Pragmatic Field-Based Cardiovascular Assessment in Combat Athletes

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Abstract

The use of laboratory-based testing techniques for cardiovascular evaluation in sports populations frequently limits its application in practical contexts. This study suggests a practical, field-based paradigm that combines post-exercise blood pressure responses, graded treadmill exercise testing, heart rate recovery (HRR-1), and electrocardiographic screening. Combat athletes with training performed maximum treadmill testing utilising the Bruce protocol after an ECG examination. Metabolic equivalents (METs) were used to quantify functional capability, while HRR-1 and blood pressure changes were used to assess autonomic recovery and haemodynamic response. The results show that easily available, non-invasive methods can be used to create a multidimensional cardiovascular profile. This method offers a scalable methodology for cardiovascular risk assessment and athlete monitoring, making it especially appropriate for settings with low resources.

Keywords

cardiovascular fitness; hrr-1; mets; bruce protocol; combat athletes

1. Introduction

Long-term health and sports performance are significantly influenced by cardiovascular fitness. However, the practical application of standard assessment methods in field situations is limited since they require specialised laboratory infrastructure, such as VO_2 max measurement. A distinct physiological group defined by high-intensity intermittent activity is represented by combat athletes. Despite this, there are still few readily available and clinically significant cardiovascular assessment models. The goal of this research is to create a scalable and practical system for field-based cardiovascular profiling.

2. Related Work

Laboratory-based cardiovascular evaluations have been the main focus of earlier research [1]. While exercise-induced blood pressure responses offer insights into vascular adaptation [3], heart rate recovery

(HRR-1) is well known as a measure of autonomic function and cardiovascular health [2]. Nevertheless, there is still little integration of these characteristics into a single, field-relevant framework.

Table 1. Comparison with Previous Studies

Study	HRR	BP Response	Field Applicability
[1]	No	Yes	No
[2]	Yes	No	No
[3]	Yes	Yes	No
This Work	Yes	Yes	Yes

3. Key Contribution

This research offers:

- A multifaceted framework for cardiovascular evaluation
- Combining haemodynamic response, autonomic recovery, functional capability, and ECG
- A scalable, inexpensive method for field settings
- A basis for upcoming cardiovascular prediction analysis

4. Method, Experiments and Results

Trained combat athletes participated in a cross-sectional observational physiological investigation. To guarantee cardiovascular stability, participants initially completed a clinically supervised resting 12-lead ECG test. The Bruce treadmill procedure was used for exercise testing, and subjects worked out until they were voluntarily exhausted. Peak heart rate (HR_peak), stage attained, and overall exercise time were important characteristics noted.

Stage-based metabolic equivalents (METs) were used to determine functional capacity. Heart rate recovery at one minute post-exercise (HRR-1), which is computed as the difference between peak heart rate and heart rate after one minute of recuperation, was used to measure autonomic recovery. The dynamic changes in heart rate during exercise and recovery are illustrated in Figure 2.

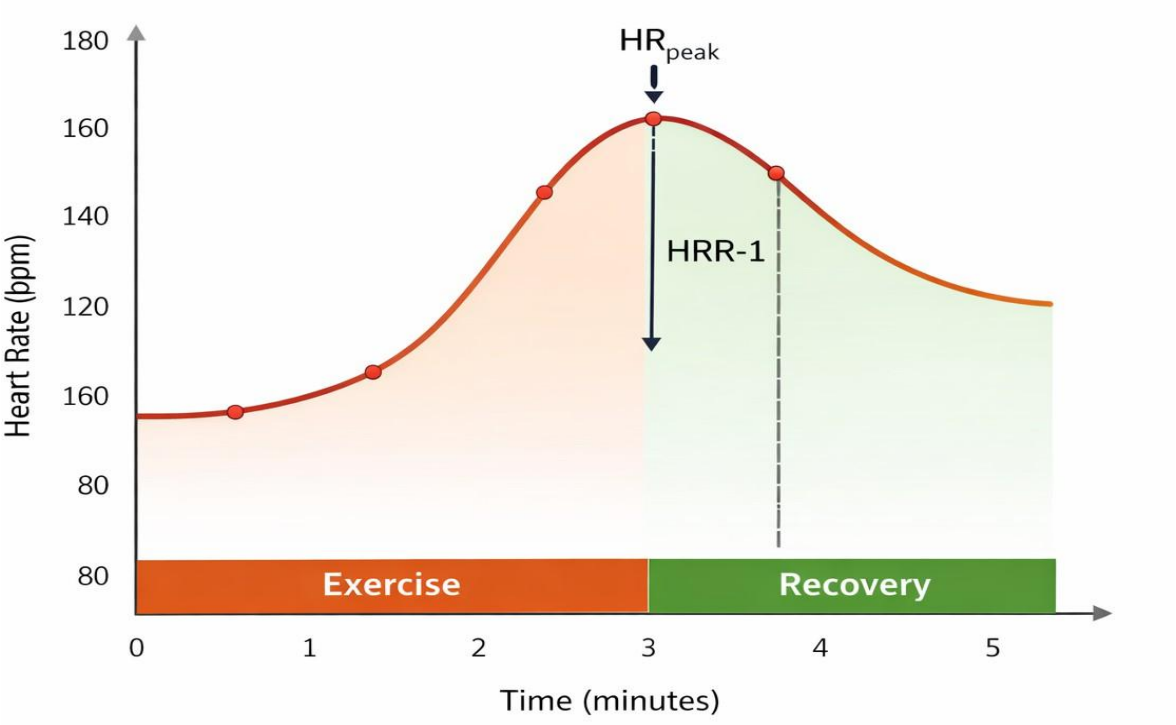

Figure 2. Representative heart rate response during exercise and recovery phases.

Systolic and diastolic blood pressure measurements at rest and after exercise were used to calculate ΔSBP and ΔDBP in order to assess haemodynamic response.

Table 2. Cardiovascular Variables and Significance

Variable	**Phase**	**Significance**
Resting HR	Pre-exercise	Baseline cardiac function
METs	Exercise	Functional capacity
HRR-1	Recovery	Autonomic function
ΔSBP / ΔDBP	Post-exercise	Hemodynamic response

The integrated framework combining ECG screening, functional capacity, autonomic recovery, and hemodynamic response is illustrated in Figure 1.

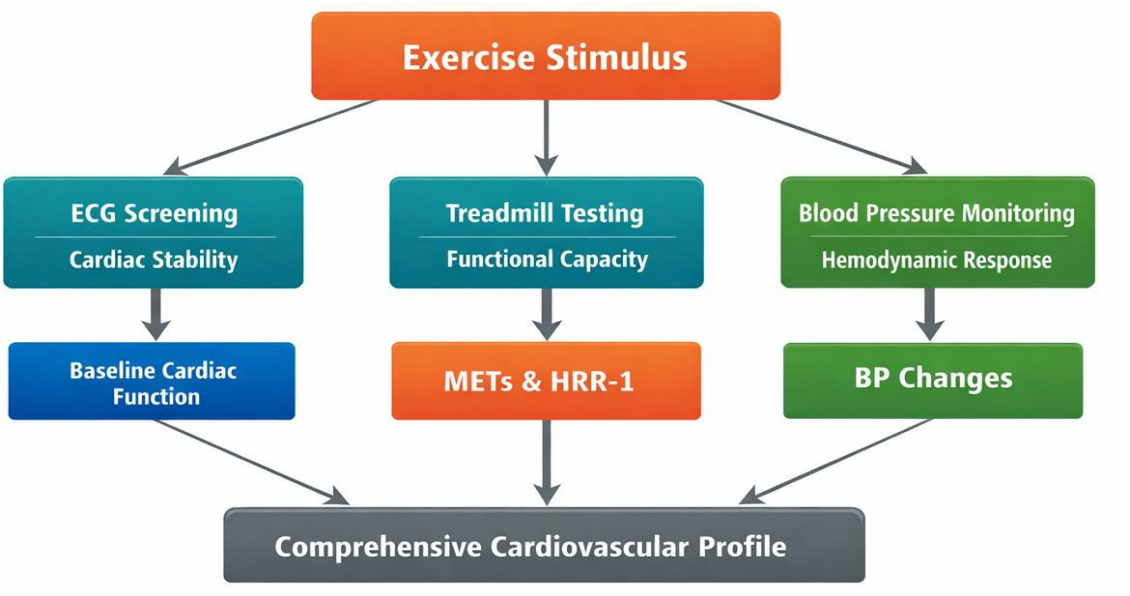

Figure 1. Conceptual framework linking exercise stimulus to cardiovascular responses.

5. Discussion

The suggested framework shows that accessible instruments can be used in field situations to provide thorough cardiovascular examination. While HRR-1 offers information on autonomic recovery, ECG screening guarantees participant safety. Blood pressure responses show vascular adaptability, and METs show functional capacity. A comprehensive understanding of cardiovascular performance is made possible by the integration of various measures, which eliminates the need for laboratory equipment.

6. Conclusion

- **Problem addressed:** Inadequate techniques for field-based cardiovascular evaluation
- **Method used:** Integrated ECG, treadmill testing, HRR-1, and blood pressure response
- **Key findings:** Feasible, non-invasive, multifaceted assessment framework
- **Limitations and future work:** small sample size; future research should use larger populations and predictive modelling.

References

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