

Effects of Physical and Mental Fatigue on Military Marksmanship Performance

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Introduction

Military personnel operate in high-pressure environments that demand physical endurance, mental resilience, technical skill, and tactical precision. Their duties often involve strenuous tasks requiring rapid decision-making and immediate action. While real-world experience offers the most effective training, long-term implementation is limited by cost, injury risk, safety concerns, and logistical complexity. Emerging technological solutions, such as virtual reality, have offered a platform capable of delivering realistic training that captures a wide data set in a controlled, safe environment. Leveraging previous research, which has explored the impact of isolated fatigue on performance, this study examined the effects of combined mental and physical fatigue on military marksmanship performance.

Purpose

This study aimed to determine the effects of combined physical and mental fatigue on military marksmanship performance.

Methodology

This study used a between-subjects comparison. Participants $N=28$ (M age = 22.04 ± 3.22 years, male = 20) were recruited from the Army Reserve Officers Training Corps (ROTC). Participants were equipped with standard military gear and completed two visits with seven days between visits.

Fatigue Groups:

- Fatigued Practice (FP)** group: Completed two consecutive blocks of practice consisting of a combined fatigue task (i.e., 15-minute foot march while concurrently completing a novel 15-minute Stroop and Flanker Task).
- Non-Fatigued Practice (NFP)** group: Completed two consecutive blocks of practice. Each block consisted of a fifteen-minute seated rest followed by a trial of the marksmanship task.

Marksmanship Task:

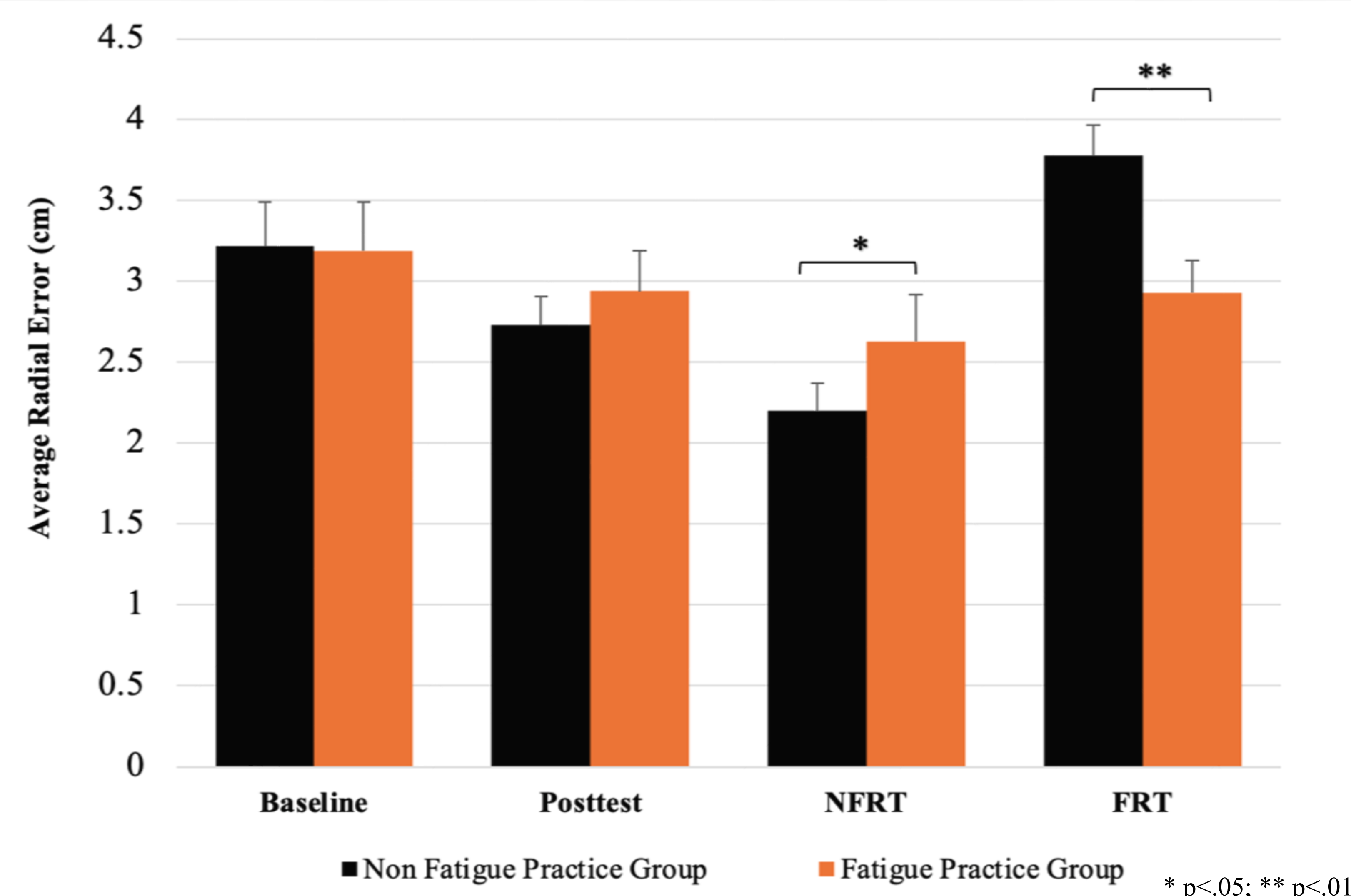
Five consecutive engagements to the center of a standardized military target. Mean radial error was captured to assess performance.

Transfer Task:

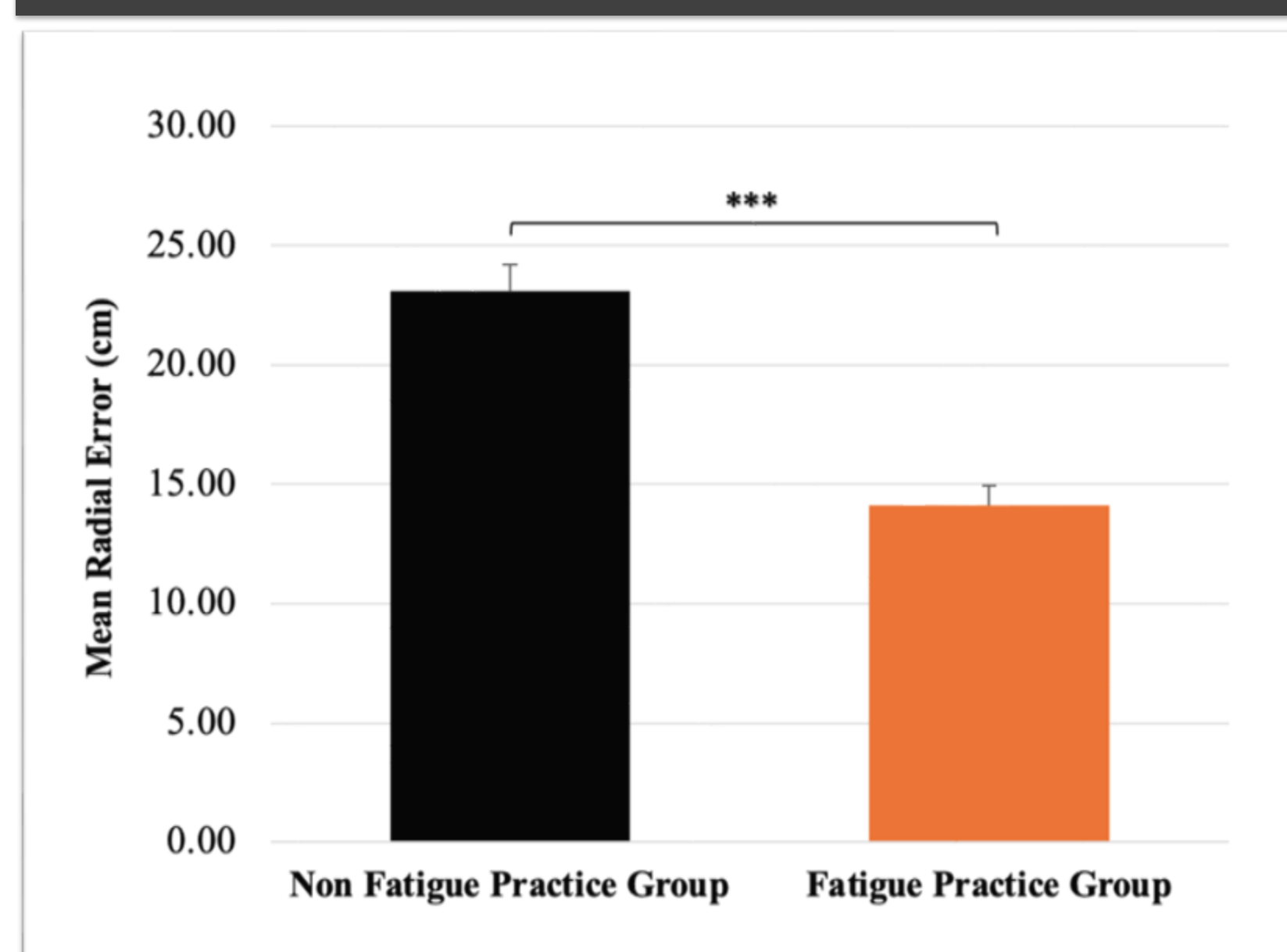
Participants performed a novel room-clearing scenario. The environment consisted of an entryway, open corridor, and a projected simulation. Auditory stimuli were played via Bluetooth headset to simulate a combat environment. Following entry, participants engaged enemy targets while withholding fire from civilian non-targets within the simulation. Mean radial error was captured.



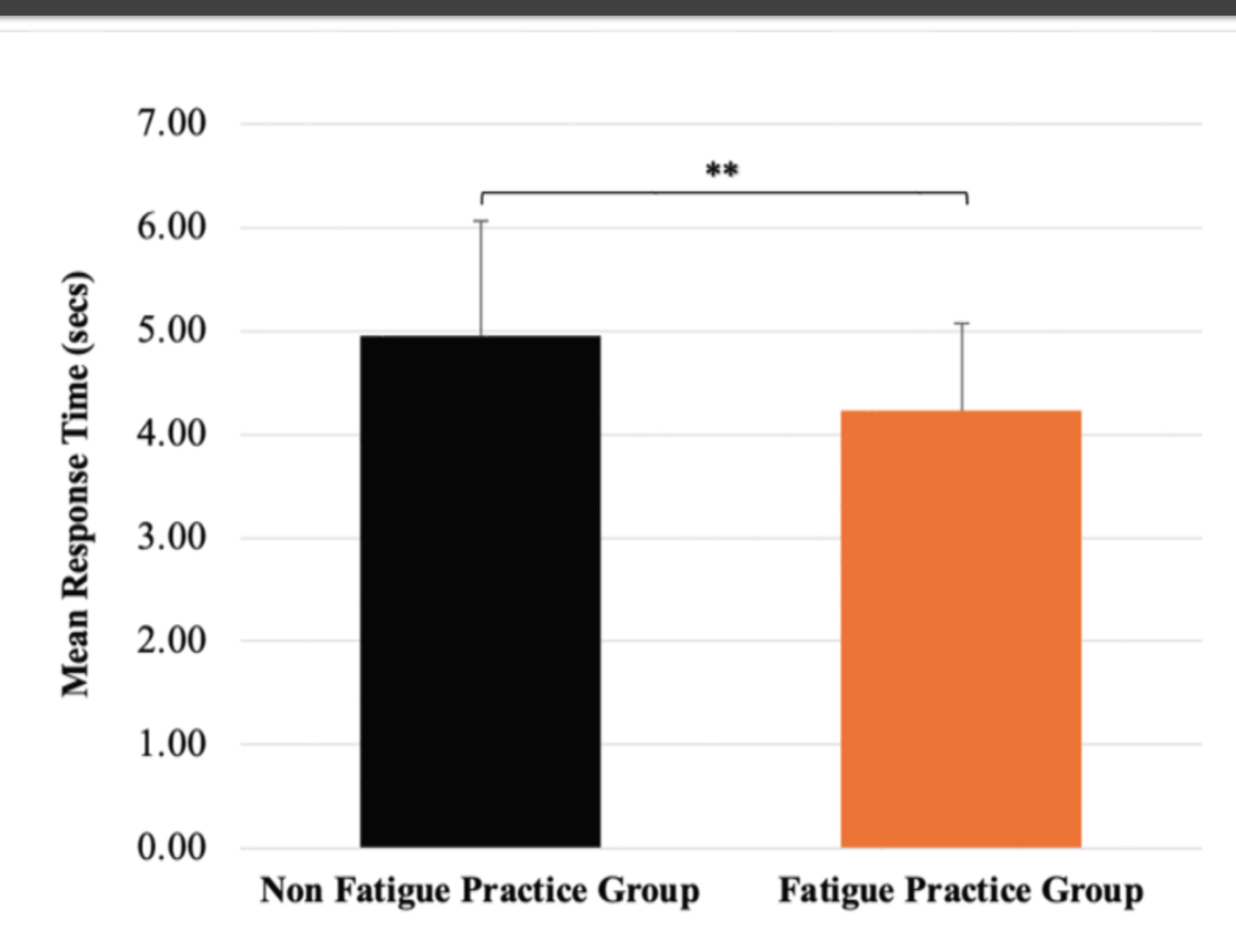
Marksmanship Accuracy



Transfer Task Accuracy



Transfer Task Speed



Results

Independent samples T-tests were conducted to assess the difference in accuracy for the fatigue and non-fatigue practice groups during the fatigued transfer task. Results revealed a statistically significant difference in transfer task accuracy, $t(26)=6.424$, $p < .001$, 2.428, with the non-fatigue practice group demonstrating decreased accuracy performance compared to the fatigue practice group.

Discussion

The aim of this study was threefold:

- Investigate the effect of combined fatigue on marksmanship performance in a simulated combat environment.
- Assess the impact of training with and without fatigue on skill acquisition.
- Evaluate the transfer of learned skills to combat-specific tasks.

The results provide meaningful insight into the effects of combined acute state fatigue on immediate performance and skill acquisition, motor learning under various fatigue conditions, and transfer of acquired skills to demanding real-world environments. Furthermore, it extends the understanding of fatigue by highlighting the compounding effect of exposure to multiple simultaneous fatiguing tasks. Consistent with previous research results demonstrate combined fatigue's adverse, compounding effects on military performance.

Implications for Military Populations

By integrating combat-specific fatigue into training, military personnel will develop and execute the necessary skills for effective transfer to real-world combat environments. Additionally, Soldiers will gain additional exposure to the increased demands of combat, which may lead to an increased resistance to the perception of fatigue during extended military operations. Using synthetic training environments further expands opportunities to execute safe yet effective training that can introduce task and fatigue variations to enhance long-term performance adaptation.

