Resistance Training Modulation of Fat Metabolism in Postmenopausal Women with Obesity

Molly Keith, Hayley Schermer, Michael Ormsbee, Robert Hickner, and Mostafa Ali
Collage of Education, Health, and Human Sciences

Abstract:

Through our research, we aim to better understand the possible positive outcomes of regular exercise in preventing diabetes in postmenopausal women. We hope to provide these women with greater insight into improving their health. Our study involves participants undergoing twelve weeks of a guided exercise program, focusing on either resistance or endurance training. Using microdialysis, we evaluate their fat metabolism and lipolytic activity before and after the exercise interventions. Microdialysis is a minimally invasive approach to collecting extracellular fluid from the interstitial space of tissues in the body; for this study, we focus on subcutaneous gluteal and abdominal adipose tissue.

Background:

- Prediabetes is an extremely common, and serious condition that has been found in more than half of postmenopausal women.
- Women with this condition are characterized with insulin resistance and impaired lipolytic activity.
- Lipolysis is the means by which glycerol and free fatty acids are produced from triglycerides through hydrolysis.

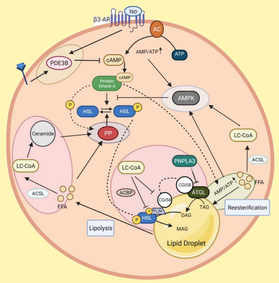


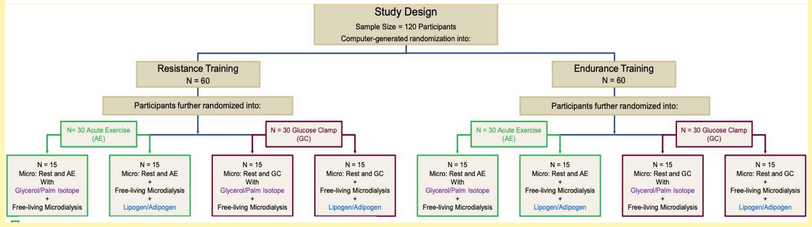
Figure 1: The intracellular process of adipose tissue lipogenesis (Li et al. 2022)

- Insulin resistance, however, can be improved with regular aerobic exercise.
- The difference in impact of specific types of exercise has not been studied.

Methods:

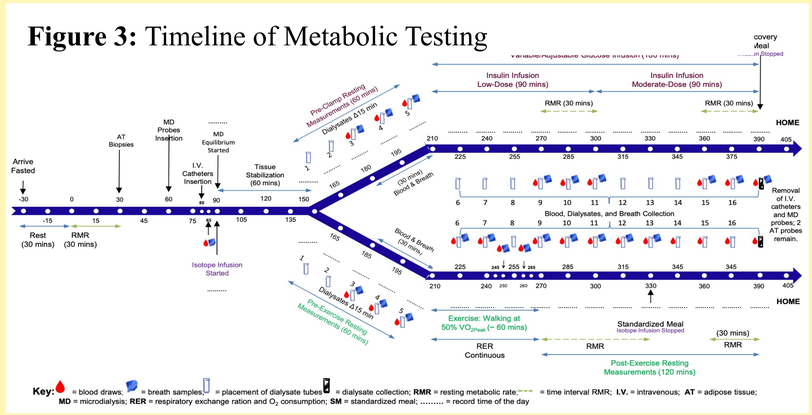
- 120 postmenopausal, pre-diabetic women were selected to undergo either 12 weeks of resistance training or endurance training and within these two subgroups, the participants were further randomized into either an acute exercise group or a glucose clamp group

Figure 2: Random Allocation of Participants

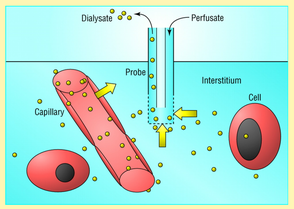


- Prior to and after the 12 regulated weeks of exercise, the participants will undergo metabolic testing, including a fat biopsy on both the abdominal and gluteal tissues, as well as general participant information such as weight and height.

Figure 3: Timeline of Metabolic Testing



- Microdialysis is utilized for metabolic testing during which a saline-ethanol mixture was pushed into fat deposits via probes placed into both gluteal and abdominal fat tissue.



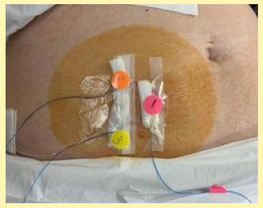


Figure 4: Microdialysis and Adipose Tissue Probe Insertion

Results:

Table 1: Characteristics of enrolled study participants

	Endurance Training (N = 16)		Resistance Training (N = 19)	
	Insulin Clamp (N = 8)	Acute Exercise (N = 8)	Insulin Clamp (N = 8)	Acute Exercise (N = 11)
Age (yrs.)	60.17 ± 1.32	60.75 ± 1.66	61.5 ± 1.44	59.91± 1.36
Hight (cm)	160.1 ± 2.79	162.7± 1.99	164.23 ± 2.43	164.82 ± 1.57
Weight (kg)	92.70 ± 4.67	88.59 ± 4.26	91.25 ± 4.12	93.89 ± 2.68
BMI (kg/m²)	36.08 ± 1.30	33.39 ± 1.19	33.82 ± 1.38	34.56 ± 0.87
FBG (mg/dL)	103.14 ± 3.70	104.7 ± 5.44	103.4 ± 2.51	100.86 ± 2.83
HbA1c (%)	5.74 ± 0.07	5.83 ± 0.13	5.71 ± 0.19	5.83 ± 0.08
2-hr OGTT (mg/dL)	151.71 ± 6.69	159.70 ± 9.00	153.00 ± 13.27	157.00 ± 9.05
WHR	0.87 ± 0.01	0.87 ± 0.02	0.83 ± 0.04	0.89 ± 0.01

Data are shown as means ± SEM; BMI= Body Mass Index; FGB= Fasting Blood Glucose; HbA1c= Amount of Blood Sugar (glucose) Attached to Hemoglobin (oxygen carrier); OGTT= Oral Glucose Tolerance Test; WHR= Waist-to-hip Ratio

Table 2: Exercise performance

	Endurance Training (n = 10)	Resistance Training (n = 10)
VO2 Max Pre (ml/kg/min)	20.96 ± 4.64	18.08 ± 4.46
VO2 Max Post (ml/kg/min)	22.73 ± 4.21*	19.69 ± 2.02
Relative VO2 Max Increase (%)	12.51 ± 33.14	19.40 ± 38.00
Chest Press 10-RM Increase (%)	2.39 ± 12.04	42.30 ± 25.63**
Leg Press 10-RM Increase (%)	5.65 ± 7.57	57.07 ± 63.50*
Seated Row 10-RM Increase (%)	6.40 ± 16.37	42.11 ± 29.12*
Quad Extension 10-RM Increase (%)	1.52 ± 14.14	70.02 ± 62.53*
Shoulder Press 10-RM Increase (%)	8.09 ± 20.71	38.15 ± 20.59*
Hamstrings Curl 10-RM Increase (%)	14.94 ± 15.70	57.48 ± 26.06*
Biceps Curl 10-RM Increase (%)	6.41± 21.24	51.99 ± 28.20*

Data are shown as means ± standard error, ml/kg/min = milliliter per kilogram per minute, % = percent, *=p≤0.05, **=p ≤0.001

Conclusion:

- As our project is still in the experimental data collection phase, final results have not been determined
- However, preliminary data demonstrates that acute resistance exercise increases lipolysis in non-obese women
- Research studies inform our hypothesis that both aerobic and resistance training will increase lipolytic flexibility, however, whether the effect of resistance training is comparable to that of the aerobic training is not fully understood.

Acknowledgements:

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References:

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•Li, Y., Li, Z., Ngandiri, D., Perez, M., Wolf, A., Wang, Y. (2022)The Molecular Breaks of Adipose Tissue Lipolysis. *Frontiers in Physiology,* 13. https://doi.org/10.3389/fphys.2022.826314