A Prospective Study of Back Belts for Prevention of Back Pain and Injury

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BACK INJURIES HAVE BEEN THE leading cause of disability in the United States for people younger than 45 years and have been the most expensive health care problem for the 30- to 50-year-old age group.1 Low back pain accounted for 23% ($8.8 billion) of total workers’ compensation payments in 1995.2 The Annual Survey of Occupational Injuries and Illnesses conducted by the Bureau of Labor Statistics indicates that in 1998 there were 279,507 back injuries due to overexertion that resulted in lost work days (89% in material-handling).3 In response to the increasing human and economic costs of back injury, employers have attempted preventive measures; specifically, the widespread use of industrial back belts, approximately 4 million of which were purchased in 1995.4 This study was designed to address 2 objectives: (1) to examine the effect of store policy by comparing a belt-use requirement policy with a voluntary belt-use policy and (2) to compare employees who reported wearing back belts usually every day with those who reported wearing the belt less frequently, based on interview responses.

METHODS
Study Design
Between April 1996 and April 1998, 50 new stores and 110 newly expanded stores (combination supermarket and merchandise) of a single corporation were enrolled on the date they first opened for regular business. A prospective cohort study was conducted following sequential assignment (according to store opening date) of groups of stores to either the traditional belt-requirement stores, while belts were made available only by request in the voluntary belt-use stores.

Of the 160 stores in the study, 89 required back-belt use and 71 had voluntary use. The original goals of introducing stores with voluntary belt use were to create an environment in which employees were free not to wear back belts without violating store policy and to compare the back injury rate with stores that required belt use. The
main focus of this study is on inter-
view data: determining employee char-
acteristics and belt wearing habits from
a baseline interview for comparison of
injury rates and a follow-up interview
to determine the incidence of self-
reported low back pain.

Study stores were distributed across
30 states from New Hampshire to
Michigan in the north and from Florida to Texas in the south; most
states included both belt requirement
and voluntary belt-use stores. We
obtained payroll records of hours
worked and workers’ compensation
injury reports for all stores for calcu-
lation of injury incidence rates. The
National Institute for Occupational
Safety and Health (NIOSH) Human
Subjects Review Board formally
approved the study’s design and data
collection instruments in August
1995, following a public peer review
meeting in April 1993.

Data Collection
A survey contractor conducted tele-
phone interviews using trained inter-
viewers. Participants completed an
informed consent form either in a prestudy
employee meeting or at the begin-
ing of the telephone interview. Telephone calls
were placed to employees while work-
ing at the store during regular working
hours. For each store, interviews were
attempted for a period of at least 30 cal-
endar days (excluding weekends). Follow-
up interviews were attempted for all
employees who had a baseline inter-
view. Interviews were not conducted
from mid-December to mid-January due
to the holiday shopping season.

Both the baseline and follow-up in-
terviews consisted of questions cover-
ing work history, lifestyle habits, medi-
cal history, job activities, psychosocial
factors, belt wearing habits, and demo-
graphic information. Participants were
asked four job satisfaction questions from
the Quality of Employment Survey de-
veloped by the US Department of La-
bor and NIOSH. The sum of the re-
sponses for these four items were used to
create a dichotomous measure of job
satisfaction using the median cut point.

Job Titles
The job title receiver/unloader identi-
fied workers with the greatest expo-
sure to physical work unloading freight
trucks; stocker was used to designate
employees with responsibility for mov-
ing stock to the merchandise floor. De-
partment managers were employees
whose physical work mostly involved
arranging stock on shelves and other
less strenuous activities, and the group
designated as others were employees
with various other jobs involving ma-
terial handling. In a separate study, re-
ceiver/unloaders had the highest expo-
sure to manual material handling (based
on lifting heavier loads more fre-
cently), followed by department man-
agers, then stockers. Job title was de-
termined from an employee’s first
baseline interview response and con-
istency in reporting job title was evalu-
ated from the follow-up interview: 85%
of department managers, 75% of stock-
ers, 71% of receiver/unloaders, and 31%
of the others were working in the same
job title that they reported during the
baseline interview.

Self-reported Back Belt Use
Self-reported belt wearing was deter-
 mined from the response to the ques-
tion: “During the past month, how
many days per week did you wear the
back belt?” Response categories were:
“never,” “once or twice a month,” “once
or twice a week,” or “usually every day.”
The “never” and “once or twice a
month” categories were combined and
are referred to herein as never. Consis-
tency was evaluated from the fol-
low-up interview with 75% reporting
usually every day, 81% reporting never,
and 31% reporting once or twice per
week in the same baseline category.

Back Belt
The back belt provided by the corpo-
ration is designed to fit around the waist
without shoulder straps. The belt is con-
structed of stretchable nylon material
with Velcro ends and mesh in back.
Tightness is adjusted by choosing the
location to attach the Velcro and tight-
ening side panels when lifting. This same
back belt was used in human subjects
laboratory studies of biomechanics (Re-
becca J. Giorgell, PhD, et al, unpub-
lished data, 1998) and physiology effects
(Thomas G. Bobick, PhD, et al, unpub-
lished data, 1998). All employees, when
first hired and regardless of the store
policy, received a short introductory
information and training session on
proper lifting and belt use via videotape
or interactive computer-based learning.

Back Pain Data
Self-reported low back pain (hereafter
back pain) was defined as a positive re-
 sponse to a question asking if respond-
ents experienced any low back pain
in the 6 months preceding the fol-
low-up interview, with a frequency of
4 or more episodes (≥ median). A his-
tory of previous back injury was deter-
mined by a positive response to ques-
tions about back pain (with the addition
of a reported severity ≥7 on a 10-
point scale) at the baseline interview;
had previous back surgery; had “ever
been told by a doctor” that he/she had
arthritis of back joints, degenerative
joint disease of the back, lupus ery-
thematosus, ankylosing spondylitis, or
spondylolisthesis; or had “seen a doc-
tor, nurse, physical therapist, or chiro-
practor” for a strain or sprain of the
lower back or ruptured disk in the back.

Injury Claims Data
The data consisted of the dates of oc-
currence and characteristics of work-
related material-handling back inju-
ries requiring medical care recorded in
the company’s own workers’ compen-
sation reporting system. The data con-
sisted of all claims received by the cor-
poration, regardless of whether the
claim was accepted or rejected for com-
 pensation. Although compensation
rules vary among states, corporation
procedures and policies regarding
which injuries are included in their cor-
porate database do not vary among
states. Material-handling compensa-
tion claims for back injuries consisted
of those with an external cause code
containing “strain” or “sprain” fol-

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ollowed by “lifting,” “pushing,” “pulling,” “reaching,” “holding,” or “carrying.” Back injuries unrelated to material handling (such as “fall,” “caught by,” “caught between,” “struck by,” “slip,” or “trip without fall”) were excluded.

Statistical Methods
The regression models used to investigate the effects of belt wearing and store policy were selected to control for type of store (new stores or newly expanded stores that are a combination of supermarket and merchandise), demographic risk factors (age, race, and sex), work exposure (job title and lifting frequency), variables found important in previous studies (history of previous back injury and job satisfaction), and a standard health-risk factor (smoking). These 11 covariates were investigated using Poisson regression to model the incidence rate of back injury claims, taking account of the variable work-hours of follow-up for each employee. Logistic regression was used to model the incidence of back pain as a binary outcome in which employees had similar length of follow-up. Potential effect modification was investigated using interaction terms and separate analysis of subgroups of data. Subgroup analyses were conducted for those who were concordant for belt wearing at both the baseline and follow-up interviews and for employees with the most strenuous job tasks. Regression analyses and confidence intervals (CIs) for odds ratios (ORs) and rate ratios (RRs) were calculated using SAS statistical software. Other CIs were calculated using StatXact. 

RESULTS
There were a total of 144,469 employees who worked in the 160 stores during the study period. Of these, 13,873 (10%) were identified by store management as involved in material handling tasks prior to the interview process (FIGURE). For the 6,311 employees who completed both a baseline and a follow-up interview, the median (and mode) of the length of time between baseline and follow-up interview was 6½ months. Payroll and workers’ compensation data collection ended December 1998.

TABLE 1 shows employee characteristics from the baseline interview by store-belt policy and belt wearing. There was a lack of compliance with the store belt-wearing policy. In the stores requiring belt use, 58% of employees reported wearing belts usually every day; 14%, once or twice a week; and 28%, never. In the stores with voluntary belt-use, 33% of employees reported wearing belts usually every day; 11%, once or twice a week; and 56%, never. There was a slight difference in the proportions who completed a follow-up interview, worked in new stores, or had a history of previous back injury by frequency of belt wearing. Employees who reported belt wearing usually every day were more likely to be receivers/unloaders or stockers and were less likely to be department managers or others, and were also more likely to report lifting more than 9 kg (20 lb) at work usually every day. Among the 9,377 who completed a baseline interview and were matched to payroll data, there were 195 back injury claims (12.9 million work-hours) for a crude incidence rate of 3.03 per 100 full-time equivalent (FTE) (95% CI, 2.62-3.48). Among the 6,311 who completed a baseline and follow-up interview, there were 1,088 cases of back pain (17%; 95% CI, 16%-18%). There were no statistically significant protective effects comparing employees who wore belts usually every day with employees who never wore belts for either back injury claims (RR, 1.22; 95% CI, 0.87-1.70) or low back pain (OR, 0.97; 95% CI, 0.83-1.13). There were no statistically significant protective effects comparing employees who wore belts once or twice a week with employees who never wore belts for either back injury claims (RR, 0.95; 95% CI, 0.56-1.59) or back pain (OR, 0.92; 95% CI, 0.73-1.16). Table 2 presents percentages reporting back-pain and back injury claim rates, stratified by risk factors. Table 2 also presents multivariate regression estimates with each variable adjusted for all other variables listed.

Figure. Interview Participants and Loss to Follow-up by Store Policy

Among the other risk factors in the models, a history of previous back injury was the strongest risk factor for both outcomes. Frequent lifting of heavier than 9 kg (20 lb) at work was associated with significantly increased odds of back pain but not for back injury claims. Women had significantly more back pain than men, but they did not have a higher back injury claim rate. Other races did not differ significantly from white persons for back pain but persons of other races had a higher back injury claim rate. Similarly, results for job satisfaction and smoking differed by outcomes. Poor job satisfaction was significantly associated with increased risk of back pain but not with a higher back injury claim rate. Current smokers had higher risk for back injury claims and former smokers had higher risk for back pain.

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There was no statistically significant difference for the preplanned comparison of back injury claim rates among the 13873 employees identified by store management as involved in material-handling tasks prior to the interview process. Stores with a belt requirement had 236 material-handling back injury claims among 12.5 million work-hours for a crude incidence rate of 2.94 per 100 FTE (RR, 0.90; 95% CI, 0.75-1.09). Additionally, we found no effect of the belt requirement store policy among those interviewed for either back injury claims (RR, 0.94; 95% CI, 0.70-1.28) or back pain (OR, 1.06; 95% CI, 0.92-1.22).

No statistically significant effects of back belts were found among the subgroup of employees who had no history of previous back injury, using regressions with the same covariates shown in Table 2. Back pain was not different between those who reported belt wearing usually every day and those who reported never wearing a belt (OR, 0.98; 95% CI, 0.82-1.17), and the back injury claim rate was not different for these groups (RR, 1.34; 95% CI, 0.91-1.98). Among the subgroup who had a previous history of back injury, there were no effects of belt wearing on back pain (OR, 0.90; 95% CI, 0.65-1.25), or back injury claim rate (RR, 0.92; 95% CI, 0.47-1.79).

Back belt use may be considered as a measure of compliance with store policy, so an interaction term between belt wearing and store policy was examined for the models shown in Table 2. This interaction term shows that there is no effect of back belts when comparing employees who reported belt wearing usually every day in stores that required belt use with those employees who reported never wearing a belt in voluntary belt-use stores for back pain (OR, 1.07; 95% CI, 0.89-1.29) or for back injury claims (RR, 1.19; 95% CI, 0.79-1.78).

Back belt use is affected by store policy, so to assess the possibility that a model including both covariates might introduce excess error, the store policy covariate was removed from the regression models shown in Table 2. Back pain was not different between those who reported belt wearing usually every day compared with those who reported never wearing a belt (OR, 0.99; 95% CI, 0.85-1.14), and the back injury claim rate was not different for these groups (RR, 1.20; 95% CI, 0.87-1.65) after removing the store policy covariate.

No statistically significant effects of belt wearing were found among a subgroup who reported consistent belt wearing habits on both the baseline and follow-up interviews. Using the same covariates shown in Table 2, regressions were used to compare employees who reported in both interviews wearing belts usually every day with those who reported in both interviews never wearing a belt. There was no evidence that wearing back belts reduced back pain (OR, 0.88; 95% CI, 0.73-1.07) or back injury claims (RR, 1.57; 95% CI, 0.98-2.50) in these groups that reported consistent belt-wearing habits.

To focus on those employees who frequently lifted heavier loads, regressions were restricted to the subgroup of employees with the most strenuous job. Using the same covariates as shown in Table 2, for an analysis restricted to receiver/unloaders, back pain was not different

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Table 1. Characteristics of the Study Population by Self-reported Belt Wearing at Baseline Interview*

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Required Belt-Use Store</th>
<th>Self-reported Belt Wearing</th>
<th>Voluntary Belt-Use Store</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Usually Every Day</td>
<td>1 to 2 Times a Week</td>
<td>≤1 to 2 Times a Month</td>
</tr>
<tr>
<td>No. of baseline interviews†</td>
<td>3004</td>
<td>700</td>
<td>1474</td>
</tr>
<tr>
<td>Mean age, y</td>
<td>36</td>
<td>36</td>
<td>36</td>
</tr>
<tr>
<td>New store type‡</td>
<td>728 (24)</td>
<td>161 (23)</td>
<td>434 (29)</td>
</tr>
<tr>
<td>History of previous back injury</td>
<td>430 (14)</td>
<td>99 (14)</td>
<td>217 (15)</td>
</tr>
<tr>
<td>Lifting &gt;9 kg/d§</td>
<td>1873 (62)</td>
<td>384 (55)</td>
<td>791 (54)</td>
</tr>
<tr>
<td>Job titles</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Department manager</td>
<td>644 (21)</td>
<td>260 (37)</td>
<td>469 (32)</td>
</tr>
<tr>
<td>Receiver or unloader</td>
<td>795 (26)</td>
<td>112 (16)</td>
<td>278 (19)</td>
</tr>
<tr>
<td>Others</td>
<td>258 (9)</td>
<td>77 (11)</td>
<td>188 (13)</td>
</tr>
<tr>
<td>Good job satisfaction</td>
<td>1702 (57)</td>
<td>344 (49)</td>
<td>735 (50)</td>
</tr>
<tr>
<td>Current smokers</td>
<td>1075 (36)</td>
<td>209 (30)</td>
<td>492 (33)</td>
</tr>
<tr>
<td>White</td>
<td>2334 (78)</td>
<td>585 (84)</td>
<td>1285 (87)</td>
</tr>
<tr>
<td>Women</td>
<td>1490 (50)</td>
<td>387 (55)</td>
<td>799 (54)</td>
</tr>
<tr>
<td>Follow-up interviews[[</td>
<td>1989 (66)</td>
<td>456 (65)</td>
<td>968 (68)</td>
</tr>
</tbody>
</table>

*Data are presented as number (percentage) of subjects in each column unless otherwise indicated. Row categories are not mutually exclusive.
†Row total of 6358 is less than the number of completed interviews (n = 6377) because of missing values.
‡New stores vs newly expanded stores (see “Methods” section).
§To convert to pounds divide by 0.45.
§§Row total of 6309 is less than the number of completed interviews (n = 6311) because of missing values.
between those who reported belt wearing usually every day compared with those who reported never wearing a belt (OR, 0.81; 95% CI, 0.58-1.14), and the back injury claim rates appeared to be the same for these groups (RR, 1.53; 95% CI, 0.82-2.84).

To assess the potential for selection bias, the effects of belt wearing on back injury claim rates were compared among employees who completed a follow-up interview and those who did not complete a follow-up interview. The crude back injury claim rate among the 3066 employees who completed a baseline interview but did not complete a follow-up interview (5.04 per 100 FTE; 95% CI, 3.88-6.44) was nearly twice the crude back injury claim rate compared with the 6311 employees who completed both interviews (2.61 per

<table>
<thead>
<tr>
<th>Variable</th>
<th>No. of Events/No. Interviewed (%)</th>
<th>Adjusted Odds Ratio (95% CI)</th>
<th>No. of Claims/Million Worker-Hours (Rate per FTE)</th>
<th>Adjusted Rate Ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belt wearing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤1-2 times per month</td>
<td>465/2601 (17.5)</td>
<td>1.00</td>
<td>70/5.08 (2.76)</td>
<td>1.00</td>
</tr>
<tr>
<td>1-2 times per week</td>
<td>130/759 (17.1)</td>
<td>0.92 (0.73-1.16)</td>
<td>21/1.61 (2.61)</td>
<td>0.95 (0.56-1.59)</td>
</tr>
<tr>
<td>Usually every day</td>
<td>502/2939 (17.1)</td>
<td>0.97 (0.83-1.13)</td>
<td>104/6.16 (3.38)</td>
<td>1.22 (0.87-1.70)</td>
</tr>
<tr>
<td>Store policy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voluntary belt use</td>
<td>486/2893 (16.9)</td>
<td>1.00</td>
<td>86/5.58 (3.08)</td>
<td>1.00</td>
</tr>
<tr>
<td>Belt use required</td>
<td>602/3418 (17.6)</td>
<td>1.06 (0.92-1.22)</td>
<td>109/7.30 (2.98)</td>
<td>0.94 (0.57-1.62)</td>
</tr>
<tr>
<td>Store type</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Newly opened</td>
<td>256/1585 (16.2)</td>
<td>1.00</td>
<td>66/3.23 (4.09)</td>
<td>1.00</td>
</tr>
<tr>
<td>Newly expanded</td>
<td>832/4726 (17.6)</td>
<td>1.11 (0.94-1.31)</td>
<td>129/6.35 (2.67)</td>
<td>0.69 (0.51-0.95)</td>
</tr>
<tr>
<td>Previous back injury</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>770/5427 (14.2)</td>
<td>1.00</td>
<td>148/11.05 (2.68)</td>
<td>1.00</td>
</tr>
<tr>
<td>Yes</td>
<td>318/884 (36.0)</td>
<td>3.24 (2.75-3.82)</td>
<td>104/6.16 (3.38)</td>
<td>1.22 (0.87-1.70)</td>
</tr>
<tr>
<td>Frequency of lifting ≥9 kg</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Almost never</td>
<td>131/948 (13.8)</td>
<td>1.00</td>
<td>29/1.97 (2.95)</td>
<td>1.00</td>
</tr>
<tr>
<td>1-2 times per week</td>
<td>218/1413 (15.4)</td>
<td>1.29 (1.01-1.66)</td>
<td>42/2.89 (2.69)</td>
<td>0.88 (0.54-1.42)</td>
</tr>
<tr>
<td>Usually every day</td>
<td>706/3689 (19.1)</td>
<td>1.71 (1.38-2.13)</td>
<td>113/7.45 (3.03)</td>
<td>0.87 (0.57-1.35)</td>
</tr>
<tr>
<td>Job title</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Department manager</td>
<td>328/1896 (17.3)</td>
<td>1.00</td>
<td>56/3.86 (2.90)</td>
<td>1.00</td>
</tr>
<tr>
<td>Stocker</td>
<td>439/2419 (18.1)</td>
<td>1.01 (0.85-1.20)</td>
<td>62/4.96 (2.50)</td>
<td>0.98 (0.67-1.44)</td>
</tr>
<tr>
<td>Receiver or unloader</td>
<td>220/1379 (16.0)</td>
<td>0.95 (0.78-1.17)</td>
<td>59/2.65 (4.45)</td>
<td>1.50 (1.01-2.23)</td>
</tr>
<tr>
<td>Other</td>
<td>99/607 (16.3)</td>
<td>1.04 (0.79-1.39)</td>
<td>18/1.39 (2.59)</td>
<td>0.93 (0.49-1.75)</td>
</tr>
<tr>
<td>Job satisfaction</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td>487/3493 (13.9)</td>
<td>1.00</td>
<td>109/7.09 (3.04)</td>
<td>1.00</td>
</tr>
<tr>
<td>Bad</td>
<td>600/2814 (21.3)</td>
<td>1.60 (1.39-1.84)</td>
<td>87/5.77 (3.01)</td>
<td>0.94 (0.70-1.26)</td>
</tr>
<tr>
<td>Smoking status</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td>537/3328 (16.1)</td>
<td>1.00</td>
<td>83/6.90 (2.40)</td>
<td>1.00</td>
</tr>
<tr>
<td>Former</td>
<td>165/850 (19.4)</td>
<td>1.26 (1.03-1.56)</td>
<td>29/1.75 (3.31)</td>
<td>1.56 (0.99-2.45)</td>
</tr>
<tr>
<td>Current</td>
<td>363/2133 (18.1)</td>
<td>1.10 (0.94-1.28)</td>
<td>83/4.19 (3.96)</td>
<td>1.64 (1.19-2.26)</td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>923/5213 (17.7)</td>
<td>1.00</td>
<td>149/10.64 (2.80)</td>
<td>1.00</td>
</tr>
<tr>
<td>Other</td>
<td>165/1097 (15.0)</td>
<td>0.89 (0.73-1.08)</td>
<td>46/2.23 (4.12)</td>
<td>1.46 (1.02-2.08)</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>429/2861 (15.0)</td>
<td>1.00</td>
<td>94/5.89 (3.19)</td>
<td>1.00</td>
</tr>
<tr>
<td>Women</td>
<td>659/3450 (19.1)</td>
<td>1.56 (1.34-1.82)</td>
<td>101/6.99 (2.88)</td>
<td>1.10 (0.80-1.52)</td>
</tr>
<tr>
<td>Age, y</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;25</td>
<td>219/1322 (17.8)</td>
<td>1.00</td>
<td>43/2.40 (3.58)</td>
<td>1.00</td>
</tr>
<tr>
<td>25-39</td>
<td>459/2740 (16.8)</td>
<td>0.87 (0.72-1.06)</td>
<td>103/5.61 (3.67)</td>
<td>0.96 (0.66-1.41)</td>
</tr>
<tr>
<td>40-54</td>
<td>319/1834 (17.4)</td>
<td>0.70 (0.64-0.97)</td>
<td>46/3.83 (2.40)</td>
<td>0.61 (0.39-0.96)</td>
</tr>
<tr>
<td>≥55</td>
<td>91/503 (18.1)</td>
<td>0.84 (0.63-1.13)</td>
<td>3/1.05 (0.57)</td>
<td>0.15 (0.05-0.47)</td>
</tr>
</tbody>
</table>

*Interview responses are based on 6311 total follow-up interviews. Some respondents did not answer all the questions.
†Logistic regression model with binary response outcome of pain reported at follow-up interview among 6311 employees. Estimates are adjusted for all other variables in this Table. Because of missing covariate values, 6011 observations were used for the multivariate model. CI indicates confidence interval.
‡Denominators in million worker-hours exposure are rounded to 2 decimal places. Rate per 100 full-time equivalents (FTEs) is per 200 000 work-hours.
§Poisson regression model using back injury counts and work-hours among 9377 employees with a baseline interview, estimates adjusted for all other variables in this Table. Because of missing covariate values, 8830 observations were used for the multivariate model.
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tors was incorporated in our inves-
tigation, especially a history of previ-
ous back injury and lifting frequency,
which has been lacking in some previ-
ous studies on the effects of back belts.
This is the largest prospective study to
date of material-handling workers with
individual data on back-belt use, back
pain, and important confounders. Re-
results based on these multiple analyses
of data all converge to a common con-
clusion: back-belt use is not associ-
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