

# In Vivo Investigate the Effect of the Lactate on the Apoptosis, Necrosis, and Survival of the of Peripheral Blood Mononuclear Cells

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## Introduction

- The optimal intensity of exercise is helpful in the prevention and therapy of disease.
- Lactate is a metabolic byproduct during or after exercise which influences the immune system.
- Lactate can affect the immune system including cell death, altering the viable percentage, and pro-inflammatory cytokines.
- Exercise can cause both types of cell death, apoptosis, or necrosis.
- Apoptosis is a physiological type of cell death that eliminates fragments of cells without inflammation within the tissue microenvironment.
- necrosis occurs when cells endure cytotoxic damage and characterize by swelling, cell disintegration, and inflammation.

## Gap in Literature

- The direction of the effect of lactate, positive or negative, on the immune cells does not clearly understood.

## Materials and Methods

- Ten young healthy women ranging from 22 to 29 years old with 30.60 Percent Body Fat.
- Inclusion Criteria:**
  - 1) No smoking
  - 2) No regular exercise
  - 3) No cardiac, pulmonary orthopedic, and metabolic diseases
  - 4) No immune system disease or diagnosed infection
  - 5) No supplements consumption
- Participants who cannot meet inclusion criteria during the study period, they excluded from the study.
- The study is approved by the ethics committee of the Ferdowsi University of Mashhad: 055.1397.REC.UM.IR

- HRmax:** Bruce protocol used to find Maximum Heart Rate
- Heart Rate Calculation:**
  - subgroup 60% HRmax: (Maximum heart rate × 60)/100
  - subgroup 90% HRmax: (Maximum heart rate × 90)/100
- Exercise Protocol:**
  - performed Bruce protocol until reached aimed heart rate reached then continued to exercise for three minutes at that specific heart rate with plus or minus 10 beats.
  - Two weeks interval between each session

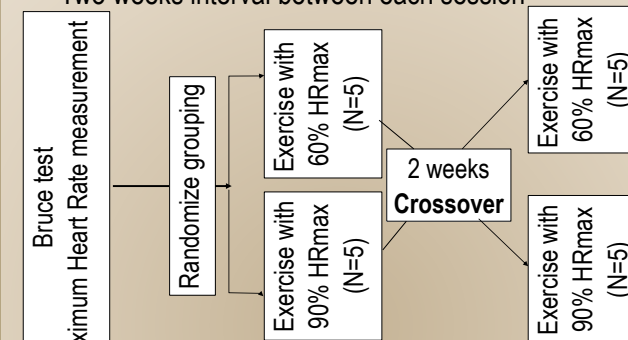


Figure 1. Study Protocol

- Blood Sample:** Blood was drawn before and five minutes after the second and third session of exercise by the nurse.
- Plasma level of lactate** measured with Colorimetric LOD-PAP-Test and Greiner GA 400 Auto Chemistry Analyzer.
- Peripheral Blood Mononuclear Cells (PBMCs)** used as a source of immune cells.
- Percentage of apoptosis, necrosis, and live of the PBMCs** measured flow cytometry using fluorescent dyes including FITC Annexin V and propidium iodide (PI).
- Statistical Analysis**
  - Shapiro-Wilk, Kolmogorov-Smirnov
  - Removal of intrasubject variance
  - Two-way ANOVA repeated measurements
  - Level of significance was 95% ( $p < 0.05$ )

## Results

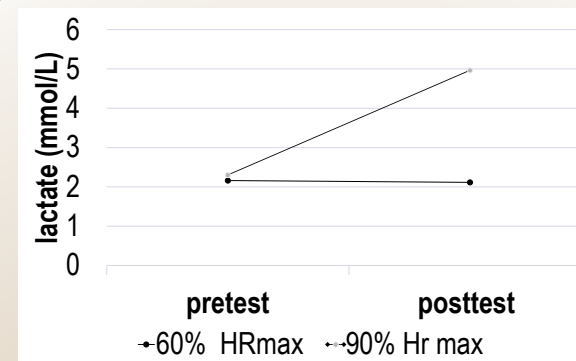


Figure 2. The main effect of the two different types of the intensity of the exercise on the lactate was statistically significant ( $p < 0.001$ ), adjusted with Bonferroni correction for multiple comparisons. The average of the lactate in the exercise with 90% HRmax was statistically higher (1.495 mmol/L) as compared to the exercise with 60% HRmax (95% CI: 195 0.91, 2.07;  $p < 0.001$ ).

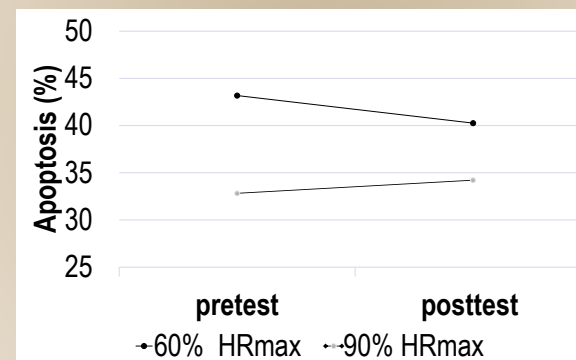


Figure 3. The main effect of the two different types of the intensity of the exercise on apoptosis of the PBMCs was statistically significant ( $p < 0.031$ ), adjusted with Bonferroni correction for multiple comparisons. The average of the apoptosis in the exercise with 90% HRmax ( $33.51 \pm 2.42$ ) was statistically lower as compared to the exercise with 60% HRmax ( $41.71 \pm 2.42$ ) with an average increase in apoptosis of the PBMCs 8.2 percent (95% CI: -15.55, -0.84;  $p = 0.031$ ).

There was not any significant within or between-subject effect on the necrosis of the PBMCs.

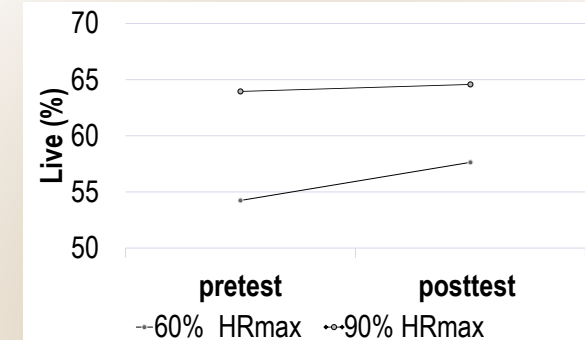


Figure 4. The main effect of the two different types of the intensity of the exercise on the survival of the PBMCs was statistically significant ( $p < 0.038$ ), adjusted with Bonferroni correction for multiple comparisons. The average of the survival in the exercise with 90% HRmax ( $64.26 \pm 2.57$ ) was statistically higher as compared to the exercise with 60% HRmax ( $55.93 \pm 2.57$ ) with an average decrease in survival of the PBMCs 8.32 percent (95% CI: 0.53, 16.12;  $p = 0.038$ ).

## Conclusion

- Lactate went higher after intense exercise.
- Apoptosis of the PBMCs was significantly lower in the 90% HRmax.
- The survival of the PBMCs was higher in the 90% HRmax than 60% HRmax.
- No significant difference in the necrosis between 90% HRmax and 60% HRmax.
- elevated lactate levels protect lymphocytes from apoptosis and promote cell survival.
- Lactate is a source of carbohydrate for the tricarboxylic acid cycle (TCA), as a result, internal sources are maintained with lactate then apoptosis of T lymphocytes decreases.

## References

