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Trends in Work-Related Musculoskeletal Disorders from the 2002–2014 General Social Survey, Quality of Work Life Supplement

Robert B. Dick[#], **Brian D. Lowe**[*], **Ming-Lun Lu**, **Edward F. Krieg**

National Institute for Safety and Occupational Health, Division of Field Studies and Engineering, 1090 Tusculum Ave, Mail Stop C-27, Cincinnati, OH 45226

Abstract

Objective: To update trends in prevalence of back and upper limb musculoskeletal symptoms and risk factors from the 2014 Quality of Work Life (QWL) Survey.

Methods: Quadrennial QWL Surveys, 2002–2014 (with N = 1455, 1537, 1019, and 1124 in 2002, 2006, 2010, and 2014 surveys respectively) were analyzed for reports of back pain and pain in arms.

Results: In the fourth analysis of this survey, twelve-year trends continue to show a decline in back pain and pain in arms. Key physical (heavy lifting, hand movements, very hard physical effort) and psychosocial/work organizational factors (low supervisor support, work is always stressful, not enough time to get work done) remain associated with back and arm pain, with the physical risk factors showing the strongest associations.

Conclusion: Physical exposure risk factors continue to be strongly associated with low back and arm pain and should be the focus of intervention strategies.

Keywords

Musculoskeletal Disorders; Back Pain; Arm Pain; General Social Survey; Quality of Work Life

1. INTRODUCTION

This is the fourth publication on the results of the National Institute for Occupational Safety and Health (NIOSH) quadrennial Quality of Work Life Survey (QWL) related to prevalence of back pain and upper limb pain in the general working population. The QWL survey contains items that evaluate the individual, physical and psychosocial risk factors for musculoskeletal pain. With a 12-year window into the risk factors for musculoskeletal disorders (MSDs) this analysis of the most recent QWL data set provides information on

[*]corresponding author (blowe@cdc.gov).

[#]Robert B. Dick, Ph.D., Captain USPHS, is retired

changes (trends) in the American work force as well as the stability of some of the response indicators from the previous survey analyses. In the prior publication of this series[3] it was concluded that physical exposure factors have been consistent indicators of musculoskeletal pain (back and arms) and that the association of psychosocial factors with musculokseletal outcomes may be more sensitive to economic conditions that have fluctuated over the 2002–2010 time period. This was more evident in the latter recessionary part of the 2000's decade (2010 survey). The 2014 QWL survey analysis reported here is an opportunity to further examine the QWL survey results for work related musculoskeletal pain in the post-recessionary environment.

Previous publications in this series[1,2,3] have summarized literature on work related MSDs and there continues to be active research in this area with a focus on prevalence of MSDs by industry/occupation and intervention strategies to address risk factors and systematic reviews of their effectiveness. There have been additional relevant studies subsequent to the background described with the analysis of the 2010 QWL data[3]. The brief literature summary below is an update of key studies relevant to work related MSD prevalence published since the previous publication in this series.

Two studies by Yang *et al*[4,5] report on neck and back pain using data from the National Health Interview Survey and 2010 Occupational Health Supplementary Survey with a sample size of 13,915 civilian workers ages 18–64. Results showed significant increases (ORs) in neck pain and low back pain with work-family imbalance, hostile work environment, and job insecurity. Significant organizational risk factors for neck pain were non-standard work arrangements, multiple jobs, and long work hours. Prevalence of neck pain was estimated at 14.3% and back pain at 25.7% for workers in the United States. Occupational classification showed no significant association with neck pain, however, respondents in two occupational categories, health care support and construction and extraction, reported greater prevalence of back pain.

Anderson and Oakman[6] (2016) conducted a review of the prevalence and risk factors for work-related MSDs in allied health professions (physiotherapy, occupational therapy, sonography, medical imaging, and podiatry) using results for 22 studies representing 14 different countries. Lower back was the most commonly reported injury area and results showed that allied health professionals have a high risk of developing MSDs in their career with the highest risk in younger therapists.

Freimann *et al*[7] conducted a cross-sectional study on 409 nurses at a University Hospital in Estonia to determine musculoskeletal pain prevalence and the relationship of psychosocial factors and mental health problems with pain reports. Seventy percent of participants reported at least one body part with musculoskeletal pain lasting longer than a day within the past year and 64% having pain in the last month. Lower back and neck were the sites most reported. Significant odds ratios for musculoskeletal pain were noted with several psychosocial factors (work demands, work pace, role conflicts, job dissatisfaction, work family conflicts, and with what the authors refer to as "somatic stress symptoms (stomach ache, headache, palpitations, tension in various muscles)"[7] (p. 3).

A series of studies on food processing workers in Finland investigated the influence of physical (biomechanical), environmental (work climate), psychosocial[8], age[9], and sickness absence[10] factors on musculoskeletal pain (MSDs). Two of these studies[8,9] surveyed Finnish food processing workers twice, at baseline in 2005 and at follow-up in 2009. The baseline group comprised 1201 respondents and at follow-up 734 workers. Results showed that multi-site pain was most prevalent at baseline (54%) and at follow-up with 69% reporting pain at baseline also reporting pain at follow-up[10]. Age and physical hazards and MSD risk were not consistent for each age group, which was stratified into younger (20–35), middle (36–49), and older (50 plus).[9] At initial data collection, physical hazards were not associated with MSD risk for the younger group, but for the middle group, repetitive movements and awkward postures were associated with increased risk. In older workers, environmental factors were associated with increased risk. Authors concluded that the findings showed no clear pattern of prediction with age for MSD risk. The number of MSD absence days increased with pain sites.[9] Single site pain did not predict absence, but multi-site pain did.

Gerr *et al*[11,12] reported the results from a prospective epidemiological study on the effects of physical risk factors, psychosocial stress and work organizational factors on MSDs in appliance manufacturing workers. The study ran from 2004 until 2007 with 318 workers continuing participation through the study. Clinical assessments, questionnaires, physical exposure measurements (electromyography, video-based posture analysis, ACGIH Hand Activity Level, Strain Index), and psychosocial measures (job content questionnaire, affectivity scale, job stress scale) were used to collect data for the outcome measures. The incidence rate for hand/arm symptoms was 58/100 person years (PY) and for neck/shoulder 54/100 PY. A statistically significant 7% increased risk of neck/shoulder symptoms was noted for each 1% of time with shoulder elevation >90°. Surprisingly, the separate physical exposure measurements did not show any significant associations, but the dichotomized Strain Index measure did for hand/arm symptoms and disorders. With the psychosocial measures, when compared to the low demand/high control category, significant hazard ratios (HRs) were reported for both the high demand/high control and high demand/low control categories for hand/arm disorders and symptoms. A significant HR was reported for low demand/low control with neck/shoulder disorders. Significant associations were between weekly stress level and neck/shoulder symptoms and disorders and weekly job change and neck/shoulder symptoms. No significant associations were found with co-worker support, supervisor support or negative affectivity.

Several systematic reviews have been performed that have provided evidential conclusions for the influence of physical and psychosocial risk factors on MSDs. Hoozemans *et al*[13] reviewed observational studies to determine if workers that performed pushing/pulling activities at work have increased risk for upper extremity symptoms when compared to workers that perform less or no pushing/pulling activities at work. Results showed “strong evidence” of pushing/pulling significantly related to upper extremity and shoulder symptoms, “moderate evidence” for neck/shoulder symptoms and “insufficient evidence” or conflicting evidence for combinations of upper arm, elbow, forearm, wrist or hand symptoms.

An updated systematic review for preventing upper extremity MSDs reported that there was “strong evidence” that a resistance training exercise intervention can help prevent and manage upper extremity MSDs.[14] There was a “moderate level of evidence” for the effectiveness of stretching programs, mouse use feedback and forearm supports, but there was also “moderate evidence” that EMG (electromyography) feedback, job stress management training, and office workstation adjustment had “no effect” on upper extremity MSD outcomes.

Lean production techniques, which the authors had previously suggested may be relevant to musculoskeletal symptoms[3], have subsequently been the subject of systematic review.[15] The potential intervention benefits of lean production techniques are autonomy, worker participation, empowerment, and job control and job enlargement. The author concluded that lean production promises did not appear to create challenging and fulfilling work, worker participation was limited and job autonomy depended more on social relations in a company. Implementation was uneven between countries and work sectors and in the automotive industry there was an increase in MSD symptoms with lean production because of increases in work pace and lack of recovery time. However, in services and other sectors, the effects of lean production were more positive if buffers such as job control and social support were present. Management style seems to be important with the implementation of lean production techniques.

Padula *et al*[16] (2017) reviewed job rotation programs for the prevention of musculoskeletal disorders. The majority of studies featured automobile assembly functions and job rotation schedules with short-cycle work task times and repetitive movements. There was “weak evidence” supporting job rotation for the prevention of MSDs and “some evidence” (three studies) that job satisfaction was increased. A randomized control study of 497 workers conducted in Brazil evaluated job rotation in textile workers using sick leave as the primary outcome variable over a 12 month period, but also MSD symptoms, psychosocial factors, fatigue, general health, and productivity as additional secondary outcome measures.[17] Results showed an increase in number of hours due to sick leave for both groups but there were no significant group differences and there were no significant differences in the secondary measures. In short, the job rotation program was not effective.

This paper extends the data analysis of the General Social Survey Quality of Work Life module to include 2014 data for investigating trends in the prevalence of back and upper extremity musculoskeletal symptoms and associated workplace factors. The analysis of the 2014 QWL data and its presentation is consistent with those previously reported[1,2,3] with three additional items added in 2014 to assess sleep problems and use of telework (working from home) and associations with musculoskeletal pain.

2. MATERIALS AND METHODS

Consistent with the previous publications in this series[1,2,3] the 2014 data were collected as part of the biannual General Social Survey (GSS) conducted by the National Opinion Research Center (NORC) at the University of Chicago (http://gss.norc.org/). NORC describes the GSS as a nationally representative survey that has been conducted to

monitor societal change and study American society. It is further described as the only full-probability, personal-interview survey designed to monitor changes in both social characteristics and attitudes currently being conducted in the United States. The Quality of Work Life (QWL) module is the module that was added to capture nationally representative opinions about work life. The survey is a face-to-face 90-minute survey administered to randomly selected, non-institutionalized U.S. adults 18 years and older. The National Institute for Occupational Safety and Health (NIIOSH) added the quadrennial QWL module to the GSS core survey (https://www.cdc.gov/niosh/topics/stress/qwlquest.html) administered to individuals who indicate they were employed or self-employed for pay in the week before the survey.[3] Respondents were required to be working ≥ 20 hours per week or currently missing work because of vacation, illness, injury or on strike. The 2014 sample size was 1,124, an increase over 2010, but not as high as 2002 and 2006. These fluctuations likely reflect employment figures as the GSS samples approximately the same number of respondents each year.

As with the previous analyses in this series[1,2,3] primary outcomes were the prevalence of back pain and pain in arms through a yes/no response to "*In the past 12 months, have you had back pain every day for a week or more?*" and "*In the past 12 months, have you had pain in the hands, wrists, arms, or shoulders every day for a week or more?*" Individual, physical, and psychosocial/work organization factors that have been relevant to the occurrence of MSDs were analyzed. These variables chosen for analysis (listed in Table 1) were based on known relationships with back pain and upper extremity pain reported in the literature, or those that were tested in previous analyses of the 2002, 2006, and 2010 QWL data sets.[1,2,3] These variables were also described fully in Waters *et al*[1].

Changes in the questions over the time period include "How often work from home" responses being available for 2002–2014, but the "sleep problems" and "why work from home" questions are available only for 2010 and 2014. Another change has been the re-coding of occupations using the 2010 Census Occupational Classification System. This system provides a better definition of occupations with 11 classifications. Two classifications, "military related" and "farming, fishing, forestry" are only listed in Table 2. Both classifications are considered unreliable for data analysis because of the possibility that some respondents misread instructions and should not have answered civilian employment questions (military) and low respondent numbers (farming, fishing, forestry). With the change to the 2010 codes comparisons with the 8 codes used in previous publications are not available for backward comparison with the 1977 Quality of Employment Survey. All tables now include a trend analysis statistic (χ^2) that shows any significant differences in trend for the outcome measures from the 2002 base year.

The data analysis procedures were similar to previous reports.[1,2,3] As a brief description: continuous distribution data were re-categorized into smaller ranges and some question items with highly correlated response choices were combined to create new variables (see Table 1 - *supervisor support*, *safety climate*). Odds ratios (ORs) were calculated using univariate logistic regression and multivariate, stepwise regression to identify statistically significant bivariate interactions. All univariate factors were forced into these models. Bivariate interaction ORs were calculated by combining the levels of two variables into

one variable and univariate regression performed. Pearson Chi-squared tests were used to compare the outcome measurements by occupation for all survey years and Wald chi-squares from logistic regression models were used to assess trends for each risk factor and their response items by survey year. A statistical significance criterion of 0.05 is used in all tables and ORs with confidence intervals that do not include 1.0. All calculations were performed with SAS® (Version 9.3, SAS Institute Inc., Cary, NC).

3. RESULTS

In the 2010 data analysis there was evidence that unemployment and overtime rates had some association with psychosocial risk factors. Thus, we report unemployment and overtime rates averaged for the months (March to September) in which the QWL survey interviews were conducted. Unemployment rates for 2002 were 5.77% for 2002; 4.64% for 2006;, 9.61% for 2010; and 6.22% for 2014. Overtime rates, as reported by the Bureau of Labor Statistics[18] for 2002, 2006, 2010, and 2014, were 4.10 hrs, 4.44 hrs, 3.81 hrs., and 3.45 hrs, respectively.

Table 2 presents the frequency results and trend statistics for the outcome measures back pain and pain in arms by 11 occupational classifications for all four QWL survey administrations. There were, however, two significant changes in the percentage of respondents by occupation over the four surveys. Compared to the 2002 year, the percentage in “service” occupations increased from 16.6% in 2002 to 19.6% in 2014 ($\chi^2 = 10.8$; $df = 3$; P = 0.013) and “production” occupations decreased from 8.2% in 2002 to 5.3% in 2014 ($\chi^2 = 14.0$; $df = 3$; P = 0.003). In the 2014 survey reports of back pain and pain in arms did not differ significantly by occupational classification (back pain: $\chi^2 = 13.8$; $df = 10$; $P = 0.17$; pain in arms: $\chi^2 = 16.4$; $df = 10$; $P = 0.09$).

Data for 2014 showed a drop in reports of back pain at 22.8% ($\chi^2 = 12.1$; $df = 3$; P = 0.007), pain in arms at 23.9% ($\chi^2 = 7.2$; $df = 3$; P = 0.07), and “both pain” at 11.9% ($\chi^2 = 8.8$; $df = 3$; P = 0.03), over the four survey reporting years. For the survey years 2004–2010 back pain reports averaged 27.3 %, “pain in arm” 27.8 % and “both pain” 15.4 %. Trend analysis results in Table 2 indicate few significant changes over the four survey years by “occupation”. The category “office/administrative” shows a significant decrease for back pain reports ($\chi^2 = 7.8$; $df = 3$; P = 0.05) and “pain in arm” reports ($\chi^2 = 8.7$; $df = 3$; P = 0.03). Professional and related also showed a significant decrease in “pain in arm” reports ($\chi^2 = 8.0$; $df = 3$; P = 0.05), but there were no significant changes with “both pain” reports by occupation. Figures 1 and 2 show the reports of back pain and pain in arms by occupation over the four survey years. For easier illustration, the responses have been dichotomized into “Light” (very light, light) and hard (somewhat hard, hard and very hard) and averaged for the 2010 and 2014 years.

To examine potential trends in telework we examined the “never” telework responses from 2002–2014, assuming that a percent *decrease* in the “never” response indicated an increase in telework. In this analysis the Cochrane-Armitage trend test (Agresti, 2002) was used and the trend was not significant (Z = −1.35, $df = 3$, P =0.18). Further examination of occupation data showed that for “management, financial, and business (Z = −2.31, $df = 3$,

P = 0.02),” “office/administrative support (Z = −2.61, *df* = 3, P = 0.009,” and “construction and extraction (Z = −2.15, *df* = 3, P = 0.03)” the percent of “never” reports decreased significantly, but for “service (Z = 2.78, *df* = 3, P = 0.005)” and “sales and related (Z = 2.18, *df* = 3, P = 0.03)” the percent “never” responses increased significantly.

3.1 Back Pain

Table 3 presents the frequency responses, trend values, ORs and 95% Wald confidence limits for the survey years. Significant values are in bold.

3.1.1 Individual Factors—There was one significant OR, 0.51 (95% confidence interval 0.27–0.97) for the age group 55–64 with the 2014 data, but overall there were no significant trend differences for age over the 4 survey years. Gender did not show any significant ORs or trends over the 4 survey years. The *“hurt at work”* risk factor ORs were significant for all response choices over all four years and the trend statistic (χ^2 = 9.0, *df* = 1; P = 0.005) was significant for the “zero” time response indicating a reduction in reports of back pain for this response (25.1 % in 2002 to 20.2 % in 2014). The three general indicators of health, “Physical Health,” “Mental Health,” and “Health days,” showed significant ORs for all reporting years for the response item ≥14 days with “back pain.” A significant trend was evident for the response item 0–13 days, which indicated a decrease in reports of “back pain.” Only one response item ≥14 days for “mental health” showed a significant trend (χ^2 = 4.1, *df* = 1; P = 0.04) of an increase in back pain reports. The “sleep problem” question showed significant ORs with response items “sometimes” in both 2010 and 2014 (1.85, CI 1.18–2.91; 1.78 CI 1.10–2.90) and “often” (3.53, CI 2.21–5.62; 5.30 CI 3.28–8.57) with “back pain.” There were no significant trends, but only two survey years were available.

3.1.2 Physical Factors—The 2014 results were similar to the results for the previous QWL survey with significant ORs for “yes” to “heavy lifting” (OR=1.86, CI 1.40–2.47) and “hand movement” (OR=1.78, CI 1.34–2.36). The 2014 results for “physical effort” were similar to the 2010 results with significant ORs for the responses “somewhat hard” (OR=2.14, CI 1.42–3.25), “hard” (OR= 2.37, CI 1.46–3.86), and “very hard” (OR=3.80, CI 2.18–6.64). There were no significant trend statistics for any physical factors response questions.

3.1.3 Psychosocial and Work Organization Factors—The 2014 results, presented in Table 3, are generally consistent with the previous reports, but there are some significant trend statistics that should be noted. Different levels of job dissatisfaction continued to have significant ORs against the reference group (*very satisfied*). That is, “somewhat satisfied”, “not too satisfied” and “not at all satisfied” had an OR=1.48 (CI 1.10–2.00), OR=2.23 (CI 1.34–3.71), and OR=2.76 (CI 1.34–5.69), respectively. However, there were no significant trend statistics for this item. Risk factors “work freedom,” “work fast,” “work hours,” and “must work,” had no significant ORs for back pain in 2014 which is generally consistent with the previous year’s reports. Some individual items within these risk factors did have significant trends when compared to the 2002 base year. An increase in back pain reports was indicated with the response choice “not too true” (χ^2 = 4.6, *df* = 1; P = 0.03) for “work freedom” from the 2002 year (26.3% to 32.2% in 2014). With “work time, “work hours” and

"supervisor support" the response items "very true," ≤40 hrs., and "very true" all showed significant trends (work time-χ^2 = 7.1, *df* = 1; P = 0.007; work hours-χ^2 = 4.1, *df* = 1; P = 0.04, supervisor support-χ^2 = 5.3; *df* = 1; P = 0.02) indicating a decrease in per cent of back pain reports. The risk factor "safety climate" had a significant trend for the comparison item "strongly agree" (χ^2 = 7.9, *df* = 1; P = 0.005) and for 2014, both the "disagree" (OR=2.88, CI 1.59–5-24) and "strongly disagree" (OR=2.49, CI 1.14–5-44) ORs were significant. Work stress had a significant OR (2.81, CI 1.46–5.42) for the "always" response in 2014 which is consistent with previous years. There were no significant trend statistics for this risk factor. Work schedule showed a significant trend with the comparison choice "day shift" (χ^2 = 10.2; *df* = 1; P = 0.001) but there was only one significant OR (1.85, CI 1.10–3.12) in 2014 and it was with the "night shift." The new item "how often work at home" showed a significant trend towards decreased back pain with the comparison item "never" (χ^2 = 6.2; *df* = 1; P = 0.01) but no significant ORs for 2014 nor 2002 and 2006. The "(why) work from home" item showed only one significant OR (1.99, CI 1.85–3.12) in 2014 with the response choice "taking work home to catch up."

Table 3 also shows the results for the dichotomized factors. No job satisfaction (OR=1.96, CI 1.30–2.97), and "work stress" (OR=2.22, CI 1.66–2.96) were significant in 2014, as they were in all previous reporting years. A positive "safety climate" was protective (OR=0.38, CI 0.24–0.62). Two risk factor comparison choices, "yes" to "job satisfaction" (χ^2 = 8.5, *df* = 1; P = 0.004) and "no" to "work stress" (χ^2 = 7.2, *df* = 1; P = 0.007) showed significant trends (decrease in per cent back pain reports). The OR for "work time" was significant and protective (0.49, CI 0.35–0.70) for 2014, but a trend is not evident.

Table 3 also shows the risk factor combination results. "Heavy lifting and work fast" (yes-no) and "hand movement and work fast" (yes-no) were significant in 2014, similar to 2002 and 2006 results. Two combinations showed significant trends with the comparison items. With "heavy lifting and work time" (χ^2 = 10.9, *df* = 1; P = 0.001) and "hand movement and work time" (χ^2 = 13.0, *df* = 1; P = 0.0003) the "no-yes" responses were associated with a decrease in reports of back pain. The 2014 results do show some differences from the 2010 results that are related to changes in back pain reports. For the combination of "physical effort" and "work stress" the interaction (OR=1.92, CI 1.04–3.53) was significant in 2014 due to a decrease in back pain reports for the "no-yes" and "yes-no" combinations but an increase in reports for the "yes-yes" combination. There were no significant trend statistics with this combination. The "physical effort" and "work fast" risk factor showed both the "yes-no" (OR=2.04, CI 1.18–3.52) and "yes-yes" (OR=2.03, CI 1.32–3.12) combinations were significant. There were no significant trend statistics and the interaction was not significant for this combination.

3.2 Pain in Arms

Table 4 shows the results for the pain in arms outcome measure. Significant values are in bold.

3.2.1 Individual Factors—The age and gender factors in 2014 showed no significant ORs and there were no significant trend statistics. The "hurt at work" risk factor was also

consistent with past results. In 2014 the three general health indicators, “physical health” (OR=10.68, CI 5.83–19.6), “mental health” (OR=5.42, CI 3.59–8.20) and “(poor) health days” (OR=12.0, CI 4.8–30.1) had significant ORs. Trend statistics were also significant for all three factors. With the 0–13 poor health day’s response there was a decrease in pain reports over the survey years, but for the ≥ 14 days pain in arms increased. The “sleep problem” question showed significant ORs with response items “sometimes” and “often” (2.59, CI 1.58–4.23; 5.83, CI 3.54–9.65).

3.2.2 Physical Factors—The 2014 results were similar to the results for the previous QWL survey year with significant ORs for “yes” to “heavy lifting” (1.67, CI 1.27–2.20) and “hand movement” (2.66, CI 2.00–3.55). Trend statistics were not significant. In 2014 ORs were significant for “physical effort” responses “somewhat hard” (1.61, CI 1.08–2.40), and “very hard” (3.38, CI 1.98–5.78) but not “hard” (1.38, CI 0.85–2.24). There were no significant trend statistics.

3.2.3 Psychosocial and Work Organization Factors—“Job satisfaction” only had one significant response item “somewhat satisfied” (1.54, CI 1.15–2.01) in 2014. There were no significant trend statistics for this item. Risk factors “work hours,” and “work schedule” had no significant ORs for pain in arms in 2014, consistent with the previous year’s reports, but there was a significant decreasing trend statistic for “work hours” ≤ 40 hrs. ($\chi^2 = 7.72$, $df = 1$; P = 0.005) and there was a similar decline for the “work schedule” comparison item “day shift” ($\chi^2 = 7.64$, $df = 1$; P = 0.006). Supervisor support had a significant OR for the response choice “not at all true” (1.88, CI 1.01–3.50), but there were no significant trend statistics. Work time response items “not too true” (OR=1.57, CI 1.02–2.40) and “not at all true” (OR=2.87, CI 1.44–5.75) were significant. There were no significant trend statistics for “work time”. *Work freedom* responses “somewhat true” (OR=0.33, CI 0.16–0.68) and “very true” (OR=0.31, CI 0.16–0.63) were protective. For “work fast” the response choice “agree” showed a significant protective OR (0.33, CI 0.13–0.84) and a declining trend statistic for that item was also significant ($\chi^2 = 4.7$, $df = 1$; P = 0.03). The “must work” item (mandatory extra hours) is significant (1.60, CI 1.20–2.14). Safety climate results are similar to previous years with the “disagree” (OR = 2.14 CI 1.18–3.89) choice significant. Work stress was significant (2.52, CI 1.32–4.81) for the “work is always stressful” response in 2014 and is consistent with previous years.

Table 4 shows the results for the dichotomized factors. Safety climate (OR=0.52, CI 0.32–0.85) and “work stress” (OR=2.00, CI 1.50–2.66) were significant in 2014, as they were in all previous reporting years. The risk factor “job satisfaction” was significant in previous years but was not in 2014 (OR=1.26 CI 0.82–1.95). Work fast was not significant in 2014 (OR=0.96 CI 0.71–1.30) or in 2002+2006. The “work time” OR was significant (0.49, CI 0.35—0.70) for 2014, as in 2006 and 2002, but not for 2010. No trend values were significant for any of the dichotomized factors.

Table 4 also shows the risk factor combination results. The 2014 results are very similar to the previous three QWL years, except for some of the combinations with the “work fast” risk factor. With “heavy lifting” and “work stress” all combination responses (see Table 4) had significant ORs in 2014 as was true in the previous years. There were no significant

trend statistics and the interactions were not significant. The same was true for “hand movement” and “work stress” - significant ORs for all response choices, no significant trends, and a non-significant interactions. The combination “heavy lifting” and “work fast” showed no significant ORs in 2014 whereas in previous years the “yes-yes” response was significant. Trend values and the interaction were not significant. Hand movement and “work fast” had a significant OR for the “no” to “hand movement” and” yes” to “work fast” (0.60 CI 0.38–0.95) response in 2014, which was different from previous years. This indicates a protective effect resulting from a drop in “pain in arm” reports for this combination. All other response choices had significant ORs and neither the trend statistics nor interaction were significant. One comparison item, the “no-yes” response for “heavy lifting” and “work time” showed a significant trend ($\chi^2 = 5.4$, $df = 1$; $P > 0.02$) due to a drop in pain reports.

4. DISCUSSION

A key finding in the 2014 QWL analysis is the decrease in prevalence of *back pain*, pain in arms, and both back and arm pain over the four survey waves by an average of almost five percent from 2002 to 2014. Yang et al[4,5] reported a prevalence of low back pain (defined by that occurring “during the past three months”) from the National Health Interview Survey (25.7%) that was, and is still, very consistent with that found in the present series of QWL surveys, which dropped below 25% between the 2010 and 2014 survey administrations. Ferguson et al[19] recently reported a comparable back pain prevalence of 25% across a consortium of pooled studies including 2000 workers participating from six US states with jobs in a variety of distribution centers and manufacturing facilities that involved manual materials handling.

Although the decline in back pain appears to be fairly consistent across all occupations there were some trends in terms of overall survey responses by occupation when related to physical effort ratings. The percentage of participants in Management, Financial, and Business, Professional and Related, Service Occupations, Sales and Related, and Office and Administrative Support - those occupations reporting less physical effort at work - increased from 76.2% to 79.2% between 2002 and 2014. Conversely, the number of respondents in Construction and Extraction, Installation, Maintenance, and Repair, Production, and Transportation and Material Moving - occupations with greater physical effort ratings - decreased from 23% to 18.8%. The only occupational groups which show significant participation rate changes from 2002 and 2014 were for Service which increased from 16.6 % to 19.6 % and Production which decreased from 8.2 % to 5.3 % of the respondents. This shift in distribution away from occupations with greater ratings of physical effort may explain an overall decline in pain reports. Other explanations for decreased reports of musculoskeletal pain have been described. For example, Wang *et al*[20] reported a significant drop (66%) in work-related musculoskeletal disorders (WMSDs) in the U.S. construction industry from 1992 to 2014 which was attributed to intervention efforts, changes in reporting requirements (Occupational safety and Health Administration), and possible under reporting in the industry. Interestingly, the four QWL survey analyses do not show a significant decline in back pain or pain in arms prevalence in the Construction and Extraction occupation category. Mustard et al[21] reported a decreasing trend in the

Ontario musculoskeletal disorder prevalence during a similar analysis time period (2004–2011). Their study integrated three independent population-based data sources to describe trends in the incidence of work-related MSDs over an 8-year period. The authors observed decreases in MSD prevalence through emergency department utilization and workers' compensation claims and parallel decreases through the Ontario health interview surveys that are comparable to and consistent with the present QWL findings.

Further examination of the trend analysis results show that statistically significant changes in pain reports over the four survey waves, by occupation, were minimal. Only the categories Office/Administrative and Professional and Related showed a significant decrease in reports of pain in arms. These declines may reflect the use of strategies for prevention in office environments (e.g., ergonomically designed furniture, mini-breaks and other strategies to increase mobility in sedentary work).

Having sustained an injury at work ("hurt at work") in the last year exhibits significant ORs with back pain and pain in arms for all reporting years. The trend statistic for the zero times hurt at work comparison choice was significant for back pain and showed a pattern of a decrease in reports. A similar pattern was also evident pain in arms, though not reaching statistical significance ($p = 0.056$). Three general indicators of health (physical health, mental health, health days) have consistently exhibited significant ORs with back pain and "pain in arm" for the same response choices for all reporting years. Significant trend statistics were noted for the comparison choices of 0–13 days of poor health versus greater than14 days (of the prior 30 days) of poor health. With the comparison choice there was a decrease in reports, but with the ≥14 day choice it was an increase. Sleep problems showed significant ORs on the "sometimes" and "often" choice for both back pain and pain in arms.

A second key finding is that the physical exposure risk variables "heavy lifting" and "hand movement" continue to show significant ORs for back pain and pain in arms in the 2014 survey. None of the other risk factors exhibit such consistent risk associations across all survey years. This result is in agreement with many reviews of evidence for the relationship between physical risk factors and MSDs.[22,23,24] The physical exposure risk factor "physical effort" has also shown significant ORs for back pain and pain in arms when dichotomized as "hard" versus "light" physical effort.

Most psychosocial and work organization factors are consistent with previous year's results and there were some significant trend statistics that are consistent with the overall decrease in both back pain and pain in arm reports since the 2002 base year. Low "job satisfaction", lack of "supervisor support", poor "safety climate", and always having "work stress" all showed significantly reduced associations with back pain and pain in arms over the four survey years. Reduced job satisfaction level, however in 2014, was significant for pain in arms with only the "somewhat satisfied" level and not the higher levels of non-satisfaction as in previous years. For back pain all levels of job satisfaction less than "very satisfied" were significant. Psychosocial factors that have not consistently shown significant associations with the same response items were "work freedom," "work hours" and "work schedule," for back pain and "work hours" and "work schedule" for "pain in arms." Work freedom

("freedom to decide how to do my own work"), while not showing any significant relationships with back pain since 2002, has shown significant protective associations (OR < 1) with pain in arms. Significant trends were noted for the comparison choices on back pain for "supervisor support", "work hours", "safety climate", and "work schedule" for back pain and "work hours", and "work schedule" for "pain in arms." All reflected decreases in pain reports. The only increases in pain reports were on isolated response choices with "work schedule," (rotating shift for pain in arms and night shift for back pain) and "not too true" with "work freedom" for "back pain."

Strengths of this study are the national representativeness of the GSS and that the survey was administered to participants directly through face-to-face interviews. This approach is believed to lessen the likelihood that respondents would have misunderstood any questions or have been confused by response options. An additional strength is the consistency in the survey administration over the 2002, 2006, 2010, and 2014 surveys, which exhibit consistent statistical associations between musculoskeletal pain and physical exposure variables. Limitations of the study include that the QWL survey is based on recall of self-reported back and arm pain and does not confirm more specific criteria consistent with a clinical musculoskeletal diagnosis. Secondly, the workplace physical exposure factors were also obtained through self-report, rather than measurement, and inconsistencies in subjective interpretation between respondents is a threat to interpretation of those findings. Thirdly, the cross-sectional design of the survey in successive administration years does not establish causality, as the successive survey administrations are not from a consistent cohort.

5. CONCLUSION

From the 12-year period covering the QWL survey years 2002–2014, it can be concluded that physical exposure risk factors of heavy lifting (repeated lifting, pulling or pushing) and hand movement (repetitive or stressful hand movements or awkward postures) are associated with increased risk of back pain and pain in arms. These physical risk factors continue to have significant odds ratios for increased reports of back pain and pain in arms – consistent with prior survey reporting years. Over the analysis period psychosocial and work organizational factors associated with back and arm pain prevalence include mandatory working of extra hours ("must work"), reporting frequent work stress, not having enough time to get work done, low job satisfaction, low supervisor support, and reporting a poor safety climate in the work environment. Having high "work freedom" suggests a protective effect mostly with decreased prevalence of pain in arms. Individual factors associated with increased back pain and pain in arms are having sustained a previous injury at work and general indicators of overall health (e.g., physical health, mental health, health days, and sleep problems).

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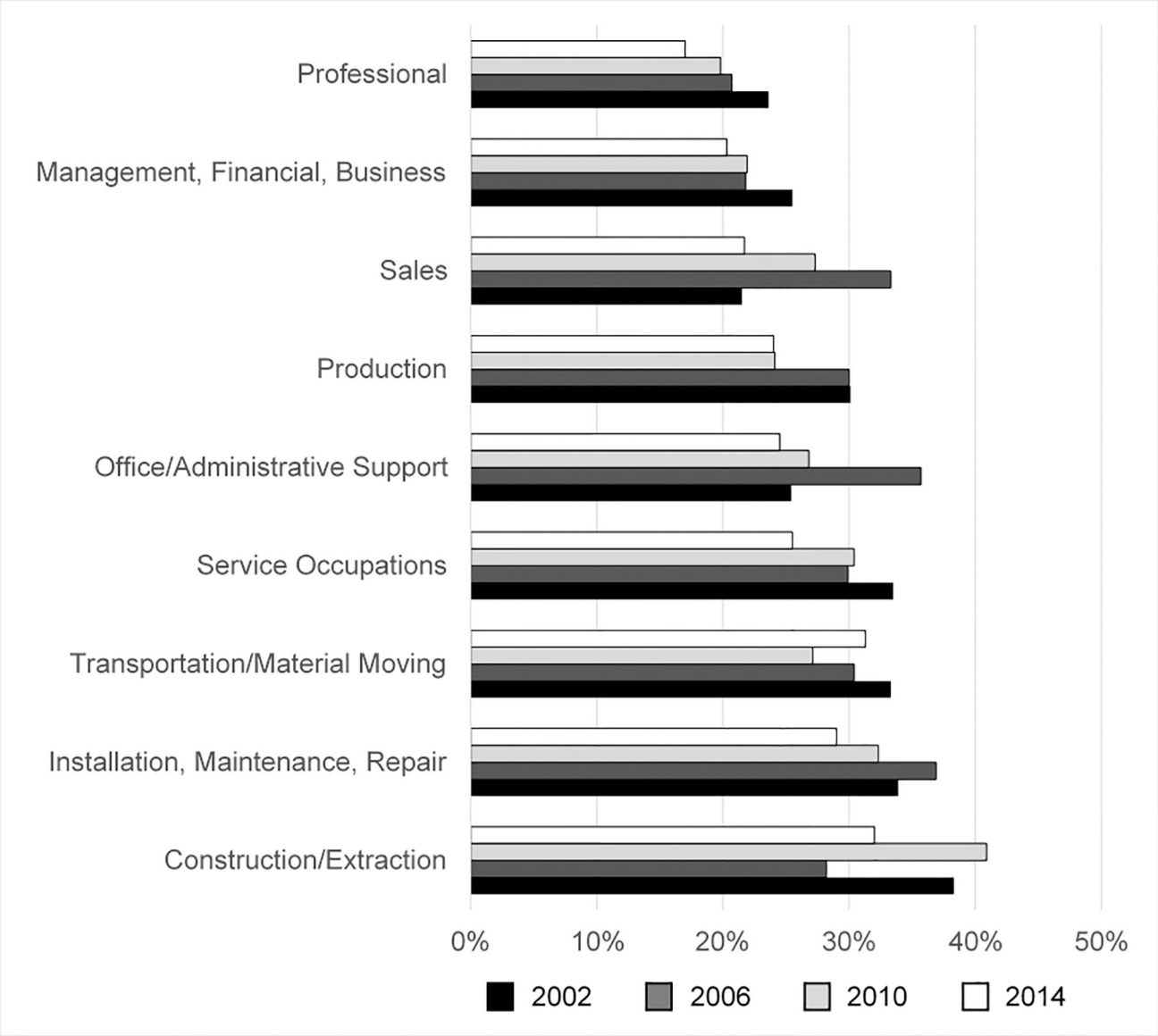

Figure 1.
Back Pain prevalence by survey administration year and occupational group.

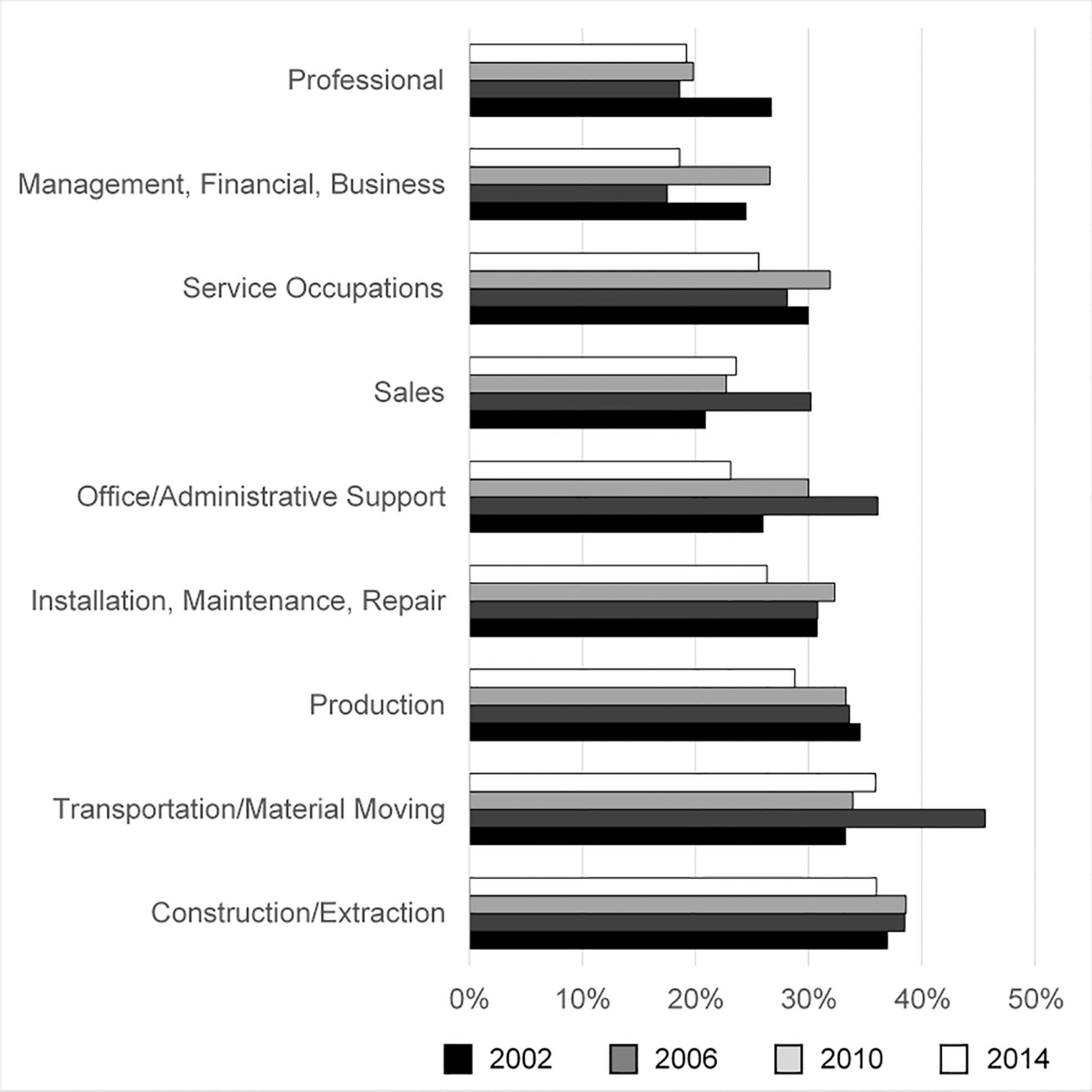

Figure 2.
Pain in Arm prevalence by survey administration year and occupational group.

Table 1.

QWL question items comprising the variables in the analysis.

Individual Variable	Question Item
Individual Factors	
Hurt at work	In the past 12 months, how many times have you been injured on the job?
Physical health	How many days during the past 30 days was your physical health not good?
Mental health	How many days during the past 30 days was your mental health not good?
Health days	How many days during the last 30 days did your poor mental or physical health affect usual activities?
Sleep problems	During the past 12 months, how often have you had trouble going to sleep or staying asleep (never, rarely, sometimes, often)
Physical Factors	
Heavy lifting	Does your job require you to do repeated lifting, pushing, pulling, or bending?
Hand movement	Does your job regularly require you to perform repetitive or forceful hand movements or involve awkward postures?
Physical effort	Please rate the overall physical effort at the job you normally do. (very light, fairly light, somewhat hard, hard, very hard)
Psychosocial and Work Organization Factors	
Job satisfaction	All in all, how satisfied would you say you are with your job?
Work freedom	I am given a lot of freedom to decide how to do my work. (not at all true ↔ very true)
Supervisor support *	My supervisor is concerned about the welfare of those under him or her. My supervisor is helpful to me in getting the job done.
Work stress	How often do you find your work stressful? (never ↔ always)
Work time	I have enough time to get the job done. (very true ↔ not at all true)
Work fast	My job requires that I work very fast. (strongly disagree ↔ strongly agree)
Work hours	How many hours did you work last week, at all jobs?
Must work	When you work extra hours on your main job, is it mandatory (required by your employer)?
Safety climate *	The safety of workers is a high priority with management where I work. There are no significant compromises or shortcuts taken when worker safety is at stake. The safety and health conditions where I work are good. Where I work, employees and management work together to ensure the safest possible working conditions.
Work schedule	Day shift, afternoon shift, night shift, split shift, irregular/on call, rotating
Work home	How often do you work at home as part of your job?
Work from home	When you work at home, is it part of your primary job at another location, are you taking work home to catch up, or do you have a home-based business.

*Multiple questions averaged to establish the variable.

Table 2.

Reports of Back Pain and Pain in Arms with 2010 Census Occupational Codes and significant trend changes across survey years.

	Frequency and Study group (%)				Trend	Frequency (%) "Back Pain"				Trend	Frequency (%)"Pain in Arms"				Trend	Frequency (%) both "Back Pain" and "Pain in Arms"				Trend
Occupation	**2002**	**2006**	**2010**	**2014**	**χ^2 p-value**	**2002**	**2006**	**2010**	**2014**	**χ^2 p-value**	**2002**	**2006**	**2010**	**2014**	**χ^2 p-value**	**2002**	**2006**	**2010**	**2014**	**χ^2 p-value**
Management, financial, business	216 (13.7)	206 (13.4)	169 (16.3)	177 (15.8)	0.09	55 (25.5)	45 (21.8)	37 (21.9)	36 (20.3)	0.65	53 (24.5)	36 (17.5)	45 (26.6)	33 (18.6)	0.07	32 (14.8)	19 (9.2)	23 (13.6)	15 (8.5)	0.13
Professional and related	326 (20.6)	367 (23.9)	227 (21.9)	241 (21.4)	0.15	77 (23.6)	76 (20.7)	45 19.8)	41 (17.0)	0.28	87 (26.7)	68 (18.6)	45 (19.8)	46 (19.2)	**0.04**	38 (11.7)	30 (8.2)	19 (8.4)	17 (7.1)	0.25
Service occupations	263 (16.6)	231 (15.1)	191 (18.4)	220 (19.6)	**0.013**	88 (33.5)	69 (29.9)	58 (30.4)	56 (25.5)	0.29	79 (30.0)	65 (28.1)	61 (31.9)	56 (25.6)	0.52	52 (19.8)	36 (15.6)	38 (19.9)	28 (12.8)	0.13
Sales and related	172 (10.9)	159 (10.4)	110 (10.6)	106 (9.4)	0.67	37 (21.5)	53 (33.3)	30 (27.3)	23 (21.7)	0.07	36 (20.9)	48 (30.2	25 (22.7)	25 (23.6)	0.25	18 (10.5)	29 (18.2)	16 (14.6)	13 (12.3)	0.22
Office/ administrative support	228 (14.4)	216 (14.1)	127 (12.3)	147 (13.1)	0.38	58 (25.4)	77 (35.7)	34 (26.8)	36 (24.5)	0.54	59 (26.0)	78 (36.1)	38 (30.0)	34 (23.1)	**0.03**	28 (12.3)	44 (20.4)	21 (16.5)	18 (12.2)	0.08
Farming, fishery and forestry	11 (0.70)	10 0.65)	12 (1.16)	5 (0.44)	0.25	6 (54.6)	3 (30.0)	2 16.7)	0 (0.0)	0.06	4 (36.4)	4 (40.0)	5 (41.7)	1 (20.0)	0.84	3 (27.3)	2 (20.0)	2 (16.7)	0 (0.0)	0.46
Construction and extraction	81 (5.1)	78 (5.1)	44 (4.2)	50 (4.5)	0.65	31 (38.3)	22 (28.2)	18 (40.9)	16 (32.0)	0.42	30 (37.0)	30 (38.5)	17 (38.6)	18 (36.0)	0.99	19 (23.5)	17 (21.8)	13 (29.6)	9 (18.0)	0.61
Installation, maintenance, repair	65 (4.1)	65 (4.2)	31 (3.0)	38 (3.4)	0.30	22 (33.9)	24 (36.9)	10 (32.3)	11 (29.0)	0.87	20 (30.8)	20 (30.8)	10 (32.3)	10 (26.3)	0.95	10 (15.4)	13 (20.0)	6 (19.4)	7 (18.4)	0.91
Production occupations	130 (8.2)	110 (7.2)	54 (5.2)	59 (5.3)	**0.003**	40 (30.1)	33 (30.0)	13 (24.1)	14 (24.0)	0.64	45 (34.6)	37 (33.6)	18 (33.3)	17 (28.8)	0.88	24 (18.5)	23 (20.9)	9 (16.7)	9 (15.3)	0.81
Transportation and material moving	87 (5.5)	79 (5.2)	59 (5.7)	64 (5.7)	0.92	29 (33.3)	24 (30.4)	16 (27.1)	20 (31.3)	0.88	29 (33.3)	36 (45.6)	20 (33.9)	23 (35.9)	0.36	18 (20.7)	19 (24.1)	14 (23.8)	15 (23.4)	0.95
Military related occupations	3 (0.2)	13 (0.9)	13 (1.3)	17 (1.5)	**0.001**	2 (66.7)	3 (23.1)	4 (30.8)	3 (17.7)	0.38	2 (66.7)	4 (30.8)	3 (23.1)	5 (29.4)	0.57	2 (66.7)	1 (7.7)	3 (23.1)	3 (17.7)	0.19
Total	1582	1534	1037	1124		(28.1)	(28.0)	(25.8)	(22.8)	**0.007**	(28.1)	(27.8)	(27.7)	(23.9)	0.06	(15.4)	(15.2)	(15.8)	(11.9)	**0.03**

Note: Significant χ^2 at the ≤ 0.05 are indicated in bold.

Table 3.

Risk Factors for Back Pain (Frequency counts, Odds ratios and trend significance values).

Risk factors	**Back Pain Frequency Measures**				**Back Pain Odds Ratios**				**Trend**
Individual factors	**Number of reports, Yes frequency, % (yes)**				**OR (95% CI)**				χ^2
	2002	**2006**	**2010**	**2014**	**2002**	**2006**	**2010**	**2014**	**p**
Age (yrs)					Compared with age 18–24 yrs.				
18–24	127, 39 (30.7)	127, 35 (27.6)	71, 20 (28.2)	69, 19 (27.5)					0.35
25–34	390, 114 (29.2)	365, 97 (26.6)	241, 68 (28.2)	261, 57 (21.8)	0.93 (0.60–1.44)	0.96 (0.61–1.50)	1.00 (0.56–1.81)	0.74 (0.40–1.35)	0.94
35–44	376, 107 (28.5)	402, 122 (30.4)	254, 60 (23.6)	264, 70 (26.5)	0.90 (0.58–1.39)	1.15 (0.74–1.79)	0.79 (0.44–1.43)	0.95 (0.52–1.72)	0.80
45–54	347, 95 (27.4)	398, 121 (30.5)	253, 63 (24.9)	260, 63 (24.2)	0.85 (0.55–1.33)	1.15 (0.74–1.79)	0.85 (0.47–1.53)	0.84 (0.46–1.53)	0.83
55–64	182, 44 (24.2)	212, 48 (22.6)	170, 44 (25.9)	217, 35 (16.1)	0.72 (0.43–1.20)	0.77 (0.46–1.28)	0.89 (0.48–1.66)	**0.51 (0.27–0.97)**	0.70
>65	37, 10 (27.0)	49, 10 (20.4)	53, 14 (26.4)	59, 12 (20.3)	0.84 (0.37–1.89)	0.67 (0.30–1.50)	0.92 (0.41–2.04)	0.67 (0.29–1.53)	0.30
Gender					Compared with Male				
Male	769, 217 (28.2)	772, 202 (26.7)	503, 126 (25.1)	565, 128 (22.7)					0.31
Female	696, 195 (28.0)	787, 231 (29.6)	540, 143 (26.5)	568, 129 (22.7)	0.99 (0.79–1.24)	1.16 (0.95–1.48)	1.08 (0.82–1.42)	1.00 (0.76–1.33)	0.96
Hurt at Work					Compared with zero time				
Zero time	1299, 326 (25.1)	1370, 343 (24.0)	938, 225 (24.0)	1030, 208 (20.2)					**0.005**
One time	106, 50 (47.2)	112, 54 (48.2)	61, 24 (39.3)	64, 27 (42.2)	**2.67 (1.78–3.98)**	**2.79 (1.89–4.12)**	**2.06(1.20–3.51)**	**2.88 (1.72–4.85)**	0.93
Two times	17, 8 (47.1)	40, 22 (55.0)	20, 9 (45.0)	19, 10 (52.6)	**2.64 (1.02–6.93)**	**3.66 (1.94–6.90)**	**2.60 (1.06–6.34)**	**4.40 (1.76–10.95)**	0.92
Three or more	37, 24 (64.9)	31, 14 (45.2)	21, 11 (52.4)	20, 12 (60.0)	**5.51 (2.77–10.95)**	**2.47 (1.20–5.06)**	**3.49 (1.46–8.32)**	**5.93 (2.39–14.69)**	0.84
Physical Health					Compared with 0–13 days				
0–13 days	1482, 394 (26.6)	1450, 382 (26.3)	958, 223 (23.3)	1074,225 (21.0)					**0.0004**
≥ 14 days	104, 52 (50.0)	89, 47 (52.8)	78, 43 (55.1)	58, 32 (55.2)	**2.76 (1.85–4.12)**	**3.13 (2.03–4.82)**	**4.05 (2.53–6.48)**	**4.64 (2.71–7.95)**	0.08
Mental Health					Compared with 0–13 days				
0–13 days	1396, 359 (25.7)	1415, 363 (25.7)	922, 206 (22.3)	1024, 203 (19.8)					**0.0002**
≥ 14 days	187, 84 (45.5)	122, 64 (52.5)	112, 58 (51.8)	107, 52 (48.6)	**2.41 (1.76–3.29)**	**3.20 (2.19–4.65)**	**3.73 (2.50–5.58)**	**3.82 (2.54–5.76)**	**0.04**
Health days					Compared with 0–13 days				
0–13 days	1521, 416 (27.4)	1495, 402 (26.9)	955, 244 (24.5)	1104, 242 (22.0)					**0.0008**
≥ 14 days	66, 30 (45.5)	46, 28 (60.1)	42, 23 (54.8)	27, 14 (52.0)	**2.21 (1.35–3.64)**	**4.23 (2.31–7.73)**	**3.73 (1.99–6.96)**	**3.84 (1.78–8.27)**	0.16

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Risk factors	Back Pain Frequency Measures				Back Pain Odds Ratios				Trend
Individual factors	**Number of reports, Yes frequency, % (yes)**				**OR (95% CI)**				χ^2
	2002	**2006**	**2010**	**2014**	**2002**	**2006**	**2010**	**2014**	**p**
Sleep problems					Compared with never				
Never			188, 31 (16.5)	201, 26 (12.9)					0.32
Rarely			286, 53 (18.5)	293, 39 (13.3)			1.15 (0.71–1.88)	1.03 (0.61–1.76)	0.77
Sometimes			340, 91 (26.8)	387, 81 (20.9)			**1.85 (1.18–2.91)**	**1.78 (1.10–2.90)**	0.91
Often			229, 94 (41.1)	252, 111 (44.1)			**3.53 (2.21–5.62)**	**5.30 (3.28–8.57)**	0.23
Physical Factors									
Heavy lifting					Yes vs. no				
No	794, 172 (21.7)	832, 192 (23.1)	553, 121 (21.9)	583, 102 (17.5)					0.07
Yes	671, 240 (35.8)	717, 241 (33.6)	489, 148 (30.3)	548, 155 (28.3)	**2.01 (1.60–2.54)**	**1.69 (1.35–2.11)**	**1.55 (1.17–2.05)**	**1.86 (1.40–2.47)**	0.45
Hand movement					Yes vs no				
No	714, 136 (19.0)	783, 167 (21.3)	557, 113 (20.3)	589, 105 (17.8)					0.54
Yes	751, 276 (36.6)	767, 266 (34.7)	485, 156 (32.2)	538, 150 (27.9)	**2.47 (1.95–3.14)**	**1.96 (1.56–2.46)**	**1.86 (1.41–2.47)**	**1.78 (1.34–2.36)**	0.07
Physical effort					Compared with very light				
Very light			264, 50 (19.0)	273, 40 (14.7)					0.18
Fairly light			295, 59 (20.0)	315, 58 (18.4)			1.07 (0.70–1.63)	1.32 (0.85–2.04)	0.51
Somewhat hard			262, 71 (27.1)	309, 83 (26.9)			**1.59 (1.06–2.40)**	**2.14 (1.41–3.25)**	0.32
Hard			121, 42 (35.0)	152, 44 (29.0)			**2.28 (1.40–3.69)**	**2.37 (1.46–3.86)**	0.90
Vary hard			98, 46 (47.0)	81, 32 (39.5)			**3.79 (2.29–6.26)**	**3.80 (2.18–6.64)**	0.99
Psychosocial and Work Organization Factors									
Job Satisfaction					Compared with very satisfied				
Very satisfied	721, 161 (22.3)	701,157 (22.4)	461, 104 (22.6)	551, 101 (18.3)					0.06
Somewhat satisfied	580, 177 (30.5)	708, 215 (30.4)	463, 115 (25.0)	465, 116 (25.0)	**1.53 (1.19–1.96)**	**1.51 (1.19–1.92)**	1.13 (0.84–1.54)	**1.48 (1.10–2.00)**	0.81
Not too satisfied	113, 50 (44.3)	97, 46 (47.4)	84, 35 (41.7)	81, 27 (33.3)	**2.76 (1.83–4.16)**	**3.13 (2.02–4.84)**	**2.45 (1.51–3.99)**	**2.23 (1.34–3.71)**	0.53
Not at all satisfied	48, 23 (47.9)	46, 15 (32.6)	35, 15 (43.0)	34, 13 (38.2)	**3.20 (1.77–5.79)**	1.67 (0.88–3.18)	**2.58 (1.27–5.21)**	**2.76 (1.34–5.69)**	0.93
Work Freedom					Compared with not at all true				
Not at all true	66, 34 (51.5)	61, 20 (32.8)	46, 14 (30.4)	34, 11 (32.4)					0.06
Not too true	118, 31 (26.3)	144, 49 (34.0)	84, 27 (32.1)	118, 38 (32.2)	**0.34 (0.18–0.63)**	1.06 (0.56–1.20)	1.08 (0.50–2.36)	0.99 (0.44–2.25)	**0.03**

Risk factors	Back Pain Frequency Measures				Back Pain Odds Ratios				Trend
Individual factors	**Number of reports, Yes frequency, % (yes)**				**OR (95% CI)**				χ^2
	2002	**2006**	**2010**	**2014**	**2002**	**2006**	**2010**	**2014**	**p**
Somewhat true	453, 139 (30.7)	482, 144 (30.0)	334, 97 (29.0)	360, 80 (22.2)	**0.42 (0.25–0.70)**	0.87 (0.49–1.54)	0.93 (0.48–1.83)	0.60 (0.28–1.28)	0.31
Very true	825, 207 (25.1)	850, 218 (25.7)	578, 131 (22.7)	618, 128 (20.7)	**0.32 (0.19–0.52)**	0.71 (0.41–1.23)	0.67 (0.35–1.29)	0.55 (0.26–1.15)	0.27
Supervisor support					Compared with very true				
Very true	524, 126 (24.1)	539, 140 (26.0)	379, 79 (20.1)	438, 88 (20.1)					**0.02**
Somewhat true	614, 168 (27.4)	641, 164 (25.6)	422, 107 (25.4)	473, 102 (21.6)	1.19 (0.91–1.56)	0.98 (0.75–1.27)	1.29 (0.93–1.80)	1.09 (0.79–1.51)	0.69
Not too true	196, 61 (31.2)	220, 83 (37.7)	163, 54 (33.1)	156, 43 (27.6)	1.43 (0.99–2.05)	**1.73 (1.24–2.41)**	**1.88 (1.25–2.83)**	1.51 (0.99–2.31)	0.73
Not at all true	102, 49 (48.1)	91, 29 (31.9)	56, 25 (44.6)	49, 21 (42.9)	**2.92 (1.89–4.52)**	1.33 (0.82–2.16)	**3.06 (1.71–5.48)**	**2.98 (1.62–5.50)**	0.42
Work time					Compared with very true				
Very true	607, 161 (26.5)	594, 158 (26.6)	405, 91 (22.5)	474, 98 (20.7)					**0.007**
Somewhat true	589, 160 (27.6)	671, 176 (26.2)	459, 127 (27.7)	485, 100 (20.6)	1.06 (0.82–1.40)	0.98 (0.76–1.26)	1.32 (0.97–1.80)	1.00 (0.73–1.36)	0.80
Not too true	169, 51 (30.2)	193, 64 (33.2)	121, 34 (28.1)	135, 43 (31.8)	1.20 (0.82–1.74)	1.37 (0.96–1.94)	1.35 (0.85–2.14)	**1.79 (1.17–2.74)**	0.17
Not at all true	106, 39 (36.8)	99, 32 (40.5)	56, 17 (30.4)	36, 16 (44.4)	**2.92 (1.89–4.52)**	**1.88 (1.16–3.05)**	1.50 (0.81–2.78)	**3.07 (1.53–6.14)**	0.28
Work fast					Compared with strongly disagree				
Strongly disagree	48, 14 (29.2)	57, 17 (29.8)	29, 5 (17.2)	19, 6 (31.6)					0.31
Disagree	477, 128 (26.8)	444, 109 (24.6)	300, 59 (21.9)	293, 61 (20.8)	0.89 (0.46–1.71)	0.77 (0.42–1.41)	1.18 (0.53–1.06)	0.57 (0.21–1.56)	0.99
Agree	619, 160 (25.9)	713, 203 (28.4)	485, 134 (27.6)	542, 110 (20.3)	0.85 (0.44–1.62)	0.94 (0.52–1.69)	1.83 (0.69–4.90)	0.55 (0.21–1.48)	0.87
Strongly agree	317, 108 (34.1)	332, 104 (31.3)	226, 71 (31.4)	274, 79 (28.8)	1.26 (0.65–2.44)	1.07 (0.58–1.98)	2.20 (0.81–6.00)	0.88 (0.32–2.39)	0.78
Work hours					Compared with ≤40 hrs.				
≤ 40 hrs.	746, 209 (28.0)	837, 221 (26.1)	583, 158 (27.1)	664, 155 (23.3)					**0.04**
41–50 hrs.	402, 124 (30.9)	377, 116 (30.8)	261, 57 (21.8)	240, 51 (21.3)	1.15 (0.88–1.49)	1.24 (0.95–1.62)	0.75 (0.53–1.06)	0.89 (0.62–1.27)	0.11
51–60 hrs.	188, 35 (18.6)	208, 58 (27.9)	129, 34 (26.4)	148, 28 (18.9)	**0.59 (0.39–0.88)**	1.08 (0.77–1.51)	0.96 (0.63–1.48)	0.77 (0.49–1.20)	0.43
61–70 hrs.	69, 22 (31.9)	60, 14 (23.3)	40, 11 (27.5)	45, 14 (31.1)	1.20 (0.71–2.05)	0.85 (0.46–1.57)	1.02 (0.50–2.09)	1.48 (0.77–2.86)	0.59
> 71 hrs.	56, 20 (35.7)	71, 24 (33.8)	30, 9 (30.0)	36, 9 (25.0)	1.43 (0.81–2.52)	1.42 (0.85–2.38)	1.15 (0.52–2.57)	1.10 (0.50–2.38)	0.54
Must work					Yes vs no				
No	1041, 262 (25.2)	1101, 288 (26.2)	724, 181 (25.0)	787, 173 (22.0)					0.06
Yes	411, 146 (35.5)	429, 140 (32.6)	303, 85 (28.1)	336, 82 (24.4)	**1.64 (1.28–2.10)**	**1.37 (1.07–1.74)**	1.17 (0.87–1.58)	1.14 (0.85–1.55)	0.07
Safety climate					Compared with strongly agree				

Risk factors	Back Pain Frequency Measures				Back Pain Odds Ratios				Trend
Individual factors	**Number of reports, Yes frequency, % (yes)**				**OR (95% CI)**				χ^2
	2002	**2006**	**2010**	**2014**	**2002**	**2006**	**2010**	**2014**	**p**
Strongly agree	504, 126 (25.0)	822, 213 (25.9)	527, 122 (23.2)	620, 128 (20.7)					**0.005**
Agree	713, 194 (27.2)	578, 161 (27.9)	414, 106 (25.6)	434, 97 (22.4)	1.12 (0.86–1.46)	1.10 (0.87–1.40)	1.14 (0.85–1.54)	1.11 (0.82–1.49)	0.57
Disagree	179, 68 (38.0)	89, 32 (36.0)	58, 20 (34.5)	49, 21 (42.9)	**1.84 (1.28–2.64)**	**1.61 (1.01–2.54)**	1.75 (0.98–3.11)	**2.88 (1.59–5.24)**	0.30
Strongly disagree	65, 21 (32.3)	51, 24 (47.1)	41, 21 (51.2)	28, 11 (39.3)	1.43 (0.82–2.50)	**2.54 (1.44–4.50)**	**3.49 (1.83–6.64)**	**2.49 (1.14–5.44)**	0.28
Work home					Compared with never				
Never	993, 298 (30.0)	913, 268 (29.4)	604, 181 (30.0)	680, 161 (23.7)					**0.01**
A few times a year.	149, 41 (27.5)	137, 35 (25.6)	97, 26 (26.8)	89, 21 (23.6)	0.89 (0.60–1.30)	0.83 (0.55–1.24)	0.86 (0.53–1.39)	1.00 (0.59–1.68)	0.74
About once a month.	85, 20 (23.5)	104, 23 (22.1)	73, 16 (21.9)	64, 15 (23.4)	0.72 (0.43–1.21)	0.68 (0.42–1.11)	0.66 (0.38–1.17)	0.99 (0.54–1.81)	0.52
About once a week.	96, 21 (21.9)	119, 38 (31.9)	80, 15 (18.8)	82, 17 (20.7)	0.65 (0.40–1.08)	1.13 (0.75–1.70)	**0.54 (0.30–0.97)**	0.84 (0.48–1.48)	0.95
More than once a week	189, 44 (23.3)	179, 49 (27.4)	133, 17 (12.8)	155, 34 (21.9)	0.71 (0.49–1.02)	0.91 (0.63–1.30)	**0.34 (0.20–0.59)**	0.91 (0.60–1.38)	0.87
Work mainly at home.	77, 24 (31.2)	82, 16 (19.5)	54, 13 (24.1)	60, 9 (15.0)	1.06 (0.64–1.74)	0.58 (0.33–1.03)	0.74 (0.39–1.42)	0.57 (0.27–1.18)	0.21
Work from home					Compared with primary job at another location				
Part of primary job at another location.			142, 22 (15.5)	134, 20 (15.3)					0.13
Taking work home to catch up.			178, 39 (21.9)	193, 51 (26.4)			1.53 (0.86–2.72)	**1.99 (1.12–3.54)**	0.55
Operating a home based business.			44, 9 (20.5)	63, 12 (19.1)			1.40 (0.59–3.32)	1.31 (0.59–2.87)	0.83
Other reasons			69, 16 (23.2)	63, 13 (20.6)			1.65 (0.80–3.38)	1.44 (0.67–3.13)	0.98
Work stress					Compared with never				
Never	88, 20 (22.7)	80, 15 (18.8)	59, 12 (20.3)	80, 17 (21.3)					0.74
Hardly ever	255, 51 (20.0)	255, 50 (19.6)	178, 32 (18.0)	197, 25 (12.7)	0.85 (0.47–1.53)	1.06 (0.56–2.01)	0.86 (0.41–1.80)	0.54 (0.27–1.06)	0.13
Sometimes	622, 151 (24.3)	694, 174 (25.1)	437, 104 (23.8)	516, 103 (20.0)	1.09 (0.64–0.85)	1.45 (0.81–2.61)	1.22 (0.63–2.39)	0.92 (0.52–1.65)	0.31
Often	350, 121 (34.6)	347, 121 (34.9)	266, 78 (29.3)	229, 65 (28.4)	**1.80 (1.04–3.10)**	**2.32 (1.27–4.24)**	1.63 (0.82–3.23)	1.47 (0.80–2.70)	0.26
Always	148, 68 (46.0)	174, 73 (42.0)	103, 43 (41.8)	109, 47 (43.1)	**2.89 (1.60–5.24)**	**3.13 (1.66–5.92)**	**2.81 (1.33–5.91)**	**2.81 (1.46–5.42)**	0.63
Work schedule					Compared with day shift				
Day shift	1078, 297 (27.6)	1168, 310 (26.5)	781, 189 (24.2)	813, 176 (21.7)					**0.001**
Afternoon shift	53, 18 (34.0)	55, 19 (34.6)	49, 13 (26.5)	56, 10 (17.9)	1.35 (0.75–2.43)	1.46 (0.83–2.59)	1.13 (0.59–2.18)	0.79 (0.39–1.59)	0.11
Night shift	94, 22 (23.4)	92, 30 (32.6)	54, 14 (25.9)	71, 24 (33.8)	0.80 (0.49–1.32)	1.34 (0.85–2.11)	1.10 (0.58–2.06)	**1.85 (1.10–3.12)**	**0.03**
Split shift	38, 11 (29.0)	29, 12 (41.4)	28, 8 (28.6)	26, 7 (26.9)	1.07 (0.53–2.19)	1.95 (0.92–4.14)	1.25 (0.54–2.89)	1.33 (0.55–3.22)	0.81

Risk factors	Back Pain Frequency Measures				Back Pain Odds Ratios				Trend
Individual factors	**Number of reports, Yes frequency, % (yes)**				**OR (95% CI)**				χ^2
	2002	**2006**	**2010**	**2014**	**2002**	**2006**	**2010**	**2014**	**p**
Irregular/on call	124, 38 (30.7)	129, 36 (27.9)	83, 23 (27.7)	86, 19 (22.1)	1.16 (0.78–1.74)	1.07 (0.71–1.61)	1.20-(0.72–1.20)	1.03 (0.60–1.75)	0.83
Rotating shift	73, 23 (31.5)	74, 25 (33.8)	44, 22 (50.0)	78, 21 (27.0)	1.21 (0.73–2.02)	1.42 (0.86–2.33)	**3.13 (1.70–5.78)**	1.33 (0.79–2.26)	0.27
Dichotomized factors									
Job Satisfaction					No vs yes				
Yes	1301, 338 (26.0)	1409, 372 (26.4)	924, 219 (23.7)	1016, 217 (21.4)					**0.004**
No	161, 73 (45.3)	143, 61 (43.0)	119, 50 (42.2)	115, 40 (34.8)	**2.36 (1.69–3.30)**	**2.08 (1.46–2.95)**	**2.33 (1.57–3.46)**	**1.96 (1.30–2.97)**	0.61
Safety Climate					Yes vs no				
No	244, 89 (36.5)	140, 56 (40.0)	99, 41 (41.4)	77, 32 (41.6)					0.87
Yes	1217, 320 (26.3)	1400, 374 (26.7)	941, 228 (24.2)	1054, 225 (21.4)	**0.62 (0.47–0.83)**	**0.55 (0.38–0.78)**	**0.45 (0.30–0.69)**	**0.38 (0.24–0.62)**	0.22
Work stress					Yes vs no				
No 3,4,5	965, 222 (23.0)	1029, 239 (23.2)	674, 148 (22.0)	793, 145 (18.3)					**0.007**
Yes 1,2	498, 189 (38.0)	521, 194 (37.2)	369, 121 (32.8)	338, 112 (33.1)	**2.05 (1.62–2.59)**	**1.96 (1.56–2.47)**	**1.73 (1.31–2.30)**	**2.22 (1.66–2.96)**	0.78
Work fast					Yes vs no				
No	525, 142 (27.1)	501, 126 (25.2)	329, 64 (19.5)	312, 67 (21.5)					**0.02**
Yes	936, 268 (28.6)	1045, 307 (29.4)	711, 205 (28.8)	816, 189 (23.2)	1.08 (0.85–1.37)	1.24 (0.97–1.58)	**1.67 (1.22–2.30)**	1.10 (0.80–1.51)	0.54
Work time					Yes vs no				
No	275, 90 (32.7)	272, 96 (35.3)	177, 51 (28.8)	171, 59 (34.5)					0.91
Yes	1187, 321 (27.0)	1265, 334 (26.4)	864, 218 (25.2)	959, 198 (20.1)	0.76 (0.57–1.04)	**0.66 (0.50–0.87)**	0.83 (0.58–1.20)	**0.49 (0.35–0.70)**	0.15
Risk factor combinations									
Heavy lifting and work stress 3,4,5					Compared with no-no				
No-no	517, 91 (17.6)	554, 108 (19.5)	354, 63 (17.8)	419, 63 (15.0)					0.24
No-yes	277, 81 (29.4)	278, 84 (30.2)	199, 58 (29.2)	163, 39 (23.4)	**1.94 (1.37–2.73)**	**1.79 (1.28–2.49)**	**1.90 (1.26–2.86)**	**1.78 (1.14–2.78)**	0.91
Yes-no	448, 131 (29.4)	474, 131 (27.6)	319, 85 (26.7)	374, 82 (21.9)	**1.94 (1.43–2.62)**	**1.58 (1.18–2.11)**	**1.68 (1.16–2.43)**	**1.59 (1.10–2.28)**	0.38
Yes-yes	221, 108 (48.9)	242, 110 (45.5)	170, 63 (37.1)	174, 73 (42.0)	**4.47 (1.45–2.80)**	**3.44 (2.48–4.78)**	**2.72 (1.80–4.11)**	**4.08 (2.73–6.11)**	0.59
Interaction					1.20 (0.74–1.93)	1.22 (0.77–1.94)	0.85 (0.48–1.51)	1.45 (0.80–2.62)	
Heavy lifting and work fast					Compared with no-no				

Risk factors	Back Pain Frequency Measures				Back Pain Odds Ratios				Trend
Individual factors	**Number of reports, Yes frequency, % (yes)**				**OR (95% CI)**				**χ^2**
	2002	**2006**	**2010**	**2014**	**2002**	**2006**	**2010**	**2014**	**p**
No-no	305, 68 (22.3)	284, 61 (21.5)	178, 32 (18.0	189, 31 (16.4)					0.08
No-yes	488, 104 (21.3)	544, 131 (24.)	372, 89 (23.9)	391, 70 (17.9)	0.94 (0.67–1.33)	1.16 (0.82–1.64)	1.44 (0.91–2.25)	1.11 (0.70–1.77)	0.40
Yes-no	220, 74 (33.6)	217, 65 (29.7)	151, 32 (21.2)	123, 36 (29.3)	**1.77 (1.20–2.61)**	**1.56 (1.04–2.35)**	1.23 (0.71–2.12)	**2.11 (1.22–3.64)**	0.97
Yes-yes	448, 164 (36.6)	500, 176 (35.2)	338, 116 (43.3)	424, 119 (28.1)	**2.01 (1.45–2.80)**	**1.99 (1.42–2.78)**	**2.36 (1.53–3.72)**	**1.99 (1.28–3.09)**	0.91
Interaction					1,21 (0.74–1.96)	1.10 (0.67–1.78)	1.35 (0.72–2.56)	0.84 (0.45–1.61)	
Heavy lifting and work time					Compared with no-yes				
No-yes	636, 135 (21.2)	671, 142 (21.2)	453, 96 (21.2)	502, 85 (16.9)					**0.001**
No-no	156, 37 (23.7)	153, 49 (32.0)	100, 25 (25.0)	81, 17 (21.0)	1.15 (0.76–1.75)	**1.76 (1.19–2.58)**	1.24 (0.75–2.06)	1.30 (0.73–2.34)	0.42
Yes-yes	551, 186 (33.8)	594, 192 (32.3)	410, 122 (29.8)	456, 113 (24.8)	**1.89 (1.46–2.45)**	**2.27 (1.63–3.73)**	**1.58 (1.16–2.15)**	**4.29 (2.67–6.91)**	0.30
Yes-no	119, 53 (44.5)	118, 47 (39.8)	77, 26 (33.8)	90, 42 (46.7)	**2.98 (1.98–4.48**)	**1.80 (1.38–2.29)**	**1.90 (1.12–3.20)**	**1.62 (1.18–2.21)**	0.12
Interaction					1.37 (0.78–2.08)	0/79 (0.45–1.38)	0.67 (0.33–1.38)	2.04 (0.97–4.30)	
Hand movement and work stress 3,4,5					Compared with no-no				
No-no	80 (16.3)	106 (19.5)	58 (15.9)	68 (15.7)					0.44
No-yes	56 (25.1)	61 (25.6)	55 (28.8)	37 (23.7)	**1.72 (1.17–2.53)**	1.42 (0.93–2.01)	**2.15 (1.41–3.27)**	**1.66 (1.06–2.61)**	0.55
Yes-no	142 (30.0)	133 (27.4)	90 (29.3)	76 (21.3)	**2.20 (1.61–3.00)**	**1.56 (1.63–3.73)**	**2.20 (1.52–3.20)**	**1.45 (1.01–2.08)**	0.23
Yes-yes	133 (48.4)	133 (47.2)	66 (37.1)	74 (40.1)	**4.81 (3.44–6.74)**	**3.69 (2.69–5.09)**	**3.13 (2.07–4.73)**	**3.70 (2.50–5.49)**	0.27
Interaction					1.37 (0.77–2.08)	**1.66 (1.03–2.66)**	0.97 (0.47–2.00)	1.54 (0.85–2.79)	
Hand movement and work fast					Compared with no-no				
No-no	301, 59 (19.6)	285, 60 (21.1)	193, 31 (16.1)	190, 33 (17.4)					0.32
No-yes	412, 77 (18.7)	494, 107 (21.7)	361, 82 (22.7)	396, 71 (17.9)	0.94 (0.65–1.38)	1.04 (0.73–1.48)	1.53 (0.97–2.42)	1.04 (0.66–1.64)	0.47
Yes-no	224, 83 (37.0)	216, 66 (30.1)	136, 33 (24.3)	120, 34 (28.3)	**2.41 (1.63–3.58)**	**1.65 (1.10–2.48)**	1.67 (0.97–2.90)	**1.88 (1.09–3.25)**	0.38
Yes-yes	524, 191 (36.5)	551, 200 (36.0)	349, 123 (35.2)	417, 116 (27.8)	**2.35 (1.68–3.29)**	**2.14 (1.53–2.98)**	**2.84 (1.83–4.43)**	**1.83 (1.19–2.82)**	0.57
Interaction					1.03 (0.63–1.67)	1.25 (0.77–2.04)	1.11 (0.58–2.10)	0.94 (0.49–1.78)	
Hand movement and work time					Compared with no-yes				
No-yes	586, 110 (18.8)	652, 138 (21.2)	474, 97 (20.5)	514,87 (16.9)					**0.0003**
No-no	126, 26 (20.6)	123, 27 (22.0)	82, 16 (19.5)	75, 18 (24.0)	1.13 (0.70–1.82)	1.04 (0.66–1.67)	0.94 (0.66–1.67)	1.55 (0.87–2.76)	0.10

Risk factors	Back Pain Frequency Measures				Back Pain Odds Ratios				Trend
Individual factors	**Number of reports, Yes frequency, % (yes)**				**OR (95% CI)**				χ^2
	2002	**2006**	**2010**	**2014**	**2002**	**2006**	**2010**	**2014**	**p**
Yes-yes	601, 211 (35.1)	613, 196 (32.0)	389, 121 (31.1)	442, 109 (24.7)	**2.34 (1.79–3.06)**	**3.21 (2.21–4.66)**	**1.76 (1.29–2.39)**	**1.61 (1.17–2.20)**	0.07
Yes-no	149, 64 (43.0)	149, 69 (46.3)	95, 35 (46.3)	94, 41 (43.6)	**2.35 (1.68–3.29)**	**1.75 (1.36–2.26)**	**2.27 (1.41.−3.64)**	**3.80 (2.34–6.07)**	0.16
Interaction					1.23 (0.68–1.67)	1.75 (0.97–3.17)	1.75 (0.65–2.91	1.52 (0.73–3.19)	
Physical effort 3, 4, 5 and work stress 3,4,5					Compared with no-no				
No-no			365, 58 (15.9)	437, 67 (15.3)					0.83
No-yes			194, 51 (26.3)	151, 31 (20.5)			**1.89 (1.23–2.89)**	1.43 (0.89–2.29)	0.39
Yes-no			306, 89 (29.1)	355, 78 (22.0)			**2.17 (1.49–3.15)**	**1.56 (1.08–2.23)**	0.21
Yes-yes			175, 70 (40.0)	186, 81 (43.6)			**3.53 (2.34–5.33)**	**4.26–2.89–6.29)**	0.51
Interaction							0.86 (0.48–1.53)	**1.92 (1.04–3.53)**	
Physical effort 3, 4, 5 and work fast					Compared with no-no				
No-no			189, 30 (15.9)	195, 33 (16.9)					0.78
No-yes			367, 79 (21.5)	391, 65 (16.6)			1.45 (0.92–2.31)	0.98 (0.62–1.55)	0.23
Yes-no			139, 34 (24.5)	116, 34 (29.3)			1.72 (0.99–2.97)	**2.04 (1.18–3.52)**	0.67
Yes-yes			342, 125 (36.6)	424, 124 (29.3)			**3.05 (1.95–4.78)**	**2.03 (1.32–3.12)**	0.20
Interaction							1.22 (0.64–2.33)	1.02 (0.53–1.94)	
Physical effort 3, 4, 5 and work time					Compared with no-yes				
No-yes			455, 84 (18.5)	509, 84 (16.5)					**0.015**
No-no			104, 25 (24.0)	79, 14 (17.7)			1.40 (0.84–2.32)	1.09 (0.58–2.03)	0.97
Yes-yes			407, 134 (32.9)	450, 45 (49.5)			**2.17 (1.58–2.97)**	**4.95 (3.08–7.94)**	**0.30**
Yes-no			72, 25 (34.7)	91, 114 (25.3)			**2.35 (1.37–4.03)**	**1.72 (1.25–2.36)**	**0.01**
Interaction							0.78 (0.37–1.61)	**2.65 (1.22–5.75)**	

Notes: Trend values are reported for each risk factor response choice compared to the response choice case year (2002 or 2010). Significant Odds Ratios (ORs) and Chi-square(χ^2) p values are in bold.

Table 4.

Risk Factors for “Pain in Arms” (Frequency counts, Odds ratios and trend significance values)

Risk factors	**Pain in Arms Frequency Measures**				**Pain in Arms Odds Ratios**				**Trend**
Individual factors	**Number of reports, Yes frequency, % (yes)**				**OR (95% CI)**				χ^2
	2002	**2006**	**2010**	**2014**	**2002**	**2006**	**2010**	**2014**	**p**
Age (yrs)									
18–24	127, 29 (22.8)	127, 33 (26.0)	71, 13 (18.3)	69, 15 (21.7)			1.38 (0.71–2.70)	1.08 (0.57–2.04)	0.74
25–34	390, 97 (24.9)	365, 76 (20.7)	241, 57 (23.7)	264, 60 (23.0)	1.12 (0.70–1.80)	0.75 (0.47–1.20)	1.38 (0.71–2.70)	1.08 (0.57–2.04)	0.74
35–44	376, 107 (28.5)	402, 118 (29.4)	254, 70 (23.6)	264, 62 (23.5)	1.34 (0.84–2.15)	1.18 (0.75–1.86)	1.70 (0.88–3.29)	1.11 (0.58–2.09)	0.81
45–54	346, 111(32.0)	397, 124 (31.2)	253, 69 (27.6)	259, 63 (26.6)	1.60 (0.99–2.56)	1.29 (0.83–2.21)	**1.99 (1.03–3.84)**	1.31 (0.69–2.47)	0.87
55–64	182, 57 (31.3)	212, 67 (31.6)	170, 57 (33.5)	216, 49 (22.7)	1.54 (0.92–2.59)	1.32 (0.81–2.15)	**2.25 (1.14–4.45)**	1.06 (0.55–2.03)	0.69
>65	37, 10 (27.0)	49, 13 (23.5)	53, 13 (24.5)	59, 14 (23.7)	1.25 (0.54–2.89)	1.25 (0.54–2.89)	1.45 (0.61–3.45)	1.12 (0.49–2.57)	0.27
Gender					Compared with Male				
Male	769, 213 (27.7)	771, 199 (26.7)	503, 122 (24.3)	565, 128 (22.7)					0.09
Female	695, 201(28.9)	781, 232 (29.6)	540, 166 (30.7)	566, 142 (25.1)	1.06 (0.85–1.33)	1.22 (0.97–1.52)	**1.39 (1.05–1.82)**	1.14 (0.87–1.50)	0.32
Hurt at Work					Compared with zero time				
Zero time	1299, 324 (24.9)	1369, 336 (24.5)	938, 238 (25.4)	1028, 217 (21.1)					0.056
One time	106, 56 (52.8)	112, 56 (50.0)	61, 26 (42.6)	64, 30 (46.9)	**3.37 (2.25–5.03)**	**3.07 (2.08–4.45)**	**2.19 (1.29–3.71)**	**3.30 (1.97–5.51)**	0.71
Two times	17, 10 (58.8)	40, 24 (60.0)	20, 8 (40.0)	19, 9 (47.4)	**4.30 (1.62–11.37)**	**4.61 (2.42–8.79)**	1.96 (0.79–4.86)	**3.36 (1.35–8.38)**	0.54
Three or more	37, 20 (54.0)	31, 15 (48.4)	21, 13 (61.2)	20, 14 (70.0)	**3.54 (1.83–6.83)**	**2.88 (1.41–5.89)**	**4.78 (1.96–11.67)**	**8.72 (3.31–22.96)**	0.13
Physical Health					Compared with 0–13 days				
0–13 days	1482, 399 (26.9)	1449, 382 (26.4)	958, 233 (24.3)	1073, 227 (21.2)					0.001
≥ 14 days	103, 48(46.6)	89, 47 (52.8)	78, 51 (65.4)	58, 43 (74.1)	**2.37 (1.58–3.55)**	**3.13 (2.03–4.82)**	**5.88 (3.60–9.59)**	**10.68 (5.83–19.6)**	<0.001
Mental Health					Compared with 0–13 days				
0–13 days	1395, 366 (26.2)	1414, 367 (26.0)	922, 227 (24.6)	1022,207 (20.3)					0.0008
≥ 14 days	187, 80 (42.8)	122, 61 (50.0)	112, 56 (50.0)	107, 62 (57.9)	**2.10 (1.54–2.88)**	**2.85 (1.96–4.15)**	**3.06 (2.05–4.57)**	**5.42 (3.59–8.20)**	0.0005
Health Days					Compared with 0–13 days				
0–13 days	1520, 414 (27.2)	1494, 406 (27.2)	955, 256 (25.7)	1103, 249 (22.6)					0.006
≥ 14 days	66, 34(51.5)	46, 23 (60.1)	42, 28 (66.7)	27, 21 (77.8)	**2.84 (1.73–4.66)**	**2.68 (1.49–4.83)**	**5.77 (2.99–11.14)**	**12.0 (4.8–30.1)**	0.003
Sleep problems					Compared with never				

Risk factors	Pain in Arms Frequency Measures				Pain in Arms Odds Ratios				Trend
Individual factors	**Number of reports, Yes frequency, % (yes)**				**OR (95% CI)**				χ^2
	2002	**2006**	**2010**	**2014**	**2002**	**2006**	**2010**	**2014**	**p**
Never			188, 33 (17.6)	201, 23 (11.4)					0.09
Rarely			286, 56 (19.6)	292, 42 (14.4)			1.14 (0.71–1.84)	1.30 (0.76–2.24)	0.73
Sometimes			340, 104 (30.6)	387, 97 (25.1)			**2.07 (1.33–3.22)**	**2.59 (1.58–4.23)**	0.50
Often			229, 95 (41.5)	251, 108 (43.0)			**3.33 (2.11–5.27)**	**5.83 (3.54–9.65)**	0.10
Physical Factors									
Heavy lifting					Yes vs. no				
No	794, 285 (35.9)	832, 183 (22.0)	553, 127 (23.0)	582, 113 (19.4)					0.15
Yes	671, 229 (34.1)	716, 248 (33.6)	489, 161 (34.6)	547, 157 (28.7)	**1.70 (1.35–2.14)**	**1.88 (1.50–2.35)**	**1.65 (1.25–2.16)**	**1.67 (1.27–2.20)**	0.76
Hand movement					Yes vs no				
No	714, 138 (13.9)	783, 132 (16.9)	557, 101 (18.1)	588, 91 (15.5)					0.10
Yes	751, 276 (36.8)	766, 299 (39.0)	485, 187 (38.6)	537, 176 (32.8)	**2.42 (1.91–3.07**	**3.16 (2.49–4.00)**	**2.83 (2.14–3.76)**	**2.66 (2.00–3.55)**	0.59
Physical effort					Compared with very light				
Very light			264, 53 (20.1)	272, 50 (18.4)					0.62
Fairly light			295, 67 (22.7)	315, 66 (20.1)			1.17 (0.78–1.76)	1.18 (0.78–1.77)	0.98
Somewhat hard			262, 64 (24.4)	308, 82 (26.6)			1.29 (0.85–1.94)	**1.61 (1.08–2.40)**	0.44
Hard			121, 46 (38.0)	152, 36 (23.7)			**2.44 (1.52–3.93)**	1.38 (0.85–2.24)	0.10
Vary hard			98, 57 (58.2)	81, 35 (43.2)			**5.54 (3.35–9.14)**	**3.38 (1.98–5.78)**	0.19
Psychosocial Factors									
Job Satisfaction					Compared with very satisfied				
Very satisfied	721, 161 (22.3)	700, 161 (22.4)	461, 116 (25.2)	550, 109 (19.8)					0.56
Somewhat satisfied	580, 180 (31.0)	708, 216 (30.4)	463, 123 (26.6)	464, 128(27.6)	**1.57 (1.22–2.00)**	**1.47 (1.16–1.86)**	1.08 (0.80–1.45)	**1.54 (1.15–2.01)**	0.41
Not too satisfied	113, 47 (41.6)	97, 36 (47.4)	84, 35 (41.7)	81, 21 (25.9)	**2.47 (1.64–3.74)**	**1.98 (1.26–3.09)**	**2.13 (1.31–3.44)**	1.42 (0.83–2.43)	0.16
Not at all satisfied	48, 25 (52.1)	46, 18 (32.6)	35, 14 (40.0)	34, 11 (32.4)	**3.77 (2.09–6.83)**	**2.15 1.16–3.99)**	1.98 (0.98–4.03)	1.94 (0.92–4.09)	0.19
Work Freedom					Compared with not at all true				
Not at all true	66, 27 (40.9)	61, 25 (41.0)	46, 19 (41.3)	34, 16 (47.1)					0.45
Not too true	118, 40 (33.9)	144, 48 (33.3)	84, 28 (33.3)	118, 37 (31.4)	0.74 (0.40–1.14)	0.72 (0.39–1.33)	0.71 (0.34–1.49)	0.51 (0.24–1.12)	0.47
Somewhat true	453, 137 (30.2)	482, 145 (30.1)	334, 90 (27.0)	360, 82 (22.8)	0.63 (0.37–1.07)	062 (0.36–1.07)	**0.52 (0.28–0.99)**	**0.33 (0.16–0.68)**	0.12

Risk factors	Pain in Arms Frequency Measures				Pain in Arms Odds Ratios				Trend
Individual factors	**Number of reports, Yes frequency, % (yes)**				**OR (95% CI)**				χ^2
	2002	**2006**	**2010**	**2014**	**2002**	**2006**	**2010**	**2014**	**p**
Very true	825, 209 (25.3)	849, 212 (25.0)	578, 151 26.1)	616, 134 (21.8)	**0.49 (0.29–0.82)**	**0.48 (0.28–0.82)**	**0.50 (0.27–0.93)**	**0.31 (0.16–0.63)**	0.24
Supervisor support					Compared with very true				
Very true	523, 136 (26.1)	539, 114 (21.2)	379, 92 (24.3)	436, 103 (23.6)					0.33
Somewhat true	614, 156 (25.4)	641, 182 (28.4)	422, 102 (24.2)	473, 99 (20.9)	0.97 (0.74–1.27)	**1.48 (1.13–1.93)**	0.99 (0.72–1.37)	0.86 (0.63–1.17)	0.69
Not too true	196, 67 (34.2)	220, 88 (40.0)	163, 68 (41.3)	156, 45 (28.9)	**1.48 (1.04–2.11)**	**2.49 (1.77–3.49)**	**2.33 (1.51–3.30)**	1.31 (0.87–1.98)	0.81
Not at all true	102, 45 (44.1)	91, 33 (36.3)	56, 22 (39.3)	49, 18 (36.7)	**2.25 (1.45–3.48)**	**2.12 (1.32–3.41)**	**2.02 (1.12–3.63)**	**1.88 (1.01–3.50)**	0.79
Work time					Compared with very true				
Very true	607, 150 (24.7)	593, 144 (24.3)	405, 99 (24.4)	473, 103 (21.8)					0.32
Somewhat true	580, 167 (28.8)	671, 182 (27.1)	459, 131 (28.5)	484, 109 (22.5)	1.23 (0.95–1.59)	1.16 (0.90–1.50)	1.23 (0.91–1.67)	1.04 (0.77–1.42)	0.45
Not too true	169, 50 (39.6)	193, 72 (37.3)	121, 39 (32.3)	135, 41 (30.4)	1.28 (0.88–1.87)	**1.86 (1.31–2.63)**	1.47 (0.94–2.29)	**1.57 (1.02–2.40)**	0.65
Not at all true	105, 46 (43.8)	79, 30 (38.0)	56, 19 (33.9)	36, 16 (44.4)	**2.38 (1.55–3.64)**	**1.91(1.17–3.12)**	1.59 (0.87–2.89)	**2.87 (1.44–5.75)**	0.79
Work fast					Compared with strongly disagree				
Strongly disagree	48, 11 (22.9)	57, 19 (33.3)	29, 7 (24.1)	19, 8 (42.1)					0.15
Disagree	477, 127 (26.6)	444, 109 (24.6)	300, 64 (21.3)	293, 68 (23.3)	1.24 (0.61–2.50)	0.65 (0.36–1.18)	0.85 (0.35–2.09)	0.42 (0.16–1.08)	0.07
Agree	619, 180 (29.1)	713, 190 (26.7)	485, 142 (29.3)	541, 105 (19.4)	1.38 (0.69–2.76)	0.73 (0.41–1.29)	1.30 (0.54–3.11)	**0.33 (0.13–0.84)**	0.03
Strongly agree	317, 94 (29.7)	332, 113 (34.0)	226, 75 (33.2)	274, 88 (32.1)	1.42 (0.69–2.90)	1.03 (0.57–1.87)	1.56 (0.64–3.82)	0.65 (0.25–1.67)	0.22
Work hours					Compared with ≤40 hrs.				
≤ 40 hrs.	746, 267 (29.6)	837, 225 (26.8)	583, 152 (26.0)	662, 151 (22.8)					0.005
41–50 hrs.	402, 111 (27.6)	377, 109 (28.9)	261, 75 (28.7)	240, 58 (24.2)	0.91 (0.69–1.19)	1.11 (0.84–1.45)	1.14 (0.83–1.58)	1.08 (0.76–1.53)	0.44
51–60 hrs.	188, 37 (19.7)	207, 61 (29.5)	129, 32 (24.8)	148, 36 (24.3)	**0.58 (0.39.0.86)**	1.14 (0.81–1.59)	0.94 (0.60–1.45)	1.09 (0.72–1.65)	0.07
61–70 hrs.	69, 21 (30.4)	60, 15 (25.0)	40, 17 (42.5)	45, 12 (26.7)	1.04 (0.61–1.78)	0.91 (0.50–1.66)	**2.10 (1.09–4.01)**	1.23 (0.62–2.44)	0.32
> 71 hrs.	55, 23 (41.1)	71, 21 (29.6)	30, 12 (40.0)	36, 13 (36.1)	1.71 (0.98–2.98)	1.14 (0.67–1.95)	1.89 (0.89–4.02)	1.91 (0.95–3.87)	0.70
Psychosocial–cont.	**2002**	**2006**	2010	2014	2002	2006	2010	2014	p
Must work					Yes vs no				
No	1041, 267 (25.7)	1100, 289 (26.2)	724, 200 (27.6)	785, 166 (21.2)					0.05
Yes	411, 146 (34.8)	429, 138 (32.2)	303, 86 (28.4)	336, 101 (30.1)	**1.55 (1.21–1.99)**	**1.33 (1.04–1.70)**	1.04 (0.77–1.40)	**1.60 (1.20–2.14)**	0.78
Safety climate (Are safety conditions good at work?)					Compared with strongly agree				

Risk factors	Pain in Arms Frequency Measures				Pain in Arms Odds Ratios				Trend
Individual factors	**Number of reports, Yes frequency, % (yes)**				**OR (95% CI)**				χ^2
	2002	**2006**	**2010**	**2014**	**2002**	**2006**	**2010**	**2014**	**p**
Strongly agree	504, 136 (27.0)	821, 197 (24.0)	527, 125 (23.7)	619, 151 (24.4)					0.48
Agree	712, 181 (25.4)	578, 172 (29.8)	414, 112 (27.1)	433, 91 (21.0)	0.92 (0.71–1.20)	1.34 (1.06–1.71)	1.19 (0.89–1.60)	0.83 (0.61–1.11)	0.20
Disagree	179, 68 (38.0)	89, 35 (39.3)	58, 26 (44.8)	49, 20 (40.8)	**1.66 (1.16–2.38)**	**2.05 (1.30–3.24)**	**2.61 (1.50–4.55)**	**2.14 (1.18–3.89)**	0.97
Strongly disagree	65, 26 (40.0)	51, 25 (49.0)	41, 25 (61.0)	28, 8 (28.6)	**1.80 (1.06–3.08)**	**3.05 (1.72–5.39)**	**5.03 (2.60–9.71)**	1.24 (0.54–2.87)	0.73
Work home					Compared with never				
Never	993, 301 (30.3)	913, 283 (31.0)	604, 194 (32.1)	679, 175 (25.8)					0.11
A few times a year.	149, 39 (26.2)	137, 36 (26.3)	97, 26 (26.8)	88, 22 (25.0)	0.82 (0.55–1.20)	0.79 (0.53–1.19)	0.77 (0.48–1.25)	0.96 (0.58–1.60)	0.67
About once a month.	85, 15 (17.7)	104, 26 (25.0)	73, 15 (20.1)	64, 13 (20.3)	**0.49 (0.28–0.87)**	0.74 (0.47–1.18)	**0.55 (0.30–0.99)**	0.73 (0.39–1.38)	0.55
About once a week.	96, 30 (31.3)	118, 22 (18.6)	80, 16 (20.0)	82, 13 (15.9)	1.05 (0.67–1.64)	**0.51 (0.31–0.83)**	**0.53 (0.30–0.94)**	0.54 (0.29–1.01)	0.08
More than once a week	188, 45 (23.9)	179, 41 (22.9)	133, 22 (16.5)	155, 35 (22.6)	0.72 (0.50–1.04)	**0.66 (0.45–0.96)**	**0.42 (0.26–0.68)**	0.84 (0.56–1.27)	0.86
Work mainly at home.	77, 18 (23.4)	82, 20 (24.4)	54, 15 (27.8)	60, 12 (20.0)	0.70 (0.41–1.21)	0.72 (0.43–1.21)	0.81 (0.44–1.51)	0.72 (0.37–1.39)	0.87
Work from home					Compared with primary job at another location				
Part of primary job at another location.			142, 27 (19.0)	131, 22 (16.8)					0.34
Taking work home to catch up.			179, 37 (20.8)	193, 40 (20.8)			1.12 (0.64–1.95)	1.30 (0.73–2.32)	0.83
Operating a home based business.			44, 14 (31.8)	63, 16 (25.4)			1.99 (0.93–4.25)	1.67 (0.81–3.50)	0.66
Other reasons			69, 16 (23.2)	63, 17 (27.0)			1.29 (0.64–2.59)	1.83 (0.89–3.76)	0.49
Work stress					Compared with never				
Never	88, 22 (25.0)	89, 12 (15.0)	59, 10 (17.0)	80, 18 (22.5)					0.86
Hardly ever	255, 55 (21.6)	254, 53 (20.1)	178, 30 (16.9)	197, 29 (14.7)	0.83 (0.47–1.46)	1.49 (0.75–2.96)	0.99 (0.45–2.18)	0.59 (0.31–1.15)	0.20
Sometimes	622, 143 (23.0)	694, 176 (25.4)	437, 116 (26.5)	515, 111 (21.6)	0.90 (0.54–1.51)	1.93 (1.02–3.64)	1.77 (0.87–3.61)	0.95 (0.54–1.67)	0.69
Often	350, 125 (35.7)	347, 110 (31.7)	266, 81 (30.5)	228, 66 (29.0)	1.67 (0.98–2.83)	**2.63 (1.37–5.06)**	**2.15 (1.04–4.45)**	1.40 (0.77–2.55)	0.33
Always	148, 68 (46.0)	174, 80 (46.0)	103, 51 (49.5)	109, 46 (42.2)	**2.55 (1.43–4.56)**	**4.82 (2.44–9.54)**	**4.81 (2.20–10.51)**	**2.52 (1.32–4.81)**	0.82
Work schedule					Compared with day shift				
Day shift	1078, 304 (28.2)	1167, 320 (27.4)	781, 206 (26.2)	812, 185 (22.8)					0.006
Afternoon shift	53, 14 (26.4)	55, 20 (36.4)	49, 16 (33.3)	56, 14 (25.0)	0.91 (0.50–1.71)	1.51 (0.86–2.66)	1.35 (0.73–2.51)	1.13 (0.60–2.11)	0.73
Night shift	94, 24 (25.5)	92, 27 (29.4)	54, 19 (35.2)	71, 20 (28.2)	0.87 (0.54–1.41)	1.10 (0.69–1.75)	1.52 (0.85–2.71)	1.33 (0.77–2.29)	0.13
Split shift	38, 11 (29.0)	29, 11 (38.0)	28, 7 (25.0)	26, 8 (30.8)	1.04 (0.51–2.12)	1.62 (0.76–3.46)	0.93 (0.39–2.22)	1.51 (0.65–3.52)	0.94

Risk factors	Pain in Arms Frequency Measures				Pain in Arms Odds Ratios				Trend
Individual factors	**Number of reports, Yes frequency, % (yes)**				**OR (95% CI)**				χ^2
	2002	**2006**	**2010**	**2014**	**2002**	**2006**	**2010**	**2014**	**p**
Irregular/on call	124, 39 (31.5)	129, 37 (28.7)	83, 25 (30.1)	86, 19 (22.1)	1.17 (0.78–1.74)	1.07 (0.71–1.59)	1.20-(0.73–1.97)	0.96 (0.56–1.64)	0.87
Rotating shift	73, 19 (26.0)	74, 15 (20.3)	44, 15 (34.1)	78, 24 (30.8)	0.90 (0.52–1.53)	0.67 (0.38–1.20)	1.44 (0.76–2.75)	1.51 (0.91–2.50)	0.05
Dichotomized factors									
Job Satisfaction					No vs yes				
Yes	1301, 341 (26.2)	1408, 377 (26.8)	924, 239 (25.9)	1014, 237 (23.4)					0.10
No	161, 72 (44.7)	143, 54 (37.8)	119, 49 (41.2)	115, 32 (27.8)	**2.28 (1.63–3.18)**	**1.66 (1.16–2.37)**	**2.01 (1.35–2.98)**	1.26 (0.82–1.95)	0.11
Safety Climate					Yes vs no				
No	244, 94 (38.5)	140, 60 (40.0)	99, 51 (51.5)	77, 28 (36.4)					0.91
Yes	1217, 320 (26.3)	1399, 369 (26.2)	941, 237 (25.2)	1052, 242 (23.0)	**0.56 (0.42–0.73)**	**0.48 (0.34–0.68)**	**0.32 (0.21–0.48)**	**0.52 (0.32–0.85)**	0.57
Work stress					Yes vs no				
No 3,4,5	965, 220 (22.8)	1029, 241 (23.4)	674, 156 (23.2)	792, 158 (20.0)					0.12
Yes 1,2	498, 193 (38.8)	521, 290 (36.5)	369, 132 (35.8)	337, 112 (33.2)	**2.14 (1.69–2.71)**	**1.88 (1.49–2.36)**	**1.85 (1.40–2.44)**	**2.00 (1.50–2.66)**	0.78
Work fast (job requires I work fast)					Yes vs no				
No	525, 139 (26.5)	501, 128 (25.6)	329, 71 (21.6)	311, 76 (24.4)					0.28
Yes	936, 274 (29.3)	1045, 307 (29.0)	711, 217 (30.5)	815, 193 (23.7)	1.15 (0.90–1.46)	1.19 (0.94–1.52)	**1.60 (1.17–2.17)**	0.96 (0.71–1.30)	0.71
Work time					Yes vs no				
No	275, 96 (34.0)	272, 102 (37.5)	177, 58 (32.8)	171, 57 (33.3)					0.50
Yes	1187, 317 (26.7)	1264, 326 (25.8)	864, 230 (26.6)	957, 212 (22.2)	0.68 (0.51–0.89)	0.58 (0.44–0.76)	0.74 (0.53–1.05)	0.77 (0.65–0.92)	0.73
Risk factor combinations									
Heavy lifting and work stress 3,4,5					Compared with no-no				
No-no	517, 94 (18.2)	554, 110 (19.9)	354, 68 (19.2)	419, 70 (16.7)					0.52
No-yes	277, 91 (32.0)	278, 73 (30.2)	199, 59 (29.7)	162, 43 (26.5)	**2.20 (1.57–3.07)**	**1.44 (1.02–2.02)**	**1.77 (1.18–2.65)**	**1.80 (1.17–2.78)**	0.59
Yes-no	448, 126 (28.1)	473, 131 (27.7)	319, 88 (27.6)	373, 88 (23.6)	**1.76 (1.30–2.38)**	**1.55 (1.16–2.07)**	**1.60 (1.12–2.30)**	**1.54 (1.08–2.17)**	0.57
Yes-yes	221, 102 (46.2)	242, 117 (48.4)	170, 73 (42.9)	174, 69 (39.7)	**3.85 (2.77–5.44)**	**3.78 (2.75–5.24)**	**3.17 (2.12–4.74)**	**3.28 (2.20–4.88)**	0.53
Interaction					1.00 (0.62–1.60)	**1.70 (1.07–2.72)**	1.12 (0.64–1.95)	1.18 (0.66–2.11)	
Heavy lifting and work fast					Compared with no-no				

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Risk factors	Pain in Arms Frequency Measures				Pain in Arms Odds Ratios				Trend
Individual factors	**Number of reports, Yes frequency, % (yes)**				**OR (95% CI)**				χ^2
	2002	**2006**	**2010**	**2014**	**2002**	**2006**	**2010**	**2014**	**p**
No-no	305, 64 (21.0)	284, 61 (21.3)	178, 38 (21.4)	188, 41 (21.8)					0.67
No-yes	488, 121 (24.8)	544, 122 (22.4)	372, 89 (23.9)	391, 71 (18.2)	1.24 (0.88–1.74)	1.06 (0.75–1.50)	1.16 (0.75–1.78)	0.80 (0.52–1.22)	0.10
Yes-no	220, 75 (34.1)	216, 67 (31.0)	151, 33 (21.9)	123, 35 (28.5)	**1.94 (1.31–2.87)**	**1.69 (1.10–2.46)**	1.03 (0.61–1.75)	1.43 (0.85–2.41)	0.08
Yes-yes	448, 153 (34.2)	500, 181 (36.2)	338, 128 (37.9)	423, 122 (28.8)	**1.94 (1.39–2.28)**	**2.07 (1.48–2.91)**	**2.25 (1.48–3.42)**	1.45 (0.97–2.18)	0.29
Interaction					0.81 (0.74–1.96)	1.19 (0.73–1.94)	**1.88 (1.01–3.49)**	1.28 (0.69–2.38)	
Heavy lifting and work time					Compared with no-yes				
No-yes	636, 137 (21.5)	671, 137 (20.4)	453, 101 (22.3)	501, 96 (19.2)					**0.02**
No-no	155, 48 (31.0)	153, 43 (28.1)	100, 26 (26.0)	81, 17 (21.0)	**1.63 (1.11–2.41)**	**1.52 (1.02–2.27)**	1.22 (0.74–2.02)	1.12 (0.63–2.00)	0.56
Yes-yes	551, 180 (32.7)	593, 189 (31.9)	410, 129 (31.5)	455, 116 (25.5)	**1.89 (1.46–2.45)**	**1.82 (1.41–2.35)**	**1.60 (1.18–2.17)**	**1.44 (1.06–1.96)**	0.27
Yes-no	119, 48 (40.3)	118, 59 (50.0)	77, 32 (41.6)	90, 40 (44.4)	**2.98 (1.98–4.48)**	**3.90 (2.60–5.85)**	**2.48 (3.50–7.98)**	**4.88 (3.26–7.31)**	0.19
Interaction					0.85 (0.48–1.49)	1.40 (0.80–2.47)	0.97 (0.55–1.74)	2.09 (0.99–4.30)	
Hand movement and work stress 3,4,5					Compared with no-no				
No-no	491, 81 (16.5)	544, 83 (15.3)	366, 54 (15.0)	432, 58 (13.4)					0.16
No-yes	223, 57 (25.6)	238, 49 (20.6)	191, 47 (24.6)	155, 33 (21.3)	**1.73 (1.18–2.55)**	1.44 (0.97–2.13)	**1.89 (1.22–2.92)**	**1.74 (1.09–2.80)**	0.79
Yes-no	474, 139 (39.3)	484, 158 (32.6)	307, 102 (33.2)	356, 98 (27.5)	**2.10 (1.54–2.86)**	**2.69 (1.99–3.64)**	**2.88 (1.98–4.18)**	**2.45 (1.71–3.52)**	0.43
Yes-yes	275, 136 (49.5)	282, 141 (50.0)	178, 85 (47.8)	181, 78 (43.1)	**4.94 (3.53–6.91)**	**5.55 (3.99–7.73)**	**5.28 (2.07–4.73)**	**3.70 (2.50–5.49)**	0.87
Interaction					1.36 (0.83–2.23)	1.43 (0.87–2.66)	0.66 (0.37–1.17)	1.14 (0.63–2.09)	
Hand movement and work fast					Compared with no-no				
No-no	301, 56 (18.6)	285, 49 (17.2)	193, 28 (14.5)	189, 38 (20.1)					0.88
No-yes	412, 82 (19.9)	494, 83 (16.8)	361, 73 (20.2)	396, 52 (13.1)	1.08 (0.74–1.58)	0.97 (0.66–1.43)	1.49 (0.93–2.40)	**0.60 (0.38–0.95)**	0.14
Yes-no	224, 83 (37.1)	215, 79 (36.7)	136, 43 (31.6)	120, 38 (31.7)	**2.57 (1.72–3.82)**	**2.80 (1.85–4.23)**	**2.73 (1.59–4.67)**	**1.84 (1.09–3.12)**	0.31
Yes-yes	524, 192 (36.6)	551, 220 (39.9)	349, 144 (41.3)	416, 138 (33.2)	**2.52 (1.79–3.54)**	**3.20 (2.25–4.55)**	**4.14 (2.63–6.52)**	**1.97 (1.31–2.97)**	0.64
Interaction					0.91 (0.55–1.49)	1.18 (0.71–1.95)	1.02 (0.54–1.92)	1.78 (0.95–3.36)	
Hand movement and work time					Compared with no-yes				
No-yes	586, 106 (18.1)	652, 105 (16.1)	474, 88 (18.6)	513, 79 (15.4)					0.14
No-no	125, 32 (25.6)	123, 25 (20.3)	82, 13 (15.6)	75, 12 (16.0)	1.56 (0.99–2.45)	1.33 (0.82–2.16)	0.82 (0.44–1.56)	1.05 (0.54–2.03)	0.20
Yes-yes	601, 211 (35.1)	612, 221 (36.1)	389, 142 (36.5)	441, 131 (29.7)	**2.45 (1.87–3.31)**	**2.94 (2.26–3.84)**	**2.52 (1.85–3.44)**	**2.32 (1.69–3.18)**	0.83

Risk factors	Pain in Arms Frequency Measures				Pain in Arms Odds Ratios				Trend
Individual factors	**Number of reports, Yes frequency, % (yes)**				**OR (95% CI)**				χ^2
	2002	**2006**	**2010**	**2014**	**2002**	**2006**	**2010**	**2014**	**p**
Yes-no	149, 64 (43.0)	149, 77 (51.7)	95, 45 (47.4)	94, 44 (46.8)	**2.41 (2.32–5.02)**	**5.57 (3.80–8.17)**	**3.95 (2.48–6.28)**	**4.83 (3.02–7.74)**	0.26
Interaction					0.89 (0.50–1.60)	1.42 (0.78–2.61)	1.89 (0.87–4.14)	1.99 (0.89–4.44)	
Physical effort 3, 4, 5 and work stress 3,4,5					Compared with no-no				
No-no			365, 62 (17.0)	437, 78 (17.9)					0.75
No-yes			194, 58 (30.0)	150, 38 (25.3)			**2.08 (1.38–3.14)**	**1.56 (1.00–2.43)**	0.35
Yes-no			306, 93 (30.1)	354, 79 (22.3)			**2.13 (1.48–3.08)**	1.32 (0.93–1.88)	0.06
Yes-yes			175, 74 (42.3)	186, 74 (39.8)			**3.58 (2.39–5.37)**	**3.04 (2.08–4.46)**	0.57
Interaction							0.86 (0.48–1.53)	1.47 0.82–2.65)	
Physical effort 3, 4, 5 and work fast					Compared with no-no				
No-no			189, 35 (18.5)	194, 44 (22.7)					0.31
No-yes			367, 85 (23.2)	391, 71 (18.2)			1.33 (085–2.06)	0.78 (0.50–1.16)	0.07
Yes-no			139, 36 (25.9)	116, 31 (26.7)			1.54 (0.91–2.61)	1.24 (0.73–2.12)	0.58
Yes-yes			342, 131 (38.3)	423, 122 (28.8)			**2.73 (1.78–4.19)**	1.38 (0.93–2.05)	**0.02**
Interaction							1.34 (0.72–2.49)	1.47 (0.79–2.75)	
Physical effort 3, 4, 5 and work time					Compared with no-yes				
No-yes			455, 92 (20.2)	508, 102 (20.1)					**0.003**
No-no			104, 28 (26.9)	79, 14 (17.7)			1.24 (0.75–2.06)	0.86 (0.46–1.59)	0.84
Yes-yes			407, 138 (33.9)	449, 110 (24.5)			**1.90 (1.12–3.20)**	1.29 (0.95–1.75)	**0.04**
Yes-no			72, 29 (40.3)	91, 43 (47.2)			**1.58 (1.16–2.15)**	**3.57 (2.24–5.68)**	**0.04**
Interaction							0.97 (0.47–2.00)	**3.22 (1.49–6.97)**	

Notes: Trend values are reported for each risk factor response choice compared to the response choice base year (2002 or 2010). Significant Odds Ratios (ORs) and Chi-square (χ^2) p values are in bold.