

Improving Performance in Medical Litter Evacuation: Evaluating the 'CLAW' Wearable During Simulated 2-Person and 4-Person Litter Carry

Lohita Mallavarapu, Michael Poppo, Jacob Seymour, Richard Nuckols

Background

Litter transport for casualty evacuation is demanding for military Service Members (SMs)

- It requires high energy expenditure
- Causes reduced grip strength
- May affect hand dexterity and SM's ability to provide medical attention
- Reduces number of SM's that can perform other tasks and provide security

The **Compact Litter Assist for Warfighters (CLAW)** (Fig 1A) redistributes litter load from the hands to the torso.

The project examines the biomechanical and human performance effects of CLAW assistance for 4-person and 2-person litter carry.

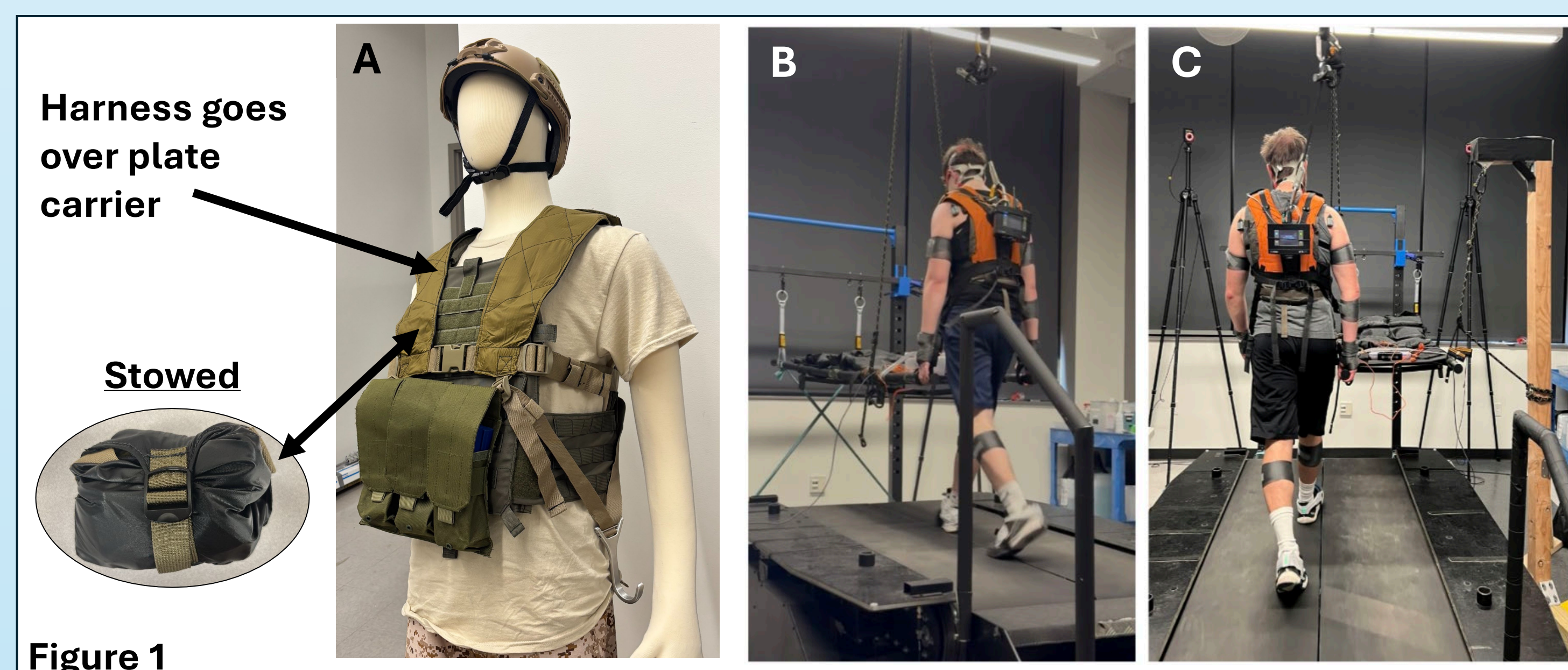


Figure 1

Hypothesis

- Individuals can walk farther during a 2-person carry with CLAW (2P_CL) compared to 4-person carry without the CLAW (4P_NC).
- CLAW would reduce grip fatigue, resulting in improved post-task grip strength.
- CLAW would improve team-level energy efficiency during litter transport.

Methods

Litter Setup:

- 40 lbs per handle, non-carried handles supported by strap (Fig 3).
- Load in CLAW straps and litter handle measured by load cells and strain gages.

Walking Tasks:

- Subjects walk at 1.5 m/s for 500 m bouts for up to 15 bouts
- Testing condition completed after litter drops in 2 consecutive bouts.
- Minimum of three walking bouts.

Primary testing conditions:

- 2P-CL** [2 Person with CLAW]
- Carry both handles (Fig 1B);
- 80 lbs total carry weight

4P-NC [4 Person without CLAW]

- Carry one handle (Fig 1C);
- 40 lbs total carry weight

Secondary testing conditions:

- 2P-NC** [2 Person without CLAW]
- 4P-CL** [4 Person with CLAW]

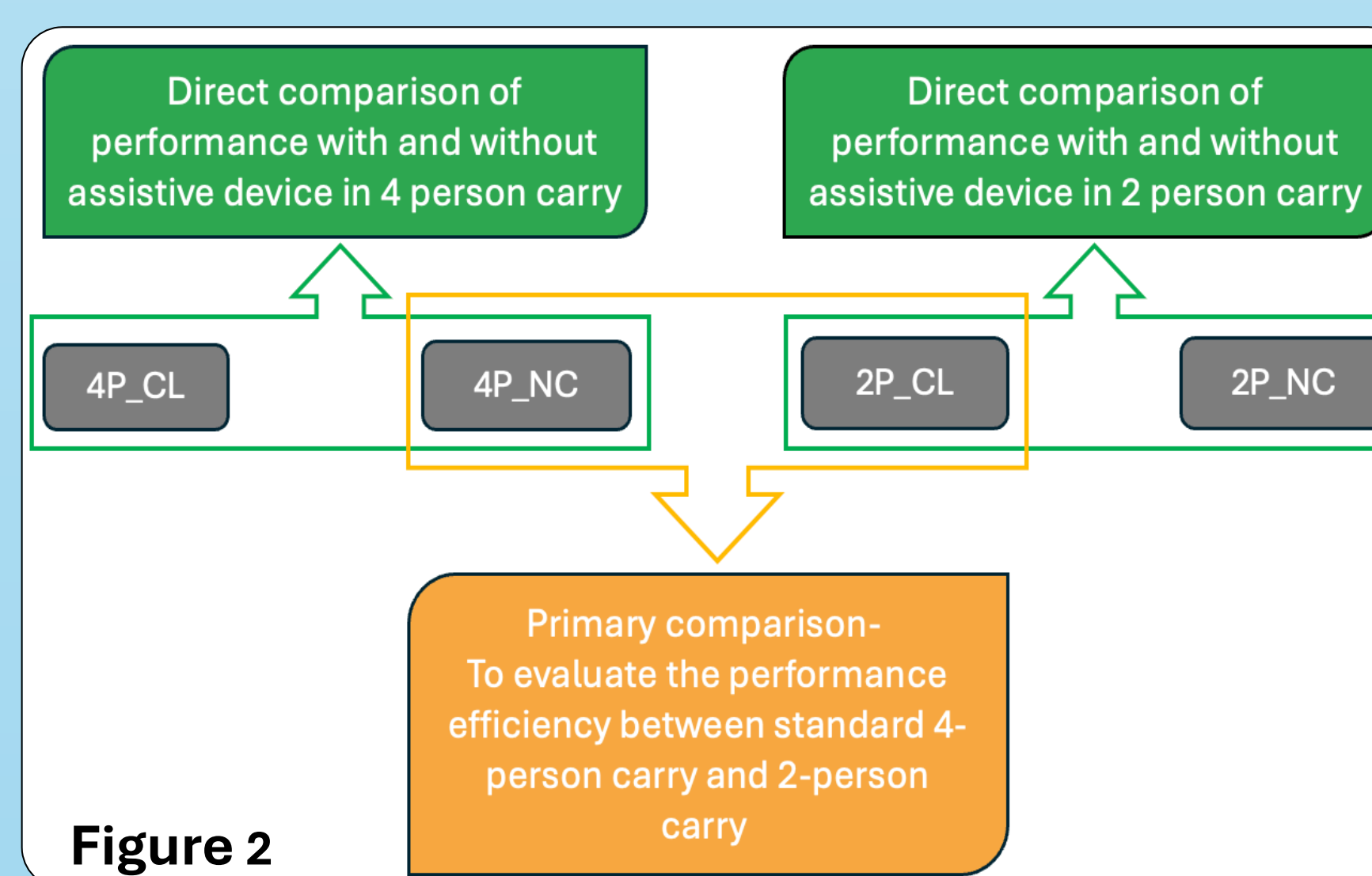


Figure 2

Protocol

- Participants tested: 10
- Target sample size : 15-20

Primary Metrics (every bout):

- Carry Distance
 - Grip strength
 - Metabolic demand
 - Questionnaire (effort/pain)
- ### Secondary Metrics
- Fine Motor Skills
 - (Hand Steadiness)
 - Marksmanship
 - Muscle activity (EMG)
 - Kinematics (MOCAP)

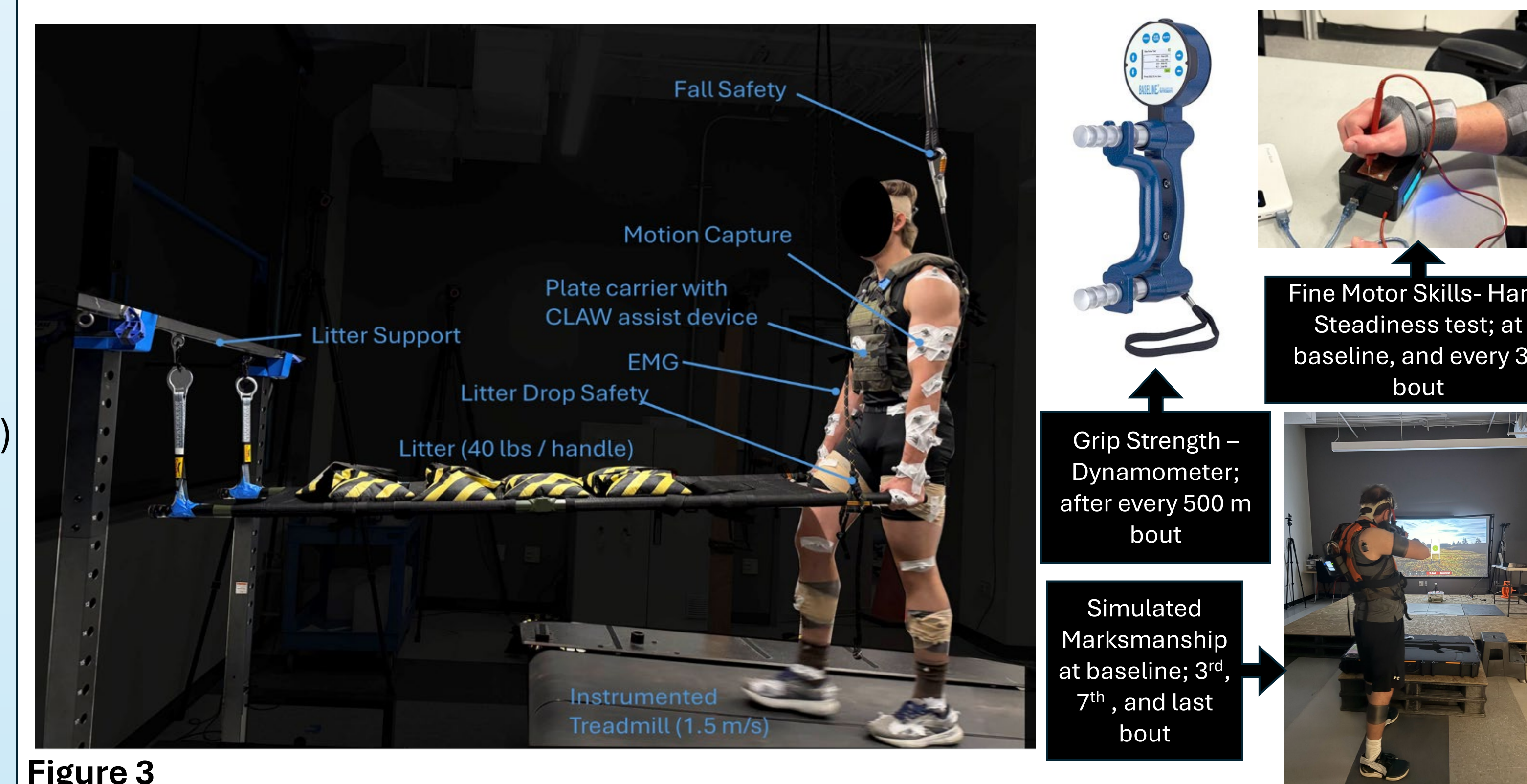
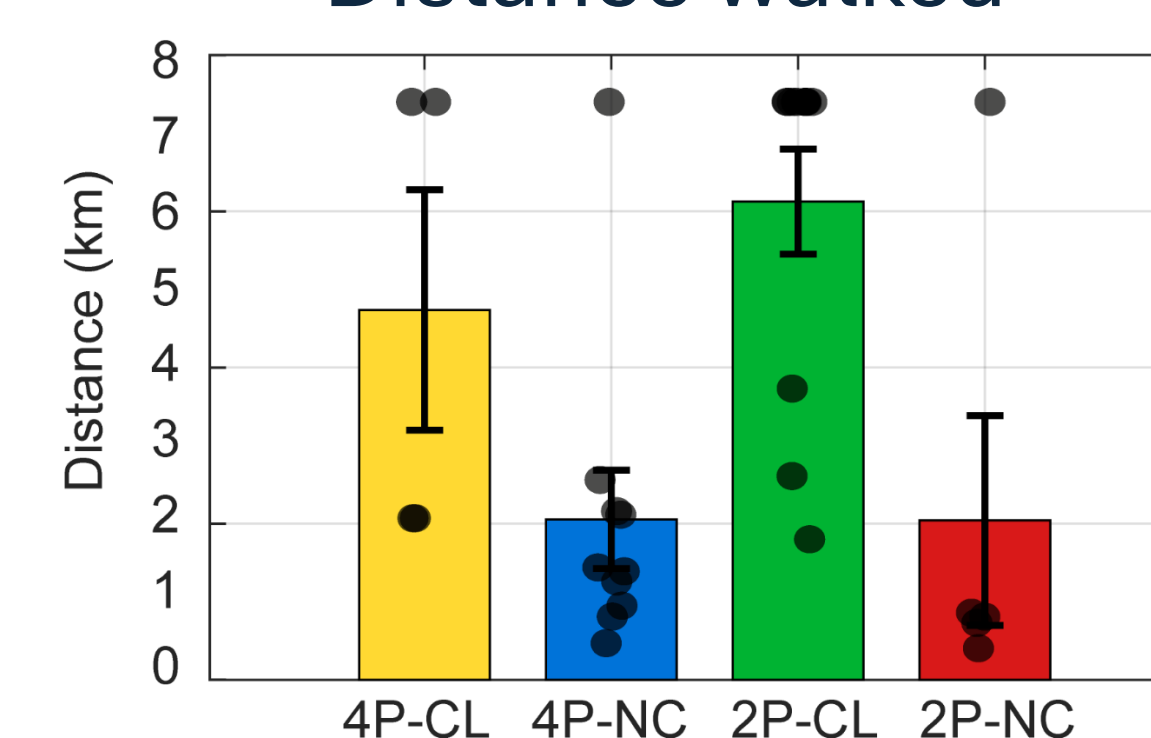


Figure 3

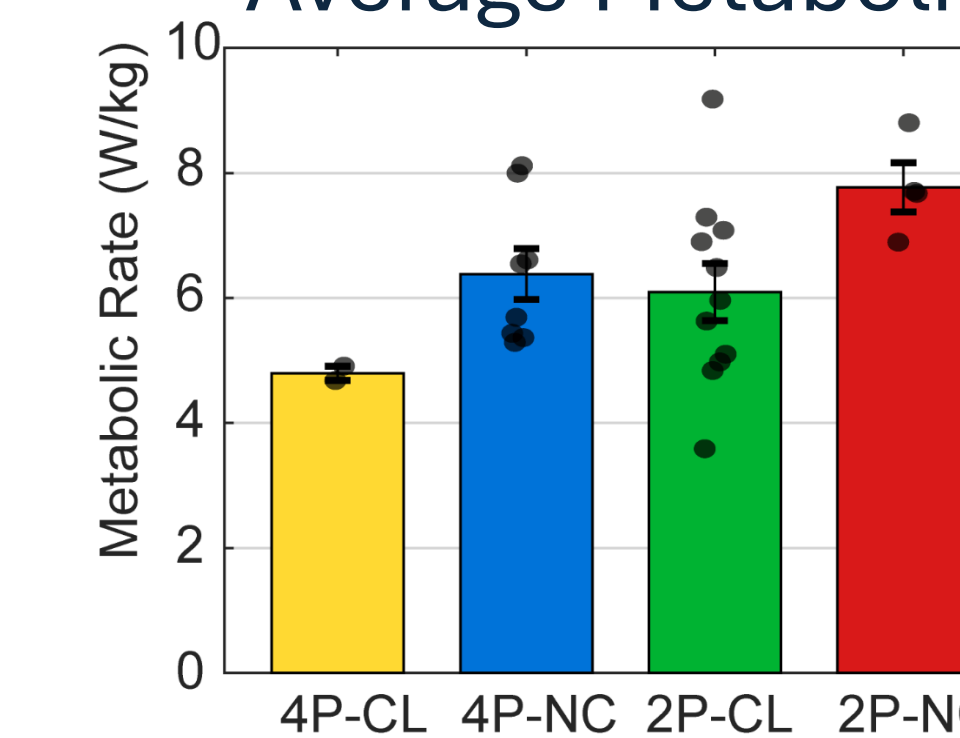
Results

Distance walked

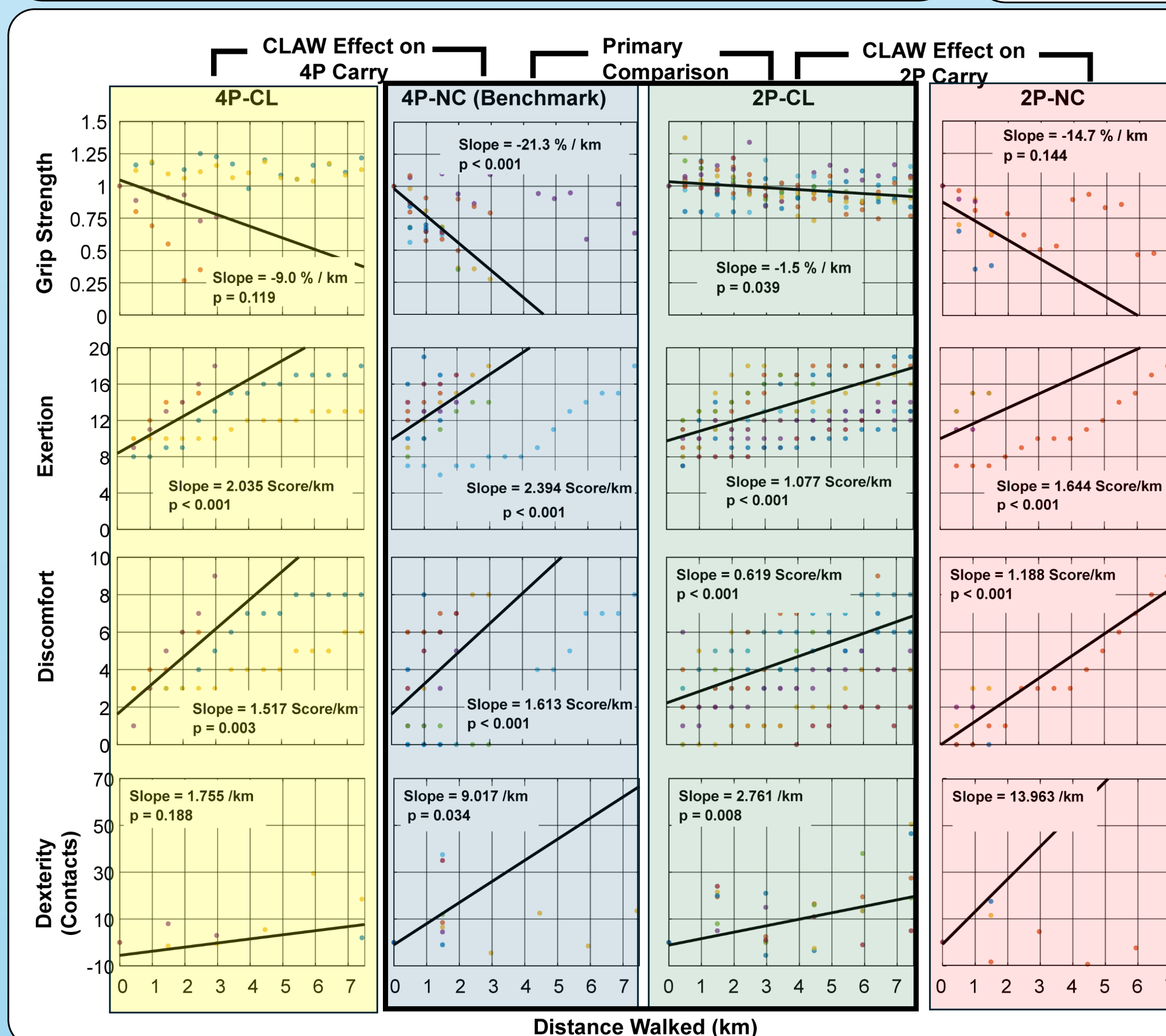


- Participants walked farther in 2P-CL than 4P-NC despite carrying more weight in 2P-CL.

Average Metabolic Rate



- Participants had similar energy use in 2P-CL and 4P-NC despite carrying more weight in 2P-CL.



Analysis: Repeated-Measures Mixed-Effects Model

- Grip strength was better maintained with CLAW.
- Exertion increased at a slower rate with 2P-CL vs 4P-NC as reported by subjects using BORG scale.
- Pain/discomfort increased at a slower rate with 2P-CL vs 4P-NC on 0-10 scale.
- Hand dexterity was maintained better with 2P-CL vs 4P-NC as shown by reduced contacts.

Discussion/Conclusions

- Walking distance and grip preservation improved with CLAW versus no assist.
- Performance appeared limited by local muscle fatigue, as subjects walked farther in 2P-CL despite similar or higher individual metabolic rate.
- Marksmanship and Fine motor skills test results have high variability with sample size of 10 participants
- Benefit from CLAW may be underestimated due to the 15-bout ceiling.

Reference

- Madison, A., et al. (2022). Evaluation of litter carriage performance and post-carry fatigue effects in prolonged combat field care environments (Part 1). USAARL-TECH-FR-2022-43.
- Ballard, M. T., et al. (2024). Evaluation of litter carriage performance and post-carry fatigue effects in prolonged combat field care environments (Part 2). USAARL-TECH-FR-2024-06.

Acknowledgments

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