The RAND Corporation is a nonprofit institution that helps improve policy and decisionmaking through research and analysis.

Support RAND

Purchase this document
Browse Books & Publications
Make a charitable contribution

For More Information
Visit RAND at www.rand.org
Explore the RAND Center for Health and Safety in the Workplace
View document details

Limited Electronic Distribution Rights
This document and trademark(s) contained herein are protected by law as indicated in a notice appearing later in this work. This electronic representation of RAND intellectual property is provided for non-commercial use only. Unauthorized posting of RAND PDFs to a non-RAND Web site is prohibited. RAND PDFs are protected under copyright law. Permission is required from RAND to reproduce, or reuse in another form, any of our research documents for commercial use. For information on reprint and linking permissions, please see RAND Permissions.
This product is part of the RAND Corporation monograph series. RAND monographs present major research findings that address the challenges facing the public and private sectors. All RAND monographs undergo rigorous peer review to ensure high standards for research quality and objectivity.
The Frequency, Severity, and Economic Consequences of Musculoskeletal Injuries to Firefighters in California

Seth A. Seabury, Christopher F. McLaren

Sponsored by the RAND Center for Health and Safety in the Workplace
This research was sponsored by the RAND Center for Health and Safety in the Workplace on behalf of the California Commission on Health and Safety and Workers’ Compensation.

Library of Congress Cataloging-in-Publication Data
The frequency, severity, and economic consequences of musculoskeletal injuries to firefighters in California / Seth A. Seabury, Christopher F. McLaren.
p. ; cm.
Includes bibliographical references.
RC965.F48S43 2010
617.1002’436337—dc22
2010022052

The RAND Corporation is a nonprofit research organization providing objective analysis and effective solutions that address the challenges facing the public and private sectors around the world. RAND’s publications do not necessarily reflect the opinions of its research clients and sponsors.

RAND® is a registered trademark.

© Copyright 2010 RAND Center for Health and Safety in the Workplace

Permission is given to duplicate this document for personal use only, as long as it is unaltered and complete. Copies may not be duplicated for commercial purposes. Unauthorized posting of RAND documents to a non-RAND website is prohibited. RAND documents are protected under copyright law. For information on reprint and linking permissions, please visit the RAND permissions page (http://www.rand.org/publications/permissions.html).

Published 2010 by the RAND Corporation
1776 Main Street, P.O. Box 2138, Santa Monica, CA 90407-2138
1200 South Hayes Street, Arlington, VA 22202-5050
4570 Fifth Avenue, Suite 600, Pittsburgh, PA 15213-2665
RAND URL: http://www.rand.org
To order RAND documents or to obtain additional information, contact
Distribution Services: Telephone: (310) 451-7002;
Fax: (310) 451-6915; Email: order@rand.org
Summary

Firefighting is one of the most important and most dangerous occupations in the United States. While firefighters face a number of unique risk factors in their jobs, the most common work-related injuries among firefighters are musculoskeletal disorders (MSDs). The strict physical demands of the job and limited modified work opportunities suggest that MSDs are potentially more disruptive and costly to firefighters than to people in other lines of work.

The importance of understanding the frequency and severity of firefighter MSDs has become heightened due to recent changes to the California workers’ compensation landscape. Since 2004, there have been a number of changes to the workers’ compensation system affecting both the level of compensation and the type and quantity of medical treatment provided to injured workers. These changes include the reduction of permanent-disability ratings that occurred due to the adoption of a new disability rating system and new rules for apportioning disability with respect to job-related causation, the adoption of treatment guidelines to provide utilization review in workers’ compensation medical care, and the imposition of caps on the number of times injured workers can be reimbursed for use of chiropractic care and physical therapy. Each of these could have a potentially disadvantageous and disproportionate impact on firefighters with MSDs.

To develop a greater understanding of firefighter MSD risk and how these workers are treated by the workers’ compensation system, this study pursued the following research objectives:

• Describe the average frequency and severity of work-related MSDs experienced by firefighters in California.
• Study the impact of work-related MSDs on the earnings and employment of firefighters several years after injury.
• Evaluate the impact of reforms to the disability rating system on the ratings of firefighters with permanently disabling MSDs.
• Assess whether reforms to the medical delivery system affected the employment outcomes of firefighters with MSDs.

We utilize a variety of methods and sources of data to address these questions. In this summary, we highlight our key findings.
Describing Firefighter Musculoskeletal Injury Risk

We use Bureau of Labor Statistics (BLS) injury and illness data from California for the years 2003–2007 to compare injury frequency and severity for firefighters with those of people in other occupations. Our review of these data demonstrates that firefighters face elevated risk from MSDs. Moreover, the risk is especially pronounced for firefighters 55 and older.

Specifically, we find the following:

- Firefighters are 3.5 times more likely to suffer a workplace injury and 3.8 times more likely to suffer a work-related MSD than a private-sector worker.
- Firefighters take 1.4 times longer to return to work than workers in the private sector for all injuries; this difference skyrockets for MSDs, as firefighters take twice as long to return to work.
- The median number of days away from work after an MSD is 1.8 times greater for an MSD than for any other injury for firefighters, whereas this ratio is only 1.25 for private-sector workers.
- Both the frequency and the severity of injuries, particularly MSDs, are worse for older firefighters than for younger firefighters.
- Older firefighters are 10.4 times more likely to suffer an MSD than are private-sector workers, and they take more than four times longer to return to work.

The sharp increase in the frequency of MSDs for older firefighters is consistent with the idea that the physical nature of the job exposes them to cumulative trauma, making them more susceptible to disabling MSDs at older ages. We note, however, that firefighters do receive special disability compensation and retirement benefits that could influence the reported severity and frequency of occupational injuries.

The Impact of Permanent Disabilities on the Earnings and Employment of Firefighters

The previous section indicates that firefighters, particularly older firefighters, are at greater risk of injuries, and that these injuries might be more severe in terms of their average number of lost workdays. Lost workdays represent a fairly limited measure of economic impact, however, especially in the case of permanently disabling injuries. Here, we use a large sample of permanent-disability claims for workers in California, including firefighters, to examine the earnings and employment of firefighters up to three years after an injury.¹

When we compare across occupations, we find that the impact of a disabling injury on the employment of firefighters is similar to that of other workers in the public sector but considerably less severe than for many private-sector occupations. This finding is highlighted in Figure S.1, which reports the relative employment ratios before and after injury, by occu-

¹ We measure economic outcomes using the matching methodology developed in, among others, Peterson et al. (1998); Reville, Boden, et al. (2001); Reville, Bhattacharya, and Weinstein (2001); Reville and Schoeni (2001); Reville, Schoeni, and Martin (2002); and Reville, Seabury, et al. (2005).
We compare firefighters to some other public safety employees (police officers and corrections officers), other public employees in a nonsafety occupation (teachers), and private-sector workers with physically demanding jobs and similar demographic profiles (construction workers and laborers). It is clear from the figure that the impact of a permanently disabling injury is considerably worse for workers in the two private-sector occupations we consider than for the public-sector workers. There is some recovery after the first six quarters after injury, but the long-term effects are extreme. As we would expect, these differences in relative employment are consistent with the differences we see in earnings losses associated with disability.

We also compare the employment outcomes of firefighters with four different categories of injuries: back injuries, knee injuries, shoulder injuries, and heart disease. We find the following:

- While the losses for firefighters who experience permanent disabilities are substantial on average, a focus on this masks considerable heterogeneity in outcomes across different injury types.

---

2 The relative employment ratios are defined as the average likelihood that an injured worker is employed compared to that of the uninjured control workers. So, a relative employment ratio of 0.8 in a quarter indicates that the injured worker is, on average, 20 percent less likely to be employed in that quarter than they would have been absent the injury.
• Heart disease is associated with the most significant reduction in employment. The relative employment ratio for firefighters with heart disease falls to less than 0.6 in the third year after the date of disability.
• The losses associated with back injuries and other common types of injuries appear to be relatively minor, particularly compared to those of workers in the private sector.

While losses are relatively minor for firefighters on average, older firefighters experience more significant losses. In Figure S.2, we compare the relative employment ratios of workers with back injuries by age and occupation. Each set of bars indicates the relative employment ratios for four different age categories by occupation. In the figure, as was the case with all injuries, it is clear that the decline in employment associated with a disability for firefighters is less severe for younger workers but that, for older firefighters, it is comparable to the private-sector workers (which is not true for the other public workers).

Assessing the Impact of Reforms on Disability Ratings for Firefighters

The 2004 reforms to the California workers’ compensation system were broad in scope and made many changes. Two of these changes were the introduction of a new basis for disability ratings—specifically, the American Medical Association *Guides to the Evaluation of Permanent Impairment* (AMA Guides) and new rules requiring disability ratings to be reduced to reflect apportionment with respect to causation of disability. These changes have contributed to a dramatic decline in the average disability ratings received by permanent-disability claimants in California. Because disability ratings are used to determine benefit levels, this has led to a large

---

**Figure S.2**

Relative Employment Ratios for Workers with Back Injuries Two Years After Injury, by Age and Occupation

- **Age**
  - 25–34
  - 35–44
  - 45–54
  - 55–60

- **Relative employment ratio**
  - 0
  - 0.2
  - 0.4
  - 0.6
  - 0.8
  - 1.0

---

*Figure S.2* Relative Employment Ratios for Workers with Back Injuries Two Years After Injury, by Age and Occupation
reduction in the average level of compensation. Our study examines how these reforms have affected the disability ratings of firefighters, particularly those with MSDs.

Figure S.3 compares the average ratings and apportionment of firefighters to those of the five other occupations considered previously for injuries occurring in 2000–2006. The figure illustrates two series. The first series reports the average ratings of claims that receive a positive rating, meaning that a physician evaluated them under the AMA Guides and found a basis for a positive rating. The second series reports the average ratings including the unrated claims as zero, meaning that no basis for a rating was found. We make this distinction because the adoption of the AMA Guides led both to a decrease in the average ratings of rated claims and to an increase in the number of claims that received no positive rating at all.

We find that firefighters experience significant declines in average ratings as a result of the new schedule being adopted. While this decline was substantial, however, it was actually somewhat less than in the other occupations. This appears to be due at least in part to the fact that the average rating for firefighters is lower than that for the other occupations in the sample. The average rating for firefighters at the end of the series appears closer to that for the other occupations. While the overall decline for firefighters is somewhat less than the other occupations, firefighters appear to have a disproportionately large fraction of cases receiving a zero rating.

Figure S.3
Trends in Permanent-Disability Ratings, by Occupation
We also use the Disability Evaluation Unit (DEU) data to examine the impact of apportionment on the disability ratings of firefighters. We find that apportionment has led to a small reduction in the average rating for firefighters, as it has for other workers. But, while the effects are small on average, there is typically a large reduction in ratings whenever apportionment is applied.

Evaluating the Impact of Medical Reforms on Employment Outcomes for Firefighters

A number of reforms have been adopted in California affecting the medical treatment after a workplace injury. In particular, Labor Code §4604.5 imposes a limit of 24 visits to a doctor of chiropractic (DC) or physical therapist (PT) for the life of a workers’ compensation claim occurring on or after January 1, 2004, unless the employer authorizes additional treatments. Furthermore, Labor Code §4610 was also adopted, requiring employers to implement utilization review systems consistent with the American College of Occupational and Environmental Medicine (ACOEM) guidelines or some other approved set of guidelines.

To evaluate the impact of the reforms, we employ a variety of methods. First, we perform a systematic literature review and analyze the Medical Expenditure Panel Survey (MEPS) to determine average utilization rates for DC and PT treatments. Next, we perform a systematic literature review to assess the existing evidence on the effectiveness of DC and PT treatments, with a focus on long-term treatments, relative to alternative methods. Finally, we conduct our own empirical analyses to evaluate whether the employment outcomes of firefighters were affected by the reforms.

Chiropractic and Physical-Therapy Utilization

Based on our utilization literature review, rates for DC and PT treatments vary by type of injury, workers’ compensation status, and geographic location. Specifically, we find the following:

- Estimates from nationally representative samples of DC and PT utilization fall in the range of 10–13 visits per year.
- Median rates are significantly lower due to a small proportion of patients consuming a large majority of visits.
- Rates tend to be higher for patients with chronic low back pain and for workers’ compensation claimants.
- The highest averages reported were from California workers’ compensation claimants prior to the recent reforms.
- After the implementation of the cap on the number of DC and PT treatments in California, utilization rates are more comparable to national estimates.

Our analysis of MEPS yields consistent estimates with previous nationally representative samples of DC and PT utilization. Further, we find that approximately 10–15 percent of patients who go to a DC or PT at least once will exceed 24 visits. Workers’ compensation
claimants with an MSD who went to a physical therapist represent the highest proportion of
more than 24 visits, at 15.7 percent.3

Existing Studies on Chiropractic and Physical-Therapy Effectiveness
Most studies evaluating the health effects of DC and PT treatments found mildly positive
results relative to general practitioner (GP) care and significant improvements relative to pla-
cebos. The evidence regarding return-to-work (RTW) outcomes and cost-effectiveness was
mixed and weak. While some studies do find that DC and PT treatments are marginally
cost-effective and return injured workers to work faster, they are sparse, and many studies find
that alternative treatments from a GP are more cost-effective. However, there is still a lack of
evidence on long-term treatments.

Using our findings, we can draw some conclusions as to the overall impact of the recent
cap on DC and PT treatments on firefighter outcomes:

• ACOEM guidelines suggest that virtually all injuries treated by a DC or PT injury condi-
tions can be treated well within the new 24-treatment cap, and our utilization estimates
confirm that most individuals do not exceed the caps.
• DC and PT treatment does not appear to be correlated with significantly better health,
RTW, or cost-effectiveness outcomes for injured workers relative to treatment from a GP.
• While there is no evidence that the firefighters would experience differential effects of
treatment, the issue has not been adequately studied.
• Firefighter DC and PT treatment levels are probably more likely to be affected by utiliza-
tion review than by the cap, because utilization review is based in part on more limited
ACOEM treatment guidelines.

Empirical Analysis of the Impact of the Medical Reforms
We use a statistical model that isolates the impact of the reforms from other potentially con-
founding factors in order to estimate whether the reforms had an impact on the employment
outcomes of injured workers. Specifically, we estimate a series of multivariate regression models
that estimate the likelihood that the injured worker has positive earnings in the eighth quarter
after injury as a function of other characteristics of individuals. The results of our statistical
analysis are reported in Table S.1.

The table provides little evidence to suggest that the reforms had a significant negative
impact on employment outcomes for injured workers, and essentially no evidence of an effect
on firefighters. The only coefficient that is statistically significant at conventional levels is the
first estimate—the impact of the reforms on all workers for all injuries. The effect suggests a
reduction of –0.03 to the relative employment ratio. The average employment level in quarter
8 of workers in our sample is 0.62, so this represents a reduction in the likelihood of working
of about –4.8 percent.

It can be challenging to draw policy implications from a null result such as this. We feel
that it is important to stress that our findings do not mean that the medical reforms had no
effect. Rather, our findings suggest either that any effect on firefighters was too small in the
average worker for us to detect or that any effect was offset by other changes in the economy

3 The reason our MEPS estimates for PT utilization are slightly higher than for DC utilization is probably because MEPS
combines PT and occupational therapy into one category.
or the workers’ compensation system. Whether the reforms had a more significant impact on workers in other occupations is unclear, though we feel that it is a subject worthy of further research.

Table S.1
Estimates from a Statistical Model of the Impact of the Medical Reforms on Employment Outcomes for Disabled Workers: Dependent Variable as Likelihood of Working Two Years After Injury

<table>
<thead>
<tr>
<th>Injury</th>
<th>Estimated Impact of Reforms</th>
<th>Standard Error</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>All workers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All injuries</td>
<td>-0.03</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>Back injuries</td>
<td>-0.03</td>
<td>0.02</td>
<td>0.11</td>
</tr>
<tr>
<td>Shoulder injuries</td>
<td>-0.05</td>
<td>0.03</td>
<td>0.18</td>
</tr>
<tr>
<td>Knee injuries</td>
<td>-0.02</td>
<td>0.02</td>
<td>0.44</td>
</tr>
<tr>
<td>Firefighters</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All injuries</td>
<td>0.02</td>
<td>0.03</td>
<td>0.52</td>
</tr>
<tr>
<td>Back injuries</td>
<td>0.02</td>
<td>0.05</td>
<td>0.75</td>
</tr>
<tr>
<td>Shoulder injuries</td>
<td>0.03</td>
<td>0.07</td>
<td>0.70</td>
</tr>
<tr>
<td>Knee injuries</td>
<td>0.03</td>
<td>0.04</td>
<td>0.43</td>
</tr>
<tr>
<td>Heart disease</td>
<td>-0.15</td>
<td>0.20</td>
<td>0.46</td>
</tr>
<tr>
<td>Back injuries versus other injuries</td>
<td>-0.09</td>
<td>0.07</td>
<td>0.20</td>
</tr>
</tbody>
</table>

NOTE: The table reports the estimated effect of the medical reforms on the relative employment ratio of workers in the eighth quarter after injury. The analysis uses data on permanent-disability claims from the California Disability Evaluation Unit linked to data on earnings from the California Employment Development Department.