

Worksite exercise interventions for low back injury prevention in firefighters: A cluster randomized controlled trial

August 17, 2016

Principal Investigator:	John M. Mayer, DC, PhD, CCRP
Project Leader:	Charity L. Lane, MS, MA, CPT, FNS
Organization:	University of South Florida
Partner Fire Departments:	FL: Hillsborough County Fire Rescue, St. Petersburg Fire Rescue, Tampa Fire Rescue, Temple Terrace Fire Rescue
Sponsor:	AFG Fire Prevention & Safety Grants, FEMA, US Department of Homeland Security, EMW-2013-FP-00723
Study Period:	August 1, 2014 - July 31, 2017

Fire Service Partners

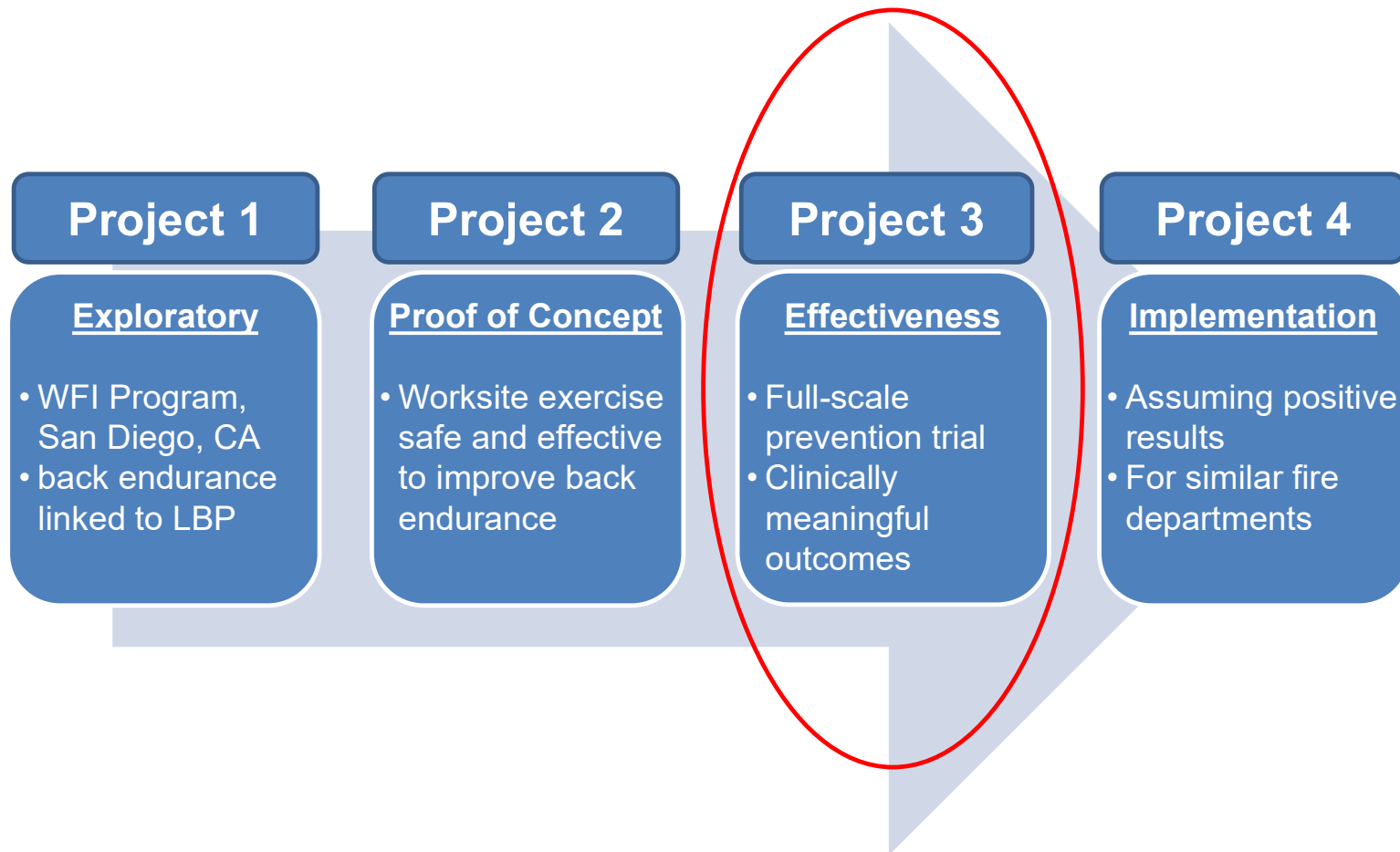
- Fire Rescue Departments:
 - St. Petersburg Fire & Rescue
 - Fire Chief James D. Large
 - Temple Terrace Fire Department
 - Fire Chief Ian Kemp
 - Hillsborough County Fire Rescue
 - Fire Chief Dennis Jones
 - Tampa Fire Rescue
 - Fire Chief Thomas E. Forward
 - Endorsements:
 - Florida Professional Firefighters (state affiliate of IAFF)
 - Jim Tolley, President
 - Florida Division of State Fire Marshal
 - Chief Mike Tucker, Bureau of Fire Standards and Training
-

Research Team

- Principal Investigator: John M. Mayer, DC, PhD, CCRP
- Project Leader: Charity L. Lane, MS, MA, CPT, FNS
- Co-Investigators:
 - Henian Chen, MD, PhD: Statistician
 - Simon Dagenais, DC, PhD: Health Economist
 - Douglas Haladay, PT, PhD, OCS, CSCS
 - William S. Quillen, PT, DPT, PhD, FACSM
- Study Physician: Paul Lunseth, MD
- Exercise Specialists
- Firefighter Peer Fitness Trainers

ClinicalTrials.gov Identifier: NCT02362243

Research strategy: Low back injury prevention in firefighters



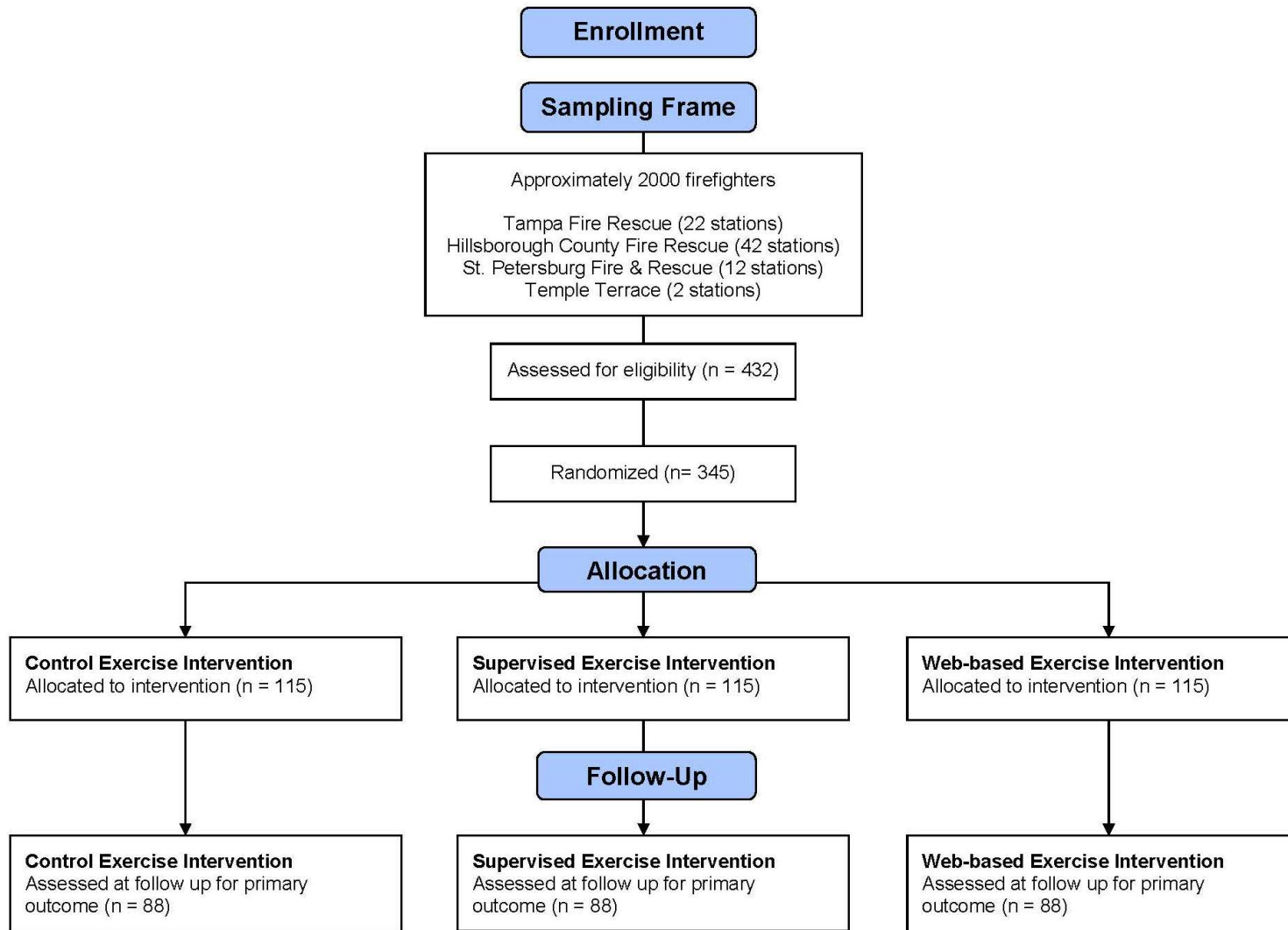
Specific Aim - Project 3

- **Specific Aim:** Compare the effectiveness of a worksite exercise intervention (delivered via direct supervision or web-based system) relative to control on reducing lost work days (shifts) related to low back injury and illness in firefighters.
 - **Hypothesis:** Exercise intervention will reduce the number of lost work days related to low back injury and illness over the 12-month intervention period by 40% compared with control.
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Methods

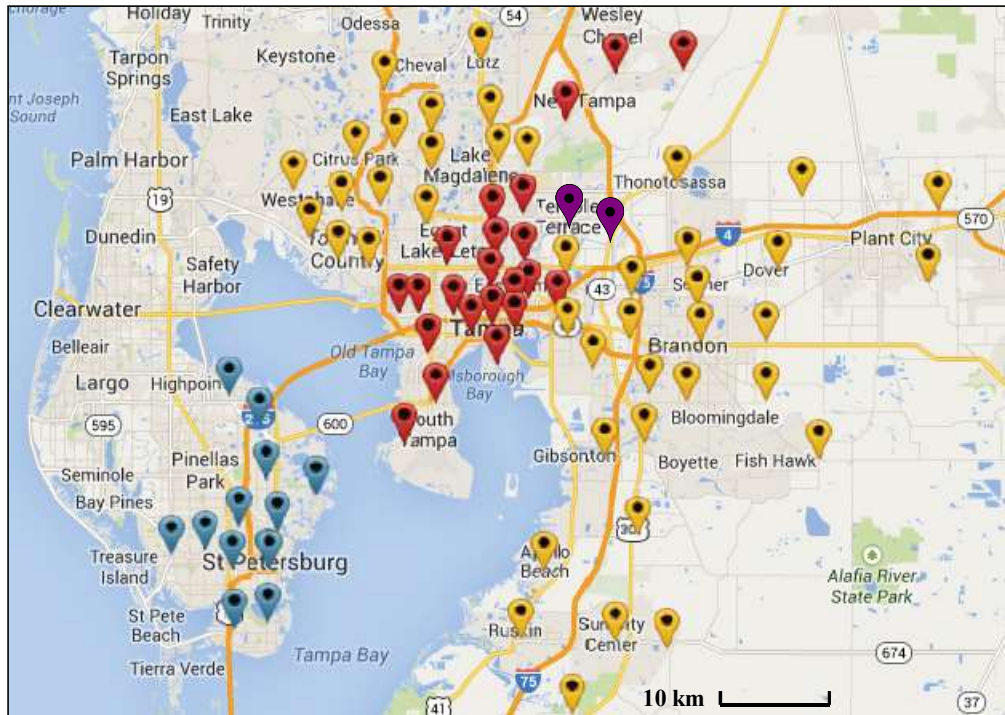
- **Design:** 3-arm cluster randomized controlled trial
 - Standard clinical outcomes to assess effectiveness
 - End-of-trial focus groups to inform implementation
 - 12-month intervention period; 3-year project period
 - **Target Population:** Full duty, career firefighters from 4 fire rescue departments in Tampa Bay region of Florida that employ approximately 2,000 firefighters
 - Minimal eligibility criteria for participation
 - safety findings of project 2
 - current study's pragmatic design features
 - **Unit of Randomization:** Cluster (fire station)
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Enrollment Flow Diagram (as approved)



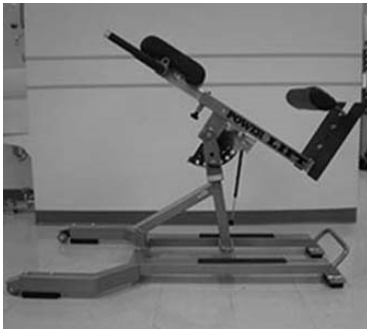
Map of Tampa Bay Region

-  Tampa Fire Rescue (22 stations)
-  Hillsborough County Fire Rescue (42 stations)
-  St. Petersburg Fire & Rescue (12 stations)
-  Temple Terrace Fire Department (2 stations)



Exercise Intervention

- 2X/week, 52 weeks, at fire station, while on-duty



Back extension
progressive resistance exercise
(Mayer 1999)

Core stability exercise
(McGill, 2002)



Exercise Intervention: Improvements

- Updated back and core exercise training manual
- Added exercise progression levels
 - Back extension exercise
 - Now 22 levels



- Core stability exercise: e.g. Side Bridge

Beginner



Intermediate



Advanced



Exercise Intervention: Supervised Arm

- Delivered in identical manner as previous study
- Direct supervision, one-on-one, by exercise specialists (e.g. peer fitness trainers)



Exercise Intervention: Improvements

- Electronic data capture - exercise logs
 - OpenClinica - supervised group

MatExer...(0/11) BEPREEX...(0/7) Reason (0/2) -- Select to Jump --

Title: Back Extension Progressive Resistance Exercise

Instructions: Please complete the information below. Hover mouse for abbreviations.

Back Extension Progressive Resistance Exercise

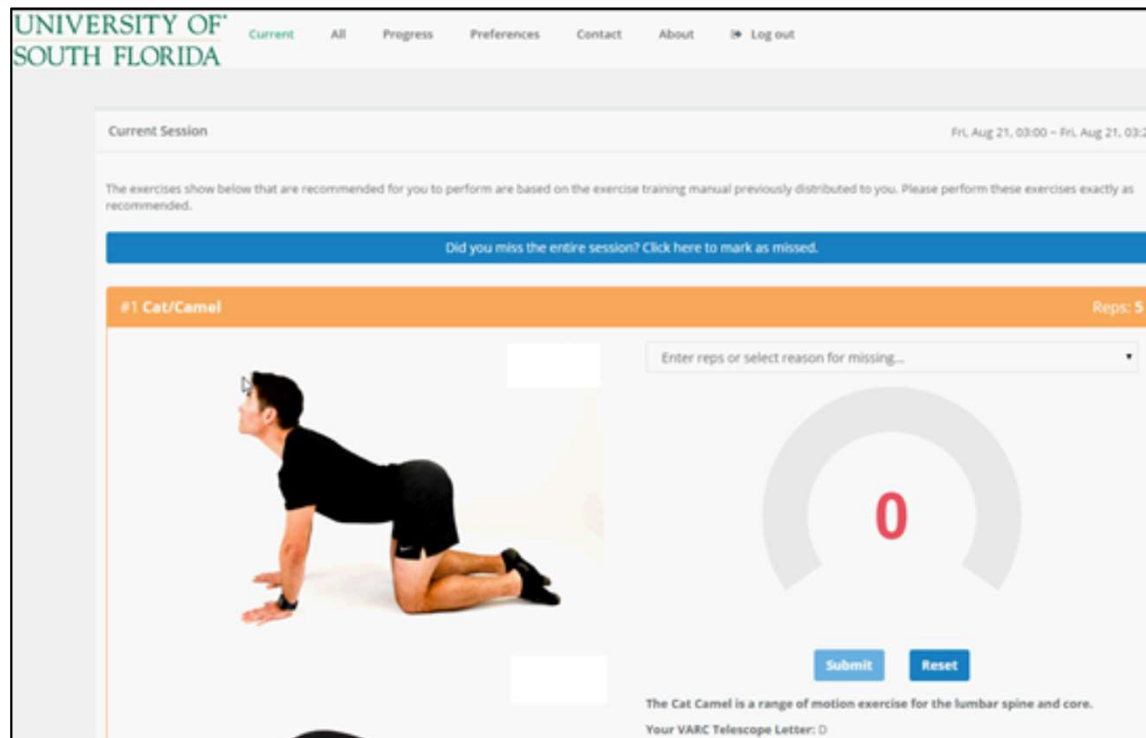
DD-MMM-YYYY	Pelvic Pad (A-J)	Angle (0°-75°)	Hands (BB,HS,GC,BH)	Repetitions	Notes	Trainer Initials	
18-Aug-2015	F	75°	BB	10		ob	X
21-Aug-2015	F	75°	BB	12		ob	X

Add

- Web-based system - web-based group
- Ex Spec addresses and wellness or nutrition topics and logs conversation in system

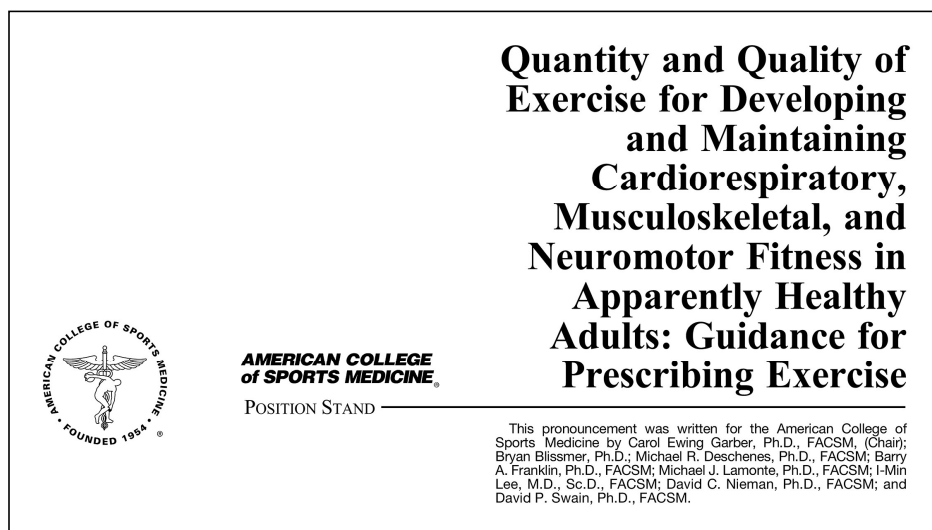
Exercise Intervention: Web-based Arm

- Web-based system for exercise instruction, guidance, logging performance, tracking progress, motivation, inquiries
- www.firefighterbackexercises.com
- Remote interaction with exercise specialists, No direct supervision



Control Intervention

- Educational session on evidence-based guidelines for exercise, physical fitness, and general physical activity
 - Garber CE et al. Med Sci Sports Exerc, 2011;43(7):1334-59.



- Deferred involvement after formal study period
-

Firefighters' Guide to Health and Wellness

1) PHYSICAL ACTIVITY

American College of Sports Medicine recommends frequent physical activity to develop and maintain:⁸

- Cardiorespiratory fitness
- Musculoskeletal fitness
- Neuromotor fitness

CARDIOVASCULAR EXERCISE⁸

- Moderate intensity cardiovascular (aerobic) exercise 5x/week, 30 minutes (moderate intensity = able to carry on a conversation while exercising), OR
- Vigorous intensity aerobic exercise 3X/week, 20 minutes.

RESISTANCE EXERCISE⁸

- Resistance exercise (weight training) can be performed using various methods, such as free weights, selectorized strength machines, cross-training, and resistance bands.
- Focus on major muscle group movements.
- 2-3X/week, 1-2 sets of 8-10 exercises.
- Strength focus: 8-12 reps/set of each exercise.
- Endurance focus: 15-25 reps/set of each exercise.
- Progressively increasing resistance exercise intensity (weight, load) is critical for making muscular strength and endurance gains over time

FLEXIBILITY EXERCISE⁸

- Stretch > 2-3 days/week . Stretching options: static (active or passive), dynamic, ballistic, proprioceptive neuromuscular fasciculation (PNF).
- Stretch to point of feeling tightness or slight discomfort and hold static stretch for 10-30 sec.
- Repeat each stretching pattern 2-4 times.

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CONTACT US

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Firefighters' Guide to Health and Wellness

Charity L. Lane & John M. Mayer
FEMA grant: EMW-2013-FP-00723
University of South Florida, 2016

We developed the *Firefighters' Guide to Health and Wellness* to assist the Exercise Specialist in counseling study participants in the supervised exercise group on Nutrition, General Well-Being, and Physical Activity using standardized approaches.

The Guide provides material to deliver about: 1) how to exercise for optimal performance, 2) what to eat for energy, weight maintenance, fat loss, and muscle mass gains, and 3) other health goals.

The Guide aligns with the FEMA and IRB approved protocol to "provide ongoing consultation, reinforcing general principles of exercise, fitness, and healthy lifestyles."

Firefighters' Guide to Health and Wellness

2) NUTRITION

GENERAL GUIDANCE

EAT SMALL MEALS every 2-3 hours.¹

EAT COMPLETE, LEAN PROTEINS.¹ Fish, turkey, eggs, meat, dairy, or beans are great options.

INCLUDE VEGETABLES in every meal.¹

EAT A COMBINATION of healthy fats.¹

E.g. Coconut oil, nuts, olives, olive oil, fish oil, flax oil.

EAT CARBS WHEN THEY WILL BE USED.¹ Include carbs when your body will use them as fuel (e.g. prior to or immediately after a lift) and focus on lean proteins, veggies, fruit and healthy fat the rest of day.

PREP MEALS IN ADVANCE.¹ This will ensure that you do not reach for whatever is in front of you when you are hungry.

PRACTICE PORTION CONTROL!¹ Use a food scale or simply use your palm to measure your portions.

- Your **palm** determines your protein portions.
- Your **fist** determines your vegetable portions.
- Your **cupped hand** determines your carb portions
- Your **thumb** determines your fat portions.
- A "**palm-sized**" portion is the same diameter and thickness as your palm.
- A "**fist-sized**" portion is the same diameter and thickness as your fist.

MAKE SMARTER CHOICES and substitute to make meals lower calorie and higher in nutrient density. Example: Choose a healthy burger: whole wheat bun, 90% lean ground beef, avocado and baked sweet potato fries in place of the traditional cheeseburger and fries.

SERVING SIZES^a

FOR WOMEN:¹

- 1 palm of protein dense foods (fish, turkey, eggs, meat, dairy, or beans).
- 1 fist of vegetables.
- 1 cupped hand of carb dense foods (whole grains, whole grain starches, or fruits) with **most** meals.
- 1 entire thumb of fat dense foods with **most** meals.

FOR MEN:¹

- 2 palms of protein dense foods (fish, turkey, eggs, meat, dairy, or beans)
- 2 fists of vegetables.
- 2 cupped hands of carb dense foods (whole grains, whole grain starches, or fruits) with **most** meals
- 2 entire thumbs of fat dense foods with **most** meals

^a**Remember:** These are general guides.

- To add muscle/bodyweight, add a serving of carbohydrates or fats.
- To lose bodyweight, remove a serving of carbohydrates or fats.

3) GENERAL WELL BEING

MAINTAIN IDEAL BODY WEIGHT

A "good" bodyfat percentage for most adults (age 20-57 years) in general population is:

- Women: 19-27%²
- Men: 15-22%²

GET APPROPRIATE REST

- 7-9 hours of sleep per night is recommended.³

NUTRITION PLAN^b

- Eat breakfast daily.⁴
- Drink (8oz) water with most meals.⁴
- Minimize soda and diet soda consumption.⁴
- Eat ≥ 7 servings per day of vegetables and fruits.⁴
- Use healthy fats in place of butter, margarine, lard.⁴, CL & JM personal recommendations
- Replace white bread and pasta with whole grain, multi grain, brown rice, or whole wheat pasta.⁴
- Minimize fast food to ≤ 1 day per week.⁴
- Eat grilled, boiled or blackened ocean (salmon, tuna, cod, haddock) fish ≥ 2 times per week.⁴
- Minimize fried food to ≤ 1 time per week (French fries, fried chicken, chicken nuggets).⁴
- Minimize sweet dessert (cake, cookies, pie, ice cream, etc.) to 1 serving per week.⁴
- Eggs 2-4 servings per week.⁴
- Poultry 2-3 servings per week.⁴
- Legumes ≥ 3 servings per week.⁴
- Limit intake of commercial sweets and refined carbohydrates < 3 servings per week.⁴
- Limit intake of soda and sugary drinks < 1 per day.⁴
- Include lean, grass fed beef in several meals per week.^{5,6}
- For active lifestyles and those seeking to build, consume at least 2g protein per kg of body weight.⁷

Recommendations adapted from nutrition plan tested in firefighters,⁴ along with our personal recommendations.

Outcome Measures

- Assessment time points:
 - Baseline, 3, 6, 9, 12 months, upon occurrence, varies by participant
- Low back injury and illness:
 - Lost work days (shifts), incidence, frequency, severity, chronicity/duration, recurrence, time to event
 - Administrative (for primary hypothesis) and self-report
- Other patient-reported outcomes:
 - Oswestry Disability Index, Back Beliefs Questionnaire, SF-12, International Physical Activity Questionnaire, Stages of Change Questionnaire

The image shows a screenshot of a web-based questionnaire titled "Low back pain and injury questionnaire monthly follow-up". The header includes the logos for "USF HEALTH" and "SCHOOL OF PHYSICAL THERAPY & REHABILITATION SCIENCES" at the "MORSANI COLLEGE OF MEDICINE". The form contains two questions with radio button options for "Yes" and "No", and a "reset" link for each. The first question asks about low back pain in the past 30 days, with a definition and a diagram of a human figure highlighting the low back area. The second question asks about low back injury in the past 30 days, with a definition.

USF HEALTH SCHOOL OF PHYSICAL THERAPY & REHABILITATION SCIENCES MORSANI COLLEGE OF MEDICINE

Low back pain and injury questionnaire monthly follow-up

Please complete the survey below.

Thank you!

In the past 30 days: Have you had low back pain?
Low back pain refers to pain or other discomfort in the body region below the rib cage and above the lower buttocks (see image below).

Yes
 No

reset

In the past 30 days: Have you had a low back injury?
A low back injury refers to a specific event, such as a fall, accident, or trauma, that results in bodily harm to the low back region.

Yes
 No

reset

Outcome Measures: Relationship to injury and these measures

- Body Mass Index
- Back muscular endurance
 - Biering-Sorensen Test
- Core muscular endurance
 - Plank Test
- Functional Movement Screen
- Health economic evaluation
- Implementation
 - Adoption, adherence, satisfaction, barriers and facilitators



(WFI 3rd ed, 2009)



(Teyhen 2012)

Progress through August 17, 2016

- **Tampa Fire Rescue**: Recruitment, enrollment, baseline assessments, randomization, and initiation of interventions completed on: June 15, 2015
 - **St. Petersburg Fire & Rescue**: Recruitment, enrollment, baseline assessments, randomization, and initiation of interventions completed on: July, 10, 2016
 - **Hillsborough County Fire Rescue**: Recruitment, enrollment, baseline assessments: underway
 - **Temple Terrace Fire Department**: Recruitment, enrollment, baseline assessments: underway
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Current Enrollment Figures

Randomized Participants through August 17, 2016

- Phone screens: n = 173
 - Screen fails: n = 8 (unable to complete study visits: n = 3, exercise group previous FEMA study: n = 2, active WC or PI case: n = 2)

 - Enrolled and randomized: n = 133
 - No shows: n = 32

 - Group Allocation:
 - Control: n = 52
 - Supervised Exercise: n = 44
 - Web-Based Exercise: n = 37
-

Table 1. Baseline Characteristics of Randomized Participants (n = 133): Continuous Variables

Variable	Mean	SD	Min	Max
Age (y)	34	8.5	19	55
Career as firefighter (y)	8.3	7.6	0	31
Body Height (m)	1.8	0.1	1.6	2.0
Body Mass (kg)	91.1	16.9	51.7	143.3
BMI (kg/m ²)	28.9	3.9	19.0	38.9
Back Endurance (sec)	70.3	30.7	8	172
Core Endurance (sec)	109.2	49.5	31	347

SD = standard deviation; BMI = Body Mass Index; Back Endurance = Modified Biering Sorensen Test; Core Endurance = Prone Plank Test; FMS = Functional Movement Screen.

Table 1. Baseline Characteristics of Randomized Participants (n = 133): Categorical Variables

Variable	n	%
Sex (% Female)	18	13.5
History of Low Back Pain (% Yes)	82	61.7
BMI classification (kg/m ²):		
Normal (18.5-24.9)	25	18.8
Overweight (25.0-29.9)	66	49.6
Obese (≥ 30)	42	31.6
Back Endurance (< 60 sec)	49	36.8
Core Endurance (< 60 sec)	22	16.5

1/3 of FF population are obese
- consistent with Jahnke, Poston, Haddock data
Obesity linked to host of health issues including metabolic syndrome and injury

BMI = Body Mass Index; Back Endurance = Modified Biering Sorensen Test;
 Core Endurance = Prone Plank Test; FMS = Functional Movement Screen.

Preliminary Findings

- Too early to provide data analysis, however, participant feedback is available, eg:
 - “After only a few sessions, my back feels stronger”
 - “I use the VARC on every shift and I was part of the pilot study. I believe that the VARC and its accompanying exercises have contributed to me having a stronger back”
 - “At first I wasn’t sure about joining such a long study, but now I see results and I’ll keep participating”
-
-

Observations: Implementation

- Efforts to get the study going have been very strong
 - Leaders are on board and very supportive
 - Participants are engaged and interested and want more than a back training protocol; they want overall training and nutrition help
 - Additional departments are asking to be added
 - Other emergency response groups are interested in the protocol
-

Observations: Implementation

- Busy stations are problematic for supervised training every shift
 - No standardization and “follow the leader” makes it difficult for new hires or any FF to follow a reliable program
 - Lack of sleep due to conditions
 - Hormonal issues as a result of sleep, stress, poor fitness, and chemical exposure
-

Observations: Implementation

- Web based groups have easier time training in busy stations because they can choose when they train
 - Ensuring that new hires understand the need for back strength is key
-

Observations: Implementation

- Solution may be to use a hybrid approach with a set supervised training visit followed by participant training on own time and logging exercises to maintain accountability
 - Trainer would review progress and make changes
 - Trainer would make scheduled visit to ensure proper form, progression and assess needs

Observations: Implementation

- Helping provide a standardized approach to overall wellness needs (i.e. training, cooking, health, issue reduction)
 - A team that will effectively take research into implementation is key to improving health and reducing issues in the fire service
-

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