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Optimizing Post-Exercise Recovery: Effect of Body Position on Heart Rate Restoration Following a Submaximal Walk Test in Obese Young Adults

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Abstract
Heart rate recovery (HRR) is a well-established, non-invasive indicator of autonomic function and cardiovascular fitness. Individuals with obesity commonly exhibit delayed HRR due to reduced parasympathetic reactivation after exercise. Since post-exercise body position influences venous return and autonomic modulation, it may significantly impact HRR. This study compared HRR in four recovery postures—supine, sitting, standing, and supine with 30° leg elevation—after a submaximal 6-minute walk test (6MWT) in obese young adults. Findings demonstrated that the supine position with leg elevation produced the most rapid and greatest decline in heart rate, followed by supine, sitting, and standing. The results highlight the clinical importance of selecting appropriate recovery posture during exercise assessment and rehabilitation in obese individuals.

Index Terms: Autonomic function; body posture; heart rate recovery; leg elevation; obesity; submaximal exercise

I. INTRODUCTION

Obesity is characterized by excessive accumulation of body fat and is strongly associated with cardiometabolic and autonomic impairments. Individuals with obesity often demonstrate reduced parasympathetic tone and increased sympathetic activity, resulting in delayed heart rate recovery (HRR) after exertion. HRR, defined as the reduction in heart rate from peak effort to a specified recovery time point, is widely accepted as a predictor of cardiovascular health and long-term mortality risk.

Body position during recovery can modify venous return, baroreceptor activation, stroke volume, and autonomic rebalancing. Standard recovery techniques typically involve sitting or lying supine, while supine recovery with leg elevation may further increase central blood volume and accelerate vagal reactivation. Research exploring the differential effect of recovery posture in obese young adults is limited. Therefore, the objective of this study was to compare HRR across four commonly applicable recovery positions to identify the most efficient posture for autonomic recovery.

II. MATERIALS AND METHODS

A. Study Design

Experimental, comparative, cross-sectional study.

B. Participants

Sixty obese young adults aged 18–25 years with BMI ≥ 30 kg/m² participated in the study.

Inclusion criteria: clinically stable obese individuals capable of completing the 6MWT. **Exclusion criteria:** respiratory or cardiovascular disease, uncontrolled diabetes/hypertension, smoking, musculoskeletal injury, beta-blocker medication.

C. Exercise Protocol

The 6-minute walk test (6MWT) was conducted along a 30-meter indoor corridor. Each participant performed three tests separated by 48 hours, and the average of the three peak HR values was used for analysis.

D. Recovery Postures

Participants were randomly assigned to one of four post-exercise positions (n = 15 per group):

1. Supine
2. Sitting
3. Standing
4. Supine with 30° leg elevation

E. Outcome Measures

Heart rate was recorded:

- At rest
- Immediately post-exercise (peak HR)
- At 1, 3, and 5 minutes of recovery

HRR values were calculated as:

- HRR1 = Peak HR – HR at 1 minute
- HRR3 = Peak HR – HR at 3 minutes
- HRR5 = Peak HR – HR at 5 minutes

F. Statistical Analysis

One-way ANOVA and Tukey post-hoc testing were applied ($p < 0.05$).

III. RESULTS

All groups showed a progressive decline in heart rate during recovery; however, the rate and magnitude of reduction varied significantly between postures ($p < 0.001$).

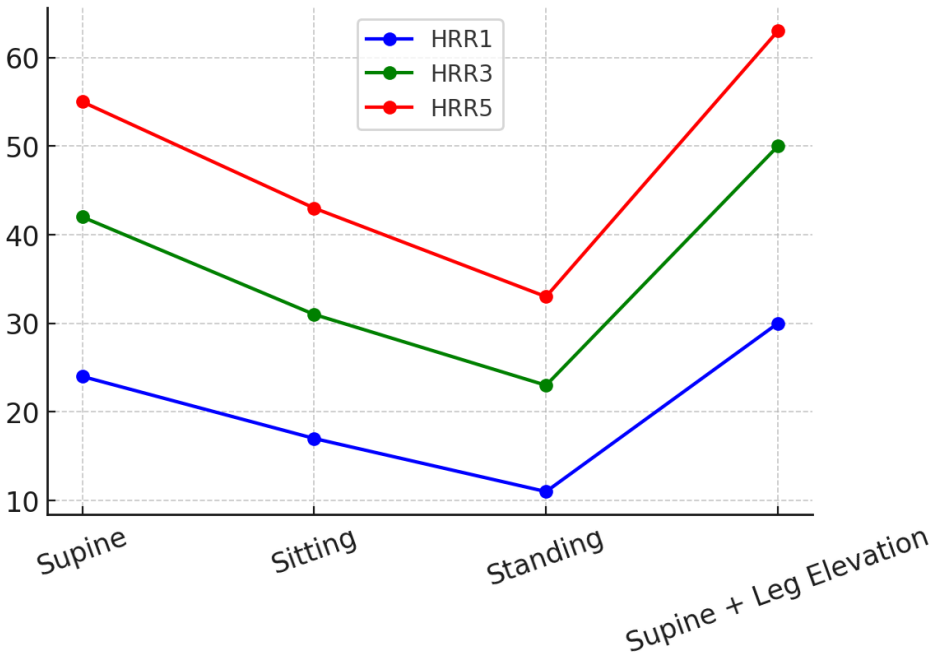

Table 1 — Heart Rate Recovery Comparison

Position	HRR1	HRR3	HRR5
Supine	24	42	55
Sitting	17	31	43
Standing	11	23	33
Supine + Leg Elevation	30	50	63

The supine position with 30° leg elevation produced significantly faster and greater HR normalization compared to all other postures.

IV. DISCUSSION

The results of this study demonstrate that body position during recovery plays a crucial role in autonomic regulation after submaximal exercise in obese young adults. Supine recovery with leg elevation proved to be the most effective posture, likely due to enhanced venous return and improved ventricular preload, which stimulate arterial baroreceptors and promote rapid parasympathetic reactivation. The standing posture showed the slowest HR decline due to gravitational pooling of blood in the lower limbs and sustained sympathetic activation.

These findings emphasize that recovery posture should not be considered passive but rather a modifiable factor that can improve hemodynamic and autonomic stabilization. For obese individuals, whose HRR is generally delayed, adopting an optimal recovery posture becomes clinically important.

V. CLINICAL IMPLICATIONS

Supine recovery with 30° leg elevation is clinically beneficial for:

- Post-exercise stabilization among obese individuals
- Standardizing HRR measurements in assessment settings
- Reducing cardiovascular strain in rehabilitation and exercise programs
- Home-based exercise routines requiring safe recovery strategies

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VI. CONCLUSION

- Body posture significantly affects heart rate recovery after submaximal exercise.
- Supine recovery with 30° leg elevation is the most effective posture in obese young adults.
- Recovery efficiency ranking: Supine + Leg Elevation > Supine > Sitting > Standing.
- Incorporating standardized recovery posture can improve assessment and exercise safety.

VII. LIMITATIONS

- Blood pressure and HR variability were not measured
- Limited to young adults with obesity
- Only one leg-elevation angle was assessed

VIII. RECOMMENDATIONS

Future research should explore:

- BP and HRV-based autonomic assessment
- Other age groups and clinical conditions
- Multiple recovery elevation angles and positions

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