Impact of Menopausal Status and BMI on Metabolic Flexibility

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INTRODUCTION

Menopause and the associated changes in hormones (i.e. estrogen and progesterone) are known to negatively impact body composition and metabolism, ultimately producing a metabolically compromised phenotype. Physical activity and exercise may mitigate these changes; however, little is known about substrate utilization and metabolic flexibility in menopausal women. Identifying changes in metabolic flexibility may highlight a critical window for preventative interventions.

PURPOSE:
The purpose of this study was to compare fat and carbohydrate oxidation at rest and during exercise (metabolic flexibility) in pre-menopausal (PRE), peri-menopausal (PERI), and post-menopausal (POST) women of varying adiposity levels.

FORMULAS

$$\mathbf{RER}(a.u.) = \frac{VCO_2\ (L * min^{-1})}{VO_2\ (L * min^{-1})}$$

Intensity	%HRR
Low	≤ 30%
Moderate	31-≤50%
High	>50%

Table 1. Designated HRR ranges for the intensities from the submaximal exercise test.

PRACTICAL APPLICATION

At all intensities (rest, low, moderate, and high), **post-menopausal women** oxidized the **most carbohydrates (and least amount of fat)** as indicated by a higher RER. Metabolic flexibility displayed in pre-menopausal women is **diminished in both peri- and post-menopausal women**.

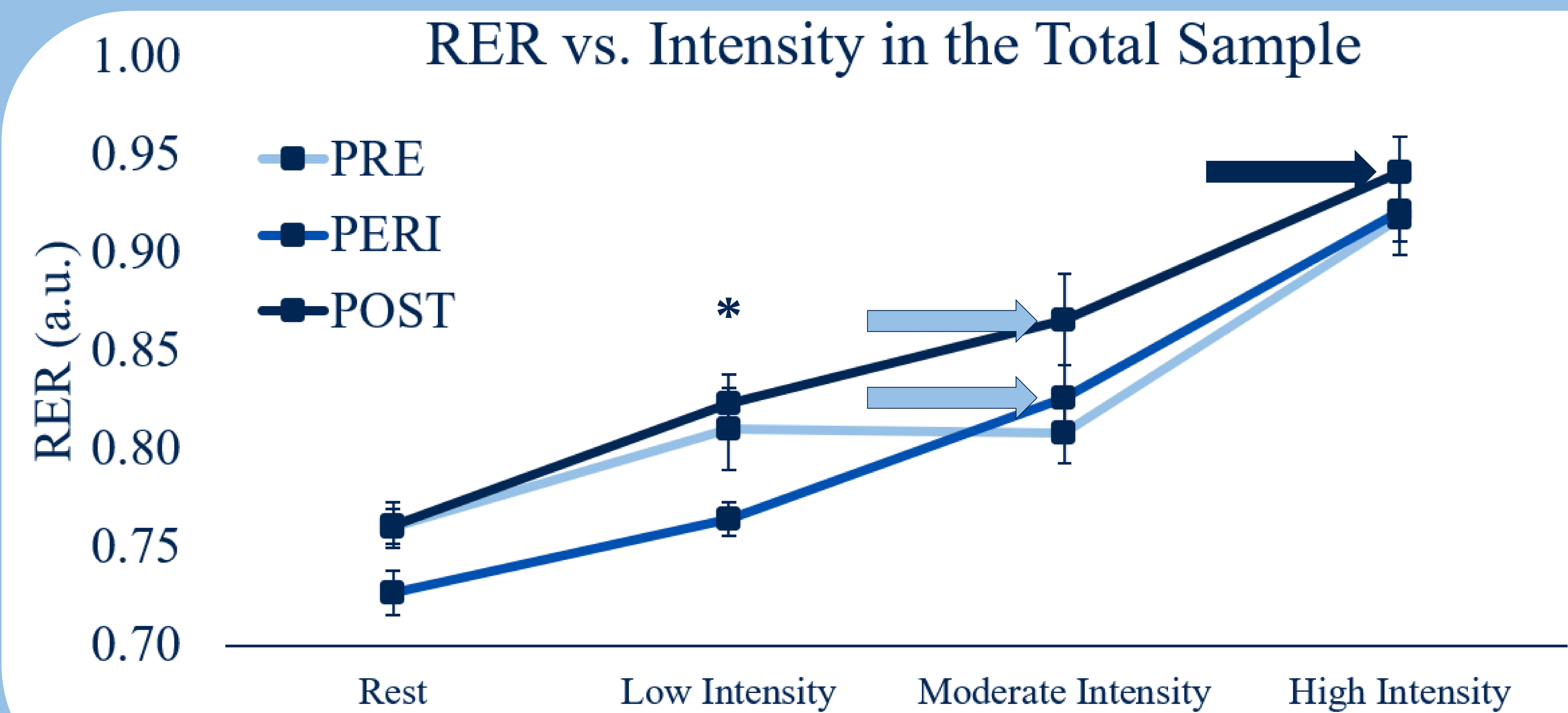


Figure 1. RER versus intensity. Lower RER = greater fat oxidation. Mean data are presented per menopausal group, and error bars represent standard error. * indicates statistical significance (p<0.05) between PERI and POST.

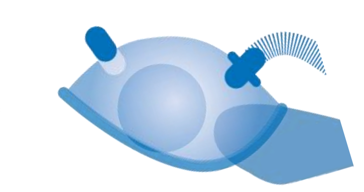
It appears that **menopause yields reduced fat oxidation** during **moderate intensity** exercise to a greater extent in POST than PERI (light blue arrows). This reduction **persisted** during **high intensity** exercise in **POST** (dark blue arrow). The lower RER values observed in PERI at rest and during low intensity exercise were not sustained.

Reduced metabolic flexibility in PERI compared to PRE may identify **peri-menopause** as a **critical window** for **preventative intervention**.

METHODS

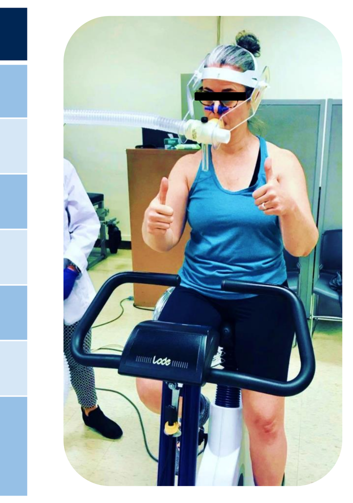
72 healthy women (24 PRE, 24 PERI, 24 POST) (Mean±SD: Age: 48.28±7.21 yrs, BMI 26.01±5.21 kg/m^2, Range: 18.81-41.00 kg/m^2) underwent metabolic assessments at rest and during exercise

Resting Metabolism
Indirect Calorimetry; TrueOne 2400, Parvomedics, Inc., Sandy, UT, USA



Exercise Metabolism
Indirect Calorimetry; TrueMax 2400, Parvomedics, Inc., Sandy, UT, USA. Participants cycled on a cycle ergometer wearing a heart rate monitor until they reached 75% of their heart rate reserve (HRR).

Stage	Length	Wattage
Warm-Up	2 min	0
1	2 min	25
2	2 min	50
3	2 min	75
4	2 min	100
5	2 min	125
Continue until 75% HRR, (([Max HR-Resting HR])*0.75+ Resting HR)		



One-way ANOVAs with Bonferroni post-hoc comparisons were conducted by intensity (Rest, Low, Moderate, High) for the total sample and stratified by BMI: Normal: 18.5-24.9 kg/m^2; Overweight/Obese: ≥25.0 kg/m^2

CONCLUSION

Transitioning to menopause appears to reduce metabolic flexibility during exercise, impacting POST women to a greater extent than PERI; metabolic inflexibility through menopause may be exacerbated by obesity.

RESULTS

Variable	PRE (n=24)	PERI (n=24)	POST (n=24)
Age (yrs)	39.79 ± 3.27*	49.96 ± 3.37*	55.08 ± 3.49*
BMI (kg/m²)	25.25 ± 5.06	26.48 ± 5.44	26.42 ± 5.24
Salivary Estradiol (pg/mL)	0.85 ± 0.47	1.02 ± 0.42	0.79 ± 0.29
Resting RER (a.u.)	0.76 ± 0.04	0.73 ± 0.06†	0.76 ± 0.06
Low Intensity RER (a.u.)	0.81 ± 0.10	0.76 ± 0.04*	0.82 ± 0.07
Moderate Intensity RER (a.u.)	0.81 ± 0.08	0.83 ± 0.08	0.87 ± 0.11
High Intensity RER (a.u.)	0.92 ± 0.09	0.92 ± 0.08	0.94 ± 0.09

Table 2. Results from ANOVAs in the total sample. Data are presented as mean ± standard deviation. * indicates significance (p<0.05) between PERI and POST, and † indicates trending toward significance (p=0.09) between PERI and PRE.

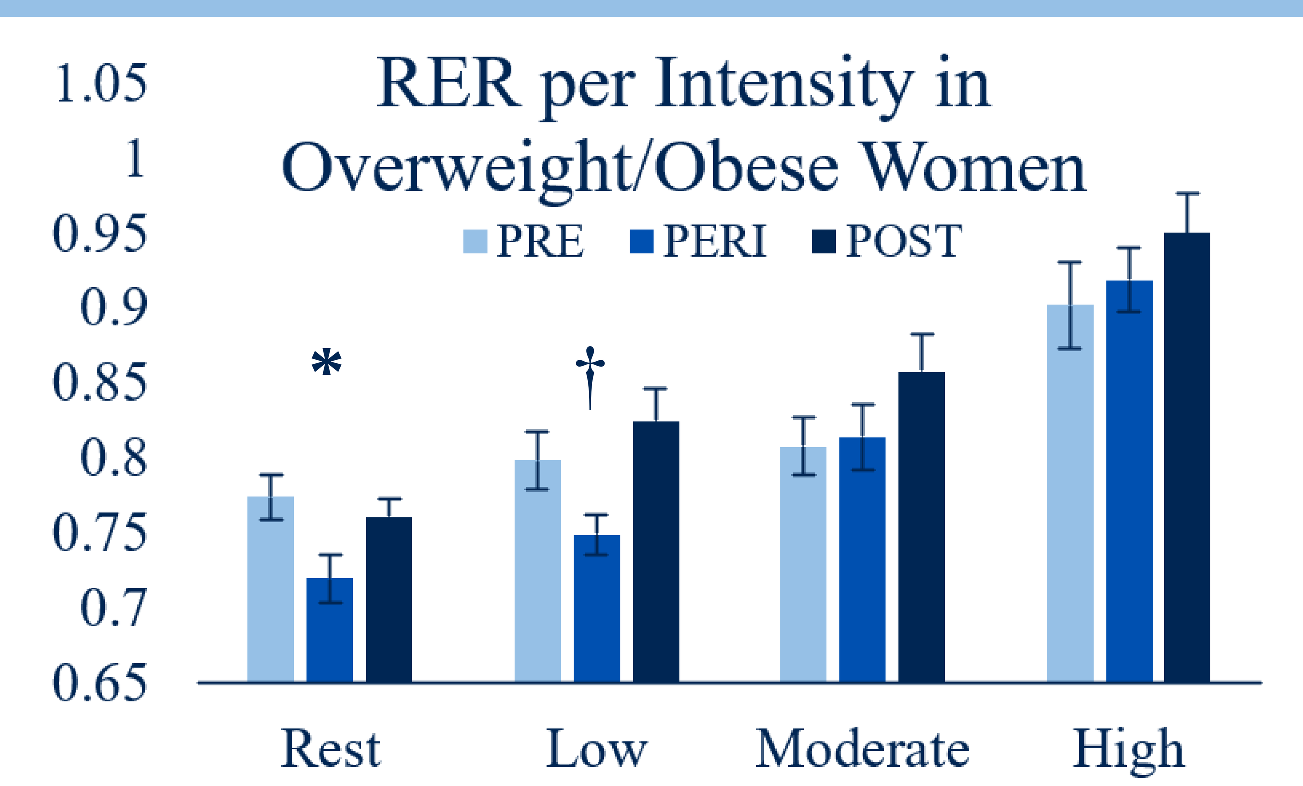


Figure 2. RER per intensity in Overweight/Obese women. Data are presented as mean ± standard deviation. * indicates significance (p<0.05) between PERI and PRE and † between PERI and POST.

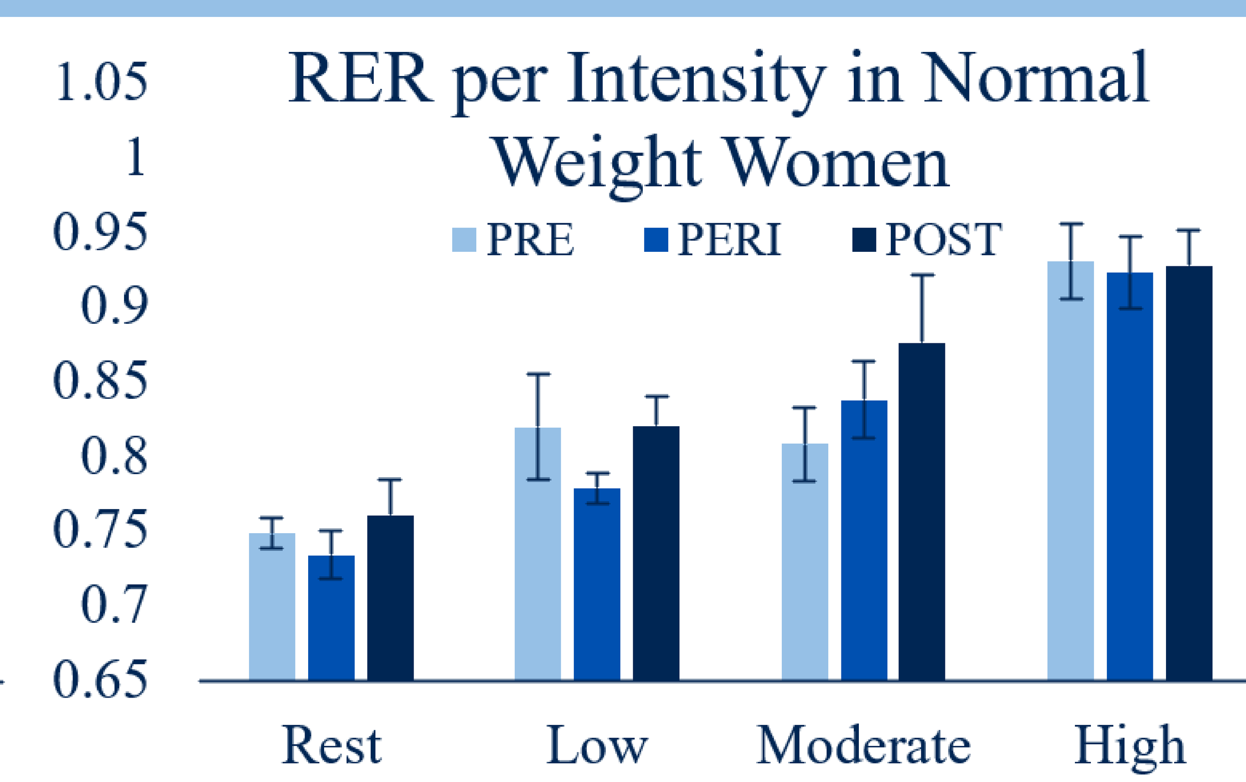


Figure 3. RER per intensity in normal weight women. Data are presented as mean ± standard deviation. RER was similar between groups at all intensities (p>0.05).

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