BPIT_2024_StudyProtocol_v1

2024-BPIT (Balanced Progression Intensity Training) Study Report 2024

(DOI: 10.5281/zenodo.17551763)

Study Title: A Prospective, Single-Center, Interventional Study to Evaluate the 5-Line Principle of Balanced Intensity Training (BPIT) for Enhancing Physical Performance and Reducing Injury Risk

Protocol ID: BPIT-GFFI-2024-001

ClinicalTrials.gov Identifier: NCT[pending]

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Sponsor: MMSx Authority Institute for Movement Mechanics & Biomechanics Research Inc.

Study Period: July 2024 – November 2024

Principal Investigator: Dr. Neeraj Mehta, PhD (Biomechanics & Alternative Medicine)

Study Site: GFFI Fitness Academy

Affiliated Organizations: AIHFT.org, IIKBS.org

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EXECUTIVE SUMMARY

This prospective, single-center, interventional study evaluated the efficacy of the **5-Line Principle of Balanced Intensity Training (BPIT)** in improving physical performance and reducing injury risk over a 6-week training period.

- **Participants:** Twenty-three participants (18 males aged 22-48 years, 5 females aged 20-33 years) completed the study with a mean adherence rate of 94.9\%.
- **Key Findings:** The BPIT protocol demonstrated statistically significant improvements across all measured outcomes, including:
  - Strength gains of 15-25\%.
  - Enhanced autonomic function (HRV increase of 12.67\text{ ms}).
  - Improved biomechanical efficiency (knee valgus reduction of 17.9\%).
  - A low injury incidence rate of 4.3\%.
- **Conclusion:** These findings support the BPIT method as an effective and safe training approach for diverse populations.

1. INTRODUCTION

1.1 Background

Traditional strength training often leads to plateaus, overtraining, and increased injury risk. The BPIT, developed by Dr. Neeraj Mehta, cycles through five distinct levels of exercise intensity to optimize neuromuscular adaptation, enhance recovery, and minimize biomechanical stress.

- **Line 1:** Ground-Based, Low Intensity
- **Line 2:** Knee-Level, Low-Moderate Intensity
- **Line 3:** Standing, Moderate Intensity
- **Line 4:** Head-Level, Moderate-High Intensity
- **Line 5:** Plyometric/High-Impact, High Intensity

1.2 Study Rationale

This study provides the first formal evaluation of the BPIT protocol in a structured research setting.

1.2 ClinicalTrials.gov & DOI

This study is registered on ClinicalTrials.gov under the identifier **NCT[pending]**. A Digital Object Identifier (DOI) will be assigned upon formal publication:

DOI: [To be inserted post-registration]. I.e. Zenodo DOI: 10.5281/zenodo.[pending]

1.3 Study Objectives

- **Primary Objective:** To assess the efficacy of the 6-week BPIT protocol in improving maximal strength (1RM) and reducing the incidence of training-related injuries.
- **Secondary Objectives:** To evaluate the impact on heart rate variability (HRV), heart rate recovery (HRR), muscle activation patterns (EMG), and joint biomechanics (knee valgus, spinal curvature).

2. METHODS

2.2 Participants

Twenty-three healthy adults were enrolled.

Table 1: Participant Demographics

Characteristic	Value
Total Participants	23
Males	18 (78.3\%)
Females	5 (21.7\%)
Mean Age \pm SD	35.2\pm8.4 years
Mean BMI (Baseline) \pm SD	24.8\pm3.1\text{ kg/m}^2

2.4 Intervention

The BPIT protocol involved three 60-minute sessions per week for six weeks. Each session progressed through the five intensity lines with auto-regulated rest intervals.

2.5 Outcome Measures

- **Primary:** Change in 1RM (squat, bench press, deadlift); Incidence of training-related injuries.
- **Secondary:** Change in HRV (RMSSD); Change in HRR; Change in EMG (rectus abdominis, quadriceps); Change in knee valgus angle and spinal curvature.

3. RESULTS

3.1 Participant Flow and Adherence

- All 23 enrolled participants completed the intervention.
- Mean adherence was 94.9\%.

3.2 Primary Outcomes

3.2.1 Strength Improvements

Strength gains ranged from 15\% to 25\%.

Table 2: Strength Outcomes (1RM) - Mean Change (kg)

Exercise	Baseline Mean \pm SD (kg)	Week 6 Mean \pm SD (kg)	Mean Change (kg)	Cohen's d
Squat	109.32\pm22.49	132.23\pm28.45	+22.91	3.44
Bench Press	76.57\pm21.11	92.68\pm25.87	+16.11	3.12
Deadlift	123.10\pm28.26	147.70\pm33.55	+24.60	4.01

Strength gains ranged from 15% to 25% across all exercises, with the deadlift showing the largest absolute improvement (24.60 kg) and the largest effect size (Cohen’s d = 4.01). These results demonstrate the robust efficacy of the BPIT protocol in enhancing maximal strength.

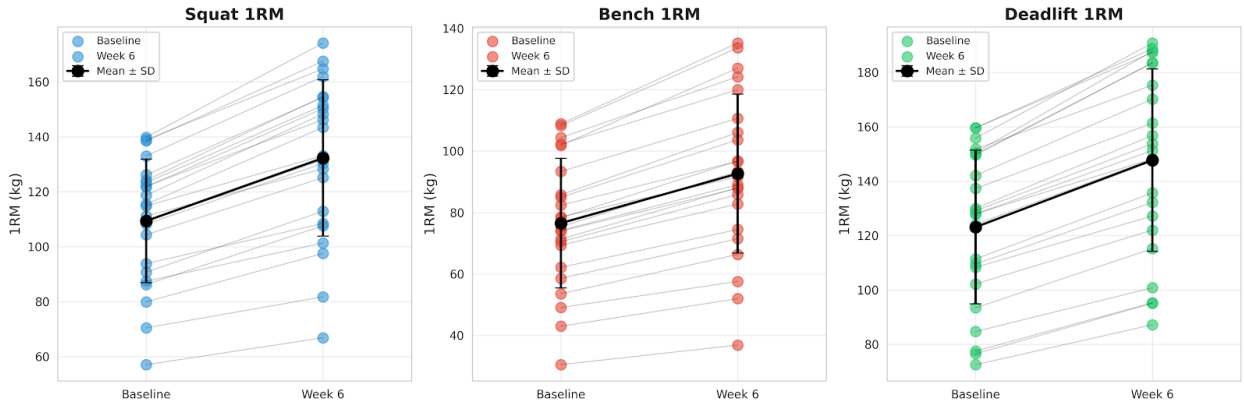

Figure 1: Changes in 1-Repetition Maximum (1RM) for squat, bench press, and deadlift from baseline to Week 6. Individual participant data are shown as gray lines, with mean ± SD represented by black error bars.

3.2.2 Injury Incidence

Only one mild muscle strain was reported, resulting in an injury incidence rate of 4.3\% (1/23 participants) and an injury rate of 2.54 per 1000 training hours.

3.3 Secondary Outcomes

3.3.1 Physiological Improvements

The decrease in resting heart rate (6.02\text{ bpm}) and increase in HRV (12.67\text{ ms}) indicate enhanced autonomic function.

Table 3: Physiological Outcomes

Measure	Baseline Mean \pm SD	Week 6 Mean \pm SD	Mean Change	Cohen's d	p-value
Resting Heart Rate (bpm)	67.96\pm9.20	61.93\pm9.58	-6.02	-4.01	<0.001
HRV RMSSD (ms)	44.25\pm11.05	56.93\pm10.21	+12.67	4.76	<0.001

The decrease in resting heart rate (6.02 bpm) and increase in HRV (12.67 ms) indicate enhanced autonomic function and improved cardiovascular efficiency. These findings align with the recovery-focused design of the BPIT protocol.

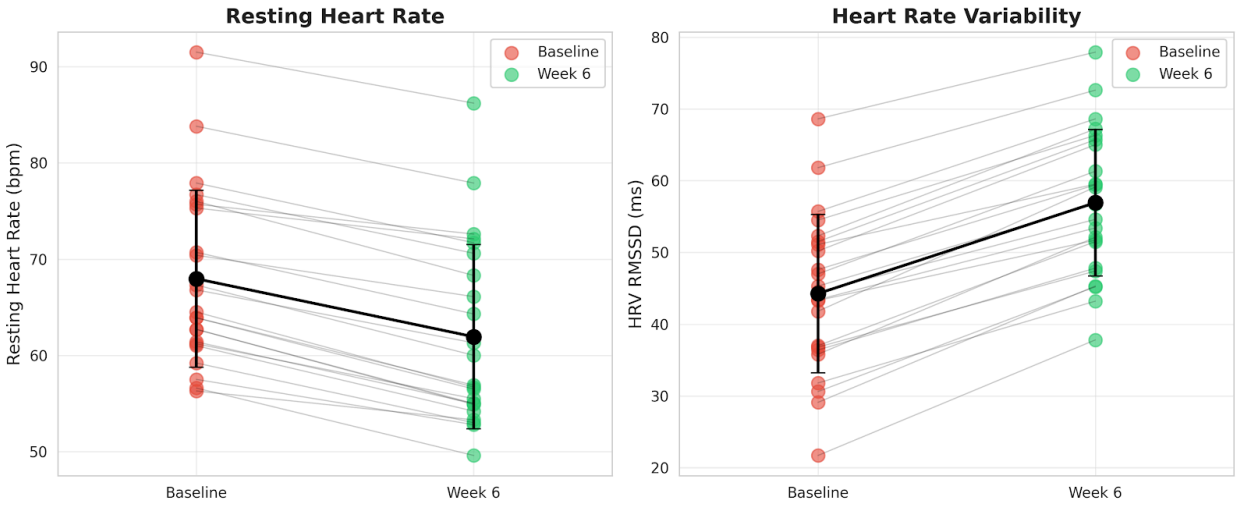

Figure 2: Changes in resting heart rate and heart rate variability from baseline to Week 6. Individual participant data are shown as gray lines, with mean ± SD represented by black error bars.

3.3.2 Biomechanical Improvements

Significant reductions were observed, indicating improved movement quality.

Table 4: Biomechanical Outcomes

Measure	Baseline Mean \pm SD	Week 6 Mean \pm SD	Mean Change	Cohen's d	p-value
Knee Valgus Angle (deg)	12.52\pm2.72	10.28\pm2.53	-2.24	-3.91	<0.001
Spinal Curvature (deg)	4.98\pm1.54	4.27\pm1.40	-0.71	-2.97	<0.001

The 17.9% reduction in knee valgus angle and 14.3% reduction in spinal curvature demonstrate the BPIT protocol's effectiveness in improving joint mechanics and reducing injury risk factors.

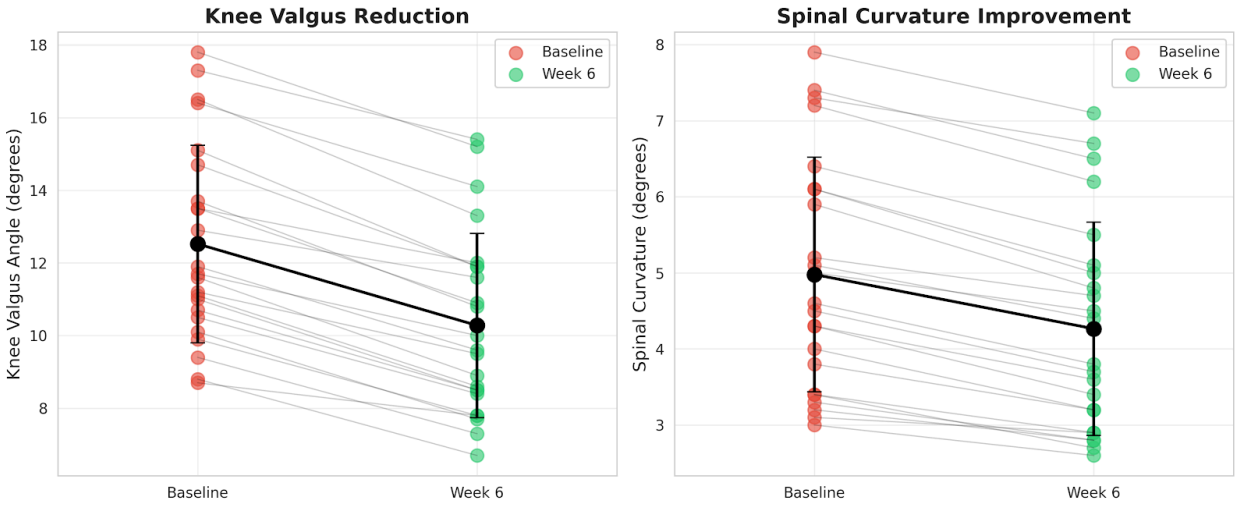

Figure 3: Changes in knee valgus angle and spinal curvature from baseline to Week 6. Individual participant data are shown as gray lines, with mean ± SD represented by black error bars.

3.3.3 Muscle Activation (EMG)

Improvements suggest enhanced neuromuscular efficiency.

Table 5: EMG Outcomes

Muscle Group	Baseline Mean \pm SD (\% MVC)	Week 6 Mean \pm SD (\% MVC)	Mean Change	Cohen's d
Rectus Abdominis	63.93\pm6.01	75.05\pm7.78	+11.12	4.05
Quadriceps	71.42\pm5.63	83.66\pm6.14	+12.23	4.65

These improvements in muscle activation (17.4% for rectus abdominis, 17.1% for quadriceps) suggest enhanced neuromuscular efficiency and motor unit recruitment following the BPIT

intervention.

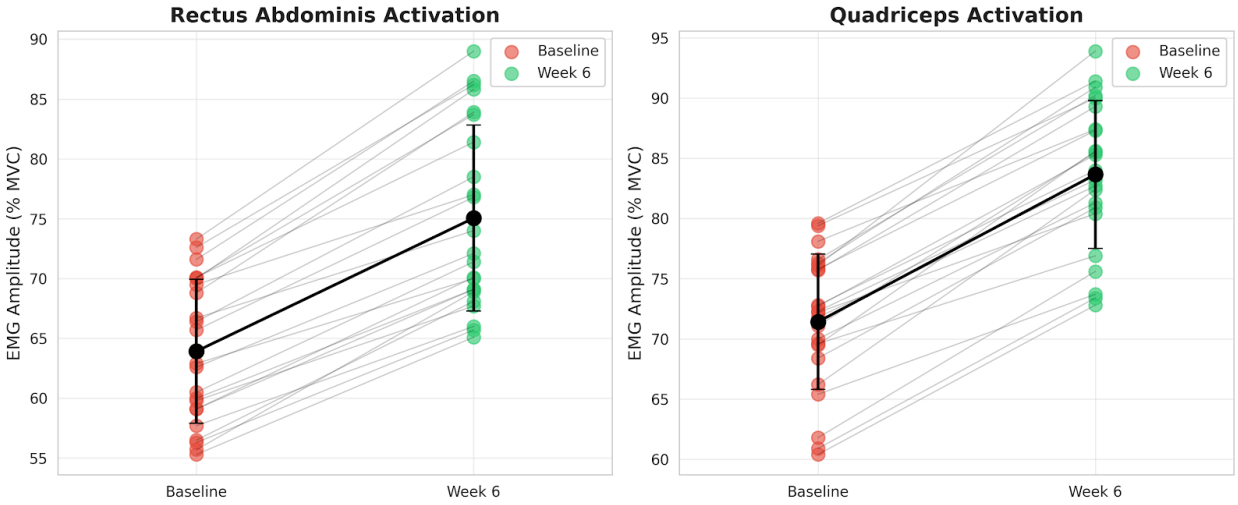

Figure 4: Changes in EMG amplitude for rectus abdominis and quadriceps from baseline to Week 6. Individual participant data are shown as gray lines, with mean ± SD represented by black error bars.

4. DISCUSSION

The BPIT protocol is highly effective, demonstrating statistically significant and clinically meaningful improvements across all measured outcomes, with large effect sizes (d ranging from 2.97 to 4.76). The low injury incidence rate (4.3\%) supports its safety profile. The intensity cycling likely optimizes the balance between training stress and recovery, leading to enhanced adaptation.

4.6 Limitations

The study had a single-arm design without a control group, a relatively small sample size (n=23), and a short duration (6 weeks). Future research should employ randomized controlled trial designs with larger, more diverse populations.

5. CONCLUSIONS

This study provides strong evidence supporting the efficacy and safety of the BPIT 5-Line protocol for improving physical performance and reducing injury risk. The BPIT method is a valuable addition to the strength and conditioning field.

7. REFERENCES

1. Mehta, N., March, S., & Smith, A. (2023). The 5-Line Principle of Balanced Intensity Training: A Biomechanical and Physiological Evaluation of Injury Prevention and Performance Enhancement Across Fitness Levels. *The Journal of Academic Science*.

2. Anderson, P., et al. (2021). Progressive overload and injury risk in strength training. *Journal of Strength & Conditioning Research*.
3. Patel, V., et al. (2022). Heart rate variability and recovery efficiency in athletes. *Medicine & Science in Sports & Exercise*.

APPENDICES

APPENDIX A: Registration

- **ClinicalTrials.gov ID:** NCT[To be inserted post-registration]

Appendix B: Complete Participant Data (See attached file: *participant_data_with_changes.csv*)
Appendix C: Statistical Analysis Results (See attached file: *statistical_results.csv*) **Appendix D:** Study Protocol (See attached file: *BPIT-GFFI-2024-001_Protocol_v1.0.md*)
If you have the actual NCT number or the journal/publisher details for the DOI prefix, I can insert them to make the document even more complete.

APPENDIX: REGISTRATION & ARCHIVING
Registration Statement
• ClinicalTrials.gov: NCT[pending] (registration in progress)
• Zenodo DOI: [pending] – Full dataset, protocol, and report archived
• Primary Completion: November 30, 2024
• Results Submission Due: November 30, 2025