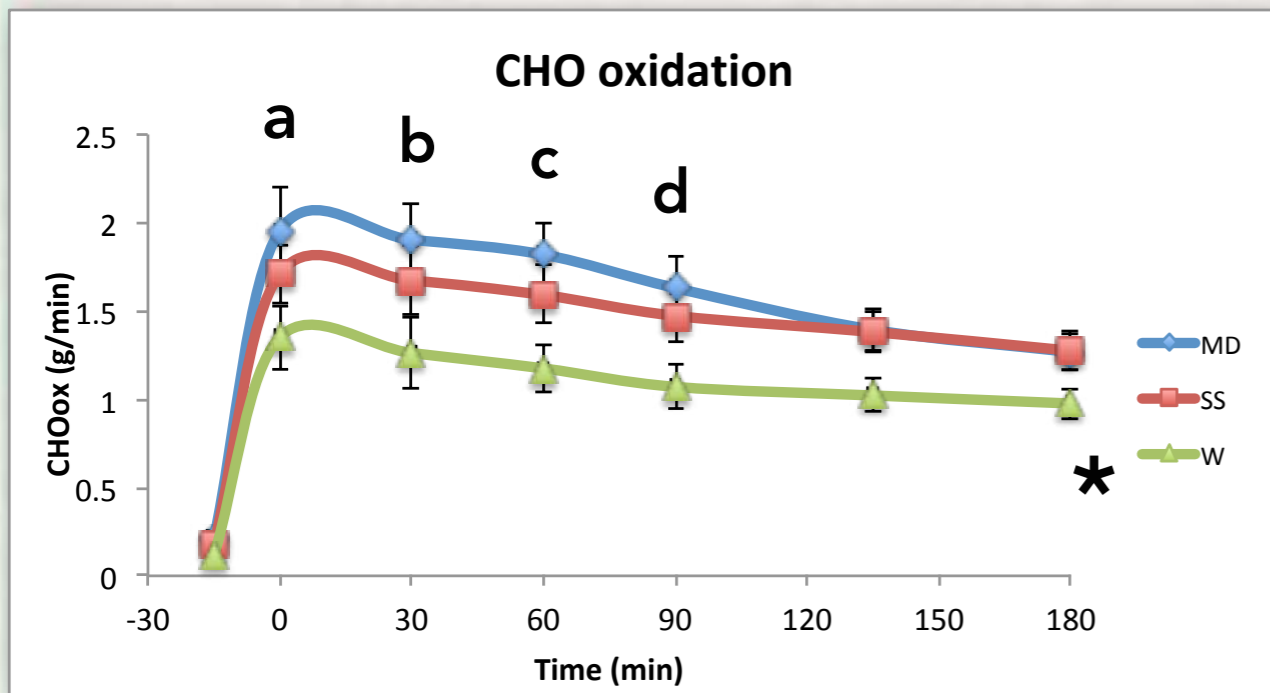


Consumed Drink

Run start

\* W significantly different from SS,  $p < 0.05$   
 a MD significantly higher than SS and W at 0 min

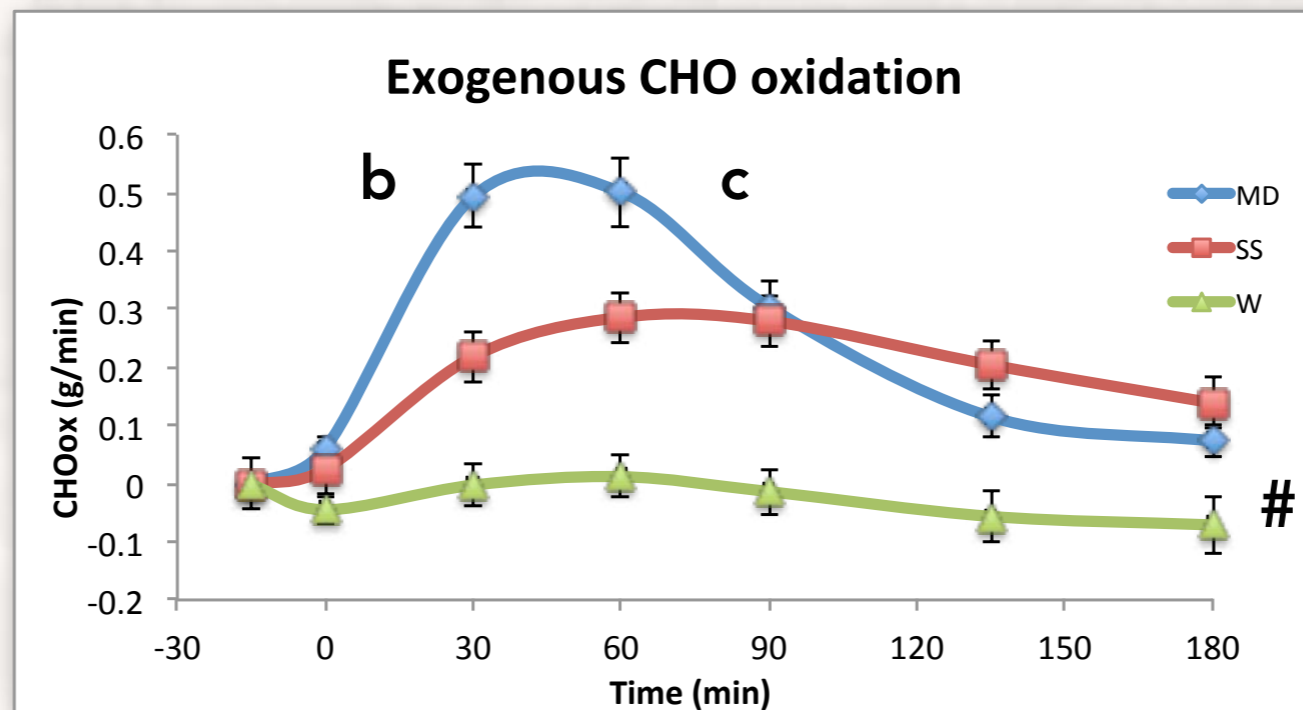
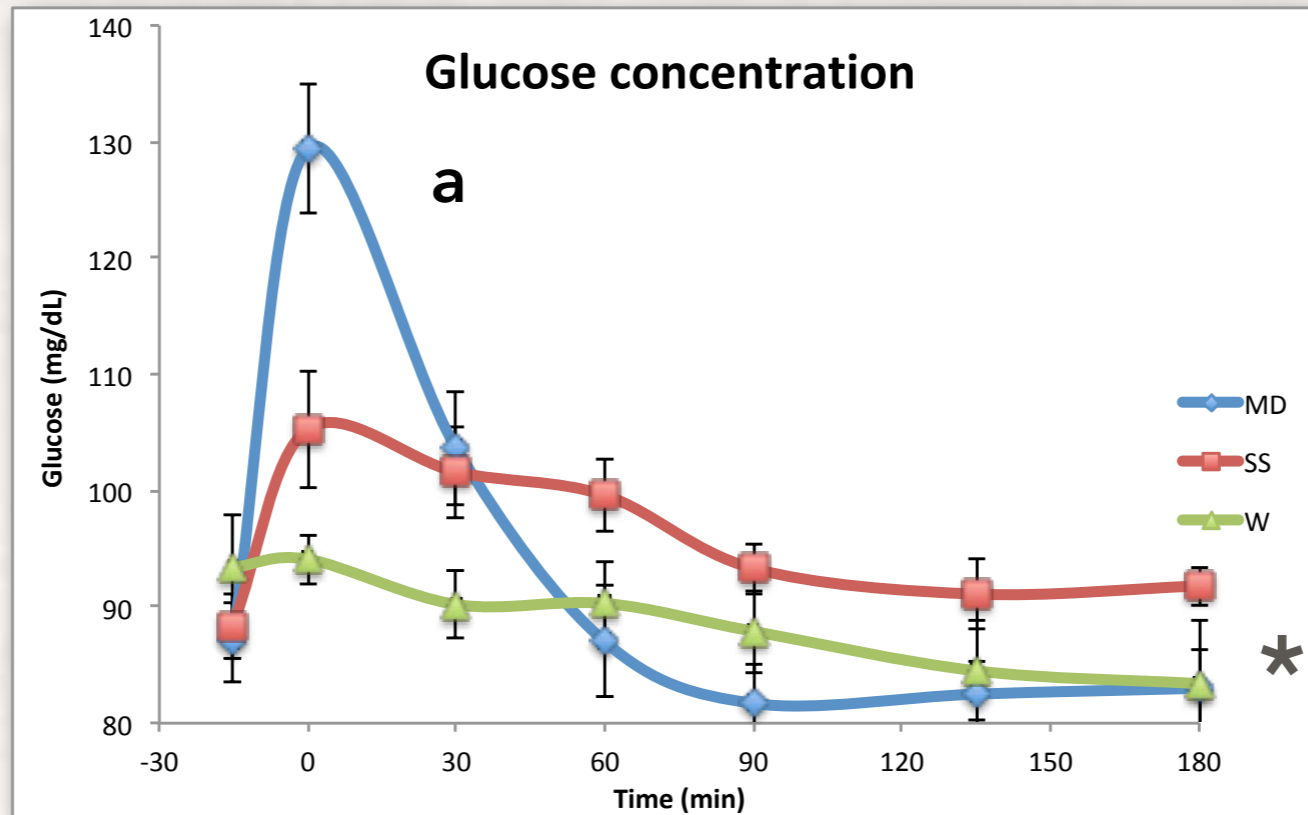




\* W significantly different from SS and MD,  $p < 0.001$

# SS significantly different from MD,  $p = 0.01$

a SS different than MD at 0 min  
 b SS different than MD at 30 min  
 c SS different than MD at 60 min  
 d SS different than MD at 90 min



\* W significantly different from SS and MD,  $p < 0.001$

a SS different than MD at 0 min

b SS different than MD at 30 min

# SS significantly different from MD,  $p = 0.01$

c SS different than MD at 60 min

# CHO oxidation

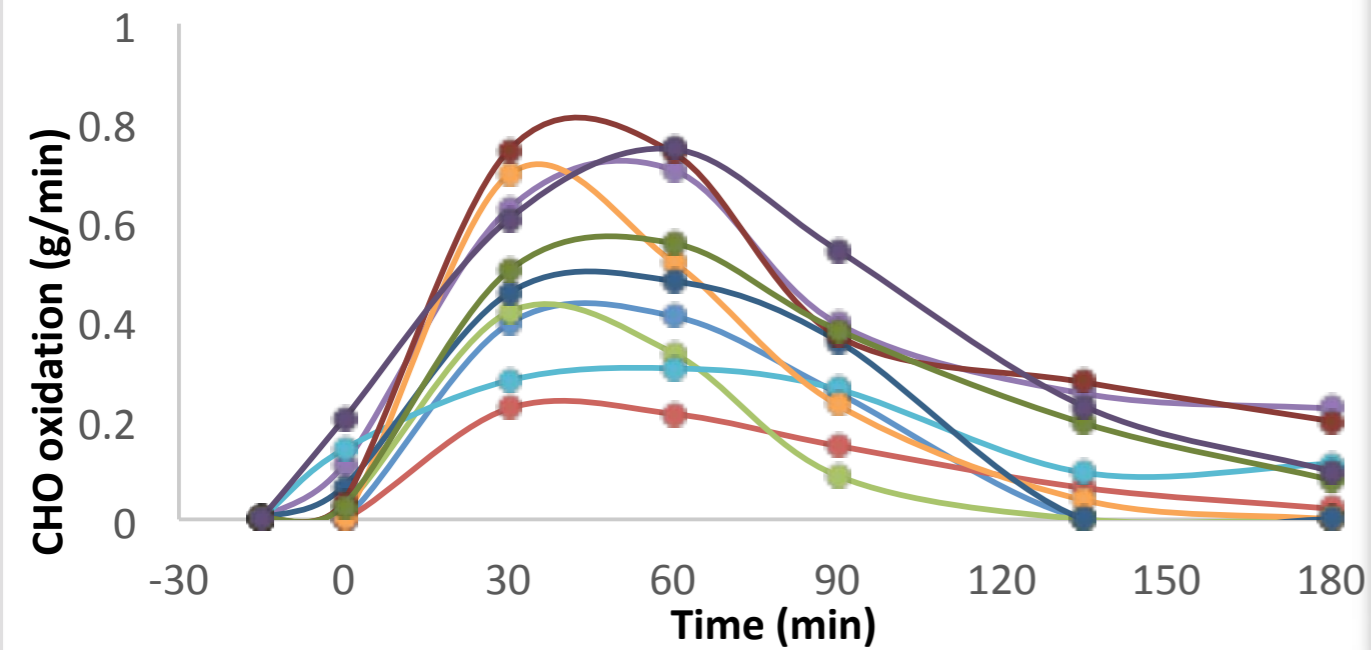
	MD	SS	W
CHOox Total	309.6 $\pm$ 30.2g	283.8 $\pm$ 25.9 g	212.4 $\pm$ 23.1g *
CHOox Exogenous	41.0 $\pm$ 5.5 g	31.9 $\pm$ 4.4 g #	N/A
CHOox Endogenous	268.6 $\pm$ 30.4g	251.9 $\pm$ 23.4g	212.4 $\pm$ 23.1g
% Recovery	82.0 $\pm$ 10.9%	63.9 $\pm$ 8.9%	NA

\* W significantly different from MD,  $p < 0.001$

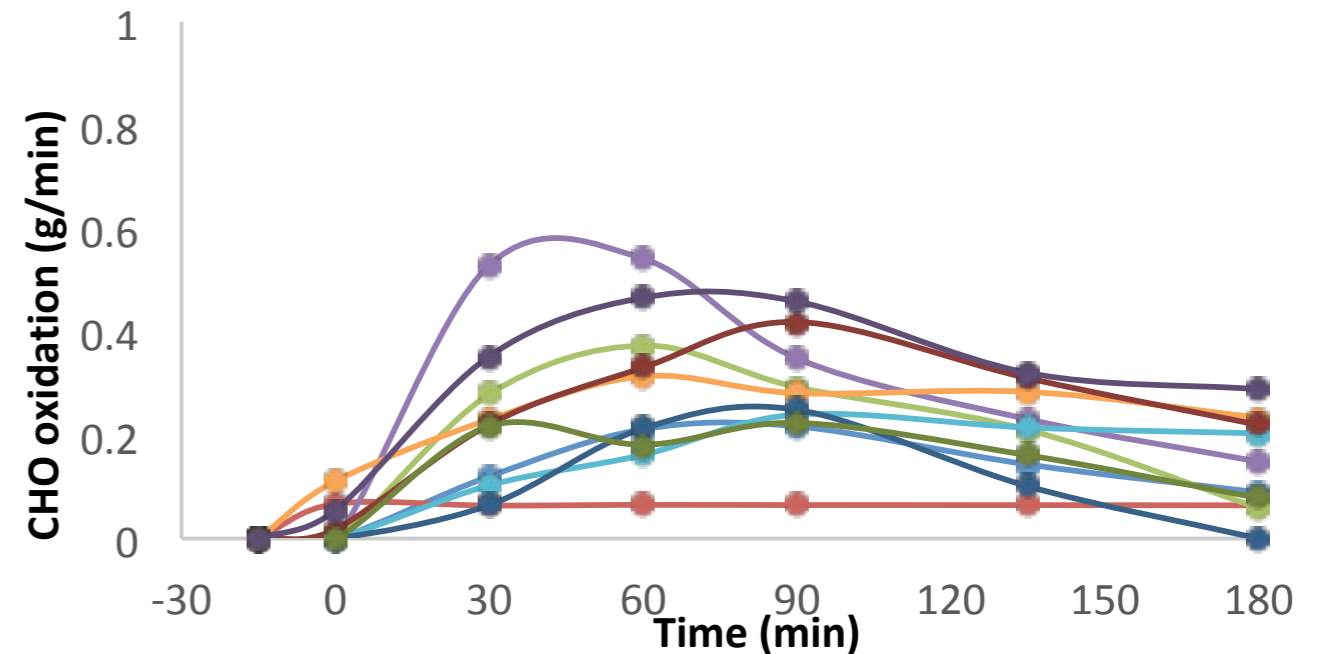
# SS significantly different from MD,  $p = <0.001$

# Individual Data Exogenous CHOox

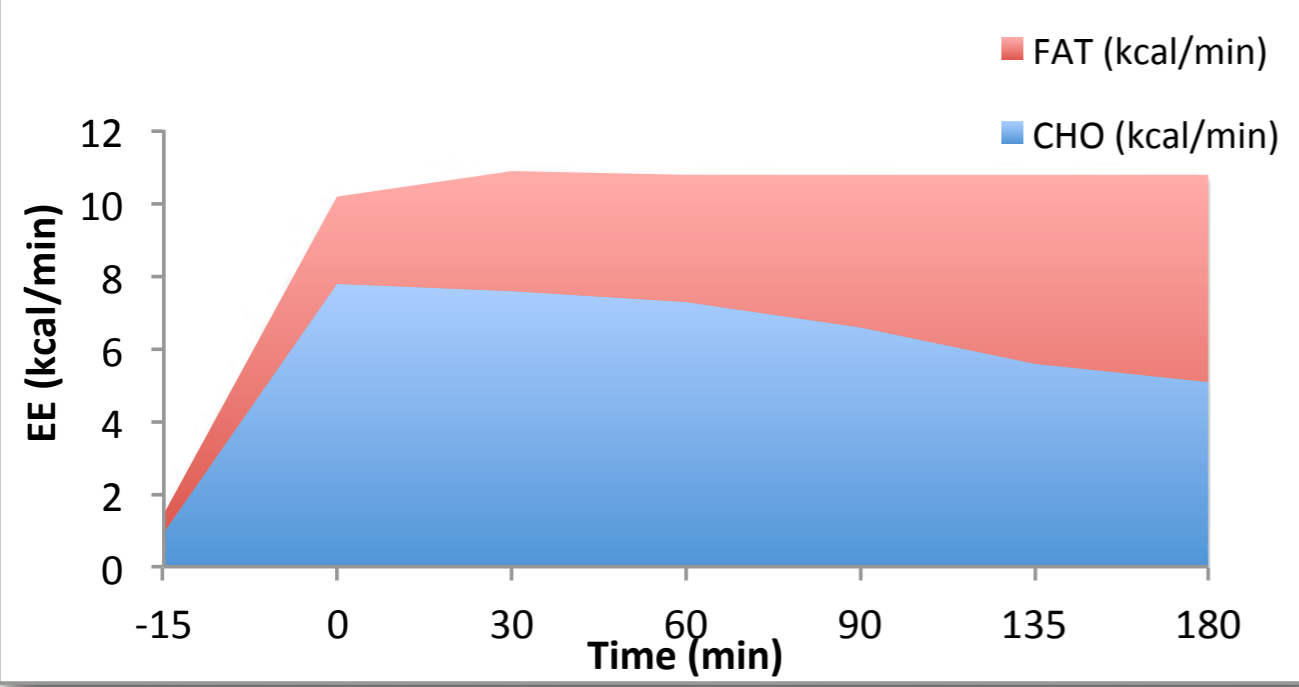
## Individual Exogenous CHOox - MD



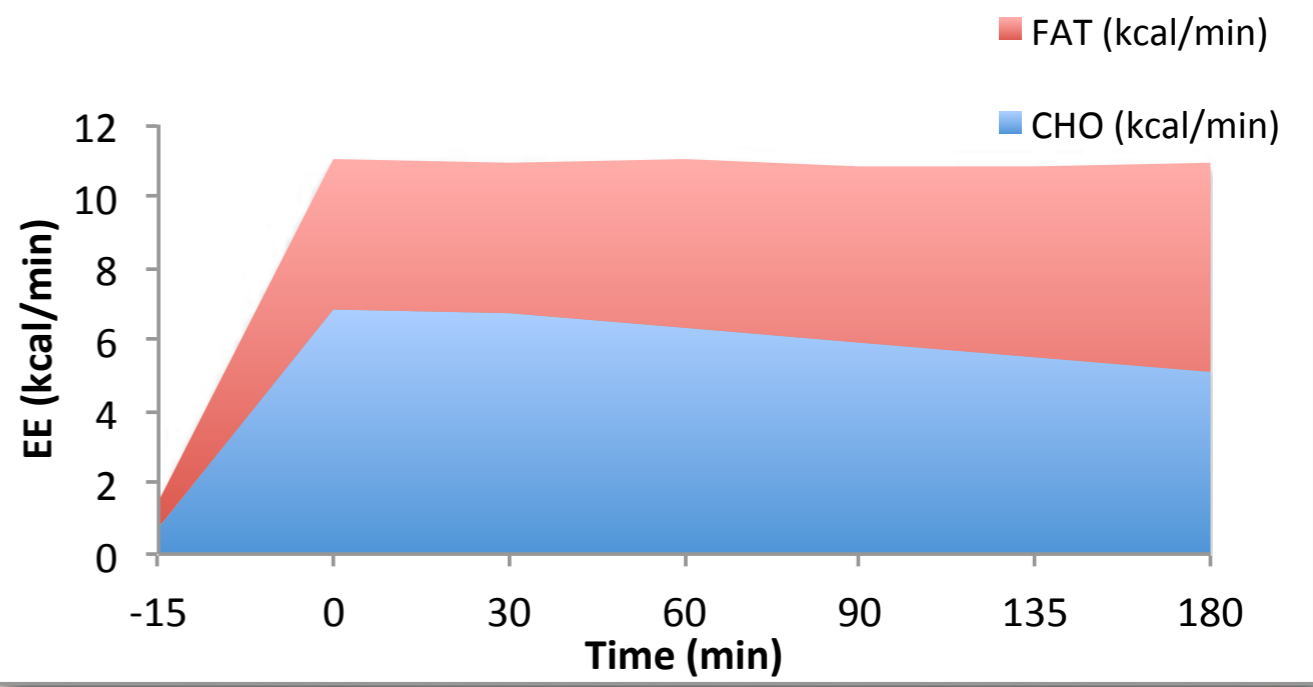
## Individual Exogenous CHOox - SS



### EE (kcal/min) Contribution - MD

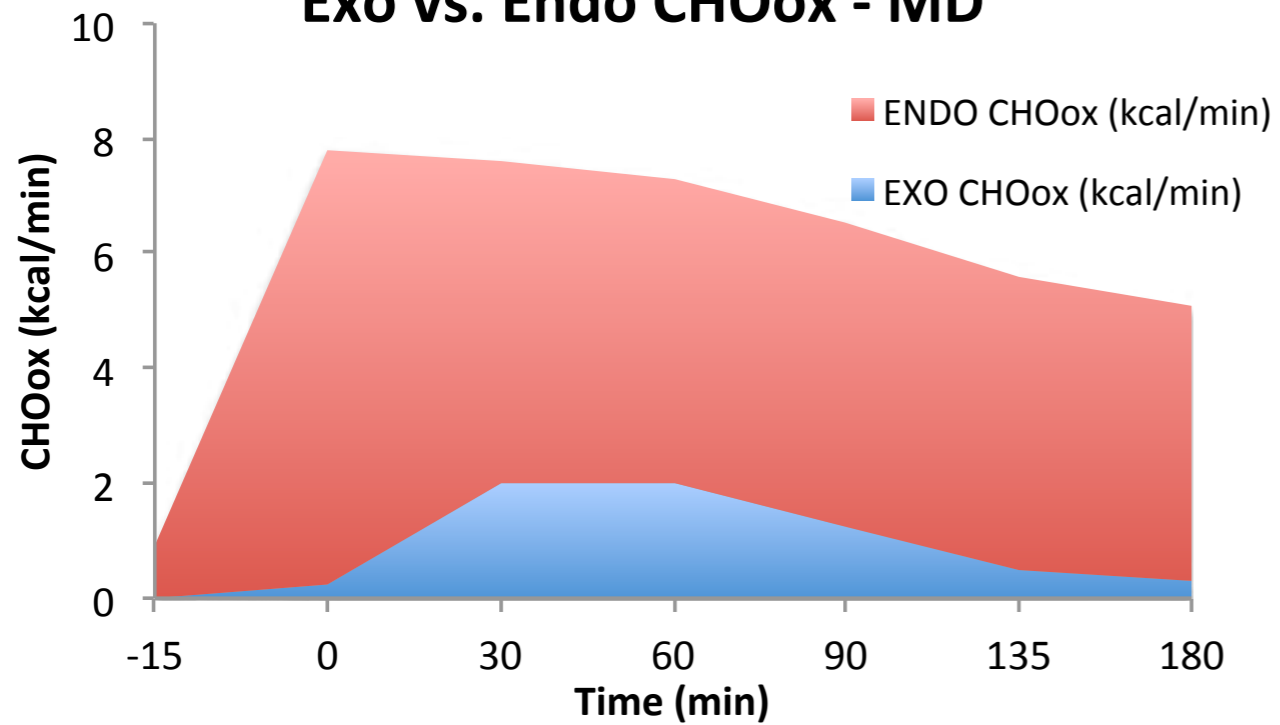


### EE (kcal/min) Contribution - SS

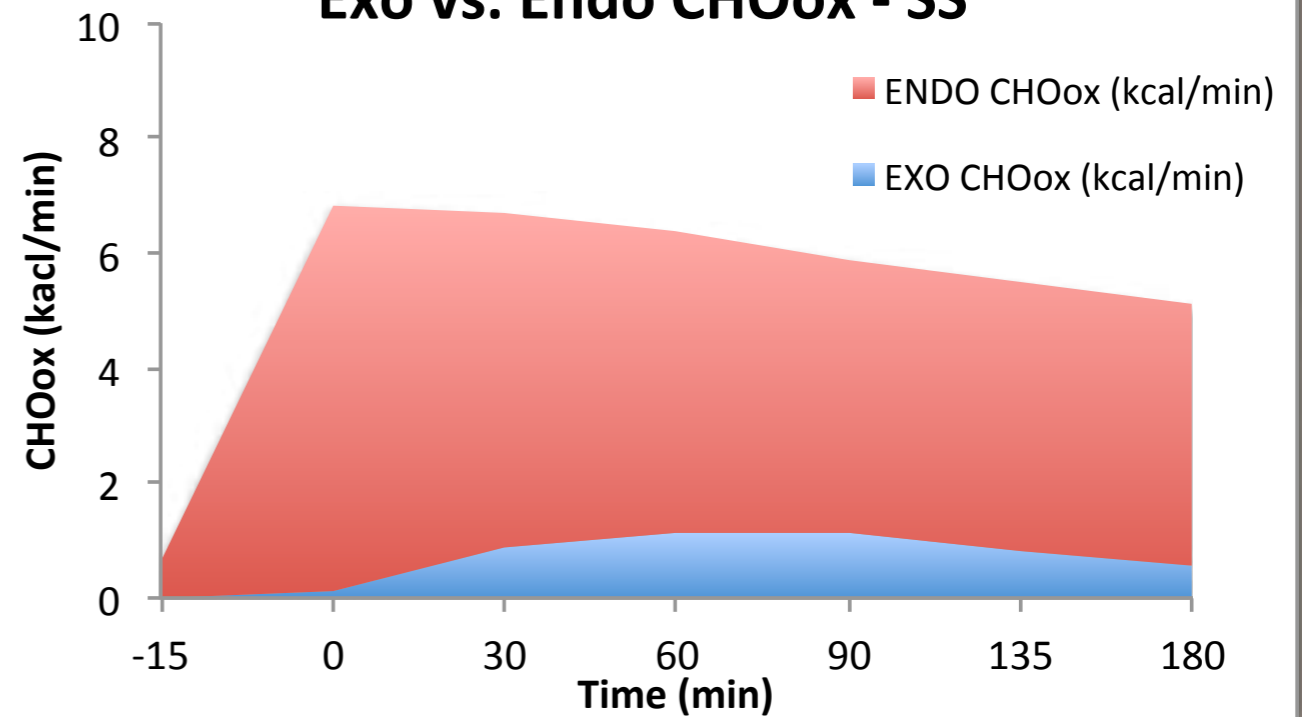




### Exo vs. Endo CHOox - MD



### Exo vs. Endo CHOox - SS

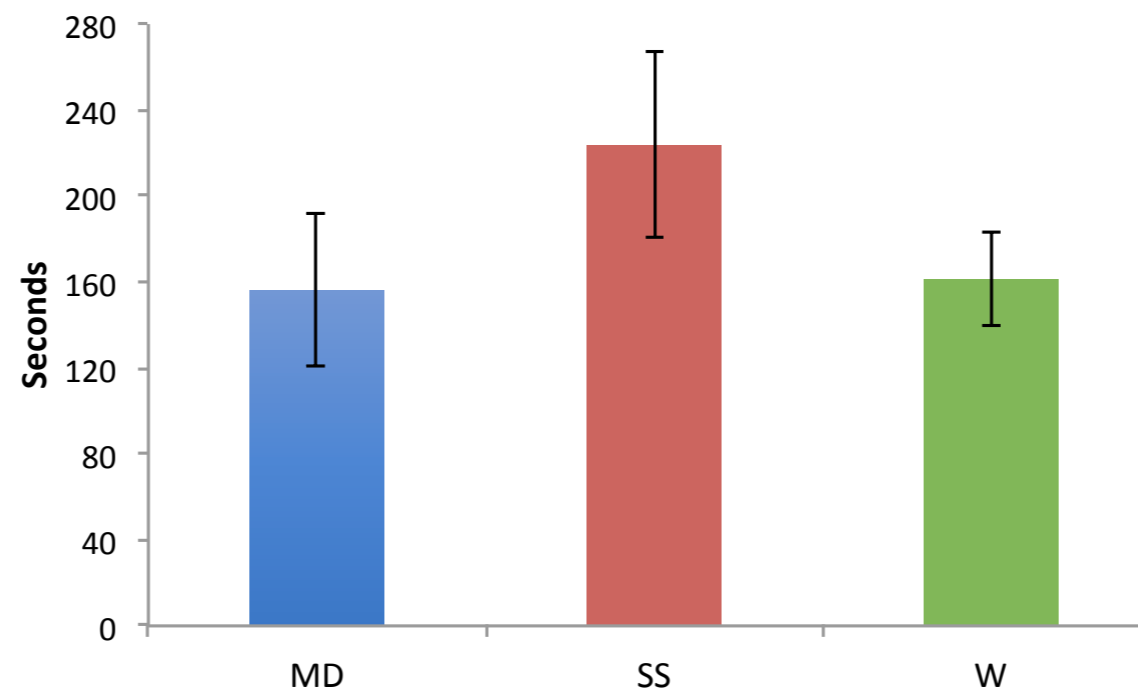


# PERFORMANCE

## Time Trial

	MD	SS	W
Speed	9.8 ± 0.6 mph	9.8 ± 0.6 mph	9.8 ± 0.6 mph
HR	177 ± 1.7 BPM	179 ± 2.2 BPM	176 ± 1.6 BPM
RPE	17 ± 0.6	17 ± 0.6	17 ± 0.6
Lactate	5.1 ± 0.8 mmol/L	6.8 ± 0.9 mmol/L	5.9 ± 0.6 mmol/L
TT Duration	156 ± 35.5 sec	224 ± 42.9 sec	161 ± 21.4 sec

### Time Trial (Time to Fatigue)



Time trial;  $p = 0.18$

# CONCLUSIONS

- The consumption of a single bolus of CHO beverage prior to a 3hr run elicits significant alterations in energy metabolism compared to just water, with slow CHO (SS) burning significantly less total carbohydrate and more fat than a rapidly digested (MD) carbohydrate.
- The SS CHO provided a more stable and consistent energy metabolism profile, in addition to the most stable glucose concentration during the run.
- These findings provide evidence that slow absorption CHO (SS) provides a consistent blood glucose and sustained exogenous energy supply during a sustained 3-hr endurance run, when given in a single bolus.
- There was no significant improvement in TT performance

# ACKNOWLEDGMENTS

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- Metabolic Solutions (Dr. David Wagner)
  
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# QUESTIONS?

