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Sociodemographic, clinical, and work characteristics associated with return-to-work outcomes following surgery for work-related knee injury

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Objective This study examined the association between return-to-work (RTW) outcomes and sociodemographic, clinical, and work characteristics among a cohort of injured workers who underwent knee surgery between 2001–2005 in British Columbia, Canada.

Methods Workers' compensation databases were used to identify the retrospective cohort and abstract the study variables. Multinomial logistic regression provided odds ratios (OR) and 95% confidence intervals (95% CI) for the association between RTW (unspecified, partial, full, or non-RTW) and the independent variables.

Results Data was abstracted for 1394 injured workers. Compared to men, women were more likely to have partial RTW (OR 2.55, 95% CI 1.53–4.23) and non-RTW (OR 2.61, 95% CI 1.35–5.03) than full RTW; low income earners were more likely than high income earners to have partial RTW (OR 3.05, 95% CI 1.86–4.99) and non-RTW (OR 4.07, 95% CI 2.19–7.57). Moreover, workers in trade, primary resource, and processing/manufacturing occupations were more likely than those in management occupations to have non-RTW than full RTW by the end of follow-up (OR 2.97, 95% CI 1.32–6.68; OR 9.31, 95% CI 3.41–25.41, and OR 2.71, 95% CI 1.07–6.5, respectively). Surgical and clinical factors were not associated with RTW outcomes.

Conclusions Using population-based data, our study found a link between sociodemographic and work characteristics and the type of RTW outcome following knee surgery for a work-related injury. Women and lower income earners tended not to have full RTW, after controlling for covariates. Workers in physically demanding occupations also tended not to have full RTW, suggesting that factors beyond clinical and surgical characteristics influence disability outcomes. RTW programs need to take into consideration these broader determinants of worker health.

Key terms disability; musculoskeletal injury; workforce participation; work-related injury outcome; cohort study.

The occupational injury rate in Canada, as measured by workers' compensation claims for lost time, has decreased over the past ten years (1). In the province of British Columbia, for example, the rate reached an all-time low of 2.96 injury claims per 100 worker-years of employment in 2008, representing a 27% reduction since 1999 (2). Nested within these statistics are musculoskeletal injuries (eg, strains, sprains, and tenosynovitis), which remain one of the major causes of work-related injury and disability. Conditions affecting the musculoskeletal system can be chronic and recurrent, and often result in long-term disability and increased demands on the healthcare system (3). According to workers' compensation reports in British Columbia, musculoskeletal

injuries accounted for almost 60% of all lost-time claims and disability days and costs (4). More specifically, the volume of knee and hip procedures has risen over the years (5), and procedures involving the knee meniscus have remained the most common surgery among all work injuries that proceed to surgical intervention in British Columbia.

Research has focused on identifying factors that influence the return-to-work (RTW) trajectory following musculoskeletal injury (6–8). Sociodemographic and work factors such as age, gender, wage, occupation, and industry have been associated with RTW and disability outcomes (6, 8). Other factors, such as job satisfaction, pain levels, goal-setting, and recovery expectations have

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been linked with RTW in some (9–11), but not all (7) studies. While much of the previous research has focused on outcomes following low-back injury or sick leave as a whole, there is little evidence regarding return-to-work outcomes following work-related knee injury and surgery, although some research has examined clinical outcomes following knee meniscectomy (12).

More than 20 different measures have been used to define work disability and RTW outcomes in previous research (13). While many studies have focused on time and cost measures (such as time to RTW, time to claim closure, days compensated, or compensation costs), only a few have investigated types of RTW such as return to full or partial duties (14–18). Refined RTW measures may be of interest to a variety of stakeholders, including workers, employers, healthcare providers, and compensation boards (19), as the type of RTW outcome may influence worker health, financial costs, and workforce productivity. Moreover, previous studies have demonstrated the importance of an earlier RTW following injury. As the likelihood of successful return decreases with longer absences (20), modified RTW programs become increasingly important in order to ensure that workers successfully return and reintegrate into the workforce (21).

The objective of this research was to examine and identify the sociodemographic, clinical, and work factors related to RTW outcomes following surgery for an accepted workers' compensation claim for a knee injury. RTW outcomes were defined by participation level in the workforce as partial, full, unspecified, or non-RTW.

Methods

Study sample

We used administrative health data maintained by WorkSafeBC, the provincial workers' compensation system of British Columbia, Canada, for this study. WorkSafeBC is an independent agency governed by a Board of Directors appointed by the government of British Columbia. The compensation system provides medical treatment, disability payments, and occupational rehabilitation to all workers who are adjudicated to have been injured while at work. An estimated 93% of British Columbia's employed workforce is covered under this no-fault system, which is funded by employers through insurance premiums. WorkSafeBC maintains a claims database containing information on the injuries reported and accepted for compensation; data include demographic variables, injury information, service dates, compensation amounts, and occupation classification.

WorkSafeBC also maintains a clinical database of documents such as physician referrals and consultation letters, operative reports, invoices for surgical services, and detailed case manager logs.

Using WorkSafeBC claims and clinical records, we identified a retrospective cohort of 3259 injured workers who underwent meniscal knee surgery between 2001–2005. The study sample was restricted to knee meniscectomy or meniscal-repair-only and day procedures (less than 24-hour total stay) for a comparison of RTW outcomes by the study variables. Due to the intensive process of manually abstracting study data from the clinical documents, we selected a random sample of 1610 claims (stratified by study year and public hospital/private clinic surgery setting) from the eligible knee surgery sample for inclusion in the study. A total of 216 claims were excluded due to either being ineligible ($N=136$) based on information obtained from the data abstraction (eg, out-of-province surgery, lost to follow-up) or missing data ($N=80$) (eg, no operative report), resulting in a final study cohort of 1394 workers (table 1). This study sample represented individuals with a time-loss claim for a work-related injury defined as an accepted short-term disability claim requiring at least one full day away from work.

The workers' compensation cohort defined by meniscal surgery for a work-related knee injury was comprised mostly of men (84%), with a mean age of 46 years and an annual wage of \$45 400 (Canadian dollars). Overall, 86% ($N=1199$) returned to work, of which 436 had partial RTW, 324 had full RTW, and 439 had unspecified RTW. The remaining 195 (14%) did not return to work within 365 days of follow-up from surgery (non-RTW). Trades (including mechanics and construction workers) accounted for 32% of all occupations. The most common co-morbidity was osteoarthritis, ranging from 34% among those partially returning to work, and 13% among those not returning to work.

Two full-time data abstraction technicians reviewed the workers' compensation clinical records to extract the study outcomes and independent variables. To assess reliability of the variables, a random sample (10%) of all records was dual-abstracted by both data technicians. RTW outcomes were entirely dual-abstracted to ensure valid and reliable outcome measures. The Behavioural Research Ethics Board of the University of British Columbia approved the research protocol (certificate number H06-80221).

Return-to-work variables

The primary RTW outcome was abstracted directly from electronic claim records (often case manager reports), and categorized into four values: partial, full, unspecified, and non-RTW. The RTW outcome was deemed

Table 1. Sociodemographic, clinical, and work characteristics for a cohort of injured workers (N=1394) who underwent meniscal knee surgery, by return-to-work (RTW) status. [95% CI = 95% confidence interval.]

	Observed	Full RTW (N=324)		Partial RTW (N=436)		Non-RTW (N=195)		Unspecified RTW ^a (N=439)	
		%	95% CI	%	95% CI	%	95% CI	%	95% CI
Age (overall mean: 45.5 years)									
<30 years	106	12.30	7.3–20.0	26.40	18.9–35.6	23.60	16.5–32.6	37.70	29.0–47.3
30–40 years	291	27.80	23.0–33.3	29.20	24.3–34.7	12.00	8.8–16.3	30.90	25.9–36.5
40–50 years	497	23.10	19.6–27.1	32.40	28.4–36.6	11.70	9.1–14.8	32.80	28.8–37.1
>50 years	500	23.00	19.5–26.9	32.40	28.4–36.6	15.40	12.5–18.8	29.20	25.4–33.3
Wage per annum (overall mean: \$45 400 Canadian)									
<\$30 000	315	17.10	13.4–21.7	24.40	20.0–29.5	24.80	20.3–29.8	33.70	28.6–39.1
\$30 000–\$40 000	275	15.60	11.8–20.4	43.60	37.9–49.6	13.10	9.6–17.6	27.60	22.7–33.2
\$40 000–\$50 000	276	24.60	19.9–30.1	36.20	30.8–42.1	8.70	5.9–12.7	30.40	25.3–36.1
\$50 000–\$60 000	231	29.40	23.9–35.6	31.20	25.5–37.4	10.00	6.7–14.5	29.40	23.9–35.6
>\$60 000	297	30.60	25.7–36.1	22.60	18.2–27.7	11.40	8.3–15.6	35.40	30.1–41.0
Gender									
Male	1165	25.10	22.7–27.6	27.60	25.1–30.2	13.40	11.6–15.5	34.00	31.3–36.8
Female	229	14.00	10.1–19.1	50.20	43.8–56.7	17.00	12.7–22.5	18.80	14.2–24.4
Occupation									
Management and professional ^b	137	23.40	17.0–31.2	32.80	25.5–41.1	8.80	5.0–14.8	35.00	27.5–43.4
Health	72	12.50	6.6–22.3	56.90	45.3–67.8	6.90	2.9–15.6	23.60	15.2–34.8
Sales and service	235	23.00	18.0–28.8	43.80	37.6–50.2	12.80	9.1–17.7	20.40	15.7–26.1
Trades ^c	446	25.10	21.3–29.4	26.20	22.4–30.5	13.90	11.0–17.4	34.80	30.5–39.3
Transport and equipment operators ^d	234	24.40	19.3–30.3	28.60	23.2–34.8	11.50	8.0–16.3	35.50	29.6–41.8
Primary-industry ^e	129	14.00	9.0–21.1	15.50	10.2–22.8	26.40	19.5–34.6	44.20	35.9–52.9
Processing, manufacturing, & utilities ^f	141	29.80	22.8–37.8	30.50	23.5–38.6	17.70	12.3–24.9	22.00	15.9–29.6
Previous same-knee surgery									
None	1109	23.80	21.4–26.4	31.80	29.2–34.6	13.30	11.4–15.4	31.10	28.4–33.9
Previous same-knee surgery	285	21.10	16.7–26.2	29.10	24.1–34.7	16.80	12.9–21.6	33.00	27.8–38.7
Osteoarthritis co-pathologies									
None	596	23.00	19.8–26.5	27.70	24.2–31.4	14.80	12.1–17.8	34.60	30.8–38.5
Osteoarthritis co-pathologies	798	23.40	20.6–26.5	34.00	30.8–37.3	13.40	11.2–16.0	29.20	26.1–32.5
RTW (yes)	1199	23.20	21.1–25.5	31.30	28.9–33.8	14.00	12.3–15.9	31.50	29.1–34.0

^a RTW was deemed unspecified if a date was found, but the data abstraction technicians could not definitively assess it as partial or full.
^b Management, business and finance, administration, social science, education, and government service.
^c Construction trades, electrical trades and telecommunications, machinists, mechanics, and trades not-elsewhere classified.
^d Heavy equipment and crane operators, and transportation equipment operators.
^e Occupations unique to primary industry (eg, mining, forestry, oil and gas).
^f Machine operators, assemblers, and laborers in mineral and metal, petroleum and gas, food and beverage, and forest products processing.

unspecified if a date was found, but the abstraction technicians could not definitively assess it as either partial or full. The time from surgery to RTW outcome was described by median calendar days (with interquartile ranges) as a secondary descriptive measure of interest. Cohort members were followed from the date of surgery until the first instance of RTW or until censored (lost to follow-up or censored at 365 days) for both the categorical and continuous measures.

Independent variables

Based on a review of the literature on RTW, the following independent variables were abstracted for analysis: (i) sociodemographic characteristics of age at the time of surgery (categorical: <30, 30–40, 40–50, >50 years);

(ii) wage at time of injury [<\$30 000, \$30 000–\$40 000, \$40 000–\$50 000, \$50 000–\$60 000, >\$60 000 (Canadian dollars)]; (iii) gender; (iv) clinical and surgical characteristics of osteoarthritis co-morbidity (yes versus no); (v) intra-articular joint co-pathologies (including osteophytosis); (vi) other previous ligament tears (anterior cruciate, medial collateral, and posterior collateral ligaments); (vii) geographic location of the procedure; (viii) surgical setting of the procedure (public hospital versus private clinic); and (ix) the expedited status of the procedure (defined as surgeries performed within approximately 21 days of decision to treat with an expedited financial fee paid by workers’ compensation system). Occupation variables were classified according to Statistics Canada’s Standard Occupational Classification (22).

Statistical analysis

Using descriptive statistics [proportions, with 95% confidence intervals (95% CI)], we compared the baseline characteristics of the study sample by the RTW outcomes. We applied multinomial logistic regression to examine the association [odds ratios (OR) with 95% CI] between the RTW outcomes and the sociodemographic, clinical/surgical, and work characteristics (23). Multinomial logistic regression for nominal outcomes is similar to running separate binary logistic models for each comparison of outcome categories. However, with multinomial logistic regression, the entire data set is used for the analysis (whereas a series of binary logits examining pairs of the outcome variables would use only the data that is available for each pair). Model selection was based on Akaike's Information Criterion (AIC) (24), to compare the fit of models with different parameters; a model was favored if the AIC value was lower. For the final multivariate models, the OR represent the change in odds of returning to partial, unspecified, or non-RTW versus full RTW, compared with the reference category for each covariate. Robust standard errors were obtained via bootstrap estimation with 1000 replications to account for potential model misspecification. The covariates of age, gender, and wage were retained in the final model as known predictors or confounders for the outcomes.

Results

Following knee surgery for a work-related injury, women had higher odds of partial or non-RTW compared to full RTW. This finding remained consistent in the final model adjusted for covariates (OR 2.55, 95% CI 1.53–4.23 for partial RTW, and OR 2.61, 95% CI 1.35–5.03 for non-RTW). Workers with lower annual incomes had higher odds of partial, unspecified and non-RTW versus full RTW following surgery. For example, workers earning <\$30 000 per year compared to those earning >\$60 000 had an increased odds for non-RTW (OR 4.07, 95% CI 2.19–7.57) and those earning \$30 000–40 000 had an increased odds for partial RTW (OR 3.05, 95% CI 1.86–4.99). Although younger workers (<30 years) tended to have a higher odds for partial, unspecified, and non-RTW compared to older workers (>50 years), the 95% CI always included “1.00” for these OR in the multivariable model. However, workers aged 30–40 years had lower odds of non-RTW compared to older workers (OR 0.59, 95% CI 0.35–0.99).

When compared to workers in management and professional occupations, healthcare workers were more likely to have partial versus full RTW (OR 2.52,

95% CI 1.00–6.35). Workers in trade occupations (eg, mechanics, construction workers), occupations unique to primary industry (mining, forestry, oil/gas), and processing/manufacturing occupations were more likely to have non- versus full RTW (OR 2.97, 95% CI 1.32–6.68; OR 9.31, 95% CI 3.41–25.41; and OR 2.71, 95% CI 1.07–6.85, respectively) (table 2).

Additional covariates including co-morbidities, geographic location of surgery, surgical setting, and expedited status were not associated with RTW outcomes in the bivariate models and were, therefore, not included in the final multivariable models.

Discussion

The majority of injured workers in this study returned to work following meniscal knee surgery for a work-related injury. However, our study identified several sociodemographic and work characteristics associated with RTW status. Women, workers with lower annual incomes, and those in occupations where tasks are physically demanding were less likely to return fully to work.

Sociodemographic characteristics

Our results concerning wage were consistent with previous literature. A review by Krause and colleagues (8) of 100 factors affecting RTW following illness and injury identified several studies showing an inverse relationship between income and work disability. Similarly in our study, workers earning lower wages had higher odds for partial, unspecified, or non-RTW outcomes compared to full RTW, and they also had longer RTW times. For higher wage earners, these findings may be explained by increased upward or lateral job mobility, or increased access to healthcare services. [Although Canada has universal access to medically necessary services under a publicly-funded system, higher income is associated with a greater use of specialist medical practitioners (25).]

Several studies (14, 26–30) have examined the association between gender and RTW outcomes, although no consistent trend has emerged. A review by Crook et al (6), for example, found that women were more likely to have increased disability following low-back injury. However, other studies have shown either the reverse trend or no effect at all for women (8, 18, 31–36). In our study, we found that women were more likely to have partial RTW or non-RTW (and took approximately 2.5 weeks longer to return to work than men), even after adjustment for other confounding factors such as wage and occupation. As occupation may not adequately capture job demands or industrial factors, these findings

Table 2. Adjusted odds ratios (OR) for sociodemographic, clinical, and work characteristics associated with return-to-work (RTW) status, multiple multinomial logistic regression.

	Partial RTW (versus full)		Non-RTW (versus full)		Unspecified RTW (versus full)	
	Adjusted	95% CI	Adjusted	95% CI	Adjusted	95% CI ^a
Age						
<30 years	1.51	0.69–3.29	1.66	0.74–3.71	1.77	0.83–3.77
30–40 years	0.77	0.50–1.17	0.59	0.35–0.99	0.85	0.57–1.27
40–50 years	1.02	0.71–1.47	0.78	0.49–1.23	1.18	0.81–1.71
>50 years (reference)	1.00	–	1.00	–	1.00	–
Wage						
<\$30 000 (Canadian)	1.40	0.85–2.31	4.07	2.19–7.57	2.00	1.22–3.30
\$30 000–\$40 000	3.05	1.86–4.99	2.62	1.36–5.06	1.82	1.10–3.03
\$40 000–\$50 000	1.86	1.18–2.94	1.13	0.60–2.13	1.18	0.76–1.85
\$50 000–\$60 000	1.45	0.88–2.39	1.09	0.57–2.10	1.00	0.64–1.55
>\$60 000 (reference)	1.00	–	1.00	–	1.00	–
Gender						
Male (reference)	1.00	–	1.00	–	1.00	–
Female	2.55	1.53–4.23	2.61	1.35–5.03	0.90	0.51–1.58
Occupation						
Management and professional (reference) ^b	1.00	–	1.00	–	1.00	–
Health	2.52	1.00–6.35	1.42	0.01–160.0	1.40	0.51–3.86
Sales and service	1.35	0.75–2.45	1.28	0.52–3.14	0.52	0.28–0.95
Trades ^c	1.16	0.65–2.08	2.97	1.32–6.68	0.99	0.59–1.69
Transportation and equipment operators ^d	1.20	0.63–2.26	2.11	0.88–5.04	0.98	0.54–1.78
Primary-industry ^e	1.31	0.57–3.02	9.31	3.41–25.41	2.25	1.03–4.92
Processing, manufacturing & utilities ^f	1.01	0.52–1.96	2.71	1.07–6.85	0.50	0.26–0.98

^a OR with 95% CI, adjusted for covariates. Standard errors were obtained via bootstrap estimation to account for potential model misspecification.
^b Management, business and finance, administration, social science, education, and government service.
^c Construction trades, electrical trades and telecommunications, machinists, mechanics, and trades not-elsewhere classified.
^d Heavy equipment and crane operators, and transportation equipment operators.
^e Occupations unique to primary-industry (eg, mining, forestry, oil, and gas).
^f Machine operators, assemblers, and laborers in mineral and metal, petroleum and gas, food and beverage, and forest products processing.

may be partly explained by reduced industrial bargaining power for women, or differential injury mechanisms and job demands compared to men resulting in the need for modified or delayed RTW outcomes (37).

Occupation

There is no consistent trend among studies that examine associations between occupational factors and RTW outcomes. A prospective cohort of 926 employees from the Netherlands was followed for ten months to identify predictors of RTW (18). Results from this previous study indicated that workers employed in public administration, construction, finance, transport, and education were less likely to return to work than those in healthcare occupations. Studies by Gluck et al (28) and Oleinick et al (29), utilizing large cohorts of Michigan workers’ compensation claims for back injuries, found that blue-collar workers returned to work earlier than their white-collar counterparts or those in service occupations. However, some studies found the opposite (34). It is evident that diverse populations, injury characteristics, and different compensation systems across studies

and jurisdictions, along with non-standardized methods for occupation classification, likely contribute to these inconsistent trends across studies.

Our study results were aligned with those finding an association between blue-collar occupations and RTW. For example, workers in trades (ie, mechanics, construction workers), occupations unique to primary-industry (ie, mining, forestry, oil/gas), and processing and manufacturing occupations had OR 3–9 times higher for non-RTW, while workers in health-related occupations had OR 2–3 times higher for partial RTW. Although we did not have direct measures, these occupations are known to have higher physical demands (eg, manual labor, patient lifting) that have been attributed to their higher injury rates in the province (4, 38). As the occupation classification available in the data may not account for all differences in physical demands of the job or workplace organizational factors, an in-depth look at the effect of job demands and regulation/policy initiatives (eg, workers’ compensation policy, occupational health and safety agencies, RTW programs) on work-disability outcomes may provide further evidence.

Other factors

Older age was found to prolong work disability in a majority of the studies in the review by Krause (8). Similarly, in their review, Crook et al (6) found an association between older age and worse RTW outcomes following low-back injuries. Other studies confirmed this finding (26, 28–30, 34, 39), although some found no association (18, 40). In our study, younger age (ie, <30 years) was associated with non-RTW in the bivariate analysis, although this effect disappeared when controlling for occupation and other covariates.

Strengths and limitations

The strength of this study was the use of a sample that is representative of all knee surgeries for work-related injury obtained from population-based data at the individual level, coupled with detailed RTW outcomes. Nonetheless, residual confounding from unmeasured variables can be a potential limitation of studies that use administrative data. Data on psychosocial characteristics included in some studies (9–11) – such as job satisfaction, pain levels, goal-setting, and recovery expectations – were not available. While it was not possible to fully adjust for all factors related to the study outcomes, we were able to access detailed and comprehensive clinical patient records in order to obtain a rich set of covariates across multiple domains known to influence work-disability outcomes.

The detailed RTW outcomes used in this study were manually abstracted from workers' compensation clinical data, often consisting of case manager reports. Although these outcomes were dual-abstracted for the entire study sample, RTW status was unknown for a proportion of workers. For these claims, a RTW date was found, but no further information on the type of RTW was available in the data. However, all available data in the study sample was used in the analysis given our use of multinomial logistic regression.

Finally, as the available data in this study may not sufficiently capture differences in morbidity, future work by the authors will examine more extensive co-morbidity factors, surgeon characteristics, and hospital/surgeon volumes on expanded outcome variables including complications, claim-closure outcomes, and total disability days. This data will be derived from administrative health records and workers' compensation data.

Concluding remarks

This study's findings are consistent with previous studies on RTW outcomes following musculoskeletal injury, although previous studies tend to look at time to RTW while this study focused on the type of RTW. Using population-based data and adjusting for confounders, our

study found a link between sociodemographic (women, income) and work characteristics (occupation) and type of RTW following surgery for a work-related injury. Stakeholders should consider these broader determinants of worker health and recovery from disability when developing RTW programs or policy initiatives.

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