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ORIGINAL ARTICLE

The association between a lifetime history of work-related low back injury and future low back pain: a population-based cohort study

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Abstract

Purpose This population-based cohort study investigated the association between a lifetime history of a work-related low back injury, in those who had recovered to have no or mild low back pain, and the development of troublesome low back pain (LBP). A secondary analysis explored the possible effects of misclassification of the exposure by examining the association between a lifetime history of having taken time off work or performed light duties at work because of a work-related low back injury. Current evidence from cross-sectional studies suggests that individuals with a history of a work-related low back injury are more likely to experience future LBP. However, there is a need to examine this association prospectively in a large population-based cohort with adequate control of known confounders.

Methods We formed a cohort of 810 randomly sampled Saskatchewan adults with no or mild LBP in September 1995. At baseline, participants were asked if they had ever injured their low back at work. The secondary analysis asked if they had ever had to take time off work or perform light duties at work because of a work-related low back injury. Prospective follow-up 6 and 12 months later, asked about the presence of troublesome LBP (grade II–IV) on the Chronic Pain Grade Questionnaire. Multivariable Cox proportional hazards regression analysis was used to estimate these associations while controlling for known confounders.

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Results The proportion followed up at 6 and 12 months was 76 and 65 %, respectively. We found an association between a history of work-related low back injury and the onset of troublesome LBP after controlling for gender (adjusted HRR = 2.24; 95 % CI 1.41–3.56). When covariates that may also be mediators of the association were added to the model, the effect estimate was attenuated (adjusted HRR = 1.37; 95 % CI 1.41–3.56). We found a similar association between a lifetime history of having taken time off work or had to work light duties at work because of a work-related low back injury, adjusted for gender (adjusted HRR = 2.31; 95 % CI 1.39–3.85) which was also diluted by the further adjustment for covariates that may also be mediators of the association (adjusted HRR = 1.80; 95 % CI 1.08–3.01).

Conclusion Our study suggests that a history of work-related low back injury or taking time off work or having to perform light duties at work due to a work-related low back injury may be a risk factor for the development of troublesome LBP. Residual confounding may account for some of the observed associations, but this was less in the group who took time off work or had to work light duties due to a work-related low back injury.

Keywords Low back pain · Occupational injuries · Risk factors · Cohort studies

Introduction

Globally, low back pain (LBP) is the leading cause of years lived with disability and this has not changed over the last 20 years [1]. LBP as a cause of disability adjusted life years (DALY) has gone from a rank of eleventh in 2000 to sixth place in 2010. This puts LBP just behind HIV/AIDS in the absolute measure of health loss [2]. The economic burden of LBP has substantial direct and indirect costs [3]. The prevalence of LBP tends to be higher in females and in those aged 40–80 [4]. Over a period of 1 month, and 1 year, the prevalence of LBP is 30.8 and 38.0 %, respectively [4]. LBP in the general population is common and is marked by a recurrent or persistent course [5]. Most LBP is mild and has a good prognosis, resulting in no primary care visits [6]. In a systematic review of prognosis studies in patients who had sought care for LBP, only one-third of patients had recovered by 12 weeks, and 65 % still reported LBP 1 year later [7]. Troublesome LBP can have an impact on future physical health related quality of life (HRQoL) [8].

Risk factors for LBP are multifactorial and include many individual, psychological and occupational factors such as low education, stress, anxiety, depression, job dissatisfaction, low levels of social support and exposure to whole body vibration [9]. Physical risk factors for LBP in occupational settings include body mass index (BMI) over 30, less work experience, poor health behaviours, low assessment of physical fitness and prior LBP [10].

A question often debated by workers, clinicians, employers and workers' compensation boards is whether a work-related low back injury will predispose a worker to experience future LBP and disability. Three cross-sectional studies found a positive association between a prior low back injury and current LBP [11–13]. Cross-sectional studies are susceptible to issues of temporality and recall bias. Yet, there is no evidence from prospective studies that work-related low back injuries increase the risk of future LBP. The purpose of this analysis was to test the association between a history of a work-related low back injury and future troublesome LBP in a general population sample. A secondary analysis examined the association between a history of time off work or light duties due to a work-related low back injury and future troublesome LBP.

Methods

Study design and source population

We used data from the Saskatchewan Health and Back Pain Survey (SHBPS), a population-based, 21-page mailed survey of the distribution, determinants and risks of spinal disorders in the province of Saskatchewan [14]. Saskatchewan is a Canadian province of approximately one million inhabitants that provides universal health care coverage. Eligible for the study were Saskatchewan residents between the ages of 20 and 69 who held a valid Health Services card on August 31, 1995. Excluded were inmates of correctional facilities, residents under the Office of the Public Trustee, foreign students and workers holding employment or immigration visas, and residents of special care homes [15].

An age-stratified random sample of residents was selected from the Saskatchewan Health Insurance Registration File. The Health Insurance Registration File is a representative and complete list of Saskatchewan residents that includes more than 99 % of the population. Saskatchewan Health randomly selected the participants and mailed all surveys to protect the confidentiality of the participants. Participation was voluntary. The University of Saskatchewan Advisory Committee on Ethics in Human Experimentation approved the SHBPS.

Study sample

Of the eligible 593,464 individuals, 2184 were randomly selected. One hundred and nineteen baseline questionnaires were returned due to mailing errors, five because of 'health reasons', four individuals had emigrated and one had died. Of the 2055 remaining participants, 1133 (55.1 %) returned

baseline questionnaires. Participants outside of the pre-determined age range completed two questionnaires and 21 participants did not complete the LBP questionnaire. Therefore, the eligible sample for this analysis includes 1110 participants. A comparison of the eligible population and the randomly selected sample revealed no important differences in age or gender. However, a comparison of participants and nonparticipants suggested that older individuals, women and those married were slightly more likely to participate [15].

Data collection

The baseline data was collected in September 1995 and the follow-up data was collected 6 and 12 months later. The 6-month follow-up questionnaire was sent to respondents of the baseline questionnaire, and the 12-month follow-up to respondents of the 6-month follow-up.

Population at risk

The population at risk for troublesome LBP (Grade II–IV LBP) for this analysis consisted of individuals who reported Grade 0 or Grade I LBP at baseline on the Chronic Pain Grade Questionnaire (CPQ) (Table 1). Given that most individuals suffer from mild (trivial) LBP annually, we included Grade I LBP in our population at risk of developing troublesome LBP (Grade 0–I LBP).

Exposure

The main exposure was measured by asking participants: "Have you ever injured your low back at work?" It is possible that some answering yes to this question had a very minor low back injury so to check for misclassification of our exposure an alternative question was assessed in a separate analysis. The secondary exposure question asked: "Have you ever had to take time off work or perform light duties at work because of a work-related low back injury?"

Outcome

LBP was measured with the CPQ at baseline, and 6 and 12 months later. The questionnaire measured the 6-month period prevalence of LBP, LBP grades, and related disability into five ordered categories (Table 1), based on seven questions, and has been described elsewhere [14, 16]. The instrument has good psychometric properties [17]. Participants reporting Grades II, III or IV LBP in the previous 6 months were classified as having troublesome LBP.

Table 1 Classification of low back pain grade

Grade	Scoring	Interpretation
'0'	No pain, no disability	No chronic pain
'I'	PI <50; DP <3	Low pain intensity/low disability
'II'	PI ≥50; DP <3	High pain intensity/low disability
'III'	DP = 3–4	High disability/moderately limiting
'IV'	DP = 5–6	High disability/severely limiting

PI pain intensity, *DP* disability points

Potential confounders

Baseline low grade LBP may either lie on the casual pathway between a history of work-related low back injury and the development of troublesome LBP (making it an intermediate variable and not a confounder), or increase the risk of troublesome LBP (potential confounding effects). The potential confounding influences were considered in a separate analysis along with other potential confounders that might instead be mediators of the association (depressive symptomatology and HRQoL).

Socio-demographics

Gender, age, marital status, education level, income, employment status and location of residence (city, town, village, rural municipality and First Nations Reserve) measured at baseline were included in the analysis.

HRQoL (SF-36)

The Medical Outcomes Study SF-36 standard English-Canadian version 1.0 was used to measure self-perceived general health status [18]. The questionnaire assesses HRQoL in eight domains: physical functioning, bodily pain, role limitations due to physical health problems, role limitations due to emotional health, mental health, social functioning, vitality, and general health. The SF-36 has been shown to have high internal consistency [19] and test–retest reliability [20]. The SF-36 has been shown to have good validity in studies involving physical and mental health criteria when compared to the longer questionnaire used in the Medical Outcomes Study [21]. This analysis uses the physical component summary (PCS) and mental component summary (MCS) measures of the SF-36 which has a reliability estimate that usually exceeds 0.90 [21, 22].

Comorbidities

The presence of comorbidities and their self-perceived impact on health were measured with the Comorbidity Questionnaire. The questionnaire includes questions about allergies, arthritis, cancer, high blood pressure, heart/circulation, digestive disorders, headaches and kidney disorders. The self-perceived impact of each comorbidity on one's health is rated on a four point ordinal scale as: (1) not

at all, (2) mild, (3) moderate and (4) severe. The questionnaire has been shown to have good test–retest reliability (ICC = 0.93) and adequate face, concurrent and convergent validity [23, 24].

Depressive symptomatology

The Center for Epidemiological Studies Depression Scale (CES-D) was used to measure depressive symptomatology [25]. This questionnaire has a possible score of 60 with 16 as the cut-off score for depression in the general population which has a sensitivity of 100 % for major depression and a specificity of 88 % [26]. The CES-D was used as a continuous variable in this analysis. The questionnaire has been shown to be reliable and valid in various populations with good internal consistency (alpha coefficients >0.85) [23, 25, 27, 28].

General health

Cigarette smoking (nonsmoker, ex-smoker or current smoker) and body mass index.

Analysis

We described the baseline characteristics of the sample stratified by exposure status. Chi square and *t* test was used to examine differences between those with a work-related low back injury to those without in both exposure groups. We aimed to determine whether loss to follow up led to attrition bias by comparing baseline characteristics between responders and non-responders at 6- and 12-month follow-up using the Chi square and *t* test.

We built Cox proportional hazards models to measure the association between a history of work-related low back injury and troublesome LBP. Our modeling included three steps. First, we built a univariable model to estimate the crude association between our exposure and outcome. Second, we built a series of bivariable models to determine which variables were confounders of the association of interest. Variables that led to a 10 % change in the exposure regression coefficient were deemed to be confounders and included in the final model. Third, our final model included the exposure and all confounders identified in the second step [29]. IBM-SPSS version 22 was used for the analysis [30]. This three-step process was repeated in a secondary analysis using the exposure question "Have you ever had to take time off work or perform light duties at work because of a work-related low back injury?"

Variables deemed to be possible mediators on the causal pathway (depressive symptomatology, HRQoL and baseline LBP) were excluded in the first Cox model and included in a separate model if there was a 10 % change in the exposure regression coefficient in the bivariate model. This process was also used for the analysis of the secondary exposure question.

Results

Sample characteristics

Our population at risk included 810 participants. A history of a work-related low back injury was reported by 269 subjects (33.2 %) and 163 subjects (22.1 %) reported having time off work or performed light duties due to a low back injury at work. Seventy-five subjects developed troublesome LBP during the 12 months of the study, 47 at 6 months and another 28 at 12 months.

More participants with a history of work-related low back injury were male, lived in a rural location, had arthritis (non-low back related) and had grade I LBP compared to those without a history of work-related low back injury (all at $p < 0.05$). Those participants who had taken time off work or performed light duties due to a work-related low back injury more were likely to be male, live in a rural setting, arthritis, headaches and grade I LBP (all at $p > 0.05$) (Table 2).

Attrition

The follow-up rate was 76.0 % (616/810) at 6 months and 64.9 % (526/810) at 12 months. Respondents at 6 months were, on average older than non-respondents by 4.4 years, less likely to smoke, and more likely to have higher education and higher income (all at $p < 0.05$). Respondents to the 12-month survey were, on average older than non-respondents by 5.2 years, less likely to smoke, less likely to have cardiovascular problems that impact their health, and more likely to have a higher income and higher education (all at $p < 0.05$). There was no statistically significant difference in baseline SF-36 scores or back pain grade between respondents and non-respondents.

Association between history of work-related low back injury and troublesome LBP

We found a positive crude association between a history of work-related low back injury and the development of troublesome LBP over a 12-month period (Hazard Rate Ratio = 2.01; 95 % CI 1.28–3.16). Adjusting for gender increased the strength of this association (HRR = 2.24; 95 % CI 1.41–3.56). Adjusting for covariates that may be mediators on the causal pathway (depressive symptomatology, PCS and baseline graded LBP) along with gender further reduced this association (HRR = 1.37; 95 % CI 0.82–2.29) (Table 3).

Table 2 Frequency distribution of the baseline demographic, socioeconomic, comorbidities and health related characteristics by exposure category

Characteristic	History of work-related low back injury		Time off/light duties due to low back injury at work	
	Yes (%)	No (%)	Yes (%)	No (%)
Age (years)				
Mean (SD)	44.7 (12.5)	44.0 (13.7)	45.8 (12.3)	43.8 (13.5)
Gender (no; %)				
Male	171 (63.6)	228 (42.1)	113 (69.3)	291 (44.4)
Female	98 (36.4)	313 (57.9)	50 (30.7)	364 (55.6)
Marital Status (no; %)				
Married	210 (78.7)	398 (74.3)	129 (79.6)	485 (74.7)
Separated/divorced	22 (8.2)	33 (6.2)	13 (8.0)	44 (6.8)
Widowed	2 (0.7)	14 (2.6)	2 (1.2)	14 (2.2)
Single	91 (12.4)	91 (17.0)	18 (11.1)	106 (16.3)
Location of residence (no; %)				
Urban	86 (32.1)	214 (39.6)	49 (30.2)	256 (39.1)
Rural	182 (67.9)	326 (60.4)	113 (69.8)	398 (60.9)
Annual household income (no;%)				
$0–20,000	56 (21.9)	96 (19.5)	35 (22.7)	118 (19.6)
$20,001–40,000	86 (33.6)	173 (35.1)	50 (32.5)	211 (35.0)
40,001–60,000	54 (21.1)	119 (24.1)	35 (22.7)	140 (23.2)
Over 60,000	60 (23.4)	105 (21.3)	34 (22.1)	134 (22.2)
Education (no; %)				
Less than grade 8	17 (6.4)	28 (5.2)	13 (8.0)	32 (4.9)
High school	64 (24.0)	103 (19.3)	41 (25.3)	128 (19.8)
High school grad	68 (25.5)	146 (27.3)	41 (25.3)	175 (27.0)
Post-secondary	84 (31.5)	167 (31.2)	50 (30.9)	202 (31.2)
University grad	34 (12.7)	91 (17.0)	27 (10.5)	111 (17.1)
Full time worker (no; %)				
Yes	152 (57.6)	269 (50.5)	95 (59.0)	332 (51.6)
No	112 (42.4)	264 (49.5)	66 (41.0)	312 (48.4)
Part time worker (no; %)				
Yes	47 (17.8)	79 (14.8)	26 (16.1)	99 (15.4)
No	217 (82.2)	453 (85.2)	135 (83.9)	544 (84.6)
Unemployed (no; %)				
Yes	14 (5.3)	26 (4.9)	7 (4.3)	34 (5.3)
No	250 (94.7)	507 (95.1)	154 (95.7)	610 (94.7)
Retired (no; %)				
Yes	29 (11.0)	61 (11.4)	21 (13/0)	70 (10.9)
No	235 (89.0)	472 (88.6)	149 (87/0)	574 (89.1)
Homemaker (no; %)				
Yes	32 (12.1)	105 (19.7)	18 (11.2)	120 (18.6)
No	232 (87.9)	428 (80.3)	143 (88.8)	524 (81.4)
Student (no; %)				
Yes	10 (3.8)	26 (4.9)	5 (3.1)	31 (4.8)
No	254 (96.2)	507 (95.1)	156 (96.9)	613 (95.2)
Comorbidities				
Allergy				
Absent	149 (57.1)	326 (61.6)	87 (55.1)	392 (61.3)
No/min impact on Hlth	86 (33.0)	157 (29.7)	52 (32.9)	194 (30.3)

Table 2 continued

Characteristic	History of work-related low back injury		Time off/light duties due to low back injury at work	
	Yes (%)	No (%)	Yes (%)	No (%)
Mod./sev impact on Hlth	26 (10.0)	46 (8.7)	19 (12.0)	54 (8.4)
Arthritis				
Absent	187 (72.2)	427 (81.6)	106 (67.9)	514 (81.1)
No/min impact on Hlth	46 (17.8)	76 (14.5)	32 (20.5)	91 (14.4)
Mod./sev impact on Hlth	26 (10.0)	20 (3.8)	18 (11.5)	29 (4.6)
Breathing disorders				
Absent	183 (69.8)	398 (75.2)	106 (67.1)	480 (74.9)
No/min impact on Hlth	60 (22.9)	106 (20.0)	39 (24.7)	130 (20.3)
Mod./sev impact on Hlth	19 (7.3)	25 (4.7)	13 (8.2)	31 (4.8)
Cancer				
Absent	257 (97.0)	511 (95.5)	156 (97.5)	621 (95.7)
No/min impact on Hlth	6 (2.3)	21 (3.9)	2 (1.3)	25 (3.9)
Mod./sev impact on Hlth	2 (0.8)	3 (0.6)	2 (1.3)	3 (0.5)
Cardiovascular disorders				
Absent	230 (87.5)	467 (87.6)	140 (88.1)	566 (87.8)
No/min impact on Hlth	27 (10.3)	50 (9.4)	17 (10.7)	60 (9.3)
Mod./sev impact on Hlth	6 (2.3)	16 (3.0)	2 (1.3)	19 (2.9)
Digestive disorders				
Absent	203 (76.6)	422 (79.2)	146 (93.6)	608 (94.6)
No/min impact on Hlth	43 (16.2)	81 (15.2)	7 (4.5)	31 (4.8)
Mod./sev impact on Hlth	19 (7.2)	30 (5.6)	3 (1.9)	4 (0.6)
Headaches				
Absent	112 (42.6)	270 (50.8)	62 (39.0)	321 (49.9)
No/min impact on Hlth	111 (42.2)	197 (37.0)	68 (42.8)	244 (37.9)
Mod./sev impact on Hlth	40 (15.2)	65 (12.2)	29 (18.2)	78 (12.1)
Hypertension				
Absent	232 (88.5)	461 (86.8)	141 (89.2)	560 (87.1)
No/min impact on Hlth	23 (8.8)	51 (9.6)	12 (7.6)	63 (9.8)
Mod./sev impact on Hlth	7 2.7	19 (3.6)	5 (3.2)	20 (3.1)
Kidney disorders				
Absent	219 83.0	453 (85.0)	133 (83.6)	546 (84.7)
No/min impact on Hlth	39 14.8	66 (12.4)	22 (13.8)	83 (12.9)
Mod./sev impact on Hlth	6 2.3	14 (2.6)	4 (2.5)	16 (2.5)
Depressive symptoms				
Score (SD)	9.7 (8.8)	8.4 (8.6)	9.8 (8.7)	8.5 (8.6)
Characteristic				
Cigarette smoking				
Never smoked	133 (51.2)	299 (57.1)	73 (46.5	365 (57.5)
Past smoker	62 (23.8)	120 (22.9)	46 (29.3	137 (21.6)
Current Smoker <1 pack	40 (15.4)	72 (13.7)	23 (14.6	90 (14.2)
Current Smoker >1 pack	25 (9.6)	33 (6.3)	15 (9.6	43 (6.8)
Body mass index (Kg/m^2) (SD)	26.5 (4.4)	25.9 (4.6)	26.5 (4.0)	26.0 (4.6)
SF36 Mean (SD)				
PCS	51.6 (7.9)	53.0 (7.6)	50.7 (8.36)	53.0 (7.4)
MCS	50.0 (10.1)	51.6 (9.1)	50.0 (10.4)	51.4 (9.2)
Graded LBP				
Grade 0	48 (17.8)	249 (46.0)	30 (18.4)	274 (41.8)

Table 2 continued

Characteristic	History of work-related low back injury		Time off/light duties due to low back injury at work	
	Yes (%)	No (%)	Yes (%)	No (%)
Grade 1	221 (82.2)	292 (56.9)	133 (81.6)	381 (58.2)

Min minimal, *mod* moderate, *sev* severe, *disabil* disability, *hlth* health

Table 3 Crude and adjusted HRRs and 95 % CIs for the association between the main and supplementary independent variables and future troublesome LBP

Exposure	Crude HRR[d]	Adjusted HRR	Adjusted HRR
Work-related low back injury ($n = 269$)	2.01 (1.28–3.16)	2.24 (1.41–3.56)[a]	1.37 (0.82–2.29)[b]
Time off or light duties due to work-related low back injury ($n = 163$)	1.99 (1.21–3.25)	2.31 (1.39–3.85)[a]	1.80 (1.08–3.01)[c]

[a] Adjusted for gender

[b] Adjusted for gender, depressive symptomatology, PCS HRQoL and baseline LBP

[c] Adjusted for gender and baseline LBP

[d] Hazard rate ratio

Association between a history of time off work or performing light duties at work due to a work-related low back injury and troublesome LBP

We found a positive crude association between a history of time off work or performing light duties at work because of a work-related low back injury and the development of troublesome LBP over a 12-month period (HRR = 1.99; 95 % CI 1.21–3.25). Adjusting for gender increased the strength of this association (HRR = 2.31; 95 % CI: 1.39–3.85). Adjusting for baseline graded LBP along with gender further reduced this association (HRR = 1.80; 95 % CI 1.08–3.01) (Table 3).

Discussion

Our survey was the first North American cohort study from the general population to prospectively investigate the association between a lifetime history of work-related low back injury in those who had recovered to have no or mild low back pain and the development of future troublesome LBP. Further, the secondary analysis examined this association in those who had lost time from work or had performed light duties from a work-related low back injury and the development of troublesome LBP. Our results suggest that the incidence of troublesome LBP may be higher in individuals who have had a work-related low back injury and in those who had lost time from work or had to do light duties. However, residual confounding may account for some of the observed association, especially in the group reporting a prior history of a work-related low back injury.

Three cross-sectional studies reported a positive association between a work-related low back injury and LBP. In a cross-sectional study using the SHBPS, Hincapié et al. found that in 1086 subjects there was a positive association between graded LBP as measured on the CPQ and a history of a work-related low back injury after controlling for covariates [11]. This association had a gradient effect with worsening LBP; grade I LBP (OR, 3.66; 95 % CI 2.48–5.42), grade II LBP (OR, 4.03; 95 % CI 2.41–6.76) and grade III-IV LBP (OR, 6.76; 95 % CI 3.80–12.01). This study examined all the participants in the baseline survey of the SHBPS, which included those with troublesome LBP. The current prospective study from the SHBPS excluded participants with troublesome LBP which may have underestimated this association since some of the subjects at baseline with troublesome LBP may have developed a new incident episode of LBP prior to the baseline survey but after the work-related low back injury. Further, excluding those with prevalent troublesome LBP at baseline helped to reduce potential differential misclassification of the exposure measure and prevalence-incidence bias. A large cross-sectional study ($n = 4290$) from the US National Health Interview Survey (1989) found an association between traumatic back injury and chronic back disability (adjusted OR = 1.65; 95 % CI 1.52–1.80) which is similar to the results of our study [12]. In a cross-sectional study on 165 seafood processing factory workers in Thailand, there was a positive association between a history of low back injury and LBP (adjusted OR = 7.82; 95 % CI 2.54–24.07) [13]. This study did not account for the intensity of LBP [13]. Cross-sectional studies cannot inform on the issue of causality, as it is difficult to ascertain whether the onset of LBP occurred prior to the low back

injury. Further, those with prevalent LBP may be more likely to recall a previous work-related low back injury.

There are several strengths to our study. First, we used data from a large prospective, population-based random sample of Saskatchewan adults. Second, we used a valid and reliable measure of LBP. Third, we used Cox Proportional Hazards modeling to control for the confounding effects of baseline socioeconomic status, general health, and comorbidity.

Our study also has limitations. Risk factors for future episodes of LBP, such as a work-related low back injury, may have a mediating effect on the incidence of pain and disability in those with a prior history of LBP. Future studies need to test this hypothesis possibly using structural equation modeling. Second, the exposure, a history of work-related low back injury, could suffer from general misclassification. We do not feel that our results suffered from misclassification bias as we found similar results when we tested a secondary question "Have you ever had to take time off work or perform light duties at work because of a low back work injury?" Third, the analysis of attrition found that the results of this study could have been underestimated. Respondents had a higher baseline socioeconomic status and were less likely to smoke than non-respondents. However, respondents were also older than non-respondents, but did not differ in their baseline HRQoL indicating that health status was no different between the two groups. Fourth, the SHBPS had a 55 % response rate in the baseline survey. This may introduce selection bias and decrease the generalizability of our findings but this is unlikely as the SHBPS used an accurate and complete sampling frame and a random sample of adults selected from the population [31]. Further, the differences between respondents and non-respondents in the initial waves of the survey suggested no selective response bias due to LBP [31]. Fifth, our data is 19 years old but we know of no secular trends in LBP that would affect our data and the measures we used are state of the art and still in use. Finally, we cannot rule out the presence of residual confounding. Baseline LBP, PCS HRQoL and depression were responsible for a reduction in the association between a history of a work-related low back injury and future LBP. The observed association may have been over-estimated, if these variables were in fact confounders. Conversely, controlling for these baseline variables may have led to over-adjustment as they may be on the causal pathway [32]. Therefore, the true association between a history of a work-related low back injury and future LBP may be somewhere between our model that adjusted for gender and the model which adjusted for gender, depressive symptomatology, PCS HRQoL and baseline LBP. This difference was not as great between the final models of the secondary analysis using the question "Have you ever lost time from work or had to perform light duties due to a work-related low back injury?" Our study design did not allow us to examine these complex pathways between mediators and confounders of the association of interest which may have led to residual confounding.

Our results inform the debate surrounding the etiology of LBP in the population. LBP is a recurrent disorder characterized by periods of fluctuating pain and disability with few studies identifying risk factors for recurrent episodes of LBP. Our study informs the hypothesis that a past history of a work-related low back injury may be one of the determinants of recurrent LBP. This paper suggests that residual confounding may account for some of the observed associations but these confounding variables may be mediators on the causal pathway between the exposure and the outcome. Future large cohort studies need to examine this association with careful a priori attention to confounding.

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Compliance with the ethical standards

Conflict of interest None.

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