SPORT PRODUCT
TESTING

PHYSICAL PERFORMANCE USING PROTOTYPE TECHNOLOGY IN APPAREL

Monday, August 26th, 2024

RELIVE

CANADIAN SPORT INSTITUTE
INSTITUT CANADIEN DU SPORT
ALBERTA

SPORT PRODUCT
TESTING

Purpose

MAIN GOAL: Investigate the effect of the use of wearable performance apparel on athlete performance.

SPECIFIC OBJECTIVES:

1. Investigate the acute and short-term performance effects of wearing prototype garments throughout a 7 to 14-day period.

2. Investigate participant perception throughout the wear period.

Methods   Participants

Sample Size	10	10
Size Distribution	M: 2; L: 5; XL: 3	M: 6; L: 4
Age	28 ± 7 years	28 ± 4 years
Height	183.1 ± 5.1 cm	168.8 ± 5.2 cm
Weight	88.8 ± 7.6 kg	67.3 ± 4.7 kg

* Injury-free and physically active

Methods

Relive Healthware | **Control**

Methods

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┌─────────────────────┐      ┌─────────────────────┐      ┌─────────────────────┐
│                     │      │                     │      │                     │
│  Performance Test   │ ──▶  │                     │ ──▶  │  Performance Test   │
│     (Pre-Wear)      │      │     Wear Phase      │      │     (Post-Wear)     │
│                     │      │                     │      │                     │
└─────────────────────┘      └─────────────────────┘      └─────────────────────┘
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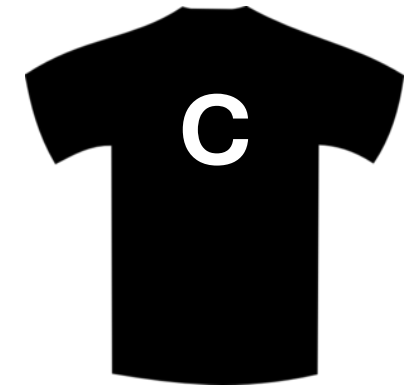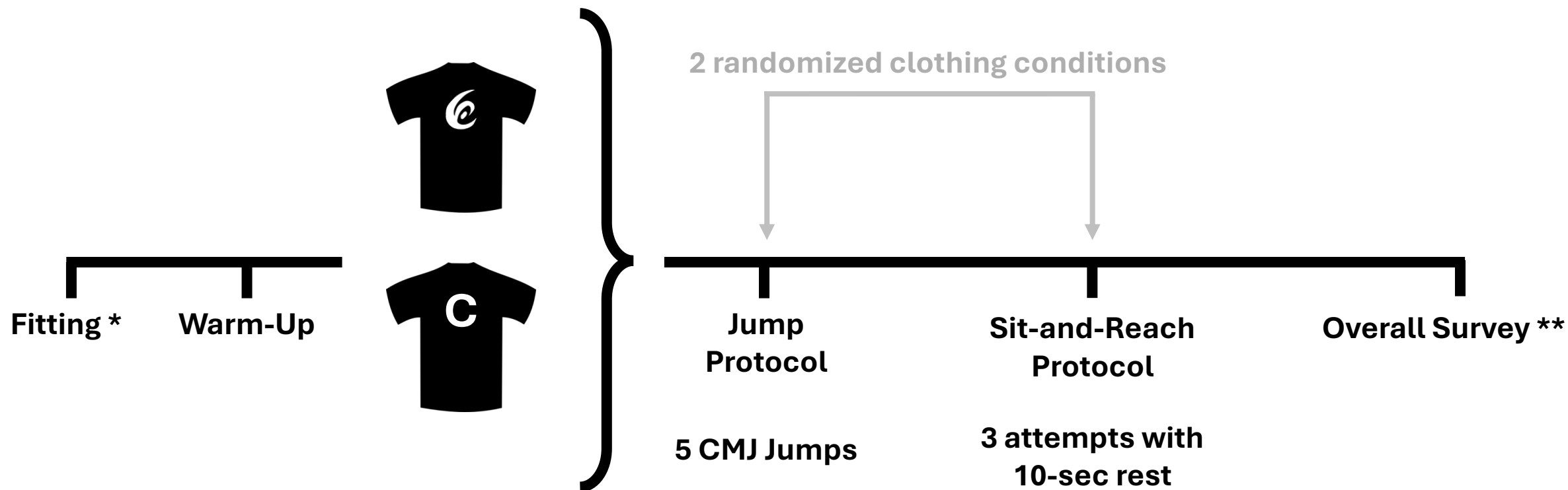
Median Duration: 8; Range: 7-13 days

Methods

Countermovement Jumps (CMJ)

- **Maximal Effort**
- **Two-Footed Take-Off**
- **10 total jumps (5 jumps per condition)**
- **5-second break**
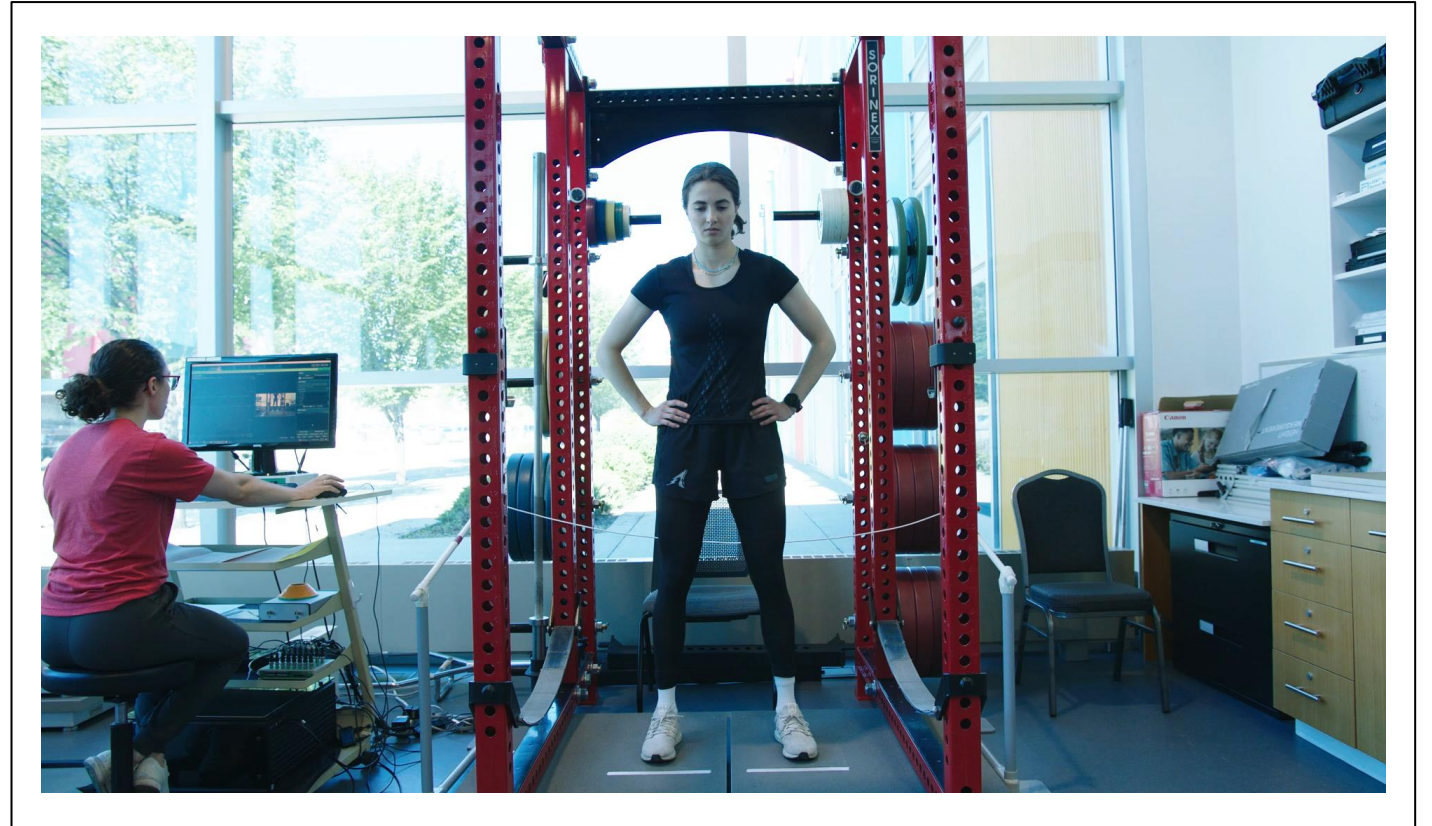
Methods

Sit and Reach

- **Maximal Effort**

- **6 total attempts (3 attempts per condition)**

- **10-second break**

Variables of interest

Reach Score

Jump Height

Peak Power

Reactive Strength Index (RSI)

Qualitative Feedback

Reach Score (cm)

- **Sit-and-Reach Device**
- **Reach Score (cm) is the best score out of 3 attempts.**

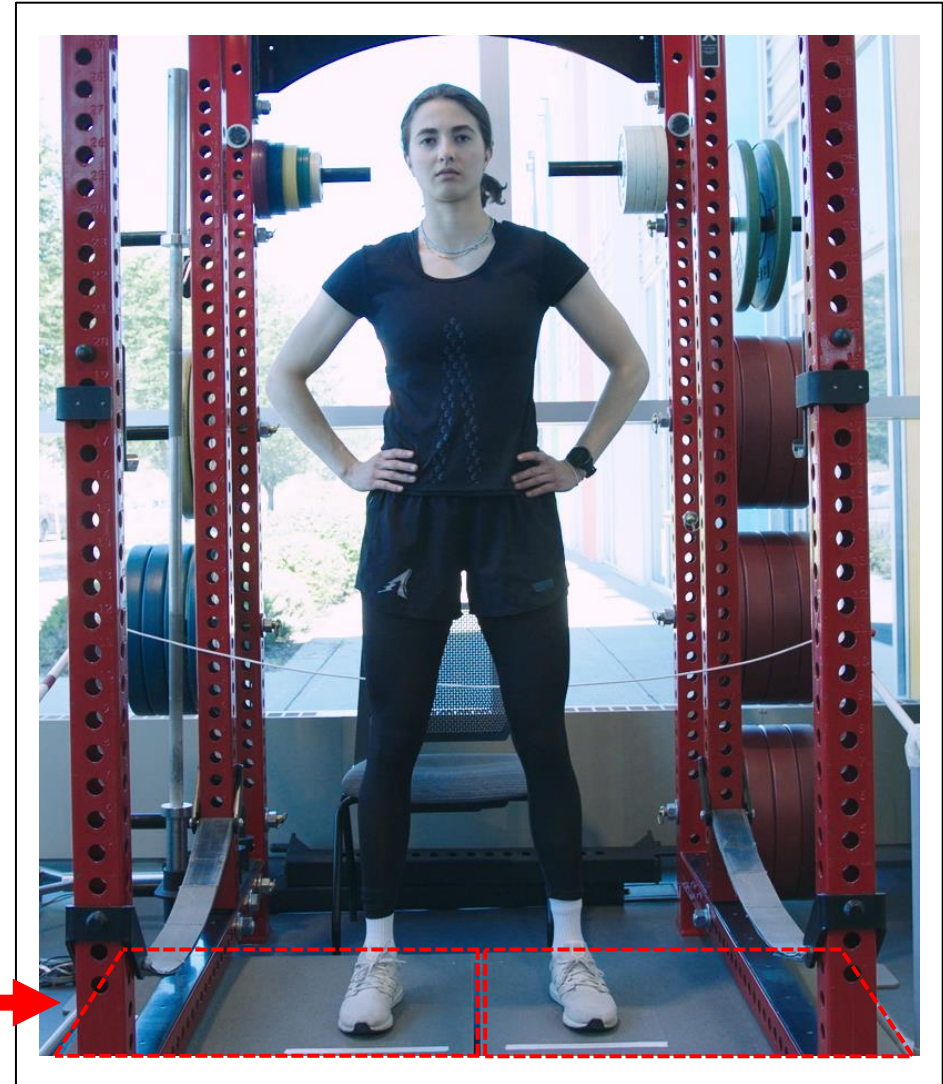- **Common metric to assess flexibility [1]**

[1] **Wells and Dillon, 1952**

Jump Height (cm)

- **AMTI Force Plates**
- **Vertical Ground Reaction Force**
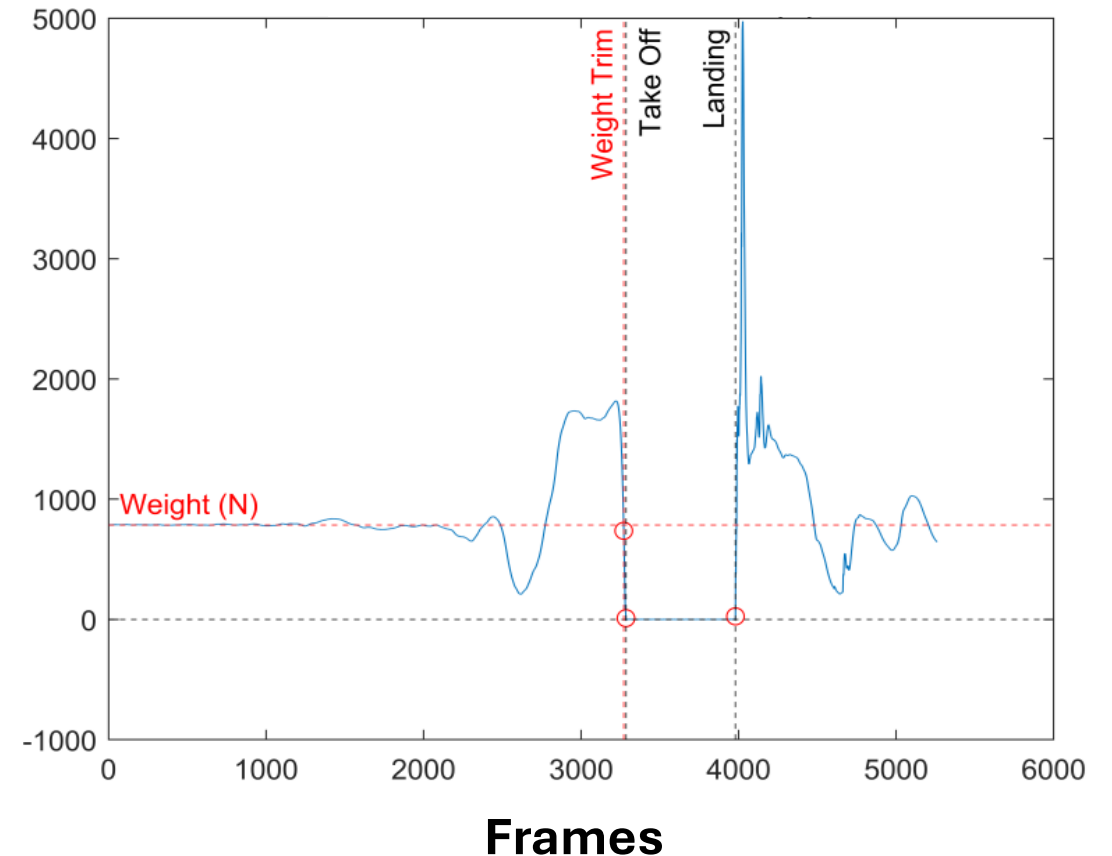

AMTI Force Plates

Jump Height (cm)

- AMTI Force Plates
- Vertical Ground Reaction Force

Assumptions and Formulas *

- **Projectile Motion Flight Time Method:**
- **First Half of Jump**
  - Velocity = ½ • gravity • flight time
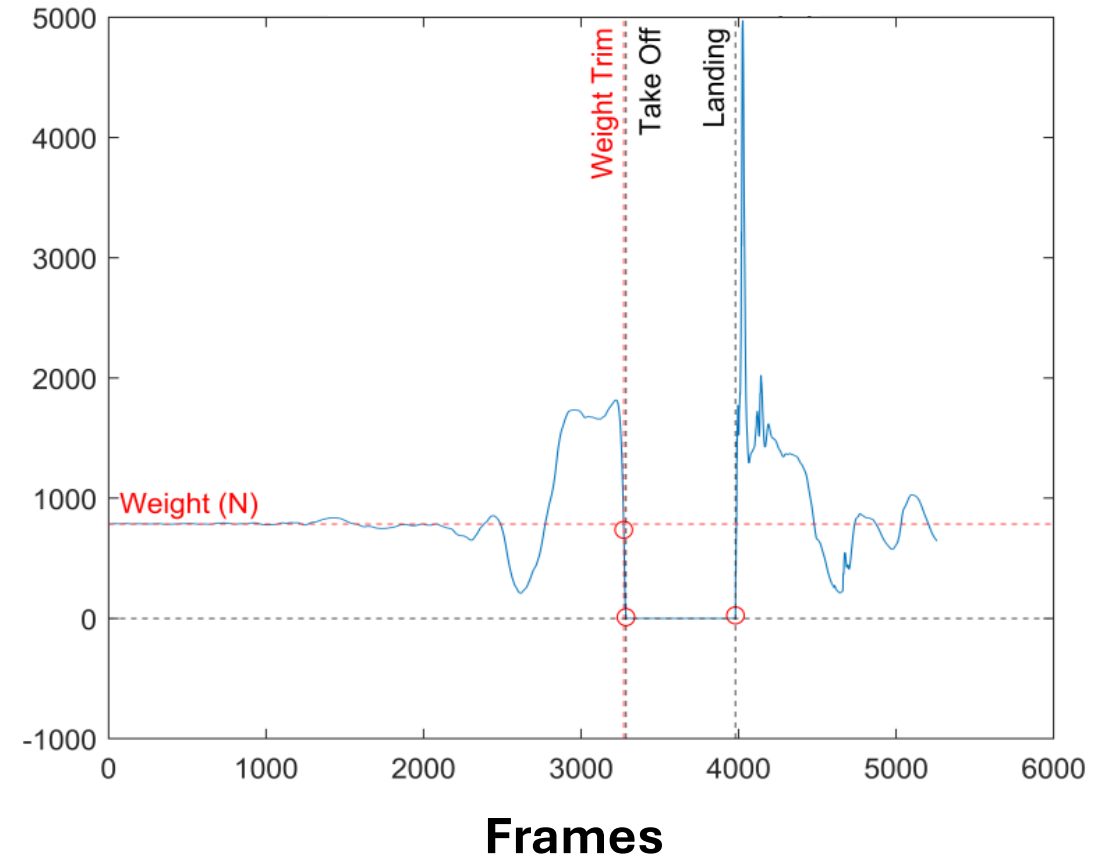 - Jump Height = velocity^2 / (2 • gravity)


Vertical Ground Reaction Force (N)

Peak Power (W • kg $^{-1}$)

- AMTI Force Plates
- Vertical Ground Reaction Force

- Max rate of mechanical work during a jump.
- Relative Peak Power = (gravity • mass • velocity^2) / mass

**Vertical Ground Reaction Force (N)**

Reactive Strength Index (RSI)

- **AMTI Force Plates**
- **Vertical Ground Reaction Force**

- **Key strength and power ability driving performance[2]**
- **RSI = flight time / jump contraction time**

Vertical Ground Reaction Force (N)

Frames
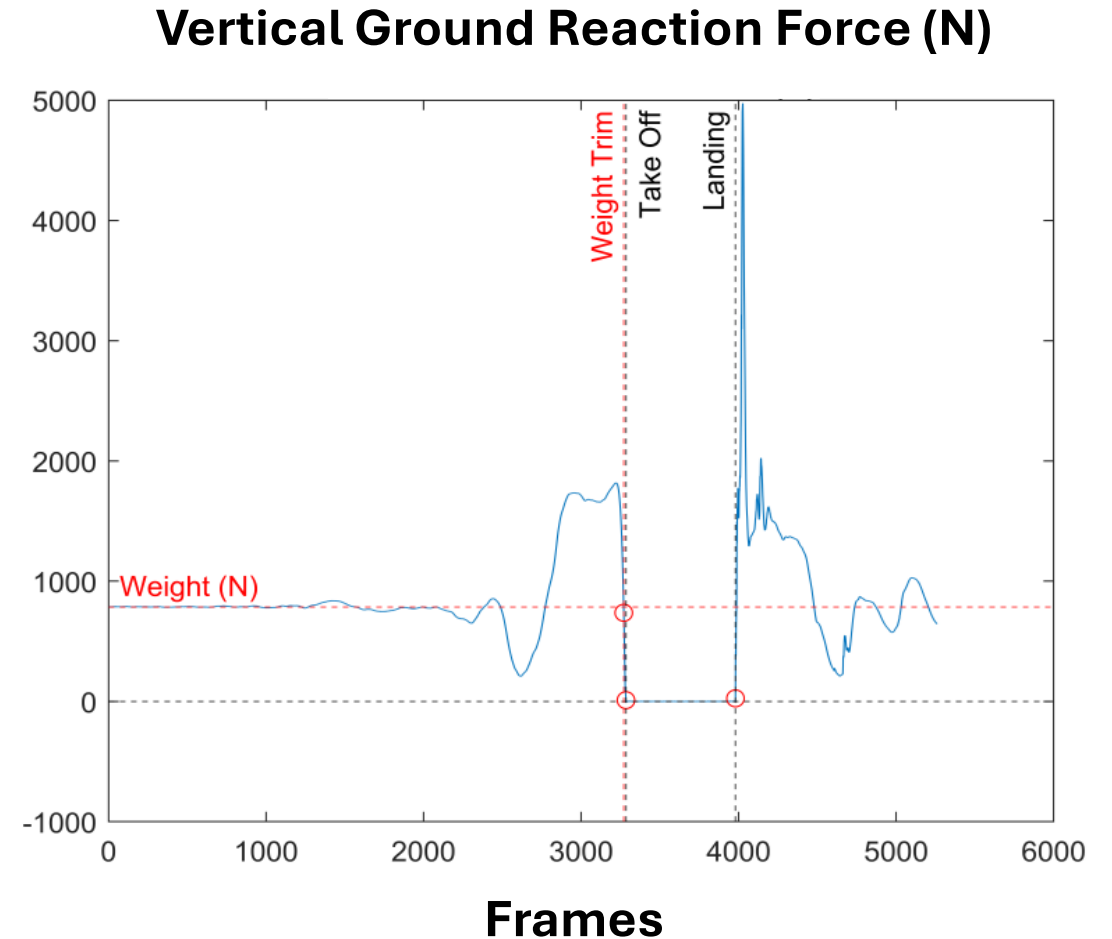
[2] **Jordan et al., 2022**

User Feedback

- **Qualtrics survey administered during the post-wear testing session.**
  - **Likert scale (quantitative)**
  - **Open-ended (qualitative)**
- **Experience over the course of the past week in these aspects of life:**
  - **sleep and recovery**
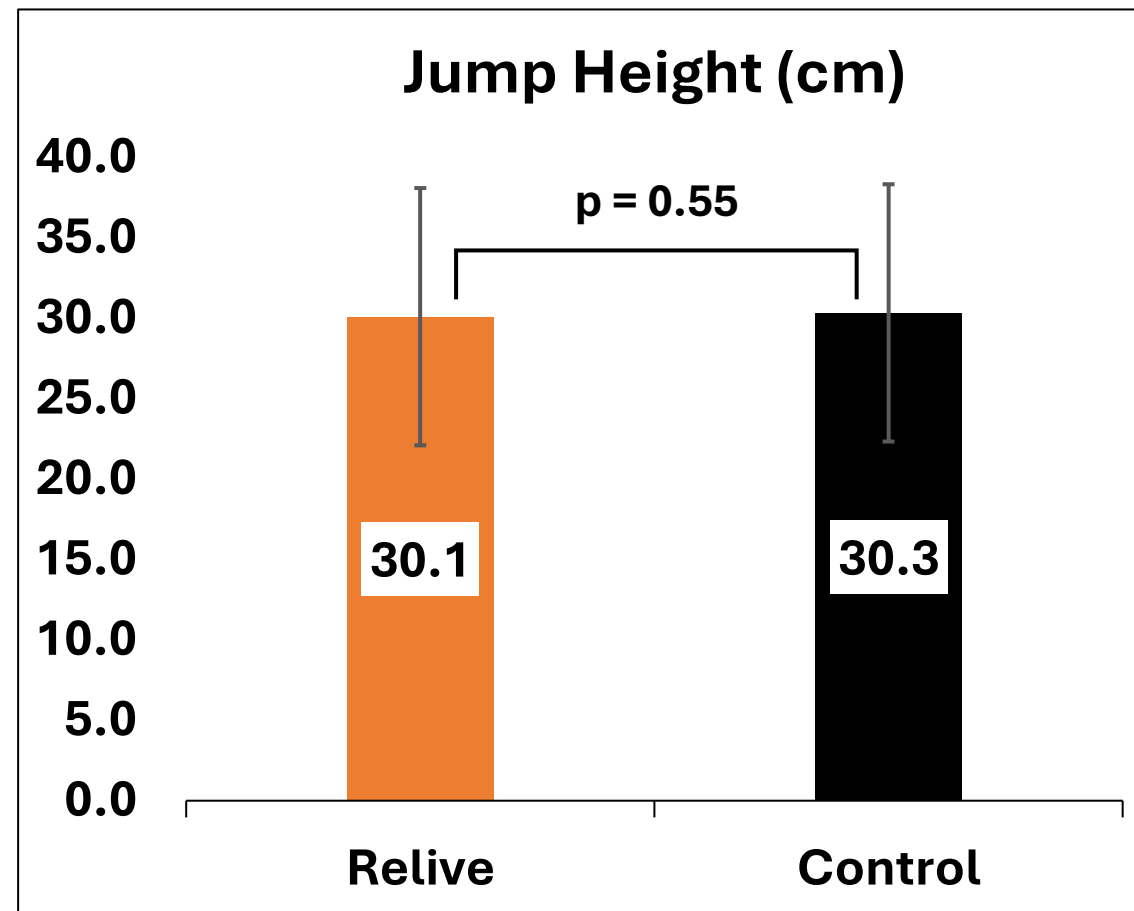 - **activities and exercise**
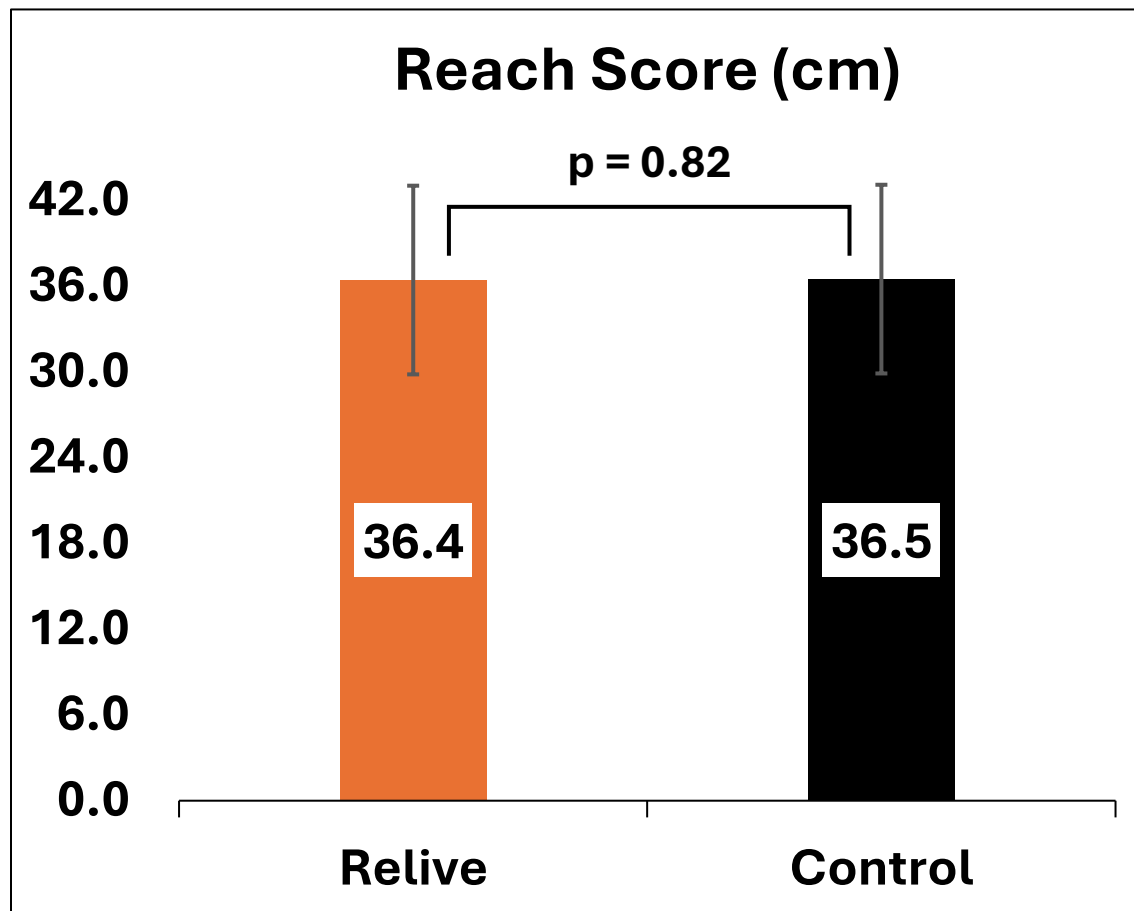 - **general health**
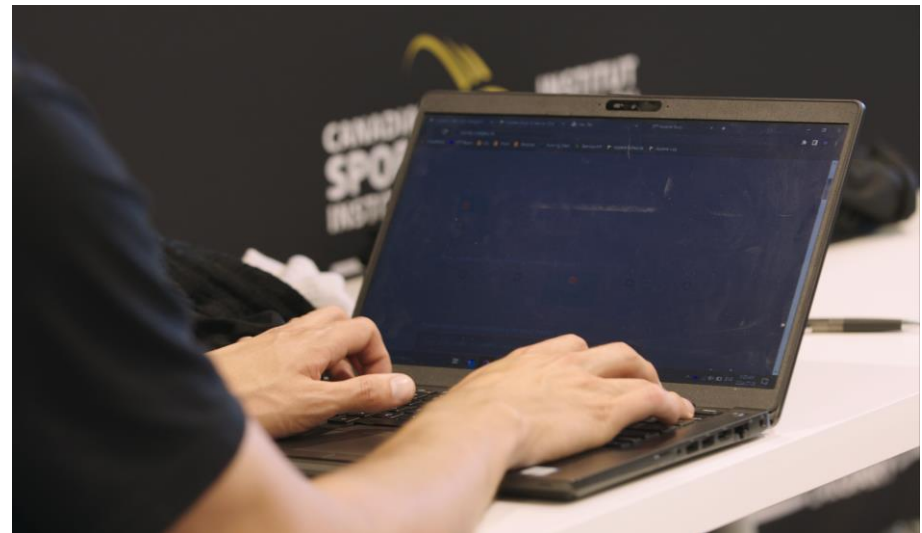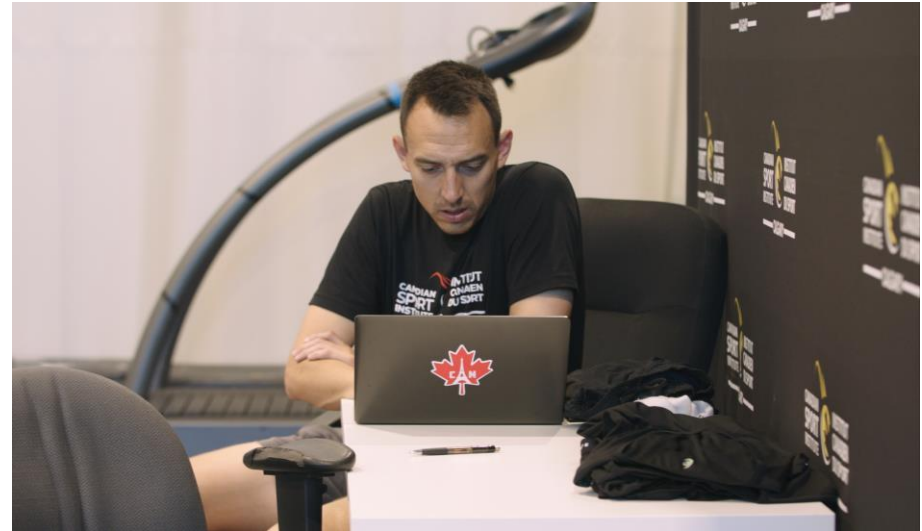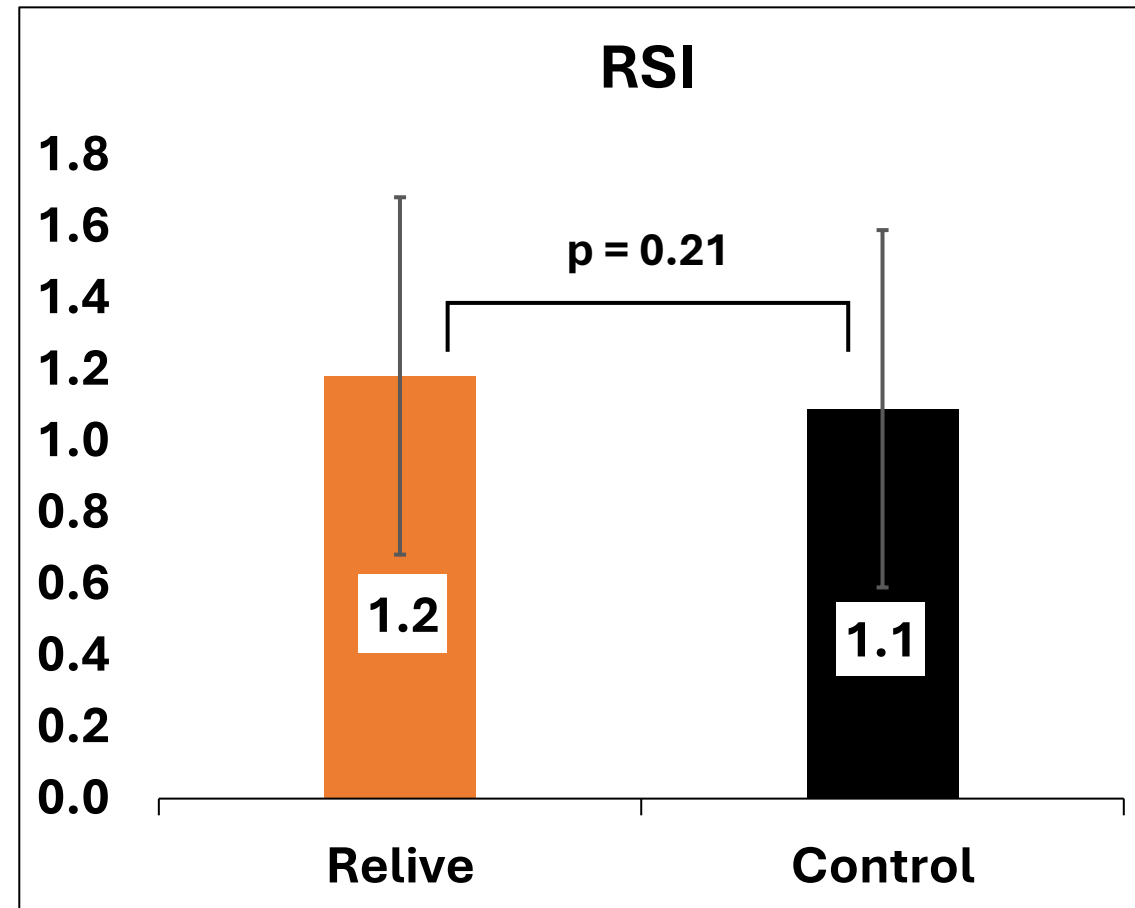
Statistical Analysis

- **Performance Measures:**
  - Best of 5 Jumps / Clothing Condition
  - Best of 3 Reach Scores / Clothing Condition
- **Descriptive Analysis:**
  - User Feedback
- **Acute effects (Relive vs. Control in Pre-Wear Session):**
  - Dependent t-tests on performance measures
- **Short-term effects (Relive vs. Control for Pre vs. Post):**
  - Two-Way Repeated-Measures ANOVA
    - Effects of (i) Clothing; (ii) Time;
    - Follow-Up Pairwise Comparisons
- **Pearson Correlation**

Results *Acute Effects*

Reach Score (cm)

p = 0.82

Relive: 36.4
Control: 36.5

Jump Height (cm)

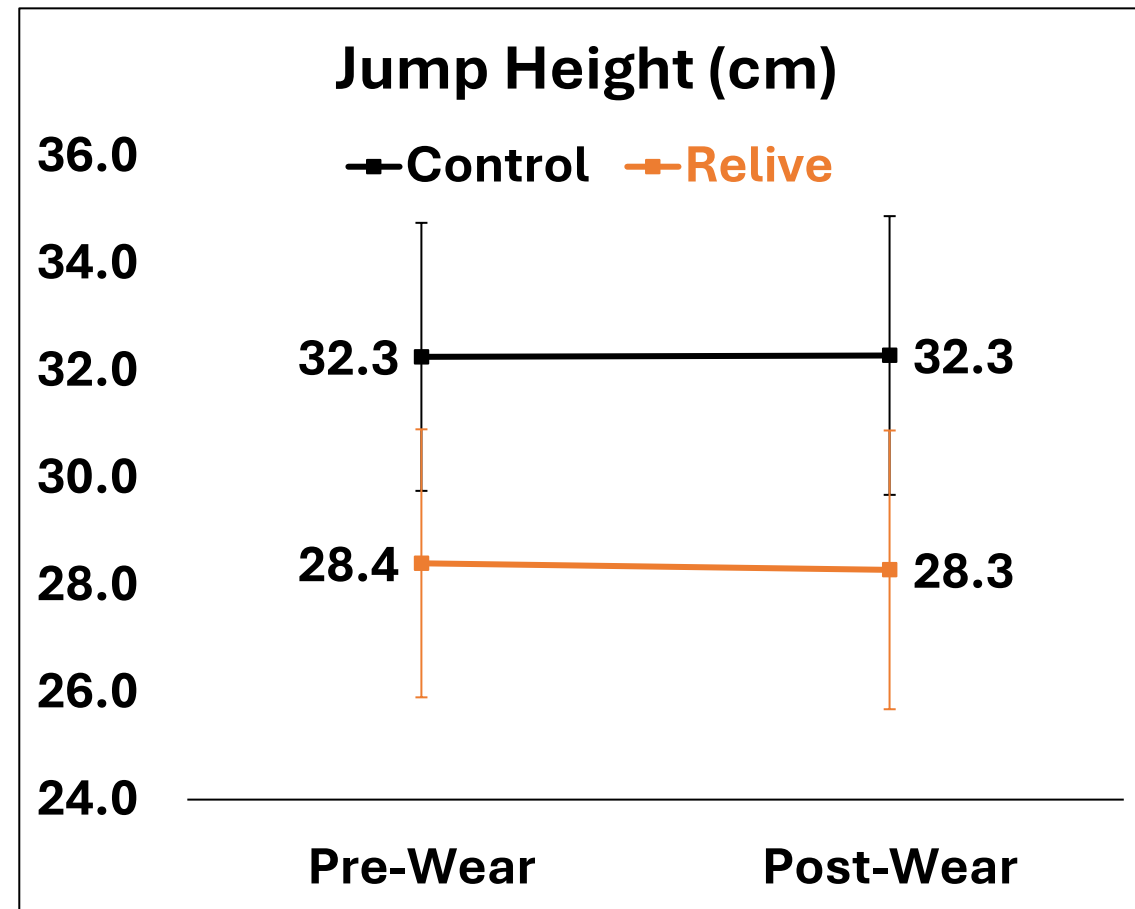p = 0.55

Relive: 30.1
Control: 30.3

* Results are not statistically significant.

Results Acute Effects
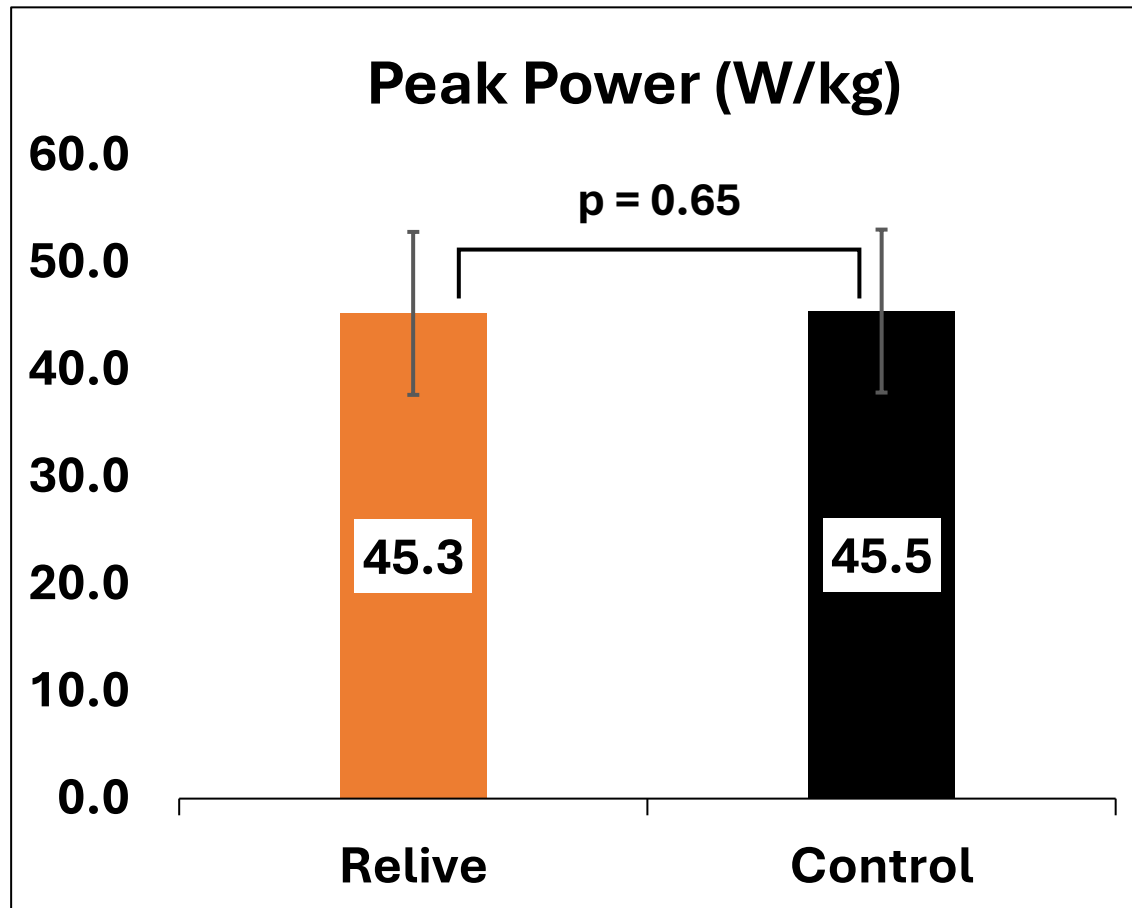
Peak Power (W/kg)

	Relive	Control
Value	45.3	45.5

p = 0.65

RSI

	Relive	Control
Value	1.2	1.1

p = 0.21

* Results are not statistically significant.

Results *Short-Term Effects*

Reach Score (cm)

— Control — Relive

42.0
40.0
38.0 — 37.7 ... 38.2
36.0
35.3 — 35.0
34.0
32.0
30.0

Pre-Wear   Post-Wear

Jump Height (cm)

— Control — Relive

36.0
34.0
32.0 — 32.3 ... 32.3
30.0
28.4 — 28.3
26.0
24.0

Pre-Wear   Post-Wear

* Results are not statistically significant.

Results Short-Term Effects

Peak Power (W/kg)

Control — Relive

	Pre-Wear	Post-Wear
Control	48.2	47.9
Relive	42.8	42.3

RSI

Control — Relive

	Pre-Wear	Post-Wear
Control	1.1	1.3
Relive	1.1	0.9
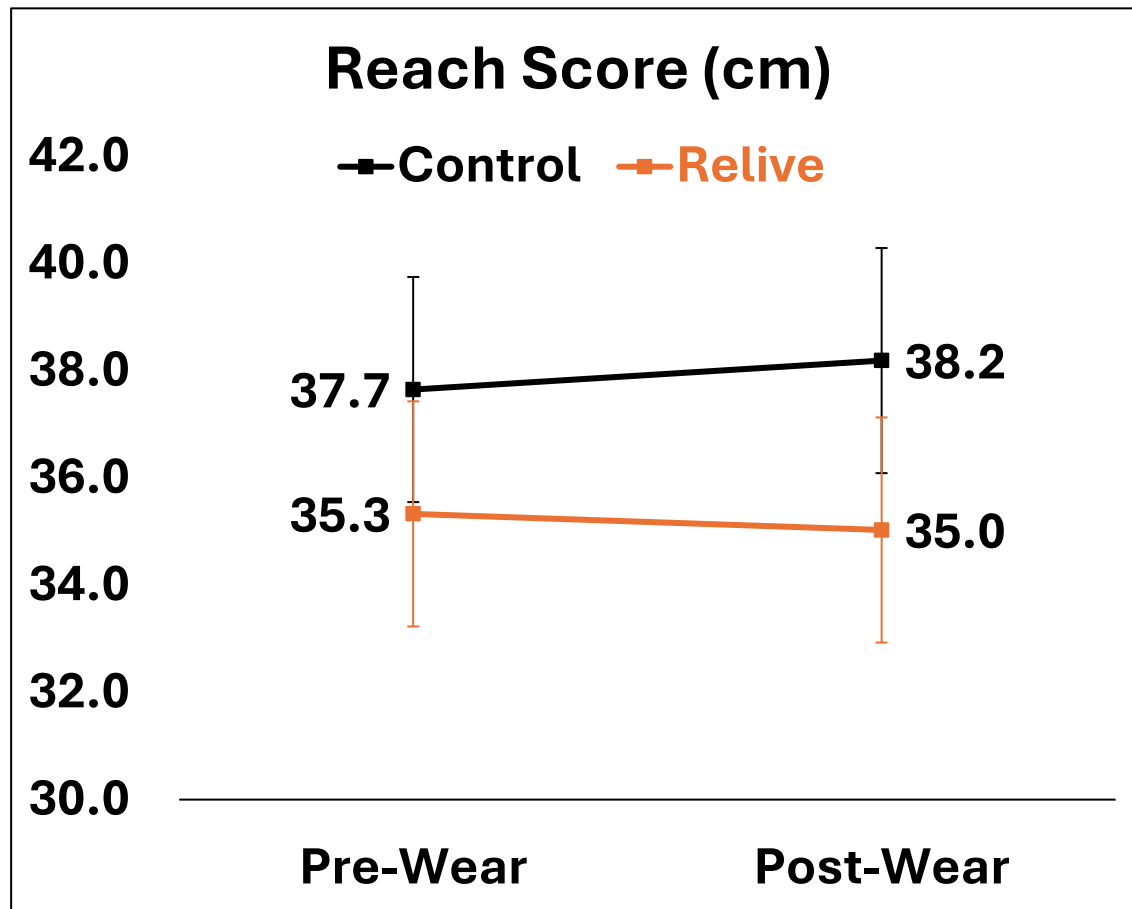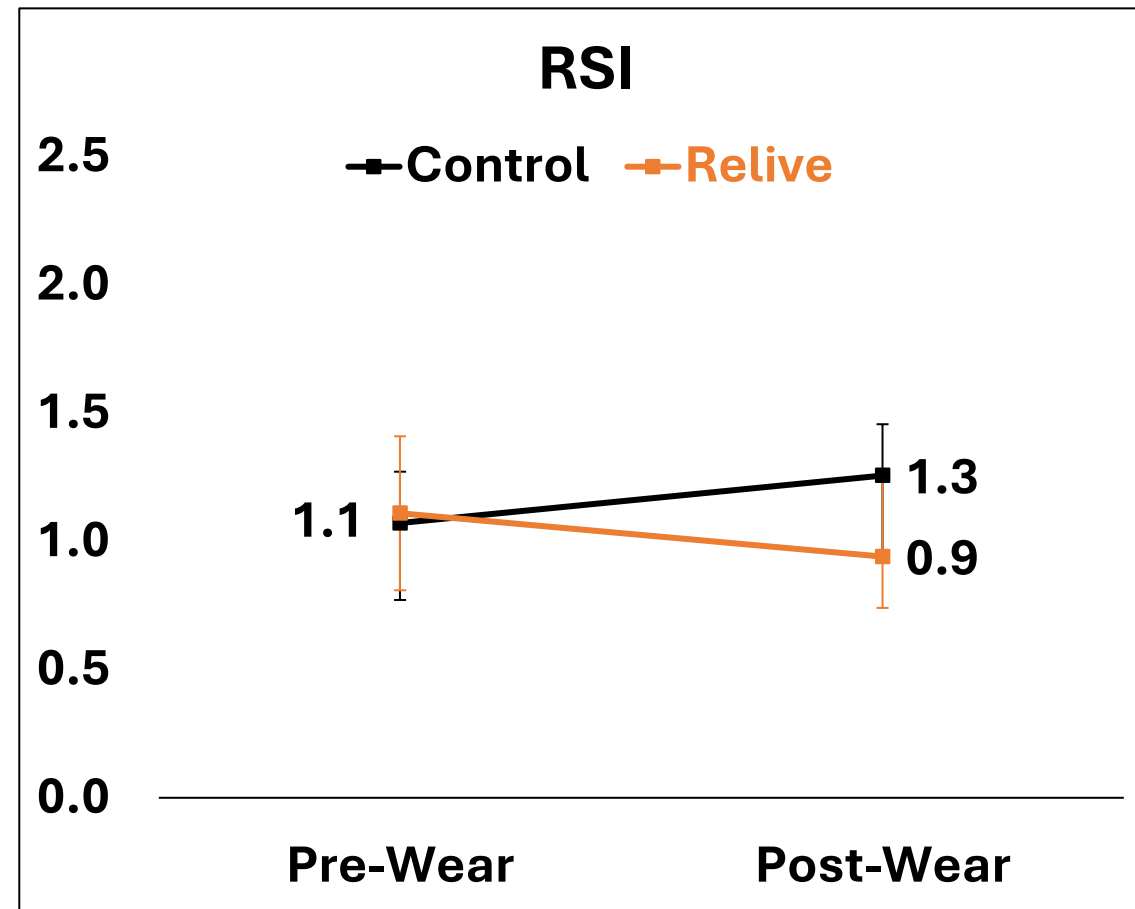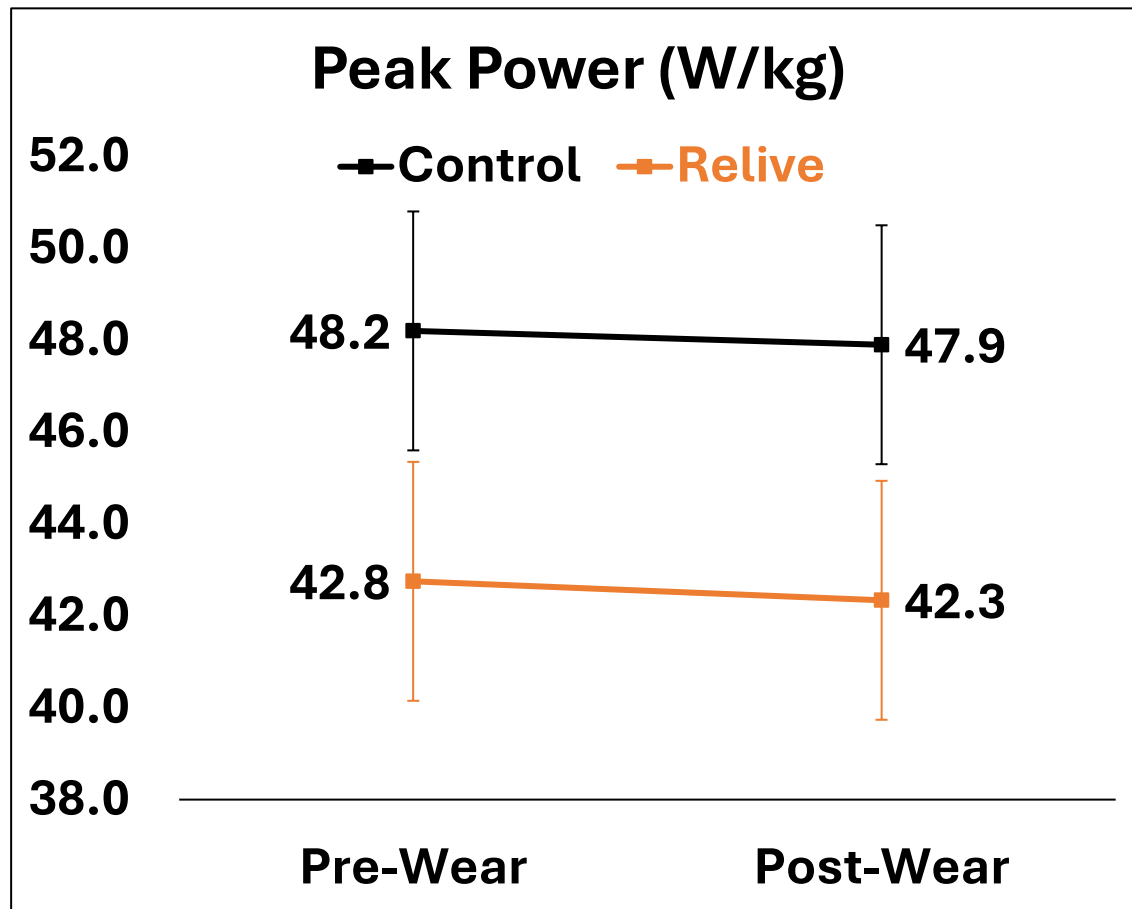
* Results are not statistically significant.

Results

Jump Performance vs. Time Relationship

RSI Improvement

■ Relive ⋯ Linear (Relive)

r = 0.47; p = 0.171

Duration (days)

RSI Improvement

■ Control ⋯ Linear (Control)

r = -0.21; p = 0.562

Duration (days)
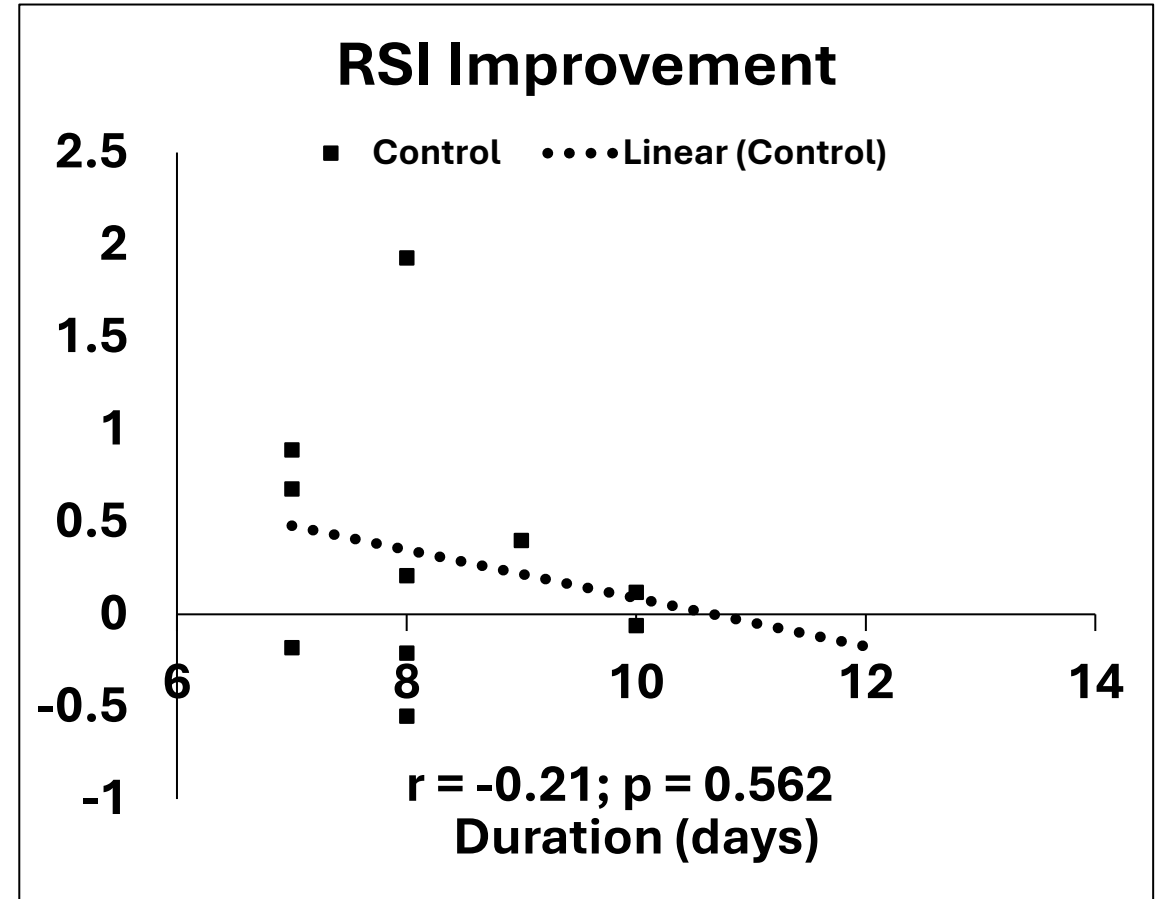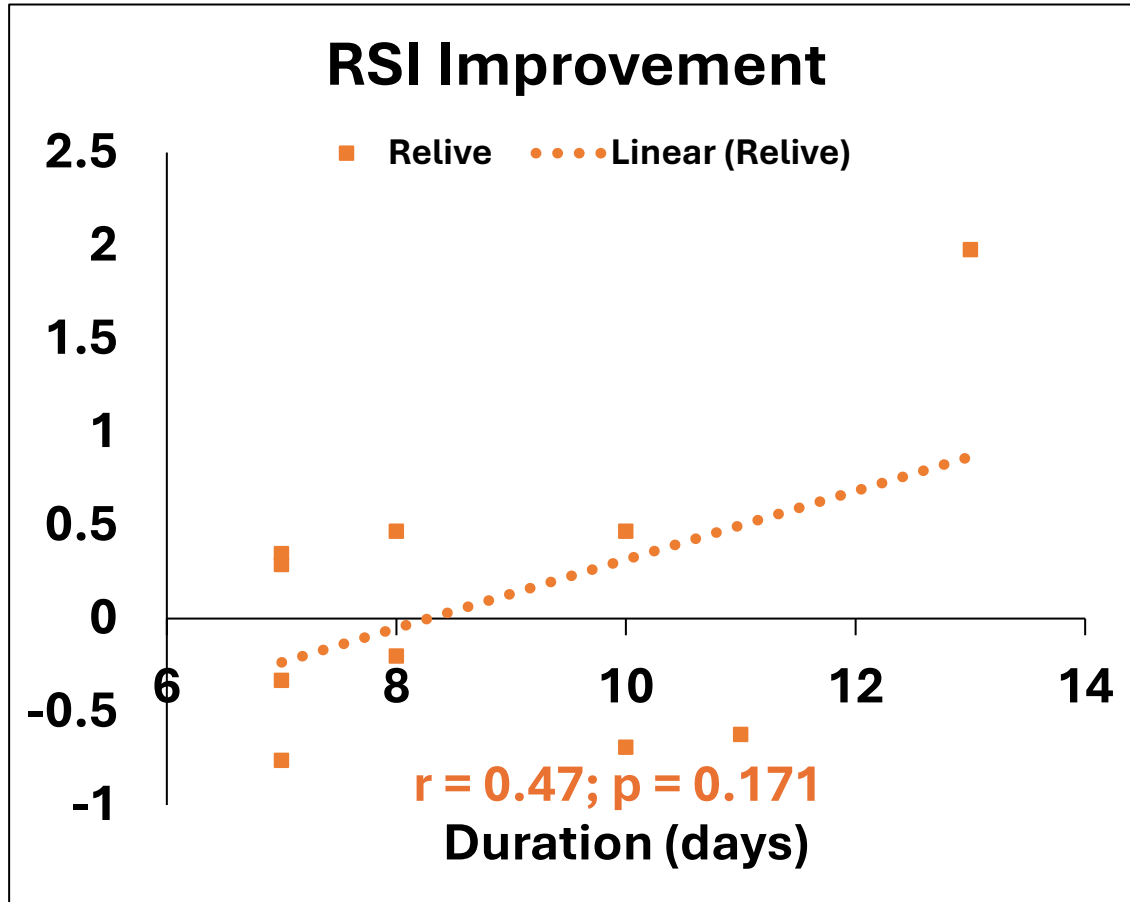
* Results are not statistically significant.

Results

Participant Feedback

Overall, how did the clothing feel?
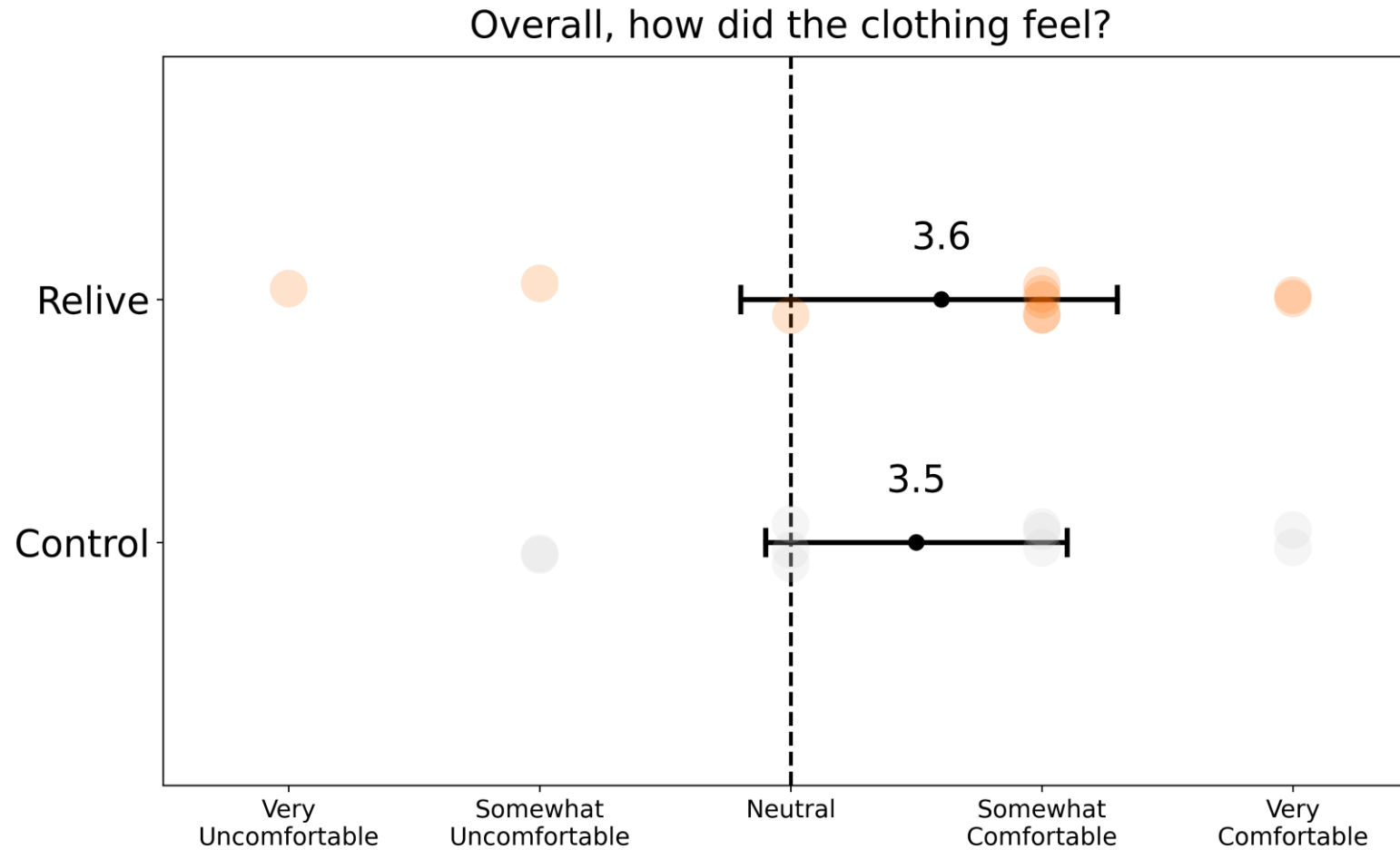
Results Participant Feedback

Did you notice any difference in your sleep quality?
Yes = 6 of 20.

Did you feel more rested upon waking?

Counts

Control
Relive

	Yes	No
Control	1	0
Relive	4	1
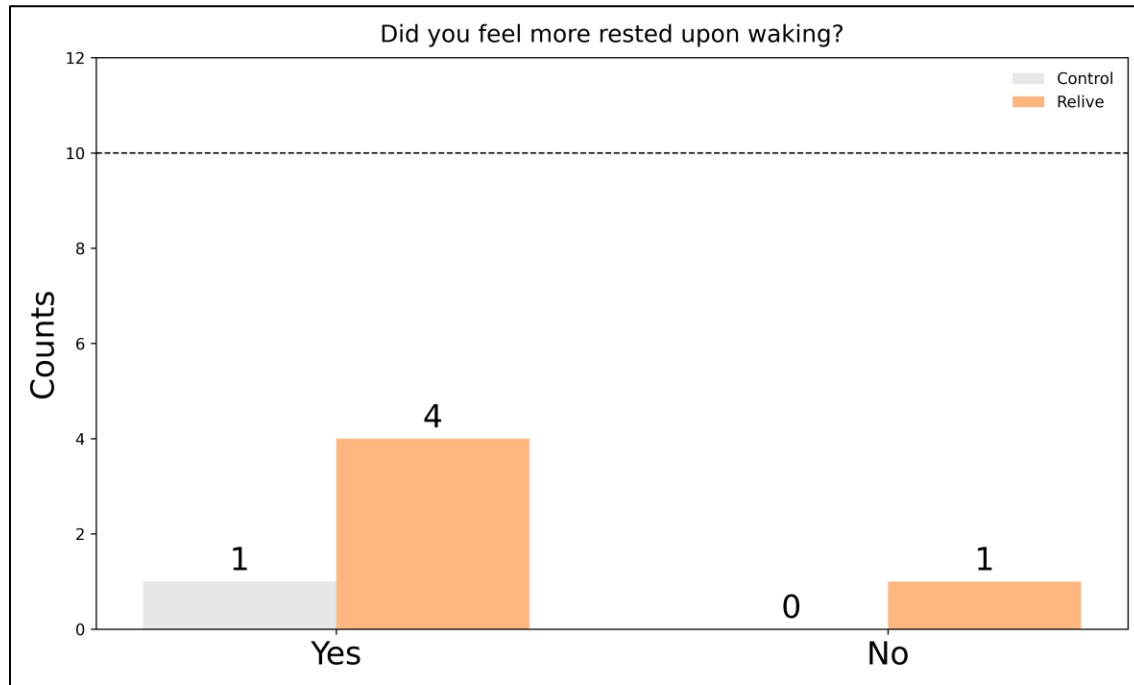
Did you notice any difference in your energy levels?
Yes = 4 of 20.

How would you rate your energy levels overall?

Relive — 4.0
Control — 3.3

Much Lower · Slightly Lower · About the same · Slightly Higher · Much Higher
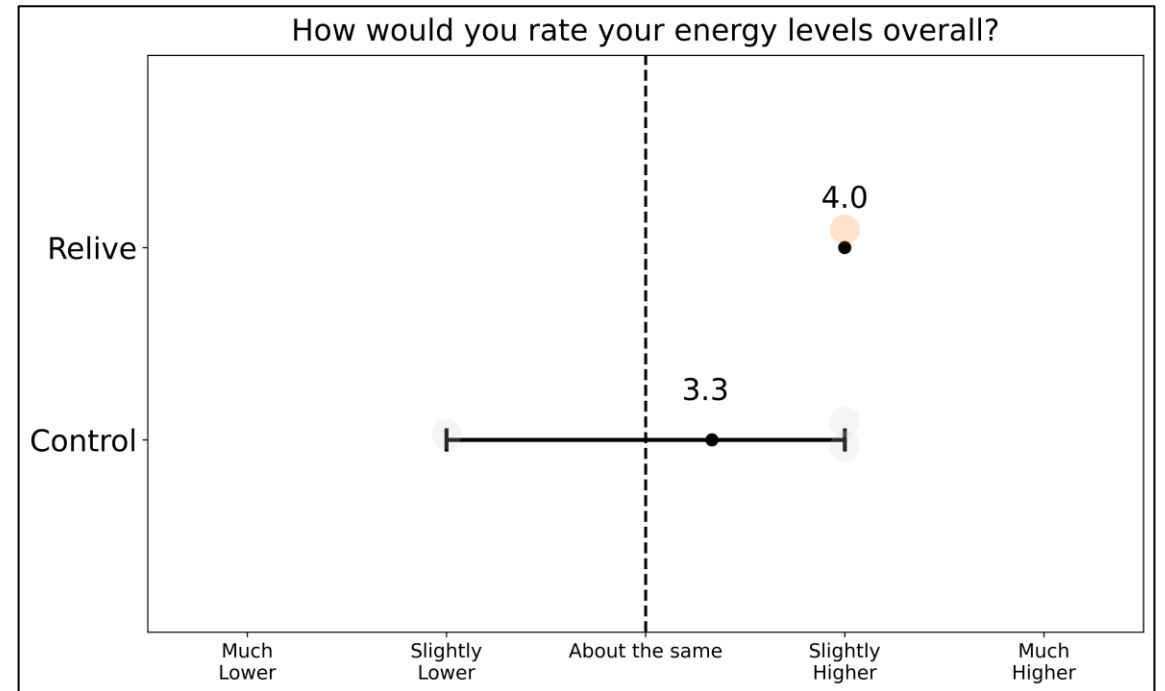
Results   Participant Feedback

Do you experience poor blood circulation?
Yes = 3 of 20.
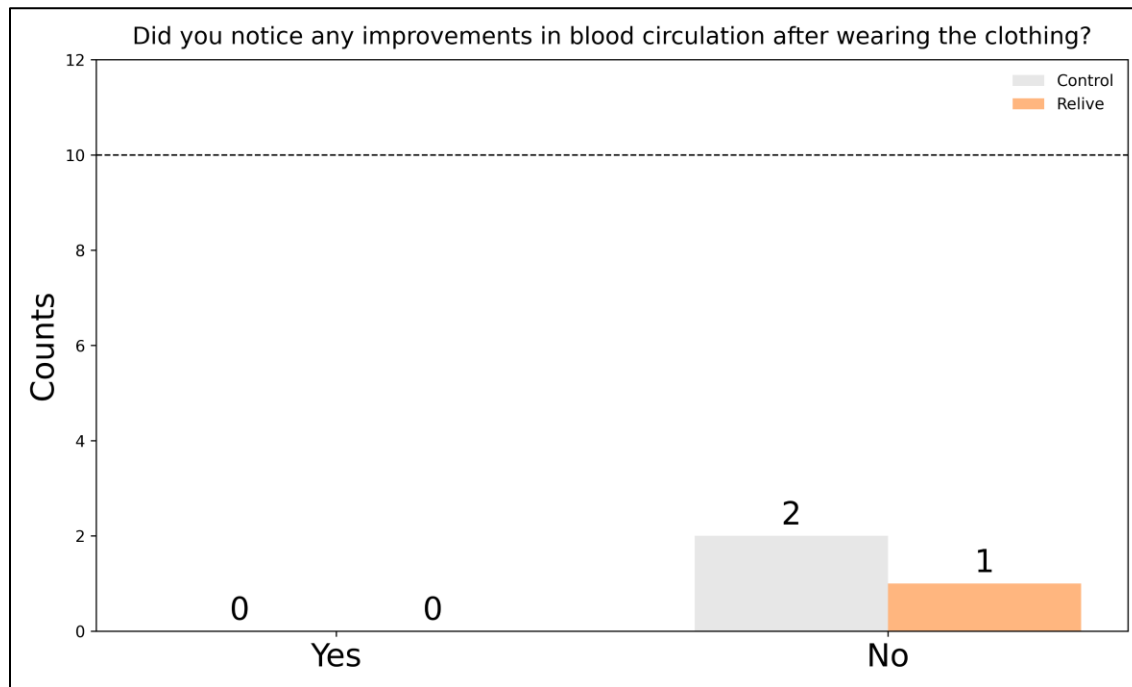
Do you normally suffer from any chronic pain?
Yes = 5 of 20.

Did you notice any improvements in blood circulation after wearing the clothing?

Legend: Control, Relive

Counts

Yes: 0, 0
No: 2, 1

Did wearing the clothing decrease any of this discomfort or pain?

Legend: Control, Relive

Counts

Yes: 0, 0
No: 4, 1

Results   Specific Participant Feedback

- **Sleep Feedback:**

  "Over half of the nights I slept in the clothes I felt I slept really well compared to the week before wearing the clothes."

  "Felt refreshed in the morning despite getting less sleep than usual."

- **Energy Level Feedback:**

  "I felt I was waking up rested before my alarm on most days."

- **Feedback for Exercise Use:**

  "They were very comfortable and not itchy at all! When I normally use a top and bottom layer for workout and I sweat it also becomes itchy but it was not itchy at all."

Results Participant Feedback

- **Positive Feedback:** Comfort and fit were well-received, especially during exercise.
- **Material Benefits:** Non-itchy material was appreciated, especially when sweating.
- **Recovery and Posture:** No notable change in fatigue levels, recovery times, or general posture compared to usual experiences.

- **Issues Noted:** Problems with the fit and design (e.g., compressive leggings, snug shirts, V-neck cut) and temperature regulation.
- **Specific Notes:** Issues with underwear riding up and leggings being translucent.

Conclusion

1. For acute performance changes on Day 1, dependent t-tests revealed no significant differences between Relive and Control apparel.

2. Results indicated no significant main effects or interactions for any performance measure.

3. Results indicated a positive trend in jump performance with longer wear duration (days).

4. Participant feedback was mostly positive or neutral.

Limitations

- **Environmental Factors:** External conditions (e.g., weather, activity level) can vary widely, affecting participant perception.

- **Uncontrolled External Factors:** Variability in external factors makes it difficult to isolate and measure the prototype's specific impact on performance.

- **Short Wear Duration:** Limited wear phase duration may not reveal long-term issues or durability concerns.

Future Considerations

1. **Focused Study:** Monitor specific aspects of participant experience.
2. **Focused Population:** Recruit a more specific population.
3. **Longer Wearing Duration:** Longer term study with multiple check-ins.

Comments and Questions

SPT Team

- **Mark Pineda**

  data collection, data analysis, report

- **Julia Russell; Joshua Ellis**

  data collection

- **Dr. Christian Clermont**

  data analysis, report

- **Dr. Victor Cossich**

  survey results

- **John Horton**

  project management, report review

- **Pro Stergiou**

  project proposal, report review

R-Value Interpretation [3]

Correlation Coefficient Value (r)	Direction and Strength of Correlation
-1	Perfectly negative
-0.8	Strongly negative
-0.5	Moderately negative
-0.2	Weakly negative
0	No association
0.2	Weakly positive
0.5	Moderately positive
0.8	Strongly positive
1	Perfectly positive

[3] **Dancey and Reidy, 2004**