EXPLORING THE IMPACT OF CRITICAL INCIDENT EXPOSURE ON PSYCHOLOGICAL FATIGUE AS A RISK FACTOR FOR MUSCULOSKELETAL INJURY DURING FIREFIGHTING TASKS

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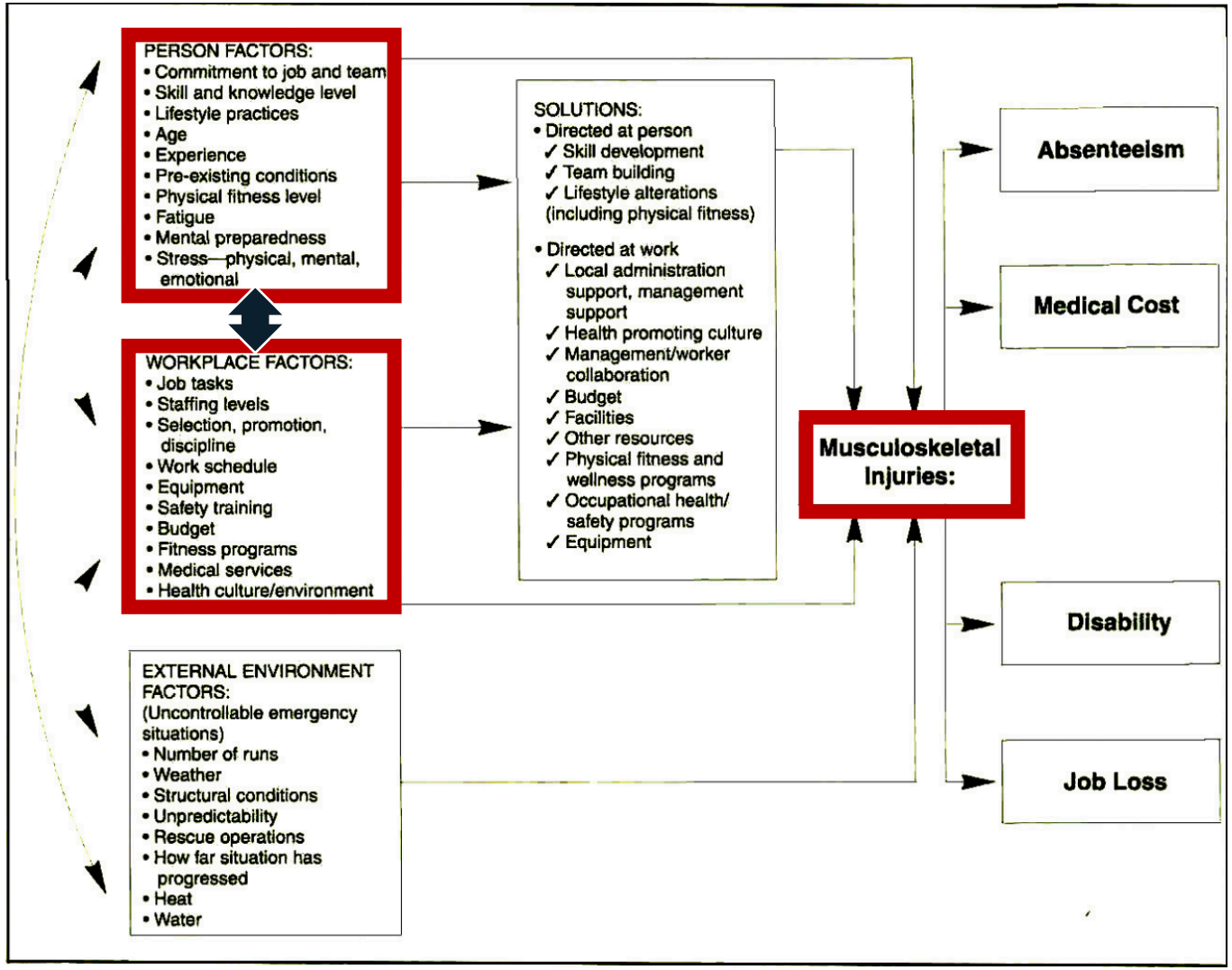
Introduction

- Firefighting is a physically and psychologically demanding job[1,2]
  - Nature of the tasks (e.g., awkward postures, heavy loads)
  - Extreme conditions & challenging work environments
  - Danger to personal safety
  - Exposure to critical incidents (i.e., traumatic events, gruesome injuries)

Introduction – MSK Injury risk



(Conrad, Balch, Reichelt, Muran, Oh, 1994)

Research Problem

- Previous literature:
  - Limited insights on psychological impacts on fatigue
  - Highly controlled environment (i.e., Lab-based)
  - Controlled tasks (i.e., treadmill protocols)
- Unique components of this study:
  - Explores psychological factors for MSK injury
  - Multiple time points
    - Effects of load over time
  - Applied research

Purpose

The purpose of this research is to quantify critical incident exposure and fatigue, as determined by HRV, among Thunder Bay career firefighters

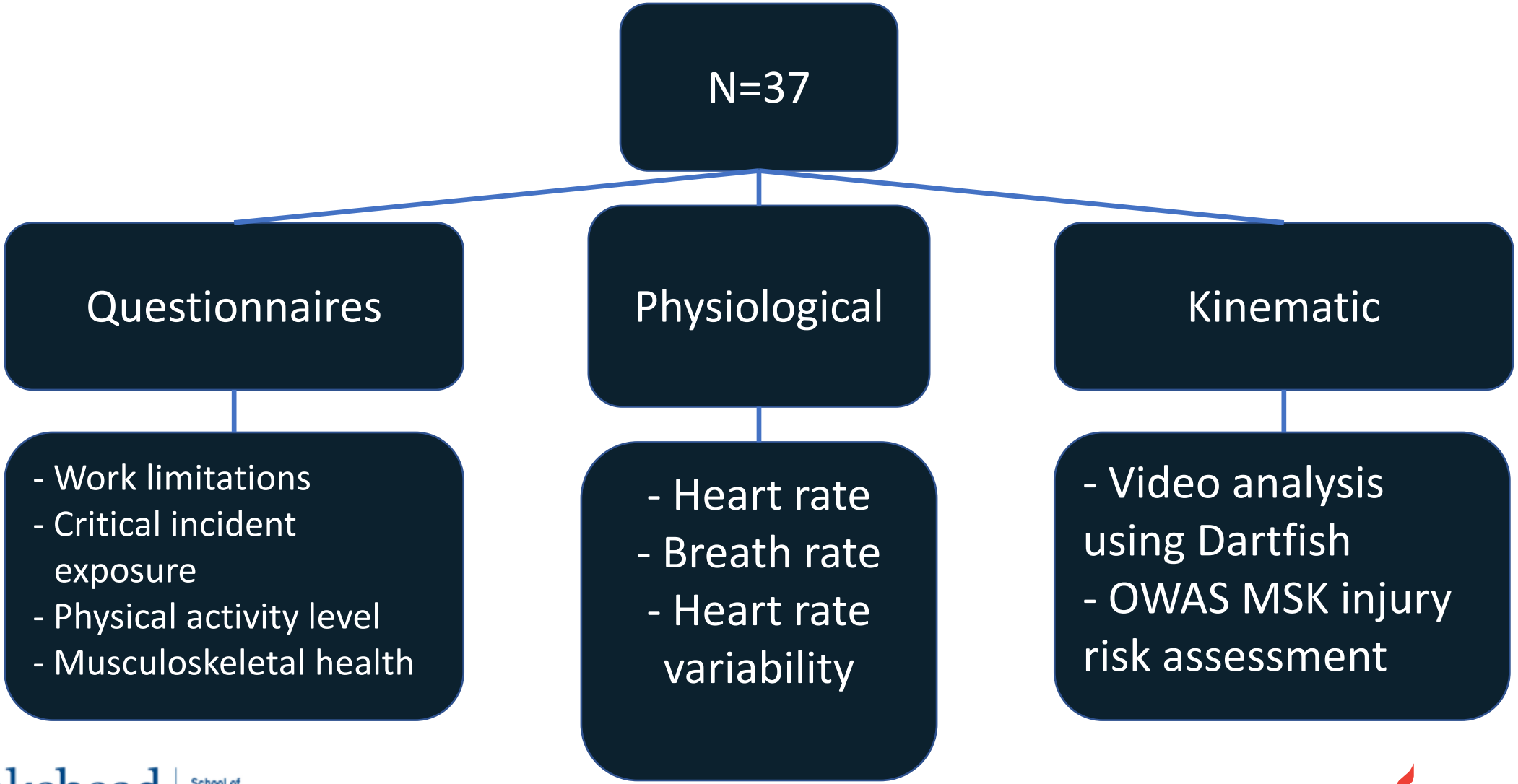
Methods: Context

CONTEXT: Thunder Bay Fire Rescue and the Thunder Bay Professional Firefighters Association

STUDY DESIGN:

- Cohort with Repeated Measures
  - Baseline - November 2017
  - Six months – May 2018
  - One year – November 2018
- Sample = 37 active-duty, career firefighters

Methods



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Methods: Protocol

- Demographic information was collected prior to task performance
  - Age, height, weight, years of service
- The Critical Incident Inventory was administered to quantify critical incident exposure
- Zephyr BioHarness used to collect HRV data [4]
- Full bunker gear including the self-contained breathing apparatus (SCBA)
- Performed two tasks (Hose Drag & Patient Transfer)

Methods: Protocol

- The hose drag task was performed using a charged line (905kpa)

Methods: Protocol

- Paired lift to transfer a weighted manikin (68kg) from the ground into a stair chair
- Each participant performed two lifts
  - Lift at the head (heavy)
  - Lift at the feet (light)

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Methods: Measures

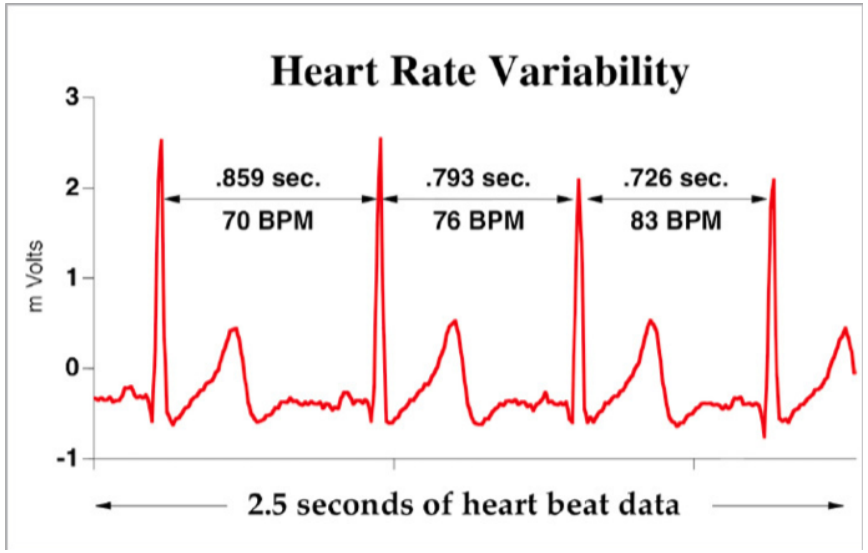
Critical Incident Inventory Questionnaire

- Measure of traumatic experiences encountered by firefighters through daily work
- 24 items (critical incidents)
- Frequency of exposure to each event (2 month period)
- Convergent validity [5]
  - Anger and depressive symptomology

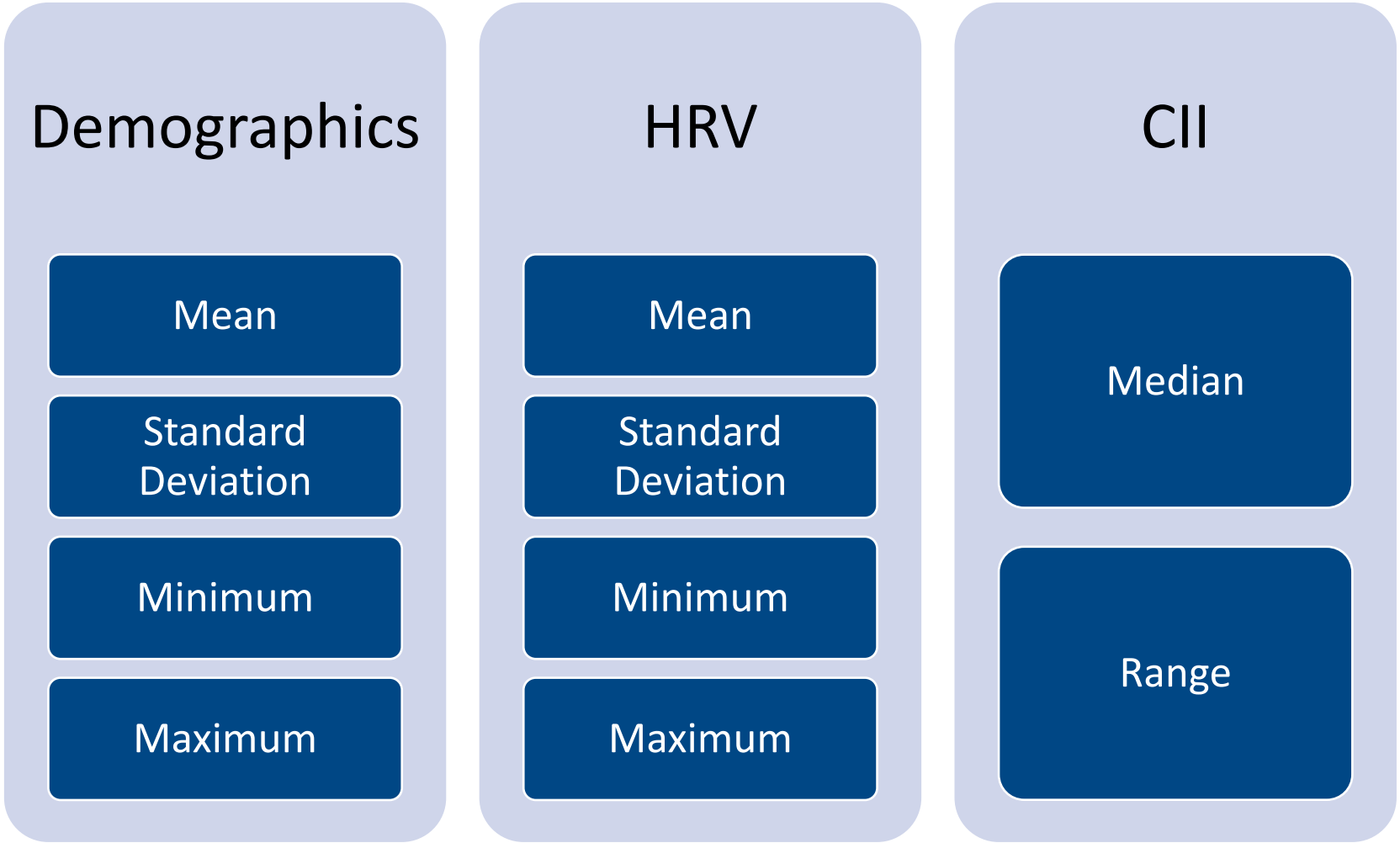
Methods: Measures

Fatigue

- Heart rate variability (Zephyr BioHarness)
  - Single lead ECG captures R waveforms (250Hz)
- Time-domain analysis
  - Standard deviation of normal-normal beats (SDNN)



Methods: Data Analysis



Results: Demographic Characteristics

	Mean (SD)	Min.	Max.
Age (yrs)	38.7 (8.9)	27	58
Height (cm)	183.95 (8.23)	167.64	198.12
Weight (kg)	99.6 (23.7)	78.5	187.96
Years of Service	11.6 (7.2)	3	26

Table 1: Demographics (n=37)

Results - CII

- Critical incident exposure and range are high at each timepoint
- Higher exposures at baseline and one-year (winter months)
- Most commonly experienced events
  - Direct exposure to blood and body fluids
  - Incidents involving one or two deaths

	Baseline	Six-months	One-year
Median	7	5	6
Range	40	19	32

Table 2. Median and range of critical incident exposure at each timepoint (# of events).

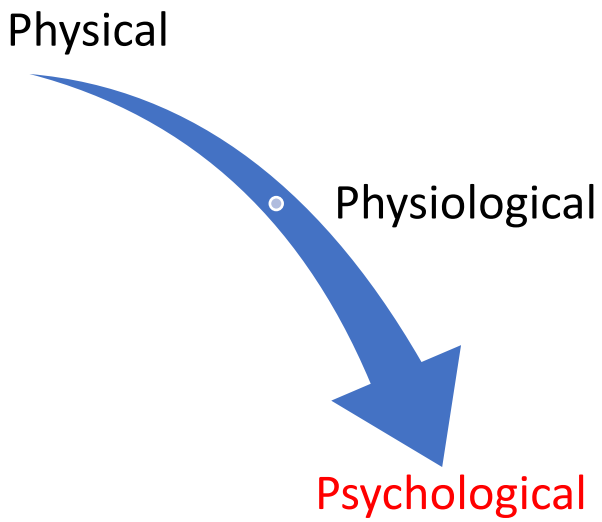
Results – HRV

- Heart rate variability is low across all timepoints
- Remains relatively unchanged over a one year period

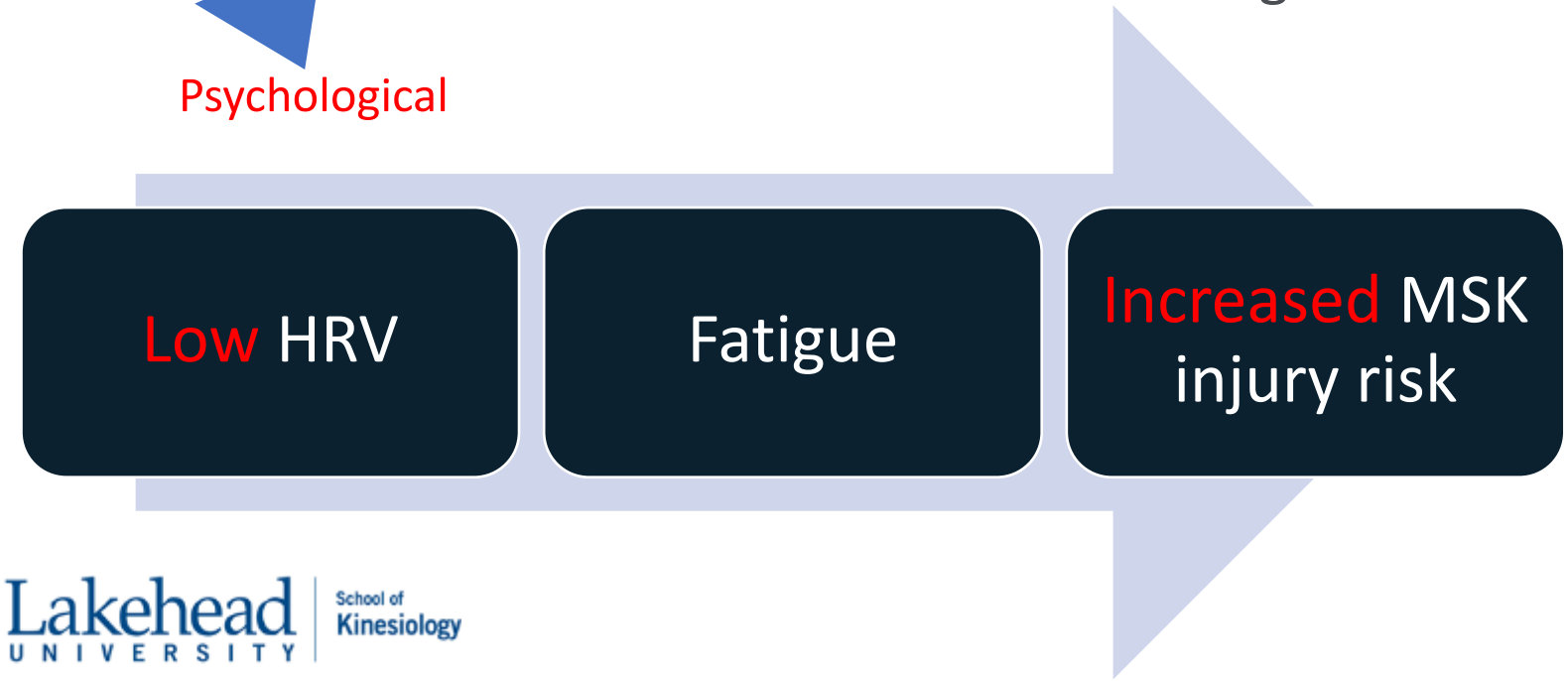
	Baseline	Six-months	One-year
Mean	62.1 (11.7)	65.5 (1.3)	61.9 (1.4)
Minimum	49.6	63.9	75.8
Maximum	73.0	66.9	78.8

Table 3. Average heart rate variability from initiation of firefighting tasks (hose drag) to completion (patient transfer) at each timepoint[$\bar{X}$ (SD)].

Discussion



- Impacts of psychological factors on MSK health are poorly understood among firefighters
- High CIE may have impacts on reduced task tolerance (low HRV) [6]
- Poor health outcomes associated with low HRV [7]
- Known link between fatigue and MSK injury in firefighting [3]



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Conclusion

Key Findings

- Consistently high exposures to critical incidents
- Findings suggest a reduced tolerance to firefighting tasks (HRV)
- Low HRV may be indicative of fatigue during task performance

Future Directions

- Upscaling with a larger sample
- Use of frequency-domain measures over longer durations to identify psychological fatigue
- Relationship between mental health factors and psychological fatigue
- Explore strategies aimed to reduce impacts of critical incident exposures

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