Psychosocial Working Conditions, Health Behaviors, and Obesity in Firefighters: Findings of the joint project of university researchers and firefighters

BongKyoo Choi, ScD MPH
Center for Occupational and Environmental Health,
University of California at Irvine
On behalf of the FORWARD research team: b.choi@uci.edu

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### Significant Contributors to the FORWARD study

- **National Institute for Occupational Safety and Health (NIOSH):**
  Grant Award #: R21OH009911

- **A fire department and an IAFF local union in Southern California**

- **UCI-COEH** - BongKyoo Choi, Peter Schnall, Marnie Dobson, Leslie Israel, Dean Baker, Javier Garcia, Stacey Kojaku, Dale Steiss, and other UCI-COEH clinicians

- **UCI-ICTS** (Institute for Clinical and Translational Science) - Pietro Galassetti, Andria Pontello, and Bridgett Duarte

- **CSE** (Center for Social Epidemiology) - Peter Schnall, Marnie Dobson, and Erin Wigger

- **SUNY** (State University of New York Downstate Medical Center) – Paul Landsbergis

- **International researchers** – HyoungRyoul Kim, Sangbaek Ko (Korea) and Boris Centadale (Columbia)
Outline

- Introduction to FORWARD study
- Some important occupational risk factors for obesity in firefighters - Sedentary work, Shift work (long work hours), and Low perceived organizational support at work
- Interaction effect between work stress and eating behaviors in firefighters
- Conclusions
Background

- **Firefighters and police** (29.8%) — 3rd in obesity prevalence out of 41 male occupations

- Supported by a fire department and an IAFF local union and funded by NIOSH (PI: Dr. BongKyoo Choi; Grant #: R21OH009911) in August 2010

- **The FORWARD study:** November 2010 to November 2013
Aims of this study

- To explore occupational and behavioral risk factors for obesity in firefighters

- To develop a firefighter-specific work and health questionnaire

- To compare adiposity measures (BMI, skinfold-body fat %, and waist circumference) in firefighters

→ to use this information to design and conduct intervention studies that lower CVD risk factors among firefighters.
A theoretical framework on working conditions, health behaviors, and obesity in firefighters. CNS: central nerve system. From Choi et al., *Safety and Health at Work* 2011;2:301-12
A survey on working conditions and health behaviors (365 FFs)

- **Participation rate = 84% (May 2011 to December 2012)**
- Sex: Men = 356 (97.5%) and Women = 9 (2.5%)
- Mean of ages: 42.3 years
  - (25-29 years): 6.8%
  - (30-39 years): 33.4%
  - (40-49 years): 32.9%
  - (50-59 years): 25.5%
  - (60+ years): 1.4%
- Position/Rank:
  - FFs (N=156, 42.7%)
  - Engineers (N=86, 23.6%)
  - Captains (N=97, 26.6%)
  - Chiefs (N=10, 2.7%)
  - Rookies (N=3) & Others (N=13, 3.6%)
Assessing obesity prevalence at WEFIT exams (365 FFs)

• **Three measures** (BMI, waist circumference, and skinfold based body fat %*)

• Using a standard assessment protocol by certified clinicians

*Estimated body fat % based on 3-site skinfold thickness using the Jackson & Pollock equation
A Substudy on Nutrition and Physical Activity (85 FFs)

• Recruited from among the questionnaire survey participants

• Participation rate = 50% (August 2011 to July 2012)

• 2-day study (1 on-duty and 1 off-duty day)
  – Record a food log
  – Wear an activity monitor (Actigraph)

• Sex, age, and position/rank of 85 FFs were similar to those of 365 FFs in the questionnaire survey
If overweight was defined as BMIs (25.0 to 29.9 kg/m²), overweight prevalence was 57.3%.

Obesity prevalence (BMI ≥ 30) in US adults: 34.9%
Obesity prevalence (BMI ≥ 30) in California adults: 25.5-29.3%
Obesity prevalence (BMI ≥ 30) in US FFs: 30-40%
Obesity prevalence (BMI ≥ 30) in OCFA FFs: 23%
“My job often requires sitting for long periods of time.” and obesity (based on measured waist circumference) in male FFs

Did not change much after controlled for age, rank, ethnicity, education, exercise at work and during leisure-time, and eating behaviors, and #s of work shifts and daily calls
Survey response: Prolonged sedentary work and central obesity in two exercise groups

- In FFs doing exercise (1 or 0/week): N=45
  - Strongly agree (n=18)
  - Agree (n=57)
  - Disagree (n=24)
  - Strongly disagree (n=3)

- In FFs doing exercise (2 or +/week): N=299
  - Strongly agree (n=19)
  - Agree (n=40)
  - Disagree (n=162)
  - Strongly disagree (n=23)

Sedentary work increased the risk of obesity among firefighters independent of exercise (moderate or vigorous level) at work station
Correlations of self-reported and measured prolong sedentary work with CVD risk factors among 81 firefighters

<table>
<thead>
<tr>
<th>Clinically measured CVD risk factors</th>
<th>Prolong sedentary work (Self-reported)</th>
<th>Sitting time from physical activity monitors</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMI</td>
<td>.40***</td>
<td>.20*</td>
</tr>
<tr>
<td>Waist Circumference</td>
<td>.30**</td>
<td>.33***</td>
</tr>
<tr>
<td>Body fat %</td>
<td>.23*</td>
<td>.38***</td>
</tr>
<tr>
<td>Systolic BP</td>
<td>.17*</td>
<td>.21*</td>
</tr>
<tr>
<td>Diastolic BP</td>
<td>.23*</td>
<td>.14</td>
</tr>
<tr>
<td>Total Cholesterol</td>
<td>.30**</td>
<td>.08</td>
</tr>
<tr>
<td>HDL-Cholesterol</td>
<td>.03</td>
<td>-.29**</td>
</tr>
<tr>
<td>LDL-Cholesterol</td>
<td>.32**</td>
<td>.20*</td>
</tr>
<tr>
<td>Triglycerides</td>
<td>.15</td>
<td>.16</td>
</tr>
<tr>
<td>Fasting Glucose</td>
<td>.22*</td>
<td>.23*</td>
</tr>
<tr>
<td>VO2 max</td>
<td>-.11</td>
<td>-.34***</td>
</tr>
</tbody>
</table>

*p < 0.20, ** p < 0.05, and *** p < 0.01
Too many shifts ($\geq 15$ shifts in the past month) increase the risk for obesity among male FFs.

Did not change much after controlled for age, rank, ethnicity, education, exercise at work and during leisure-time, eating behaviors, sedentary work, and daily calls.
**Result:** # of 24-hr shifts and **work-to-family conflict** (3 items) in 317 male firefighters: work-to-family conflict was a risk factor for infrequent leisure-time exercise

<table>
<thead>
<tr>
<th># of 24-hr shifts in the past month (% of 317 firefighters)</th>
<th>Model 1* Odds ratio (p value)</th>
<th>Model 2* Odds ratio (p value)</th>
</tr>
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<tbody>
<tr>
<td>8-11 shifts (9.5%)</td>
<td>The reference</td>
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</tr>
<tr>
<td>12 shifts (22.4%)</td>
<td>3.09 (.02)</td>
<td>3.53 (.01)</td>
</tr>
<tr>
<td>13 shifts (13.6%)</td>
<td>5.05 (.00)</td>
<td>6.13 (.00)</td>
</tr>
<tr>
<td>14 shifts (24.9%)</td>
<td>2.75 (.03)</td>
<td>2.92 (.02)</td>
</tr>
<tr>
<td>15 shifts (11.7%)</td>
<td>4.59 (.00)</td>
<td>4.90 (.00)</td>
</tr>
<tr>
<td>16 shifts (11.4%)</td>
<td>3.58 (.02)</td>
<td>3.83 (.01)</td>
</tr>
<tr>
<td>17-21 shifts (6.6%)</td>
<td>5.54 (.01)</td>
<td>6.25 (.00)</td>
</tr>
</tbody>
</table>

*Controlled for socio-demographic variables (age, marital status, education, and race/ethnicity); and **Controlled for additionally other occupational factors (rank, and # of daily calls)
Result: # of 24-hr shifts and stress-induced overeating (2 items) in 317 male firefighters: stress-induced overeating was a risk factor for obesity

<table>
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<tr>
<th># of 24-hr shifts in the past month (% of 317 firefighters)</th>
<th>Model 1* Odds ratio (p value)</th>
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<th>Model 3* Odds ratio (p value)</th>
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<tr>
<td>12 shifts (22.4%)</td>
<td>3.29 (.28)</td>
<td>2.82 (.35)</td>
<td>2.44 (.42)</td>
</tr>
<tr>
<td>13 shifts (13.6%)</td>
<td>1.31 (.83)</td>
<td>1.18 (.90)</td>
<td>0.94 (.96)</td>
</tr>
<tr>
<td>14 shifts (24.9%)</td>
<td>4.98 (.14)</td>
<td>4.53 (.16)</td>
<td>4.02 (.20)</td>
</tr>
<tr>
<td>15 shifts (11.7%)</td>
<td>3.27 (.31)</td>
<td>3.01 (.34)</td>
<td>2.42 (.45)</td>
</tr>
<tr>
<td>16 shifts (11.4%)</td>
<td>5.05 (.15)</td>
<td>5.08 (.15)</td>
<td>4.28 (.20)</td>
</tr>
<tr>
<td>17-21 shifts (6.6%)</td>
<td>6.57 (.11)</td>
<td>6.21 (.12)</td>
<td>5.00 (.18)</td>
</tr>
<tr>
<td>Trend test</td>
<td>P &lt; 0.05</td>
<td>P &lt; 0.01</td>
<td>P &lt; 0.05</td>
</tr>
</tbody>
</table>

*Controlled for socio-demographic variables (age, marital status, education, and race/ethnicity); **Controlled for additionally other occupational factors (rank, and # of daily calls); and ***Controlled for additionally work-to-family conflict.
Mental stress increases the risk for obesity among male FFs directly or indirectly through stress-related overeating.

- Psychological Distress: GHQ (23.6%)
- Work-related Exhaustion (17.8%)
- Post Traumatic Syndrome (PTSD) (12.9%)

Did not change much after controlled for age, rank, ethnicity, education, exercise at work and during leisure-time, overeating since childhood, sedentary work, and daily calls.
Does central obesity reflect “Cushing’s disease of the omentum”?

**Interpretation** Adipose stromal cells from omental fat, but not subcutaneous fat, can generate active cortisol from inactive cortisone through the expression of 11β-HSD1. The expression of this enzyme is increased further after exposure to cortisol and insulin. In vivo, such a mechanism would ensure a constant exposure of glucocorticoid specifically to omental adipose tissue, suggesting that central obesity may reflect “Cushing’s disease of the omentum”.

*Lancet* 1997; 349: 1210–13
Low perceived organizational support increase the risks for mental distress and obesity among male FFs.

Did not change much after controlled for age, rank, ethnicity, education, #s of work shifts, and daily calls.

High perceived organizational support: FFs agree to both of the following two questions: 1) management cares about my opinions; and 2) management considers my goals and values.
Obesity

Mental Stress: Psychological distress; Work-related exhaustion; and PTSD

Stress-induced Overeating

Infrequent Leisure-time exercise

Infrequent exercise at work

Sedentary Work

# of shifts (more and long shifts)

Low coworker support for exercise

Low Organizational Support

Exposure to Critical events

Work to family conflict

Overeating since Childhood
Synergistic Interaction between (work) stress-induced overeating and overeating since childhood on obesity among male FFs?

Controlled for age, rank, ethnicity, education, exercise at work and during leisure-time

<table>
<thead>
<tr>
<th>Combinations (N=314)</th>
<th>Odds ratio (95% CIs) for obesity (based on body fat, &gt; 24%)</th>
<th>Synergy Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>None of the two (N= 136)</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Stress-related overeating alone (N=12)</td>
<td>1.95 (0.96-3.93)</td>
<td>1.64</td>
</tr>
<tr>
<td>Overeating since childhood alone (N=141)</td>
<td>2.55 (0.60-10.92)</td>
<td></td>
</tr>
<tr>
<td>Both of the two (N=25)</td>
<td>5.09 (1.72-15.07)</td>
<td></td>
</tr>
</tbody>
</table>

Synergy Indexes: 1.38 (waist circumference-based obesity) and 1.14 (BMI based obesity)
Healthy Eating? (Food Diary)

MOST FFs need to EAT LESS fat (at station), sodium intake, and added sugar and need to EAT MORE fiber

<table>
<thead>
<tr>
<th></th>
<th>Work day M (SD)</th>
<th>Non-work day M (SD)</th>
<th>Recommendations for US adults</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calorie intake (Kcal)</td>
<td>2338 (841)</td>
<td>2342 (570)</td>
<td>2400-3000</td>
</tr>
<tr>
<td>Calories from Fat (%)</td>
<td>36.8 (9.4)</td>
<td>32.3 (8.4)</td>
<td>20-35%</td>
</tr>
<tr>
<td>Fiber intake (g)</td>
<td>24.3 (11.8)</td>
<td>22.9 (11)</td>
<td>More than 38</td>
</tr>
<tr>
<td>Sodium intake (mg)</td>
<td>4,291 (1,893)</td>
<td>4,008 (1,655)</td>
<td>Less than 2,300</td>
</tr>
<tr>
<td>Added sugar (g)</td>
<td>65 (47)</td>
<td>56 (46)</td>
<td>Less than 36</td>
</tr>
</tbody>
</table>

6% of FFs meet the recommendation for fiber intake
10% of FFs for sodium intake
32% of FFs for added sugar
43% of FFs for calories from fat
Conclusions

- **Improving working conditions** [e.g., avoiding too many 24-shifts per month (e.g., ≥15 shifts) and enhancing organizational support] and providing firefighters with training on **effective stress management** can be **effective work organizational strategies to address obesity among firefighters**.

- **Addressing overeating behaviors** [e.g., nutrition education program combined with the aforementioned work organizational strategies] can significantly decrease the risk for obesity among firefighters.

- **Multiple obesity measures are needed** for both firefighter WEFIT medical programs and worksite obesity intervention studies among firefighters.