

Exercise as a modality of recovery

Michael Hutchison, PhD RKin

Faculty of Kinesiology & Physical Education

David L. MacIntosh Sport Medicine Clinic

Centre for Sport-Related Concussion Research,
Innovation, and Knowledge

University of Toronto



UNIVERSITY OF
TORONTO

Toronto Rehabilitation Institute's
16th Annual Brain Injury Conference
Marriott Downtown at CF Toronto Eaton Centre
February 9, 2024



DISCLOSURES

FUNDING / GRANTS

CANADIAN INSTITUTES OF HEALTH RESEARCH (CIHR)
ONTARIO BRAIN INSTITUTE (OBI)
MITACS & OWN THE PODIUM – INNOVATION IN HIGH PERFORMANCE SPORT RESEARCH

CONSULTING

NATIONAL HOCKEY LEAGUE PLAYERS' ASSOCIATION (NHLPA)

COMMERCIAL INTERESTS

UNIVERSITY OF TORONTO START-UP: RHEA HEALTH INC.
Founding member from research program, leadership advisory member

EXERCISE AS A MODALITY OF RECOVERY

A large group of diverse people, including men and women of various ethnicities and ages, are standing on a large, ornate scale. The scale is positioned in the center of the frame, with its two pans hanging down. The people are arranged in a line behind the scale, creating a sense of a collective or community. The background is a plain, light color, and the overall lighting is soft and even.

- Do we all agree with this basic premise?
- How many people think exercise is bad / or detrimental for recovery?
- Can we think of situations where exercise is harmful following concussion?
- On the balance, 'we' generally agree that it is useful / assistive for concussion recovery, but ...
- *How do we translate this into clinical practice?*

EXERCISE PRESCRIPTION PRIMER

All exercise prescriptions require several elements outlined by the 'FITT' principle.

- F** REQUENCY
- I** NTENSITY
- T** IME
- T** YPE
- T** IME FROM INJURY



PROVIDING YOU THE END AT THE BEGINNING

F FREQUENCY

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RELEVANT BACKGROUND HISTORICAL CONTEXT

REST ≠ CORNERSTONE

The best available evidence shows that recommending strict rest until the complete resolution of concussion-related symptoms is not beneficial following SRC.

**SUBSYMPTOM THRESHOLD
AEROBIC EXERCISE**

HCPs with access to exercise testing can safely prescribe subsymptom threshold aerobic exercise treatment within 2–10 days after SRC, based on the individual's heart rate threshold (HRt).

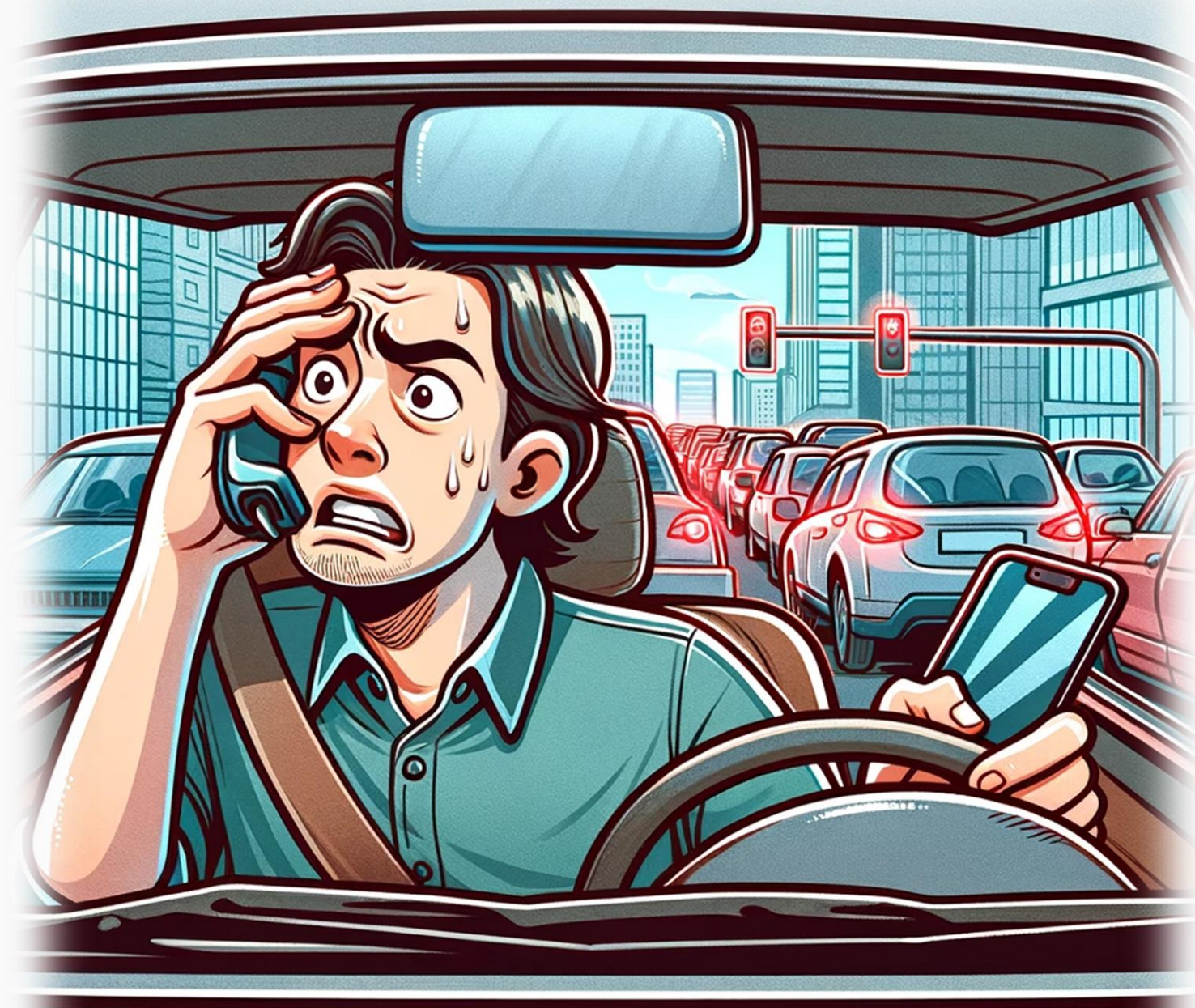
**HRt REPEAT EXERCISE
TESTING**

Subsymptom threshold aerobic exercise treatment can be progressed systematically based on the determination of the new HRt on repeat exercise testing (every few days to every week).



How did we
get here?

CONCUSSION REHABILITATION: PAIN POINT

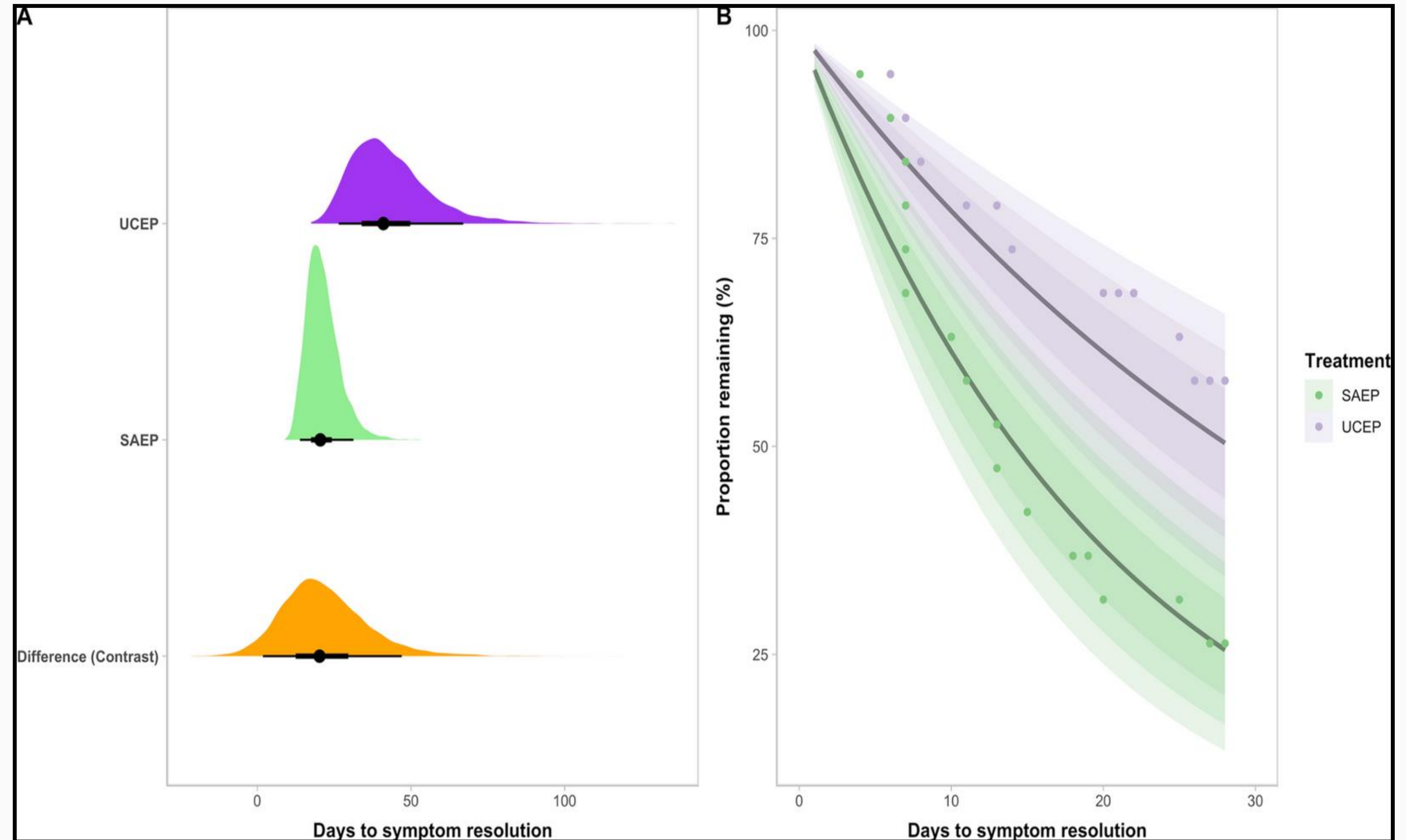
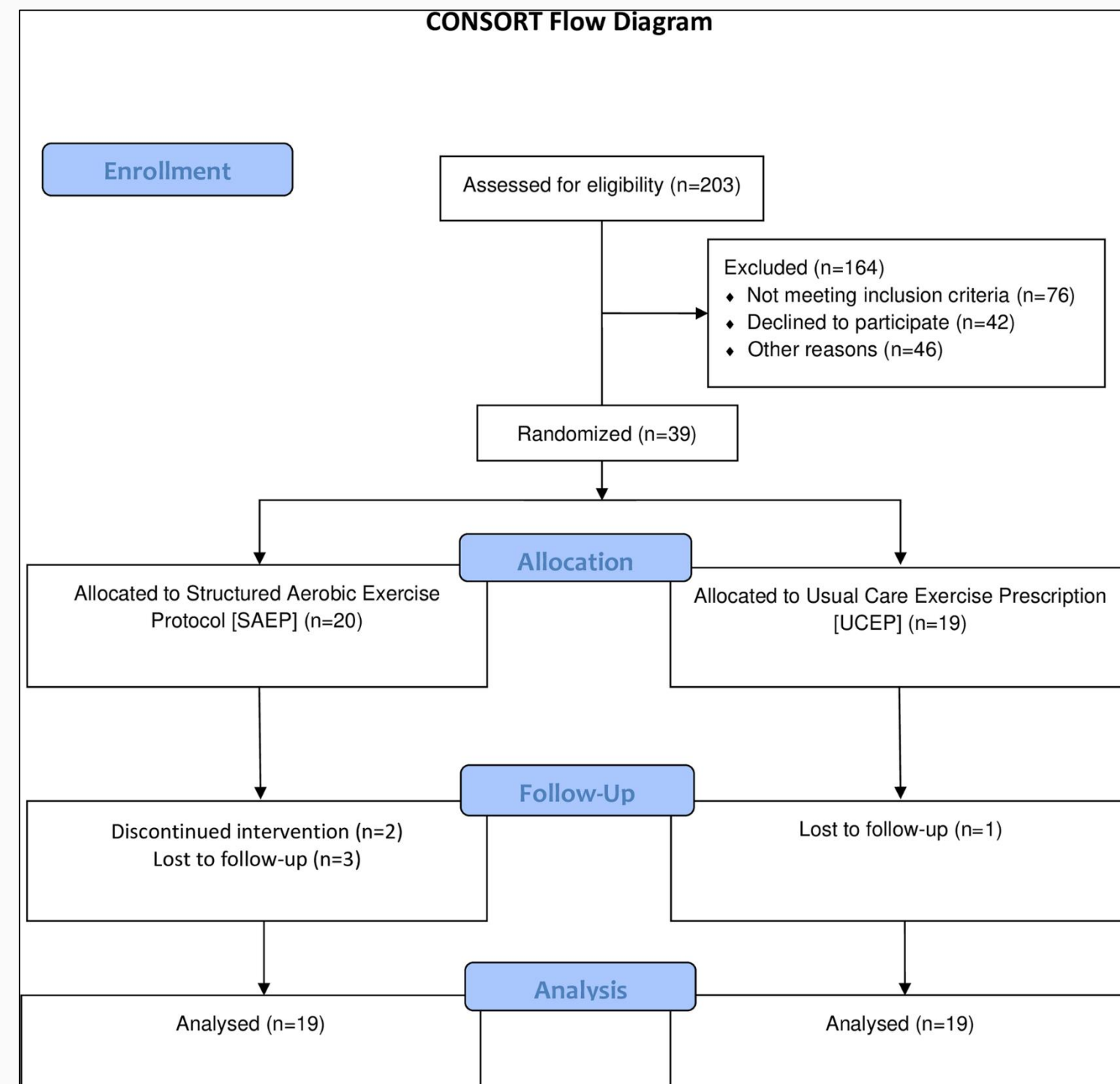


FEASIBILITY OF AGE PREDICTED HR INTERVENTION



- 11-Day Protocol: 2 days on, 1 day off.
- Session 1 -> 10 min, intensity 50% age-predicted maximal heart rate (apMHR).
- Session 2 -> 20 min, 50% apMHR.
- Session 3 -> 8, 55%, 60%, 65%, 70%, 70%, 70%.
- Feasible if: (1) symptom did not become exacerbated during or immediately after exercise compared with pre-exercise levels and (2) EXG participants were able to complete the entire AE intervention.
- 16 participants – 8 EXG vs 8 Usual Care.

MORE RECENT FINDINGS: EFFICACY apMHR



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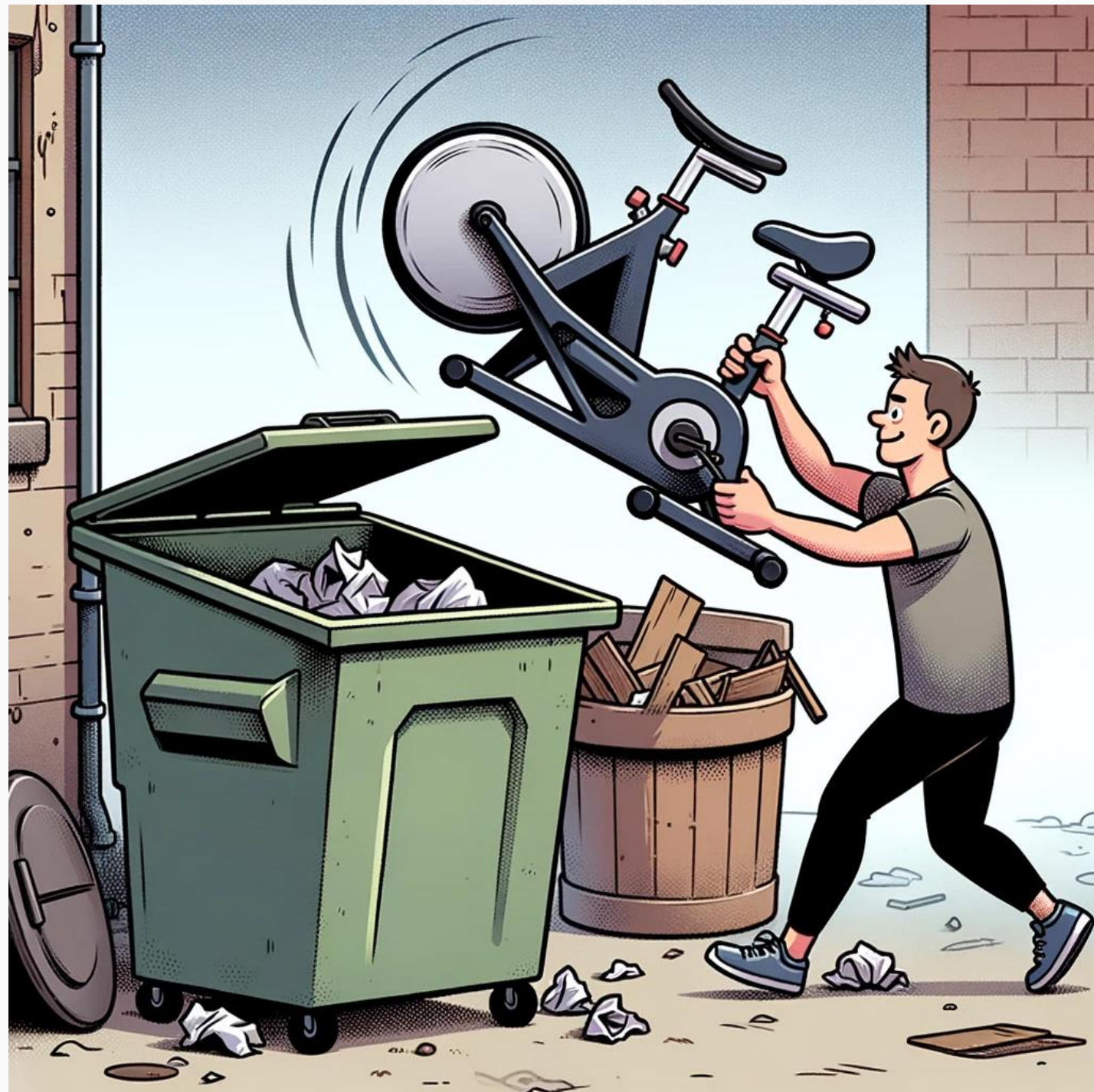
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Do you even need equipment?



Guiding principles:

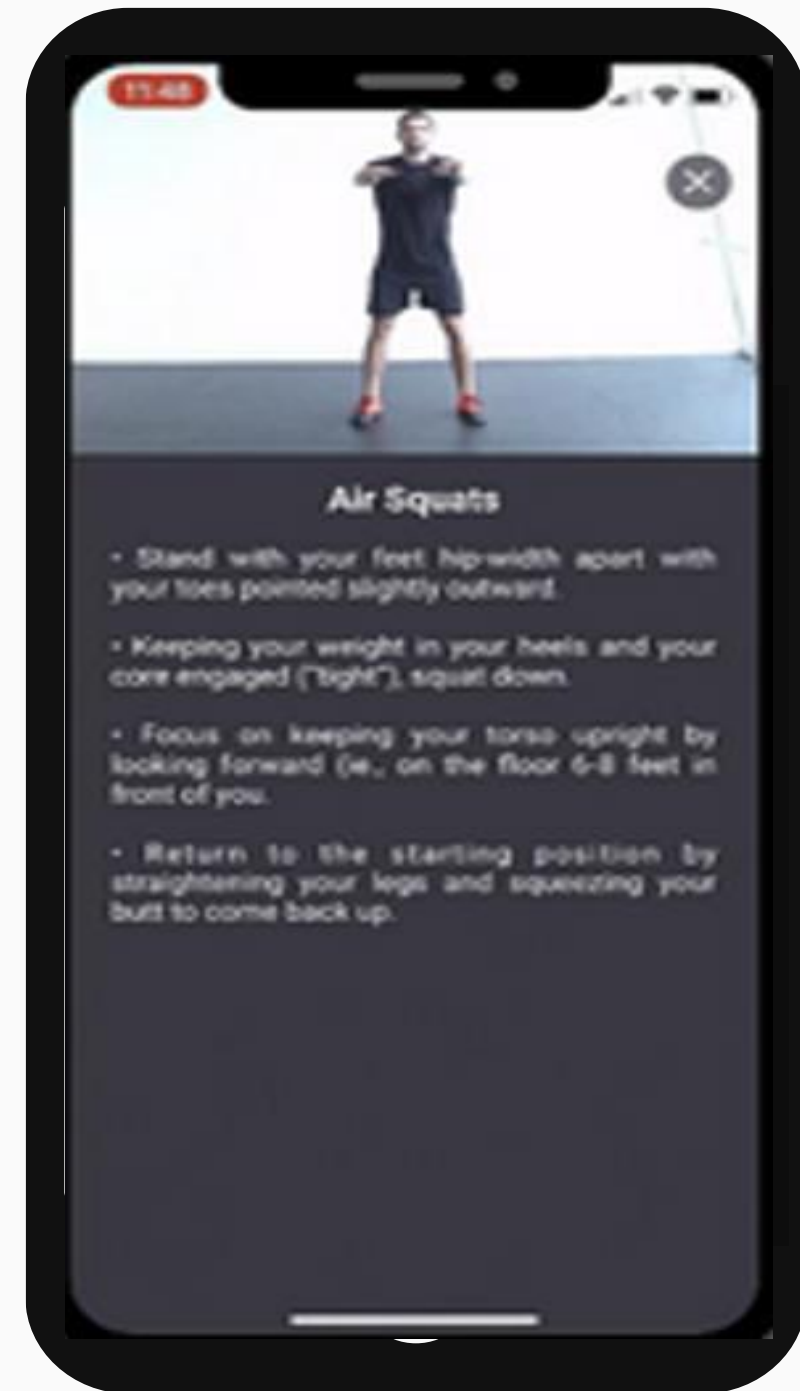
1. Head acceleration direction(s)
2. Bracing demand
3. Number of movement patterns within an exercise, and
4. Tempo or intensity of the movement

Create a stimulus aerobic activity similar to circuit-based training

Opportunity for mobile health (mHealth) intervention:

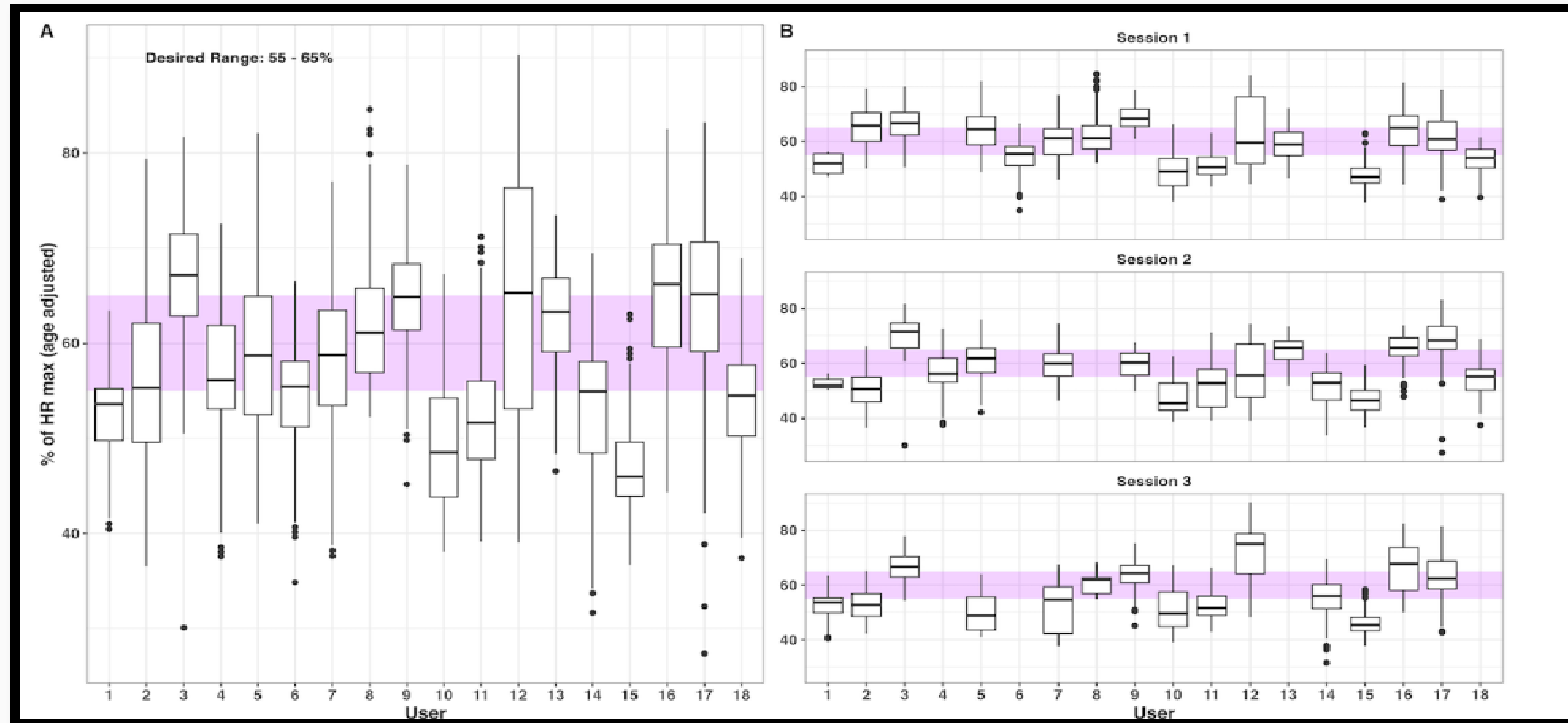
1. Helps eliminate barriers to access
2. Instructional design
3. Complement in-person care

mHEALTH DELIVERY OF AEROBIC ACTIVITY FOR CONCUSSION – V 1.0



- Given that we are using a novel modality for individuals recovering from a concussion delivered through a mobile app platform, our initial investigation sought to evaluate the feasibility of the protocol.
- We were interested in evaluating (1) adverse events and retention among users across a 3-session plan, and (2) whether users could achieve a target HR during exercise sessions.
- We hypothesized that each Continuous Aerobic Resistance Exercise (CARE) session would be completed by all participants and would elicit HRs of 55% (± 5) of participants' age-adjusted maximum HR.

MAIN FINDINGS



WHY IS AEROBIC ACTIVITY BENEFICIAL – MECHANISMS?

- **Concussion ->**
 - Dysregulation of the autonomic nervous system
 - Reduced cardiovascular function
 - Impaired regulation of cerebral blood flow
- These maladaptive physiologic functions improve with aerobic physical activity.
- **Neuroplasticity Enhancement:** Regular aerobic exercise stimulates the release of brain-derived neurotrophic factor (BDNF), a protein that supports the growth and differentiation of new neurons and synapses.
- **Neurotransmitter Regulation:** Exercise increases the production of neurotransmitters such as serotonin and dopamine. These chemicals in the brain play key roles in regulating mood and feeling states.

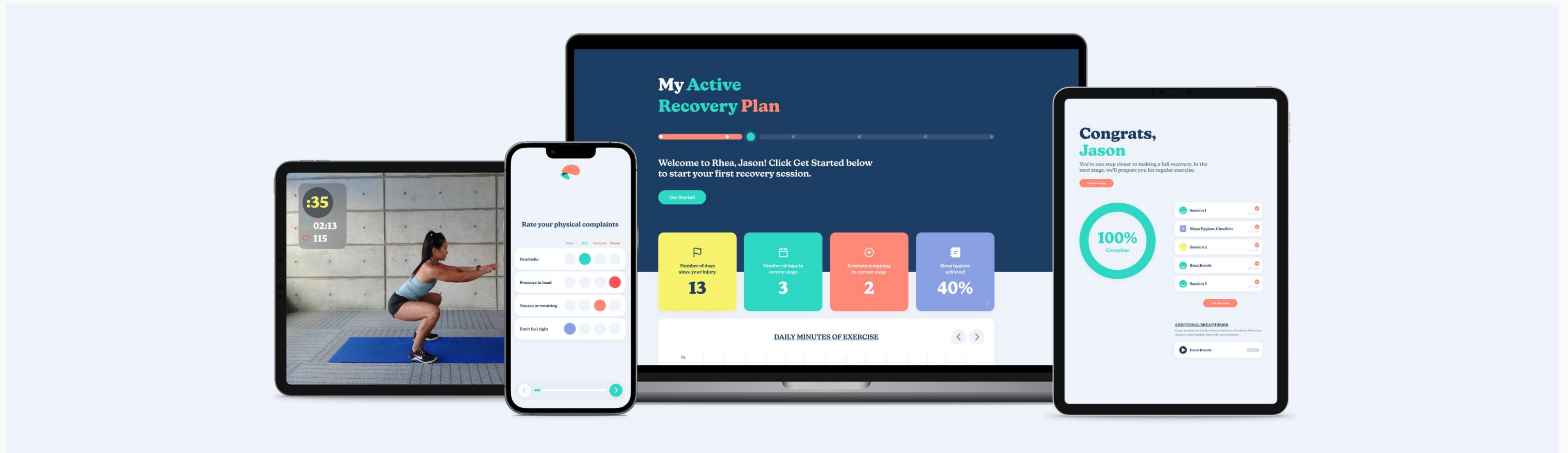


WHY IS AEROBIC ACTIVITY BENEFICIAL – MECHANISMS?

- **Hormonal Response:** Exercise helps in balancing stress hormones in the body, particularly cortisol. Norepinephrine may improve the body's ability to handle stress and also help alleviate feelings of fatigue.
- **Inflammatory Reduction:** There is evidence to suggest that concussion is associated with systemic inflammation. Aerobic exercise has been shown to have anti-inflammatory effects.
- **Endorphin Release:** Exercise leads to the release of endorphins (i.e., neuropeptides) -> mood elevators produced by the brain.
- **Psychological Benefits:** Provide a sense of accomplishment, and create opportunities for social interaction.



VERSION 2.0 mHEALTH REHAB TOOL FOR CONCUSSION



Rhea is digital platform that design's an active recovery plan tailored to patients' injury and symptoms.

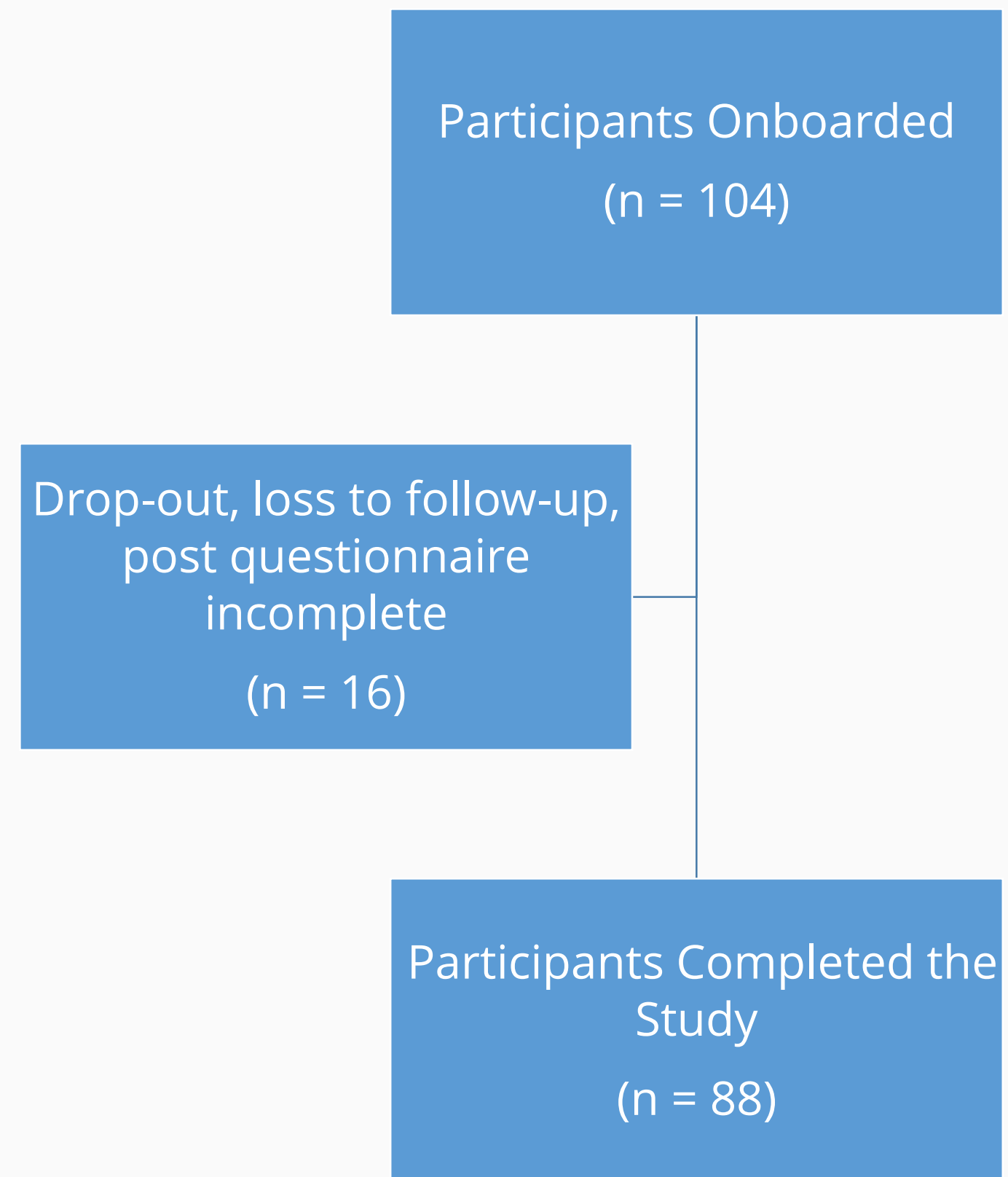
Purpose is to complement in-person care and focus on the core areas of concussion rehabilitation: physical exercise, range of motion, strength, vision, balance and coordination, overall stress reduction, and sleep.

STUDY
INDIVIDUALS WITH PSaC

To assess the effect of a natural environment submaximal resistance exercise protocol on concussion symptoms and emotional well-being via a mobile health intervention.

Concussion Symptoms (SCAT-5)
Depressive Symptoms (PHQ-9)
Symptoms of Anxiety (GAD-7)

STUDY OVERVIEW

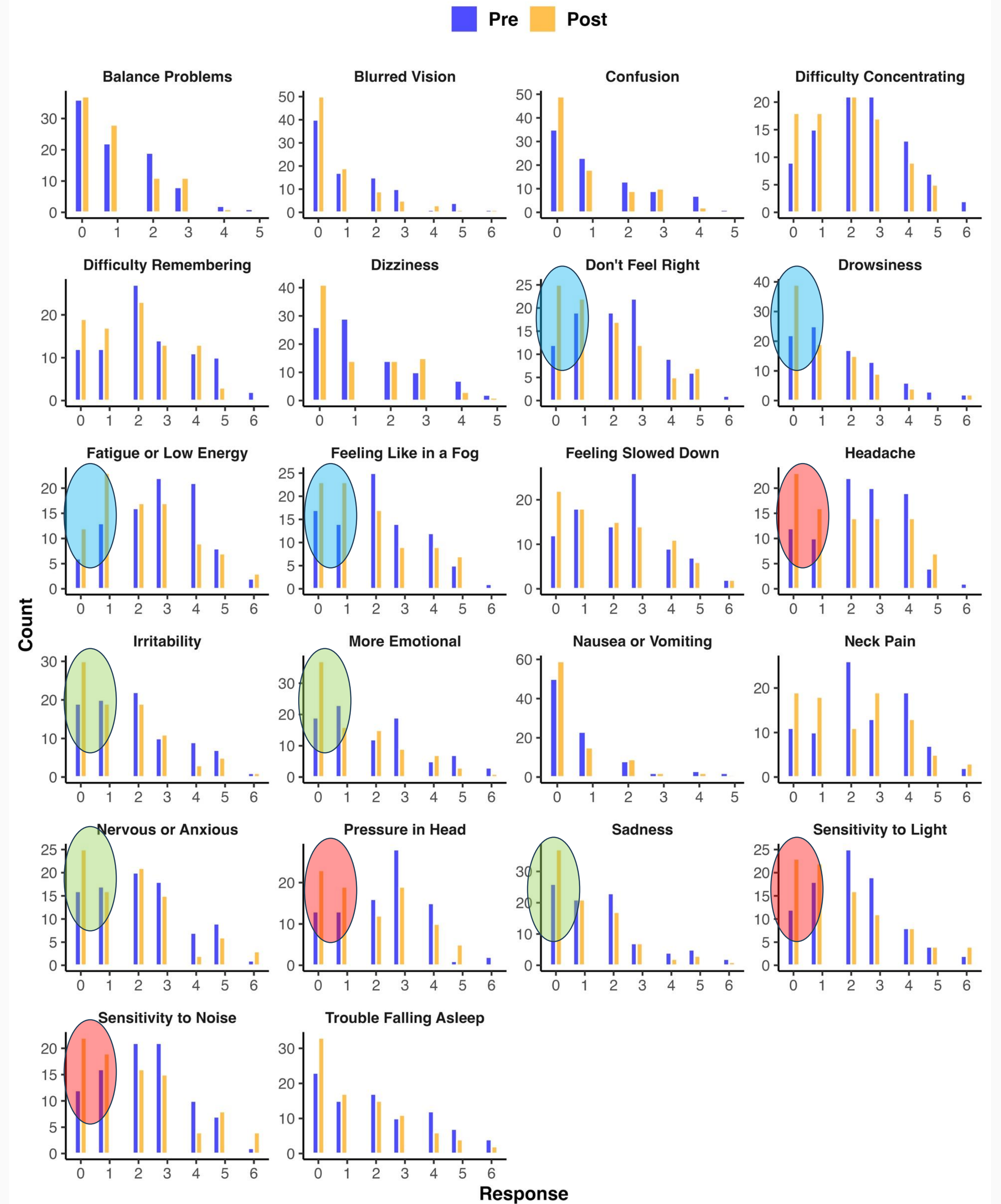
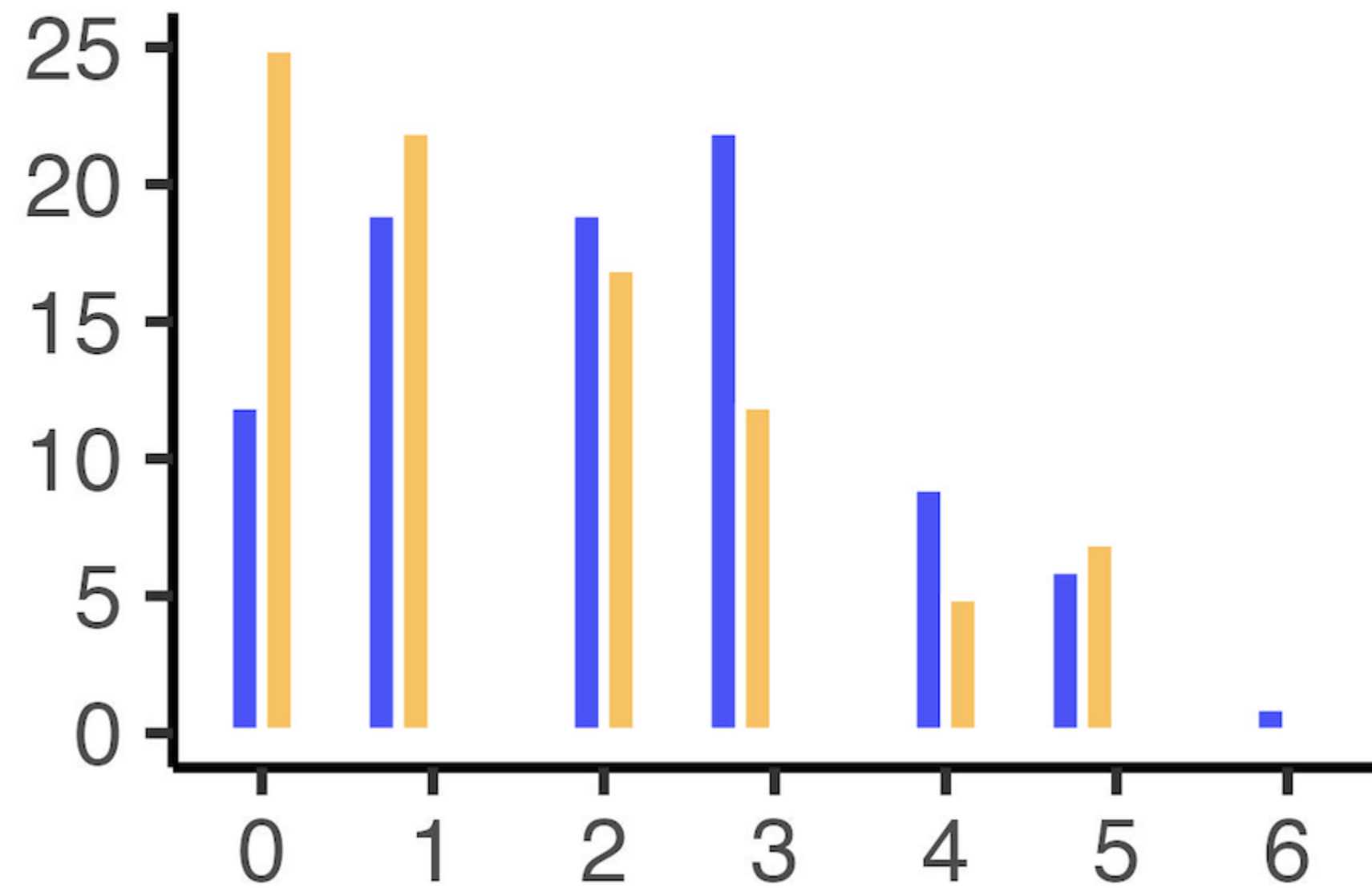


Pre-Post Study Measures		
Outcome measure	Pre, N = 88¹	Post, N = 88¹
Symptom Severity (SCAT-5)	42.5 (31.0,58.3)	32.5 (16.8,49.8)
PHQ9	10.0 (6.0,14.0)	7.0 (5.0,11.0)
GAD7	6.5 (4.0,11.0)	5.0 (2.8,8.3)

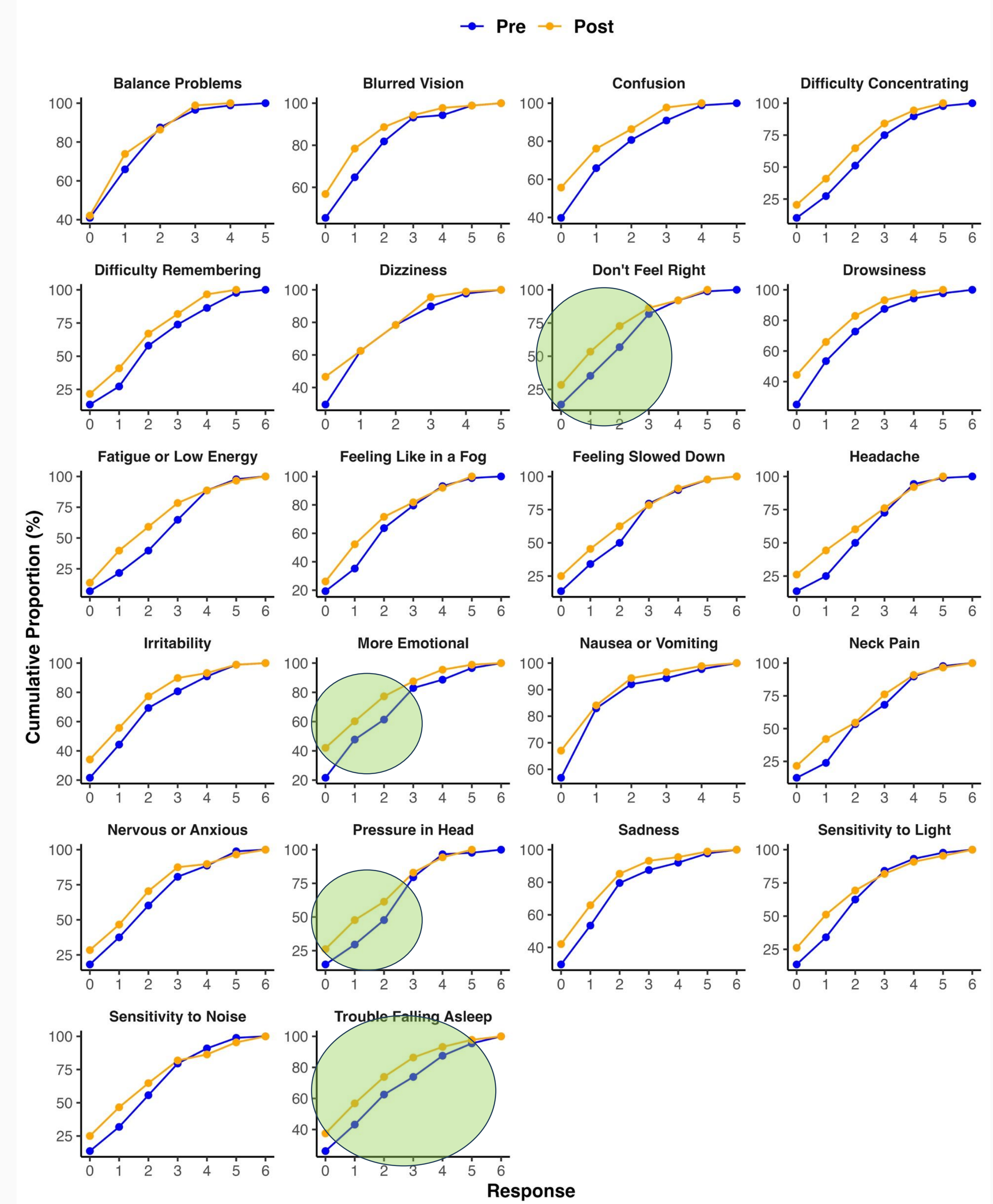
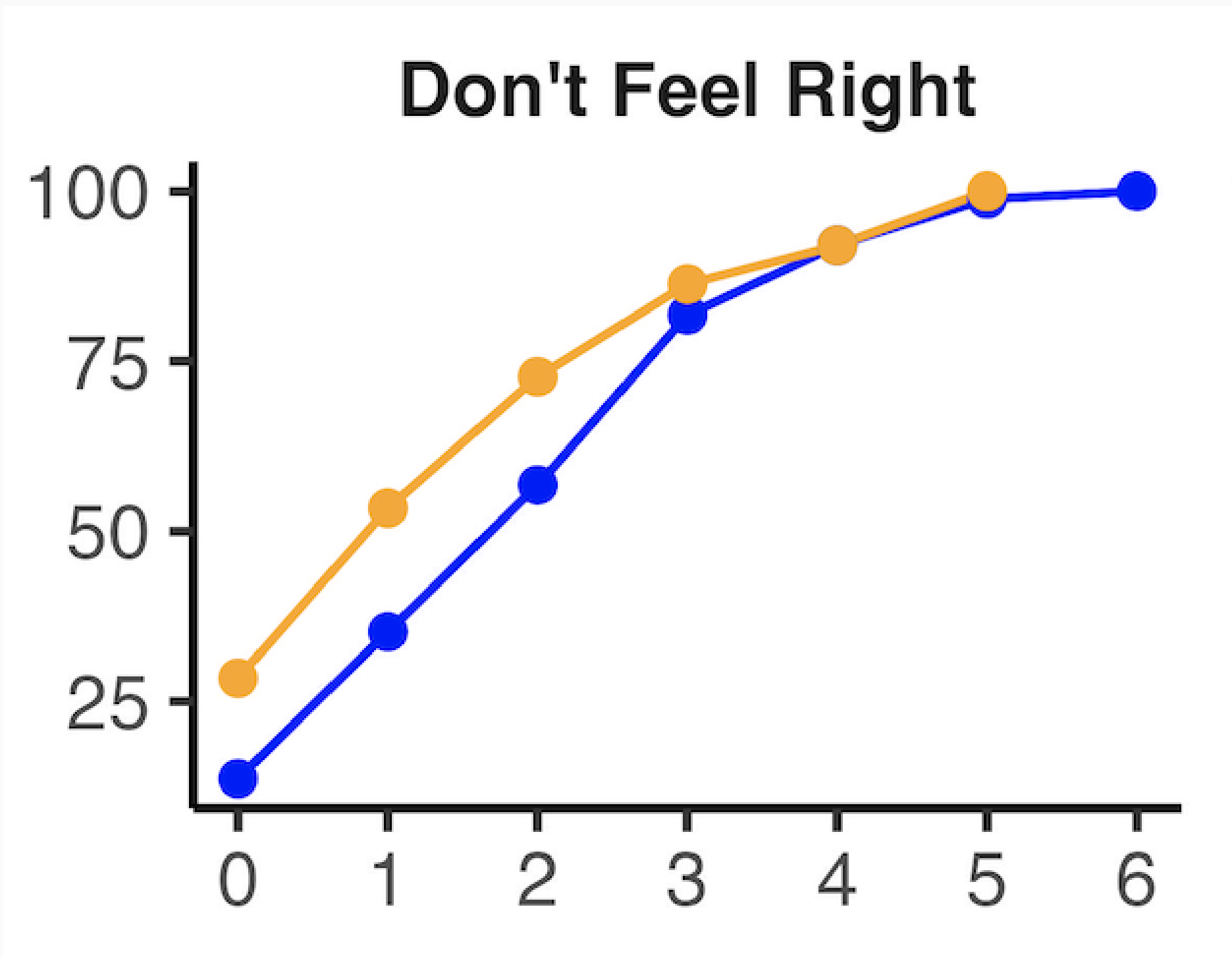
¹ Median (25%,75%)

SCAT-5 SYMPTOMS: COUNT

Don't Feel Right



SCAT-5 SYMPTOMS: CUMULATIVE DISTRIBUTION

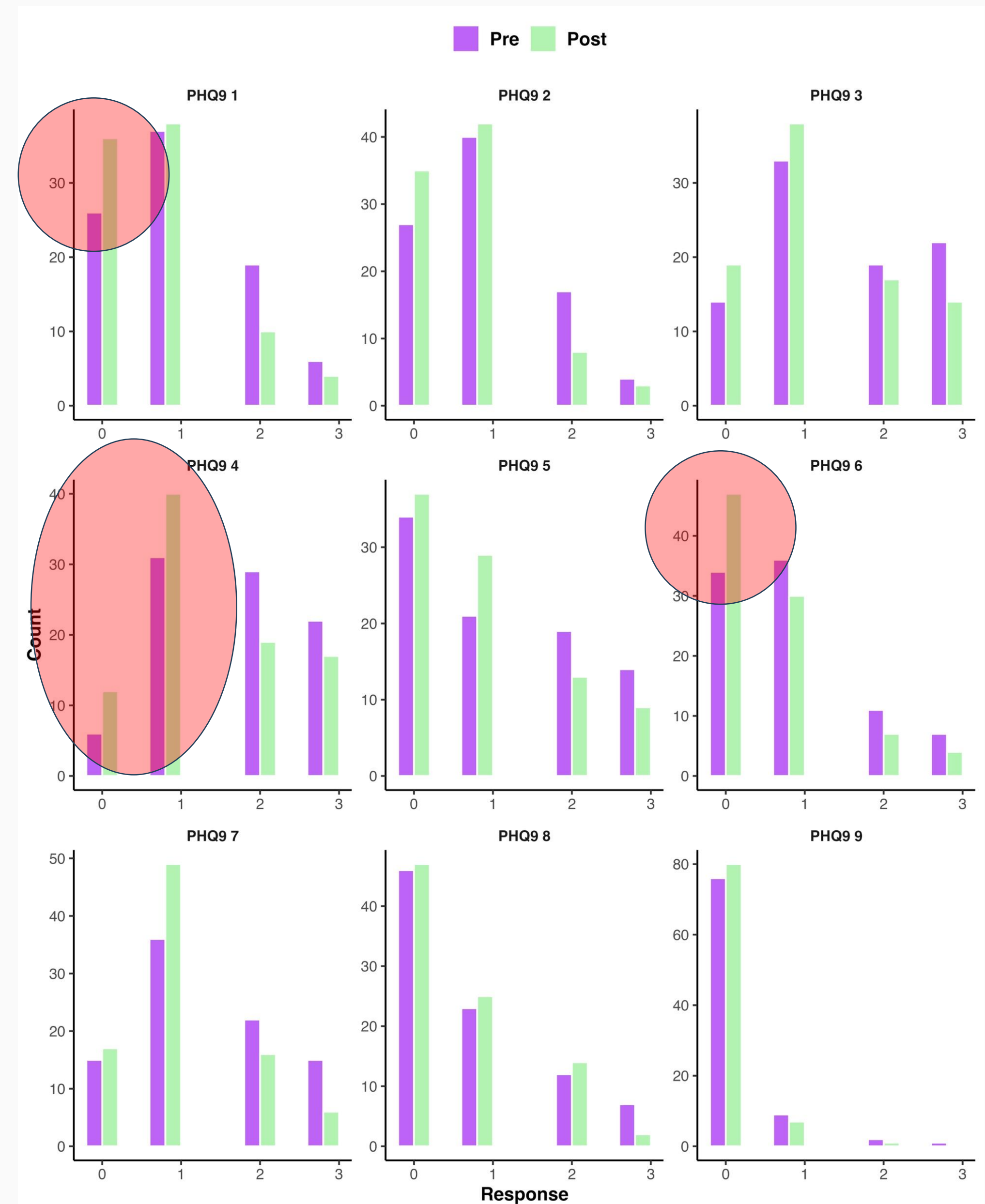


PHQ-9: COUNT

PATIENT HEALTH QUESTIONNAIRE-9 (PHQ-9)

Over the **last 2 weeks**, how often have you been bothered by any of the following problems?
(Use "✓" to indicate your answer)

	Not at all	Several days	More than half the days	Nearly every day
1. Little interest or pleasure in doing things	0	1	2	3
2. Feeling down, depressed, or hopeless	0	1	2	3
3. Trouble falling or staying asleep, or sleeping too much	0	1	2	3
4. Feeling tired or having little energy	0	1	2	3
5. Poor appetite or overeating	0	1	2	3
6. Feeling bad about yourself — or that you are a failure or have let yourself or your family down	0	1	2	3
7. Trouble concentrating on things, such as reading the newspaper or watching television	0	1	2	3
8. Moving or speaking so slowly that other people could have noticed? Or the opposite — being so fidgety or restless that you have been moving around a lot more than usual	0	1	2	3
9. Thoughts that you would be better off dead or of hurting yourself in some way	0	1	2	3



REFLECTIONS & LEARNINGS FROM mHEALTH STUDY



REFLECTIONS

- Time from injury – more symptomatic / complicated
- History of mental health surprising finding
- Very high symptom burden and certain symptom clusters = less effective
- Variability in engagement



LEARNINGS

- Promising, scalable intervention for rehabilitation
- Research, research, research.....
- Opportunity to complement in-person care or address void for those in remote rural areas or cannot access specialized care

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RATIONALE FOR EXERTIONAL CLINICAL TEST

- Determining return to unrestricted sport activities (i.e., recovery) from concussion when:
 - ✓ • Resolution of concussion related symptoms at rest; and
 - ✗ • Completion of a graded return-to-sport strategy; and
 - ✗ • No emergence of concussion-related symptoms at exertion levels required for competitive play; and
 - ✓ • Physician determines the patient's neurological function to be normal; and
 - ✓ • *Neurocognitive performance has return to baseline or normal*

MULTIMODAL EXERTIONAL TEST (MET)

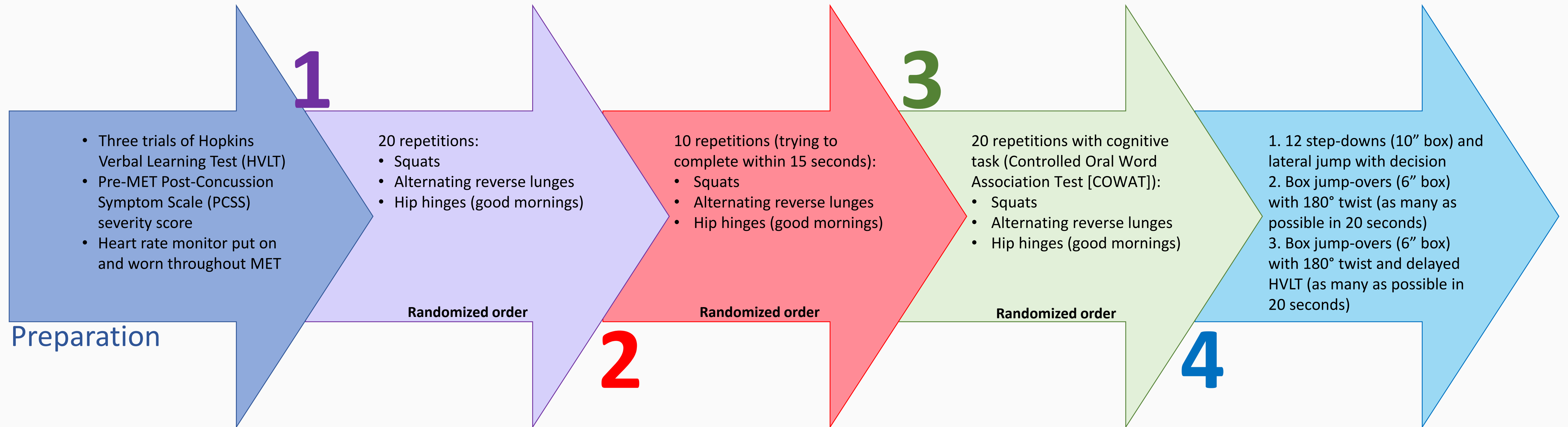


Key factors when developing the MET:

- Minimal resources required
- Any healthcare provider can administer
- Captures key elements of sport/ exercise

	Cardiovascular Load	Head Acceleration	Cognitive Task	Coordination
Stage 1	✓			
Stage 2	✓	✓		
Stage 3	✓	✓	✓	
Stage 4	✓	✓	✓	✓

MULTIMODAL EXERTIONAL TEST (MET)



IMPORTANT QUESTIONS

- Does the MET elicit a progressive exertional response in healthy athletes?
- What are the symptom responses of uninjured, healthy athletes?
- Do athletes with concussion differ in responses on the MET compared to uninjured, healthy athletes?

HEALTHY ATHLETES

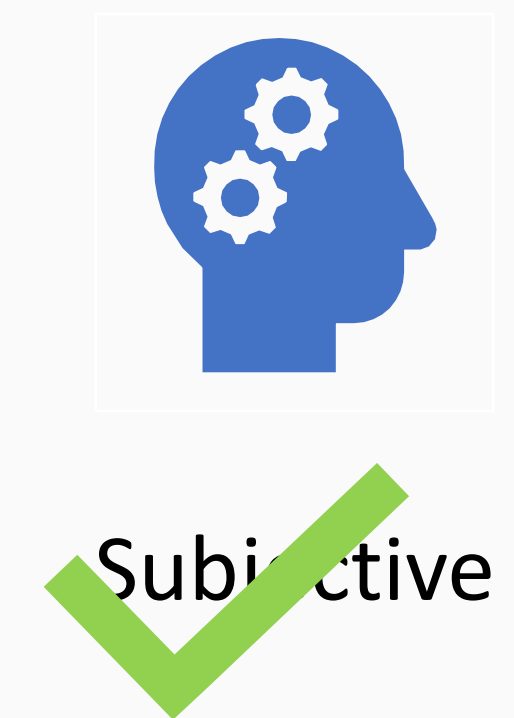
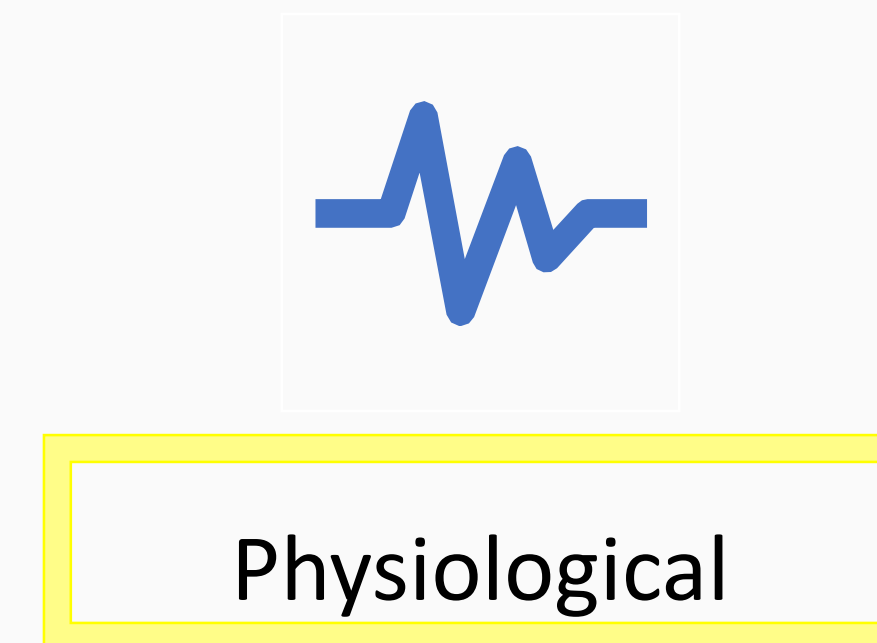
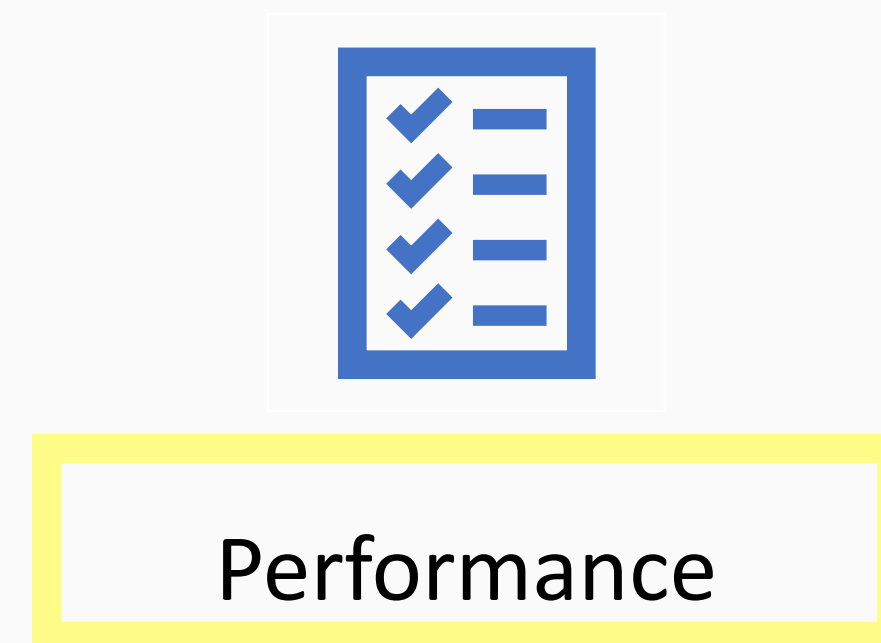
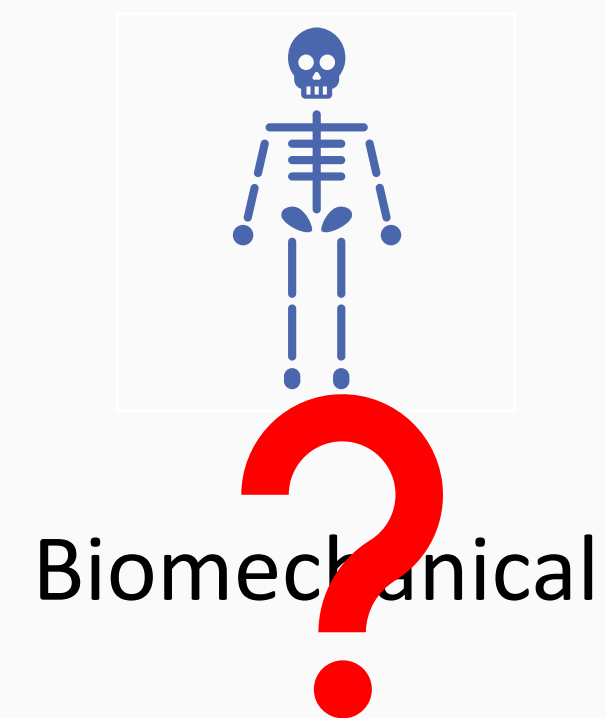
Varsity Athletes (n = 14):

- Female (n = 8)
- Male (n = 6)

Main Measures:

- Average HR
- Maximum HR
- Symptom scores

WHAT ABOUT AFTER A CONCUSSION?

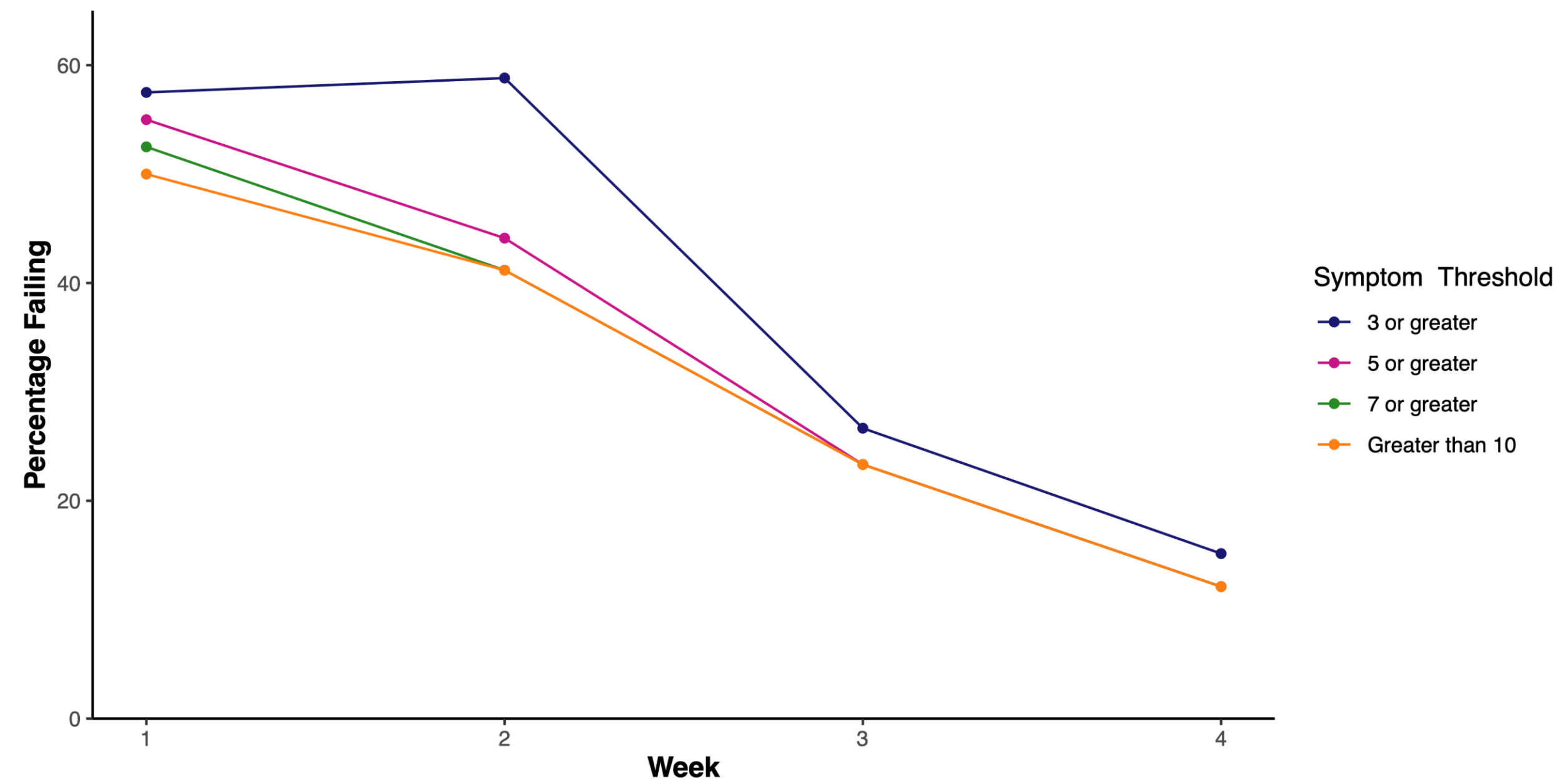


Pass: successful completion of MET

Fail:

- Symptom exacerbation
- Athlete stops MET
- Examiner stops MET

FAILING THE MET



IMPLICATIONS / LEARNINGS

- Preliminary evidence indicates value beyond current clinical tests
- Assist with medical clearance determination
- Athletes gaining insight into their own recovery
- There may be a role for prognosis or intervention strategies

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