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## Background

- Firefighters perform physically demanding, non-cyclical work associated with high injury rates.<sup>1</sup>
- 33% of firefighters injuries are musculoskeletal disorders (MSKs). Cardiorespiratory (CR) diseases are also common amongst firefighters.<sup>2</sup>
- Female firefighters (FF) represent 3% of professional firefighters<sup>3</sup>
- FF report 33% more injuries than male firefighters (MF).<sup>4</sup>
- Identifying modifiable factors linked to MSK and CR disease might elucidate the differential injury frequency between FF and MF.

## Study Purposes

- Determine physiological response of FF and MF while performing two firefighting tasks.
- Identify FF and MFs grip strength.
- Identify task performance strategies used by FF and MF during two firefighting tasks (hose drag and stair climb with a high rise pack).

## Methods

### Design

- Cross-Sectional; 2-Phase

### Participants

- Active duty, professional firefighters from a Southwestern Ontario fire service

### Data Collection

Phase 1 (N=109; FF, n=5)

- FF and MFs performed a hose drag and a stair-climb with high-rise pack (HRP).
- Heart rate (HR) and blood pressure (BP) measured pre- and post task completion.
- Grip strength was measured using a JAMAR grip strength dynamometer.

Phase 2 (N=12; FF, n=6)

- Upper (UE) and lower extremity (LE) kinematic analysis of lifting posture measured using Dartfish (DF).



Fig. 1: LE Dartfish Analysis



Fig. 2: UE Dartfish Analysis

### Data Analysis

- Descriptive statistics on all variables of interest.
- Independent T-Tests to determine differences between groups.

## Results

Table 1. Demographic Information

	Age (years)	Height (cm)	Weight (kg)	Tenure (years)
Female (n=5)	34.2 (6.9)	167.1 (4.6)	65.5 (7.8)	5.1 (3.5)
Male (n=104)	42.3 (9.5)	180.1 (6.3)	92.3 (11.0)	14.0 (9.8)

Results reported as Mean (SD)

### I. FF seem to tolerate physiological demands better than MF.

Table 2. Grip Strength and Physiological Response

	% Increase Systolic BP (mmHG)	% Increase Diastolic BP (mmHG)	% Increase Heart Rate (bpm)
Female (n=5)	13.7	2.0	35
Male (n=104)	22.0	5.3	46.9

Results reported as Mean (SD)

### II. FF seem to perform the Hose Drag Task faster than MF.

Table 3. Grip Strength and Physiological Response

	Grip Strength (kg)	Hose Drag (sec)	Stair Climb (sec)
Female (n=5)	39.2 (4.1)	42.5 (8.3)	72.1 (12.4)
Male (n=104)	54.1 (11.2)	50.0 (13.8)	64.5 (14.0)

Results reported as Mean (SD)

### III. FF performed the lift task with less forward reach than MF. $t_{(22)} = 3.034, p < 0.05$



Fig. 3: Female Firefighter (115% ± 25% of relative arm length)



Fig. 4: Male Firefighter (147% ± 26% of relative arm length)

## Conclusions

### How do FF compare to MFs?

- FF seem to have less cardiorespiratory stress when performing fire fighting tasks.
- FF demonstrated reduced grip strength compared to MF.
- FF performed a lift task with similar lower extremity postures compared to MF but use a shorter forward reach compared to MF.

### What do these findings mean?

FF may be moving their torso closer to the load (i.e., High Rise Pack) before initiating the lift to adopt a more biomechanically advantageous lift strategy.

### Why might this be?

FF may be adopting this lift strategy to accommodate for reduced strength.

## Implications

### 1. Gender-Specific Fitness Training Programs

- Programs focused on improving aspects of fitness that are related to job performance (i.e., CR and muscle strength) may need to be gender-specific.

### 2. Gender-Specific Lift-Training Programs

- Consider a differential approach to training FF and MF on lifting techniques.

## Future Research

1. Does a larger sample size reproduce these findings?
2. Do these findings extend to other fire services?
3. How does the upper extremity lifting strategy of male and female firefighters impact biomechanical loading of the upper extremity and spine?

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