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Pain-Related Work Interference is a Key Factor in a Worker/Workplace Model of Work Absence Duration Due to Musculoskeletal Conditions in Canadian Nurses

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Abstract *Objective* To examine the role of pain experiences in relation to work absence, within the context of other worker health factors and workplace factors among Canadian nurses with work-related musculoskeletal (MSK) injury. *Methods* Structural equation modeling was used on a sample of 941 employed, female, direct care nurses with at least one day of work absence due to a work-related MSK injury, from the cross-sectional 2005 National Survey of the Work and Health of Nurses. *Results* The final model suggests that pain severity and pain-related work interference mediate the impact of the following worker health and workplace factors on work absence duration: depression, back problems, age, unionization, workplace physical demands and low job control. The model accounted for 14 % of the variance in work absence duration and 46.6 % of the variance in pain-related work interference. *Conclusions* Our findings support a key role for pain severity and pain-related work interference in mediating the effects of workplace factors and worker health factors on work absence duration. Future interventions should explore reducing pain-related work interference through addressing workplace issues, such as providing modified work, reducing physical demands, and increasing job control.

Keywords Work absence · Musculoskeletal injuries · Pain · Multimorbidity · Healthcare workers · Depression

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Introduction

Work-related musculoskeletal (MSK) injuries are the most common cause of work absence among healthcare workers [1]. Sprains and strains accounted for 82.3 cases of work absence per 10,000 workers in the United States in 2005, almost 5 times the next highest category [1].

Conceptual models of work absence have recently moved away from a strictly biomedical approach and now emphasize multifactorial causation of absence duration [2–6], and as such, the role of environmental factors, such as the workplace, has gained attention [7]. The primary research gap in this literature has been that few studies have empirically addressed the multifactorial nature of work absence in a comprehensive model, most likely due to the challenge of having sufficient statistical power to do so. This is the case in the consideration of the role of pain experiences. There is substantial evidence that individual worker pain experiences contribute to work absence [8, 9], but this contribution has not been considered concurrently with workplace factors and other worker health factors that are now emerging as key factors [2–6]. In this study, we examine the impact of pain experiences on work absence duration within a balanced model incorporating multiple workplace factors as well as the worker health factor of multimorbidity.

Pain and chronic health conditions have been investigated as determinants of absence duration in workers with MSK conditions. Increasing pain has been shown to be associated with longer duration of absence [8, 9]. When studying pain, we differentiate pain severity from pain interference: severity refers to the magnitude of pain; interference refers to pain's impact on activities [10]. Although interference with work appears to increase with pain [9], a clear understanding of the relationships between severity, pain interference with work, and work absence duration is lacking.

Multimorbidity also appears to be associated with work absence duration, with higher numbers of chronic conditions showing a dose–response relationship to increased absence duration [11–14]. With respect to comorbidities, the evidence is mixed. One study [14] showed that, in workers with MSK disorders, the presence of any comorbidity resulted in longer absences; this was most pronounced when the comorbidity was another MSK condition. However, two systematic reviews [15, 16] concluded comorbidity is not related to increased absence. The discrepancy may be partly due to methodological differences: studies included in the reviews used a crude measure, comparing none to any comorbidity, while the definition of Nordin et al. [14] was more nuanced. Finally, workers with MSK injuries often experience depression and the evidence suggests an association between comorbid depression and prolonged absence among these workers [17].

Workplace factors which impact health have been conceptualized [18] as falling into eight categories: social support, work-role status, control over work, exposure to hazards, legal protections, job security, advancement opportunities, and compensation. For workers with work-related MSK injuries, existing evidence suggests work-role status and control over work may be most important in predicting absence duration [19–24].

In a previous study, we assessed factors associated with work absence in a large sample of Canadian nurses with all-cause work absences, where pain-related work interference, depression, pain severity, and respect and support at work, were identified as key proximal predictors, and multimorbidity, abuse at work and organizational culture, as key distal predictors [6]. In this current study, we focus on workers with MSK conditions. We hypothesize that workers with work absences due to MSK conditions are more vulnerable to pain and pain-related work interference and to physical workplace factors than the more general population of workers assessed previously [6]. Focusing on factors associated with work absence in workers with MSK conditions is important for ensuring that work absence reduction programs aimed at this largest group of work-injured healthcare workers are optimal.

In this study, we assess a theoretical model of work absence duration in a sample of Canadian nurses reporting a work absence due to a work-related MSK injury, focusing on the role of pain experiences of severity and interference, with the concurrent consideration of the role of multimorbidity and of workplace factors.

Methods

Theoretical Model

Building on existing literature of work absence duration and MSK injuries, we developed a model of absence which incorporates worker health and workplace factors and proposes a central, mediating role for pain experiences. The hypotheses on which our model was built were:

1. The relationship between workplace and worker health factors and work absence duration is hypothesized to be mediated by pain experiences. This is hypothesized due to evidence suggesting the importance of pain in understanding MSK-related work absence [7, 15, 16, 25, 26].
2. Pain-related multimorbidity and depression are hypothesized to be positively associated with work absence duration in workers with work-related MSK injuries. Although evidence on chronic conditions and absence duration is conflicting [11–16], studies with

more nuanced definitions of multimorbidity have found an effect [11–14]. A role for depression is hypothesized based on existing studies [17, 27–29].

3. Physical work factors are hypothesized to be positively associated with work absence duration in the above workers. This is hypothesized due to an expectation that factors such as lifting, physical demands, and job strain cause additional physical and mental distress in workers with MSK conditions, as well as existing research identifying these factors as key in MSK-related work absence [19–24].

Population and Study Sample

Data for this study come from the National Survey of the Work and Health of Nurses (NSWHN), a cross-sectional survey conducted in 2005 with a representative sample of nurses from all Canadian provinces and territories. Data were collected by Statistics Canada, the Canadian Institute for Health Information and Health Canada. Details of the survey have been published elsewhere [30].

A total of 24,443 nurses were sampled for inclusion in the survey (23,428 were eligible), using a randomized, stratified design to ensure representation from all Canadian provinces and territories, and across all nursing types. Of these, 18,876 completed the survey (response rate of 80 %). For our analyses, we restricted the sample to employed, female, direct care nurses who reported at least one day of work absence in the previous 12 months due to a work-related musculoskeletal (MSK) injury. These restrictions were included to increase comparability between nurses in workplace variables, and to allow us to identify factors related to prolonged absence rather than to any absence.

Four items were combined to determine timing and duration of work absence due to a work-related MSK injury: (1) *In the past 12 months, did you miss work due to an accident or injury to yourself*?; (2) *Was this injury related to your work as a nurse*?; (3) *Was this a musculoskeletal injury*?; and (4) *In the past 12 months, how many days did you miss due to the injury*? Only nurses who answered yes to the first three questions, and reported at least one day missed, were determined to have work absence due to a work-related MSK injury (N = 1,206).

Of this sample, 265 (22 %) were missing data for one or more measure and excluded from analysis. 214 nurses were missing information on workplace factors: organizational culture was the most commonly missing (84 non-responders), followed by job strain—demands (14 non-responders) and control (12 non-responders). The high rate of non-response for organizational culture may have been due to a lack of relevance of the subscores, such as nurse-physician relationship, for some workers. In addition, a total of 35 nurses were missing information on worker-level data: depression was the most commonly missing (17 non-responders), followed by work-related pain severity (12 non-responders). Finally, 30 nurses were missing data on work absence duration.

The final sample size was 941 nurses.

Measures

Outcome: Duration of Work Absence Due to Work-Related MSK Injuries

Duration of absence was measured by self-report of cumulative days absent from work due to a work-related MSK injury in the past 12 months. Work absence duration was coded as a three-level variable indicating short-term (1–10 days), medium duration (11–30 days) and prolonged (31 days or more) absence. Despite the potential loss of statistical power, the decision to use a categorical variable rather than a continuous variable was driven by an effort to use an outcome variable which would be meaningful within the context of the employee's work absence trajectory in the compensation, employer, and healthcare systems. Although categorizing an outcome results in a loss of statistical power, the large sample size available in this study ensured adequate statistical power even using a categorical outcome [31]. The cut-off points chosen for these categories were based on meaningful differences, since physician notes for work absence are often given in weeks. As well, some workers' compensation systems proceed to a review of a worker's case 6 weeks after the first day of injury, making a 30-day cumulative work absence duration a meaningful cut-off point. We recognize the limits of using these cut-off points, in that cumulative work absence may not always map to duration of a one-time work absence. However, for policy-makers and other stakeholders, investigating the impact of a one-day absence using a continuous variable is less meaningful than examining short-term, medium, and prolonged work absences. Work absence programs and processes, including benefit eligibility, are often driven by short-term, medium and prolonged duration cut-off points, as selected in our analysis. The 3-category distinctions were also based on the average number of cumulative sick days taken by Canadian nurses, estimated to be 11.8 days in 2001 and 14.5 days in 2005. In addition, these cut-offs were based on the distribution of work absence in the sample, as well as knowledge about work absence duration in Canadian workers: the average number of work days lost per worker in one year between 1999 and 2009 ranged from 8 to 10 days, across all occupations [32]. For full-time female employees in nursing, the average cumulative work absence was 19.2 days [33].

Worker-Level Factors

Four worker-level factors were assessed (Supplementary Table 1): (1) Pain-related physical health conditions, including arthritis, and migraines; (2) depression; (3) work-related pain severity; and (4) pain-related work interference.

1. Pain-related conditions were modeled with dichotomous variables representing the presence or absence of arthritis (including rheumatism) and/or migraines, based on nurses' self-report of diagnoses. These are among the most common chronic conditions affecting female Canadian nurses and the most common pain-related conditions after back problems [30]. Preliminary analysis suggested that the impact of each condition differed; therefore, use of separate variables was deemed more appropriate than the sum of conditions.
2. The presence of depression was modeled (*yes*/*no*) based on nurses' responses to a 14-item subset of questions from the Composite International Diagnostic Interview (CIDI) [34]. Responses were scored and transformed into a probability estimate of the occurrence of a major depressive episode. Nurses scoring at or above the 90th percentile were coded as having had depression in the past 12 months [30].
3. Work-related pain severity was inferred by combining responses on two items—self-reported severity of pain in the past 12 months and work-relatedness of pain. Pain was considered work-related if nurses reported their pain was due to work-related factors alone, or to work-related and non-work-related factors. Pain severity was coded as a five-level ordinal categorical variable ranging from 'no pain' to 'unbearable pain' [30].
4. Pain-related work interference was modeled as a four-level variable ranging from 'none of the time' to 'all of the time', in response to the question: "*In the past 6 months, how often did the pain in this body area limit or reduce your ability to do your job as a nurse?*" This variable assesses the perceived effect of pain severity on the nurse's ability to perform her job tasks. It is important to note that pain-related work interference is a measure of perceived work limitation, and does not automatically translate into work absence. Nurses reporting no pain were not asked this question and coded as having pain-related work interference '*none of the time*' [30].

Workplace Factors

We examined six workplace factors (Supplementary Table 1): (1) Emotional abuse or physical assault at work; (2) job strain—control and demand; (3) safe lifting at work; (4) organizational culture—autonomy at work, control over nursing practice, and nurse-physician working relationships; (5) workplace respect and support; and (6) workplace physical demands. In addition, we included four workplace factors as covariates: (1) employment status; (2) facility type; (3) unionization; and (4) submission of a workers' compensation claim. Together, these address all eight of Tompa et al.'s [18] categories.

1. Emotional abuse or physical assault at work was modeled as two variables (*yes*/*no*): abuse/assault by a coworker (including supervisor, nursing manager, physician, student, or other coworker); and abuse/assault by a patient or visitor, within the past year. Abuse or assault from these two sources was anticipated to have different effects on absence due to anticipated differences in psychological impact.
2. Job strain measures the degree to which control over job practices and job-related psychological demands cause work strain or stress. Job strain modeled using two variables based on Karasek's job strain measure [35]: job control and job demands. Job control (high/low) was constructed from the decision authority (2 items) and skill discretion (3 items) subscores of the job strain measure included in the NSWHN questionnaire, while job demands (high/low) was constructed from the psychological demands (2 items) subscore [30]. Cut-offs indicating high/low control and high/low demands were based on median scores. Additional methods of assessing the impact of Karasek's job strain were tested in initial analyses; dichotomous control and demand variables were determined to be the most appropriate based on preliminary modeling.
3. Safe lifting at work was based on required lifting and availability of mechanical lifting devices, with three categories: (1) no lifting required at work; (2) lifting required and mechanical lifting equipment available; and (3) lifting required, but no mechanical lifting equipment available.
4. Organizational culture was modeled as a latent variable constructed using three subscores from the Nurse Work Index from the NSWHN: autonomy at work; working relations between nurses and physicians, and control over nursing practice. Autonomy at work addresses nurses' perceptions of support from supervisors and freedom to make care decisions; control over work addresses nurses' perceptions of their ability to provide high quality care, and considers factors such as workload and staffing; and working relations between nurses and physicians addresses whether nurses perceive collaboration, team work, and support from physicians.

5. Workplace respect and support (continuous) modeled nurses' responses to the three-item Effort-Reward Imbalance scale [36] subset included in the NSWHN. Nurses responded to each item on a 5-point Likert scale. Items asked nurses to report whether they received respect and support at work from supervisors and/or coworkers, and whether nurses believe they receive sufficient respect and prestige, considering their achievements and efforts.
6. The degree of workplace physical demands was modeled as high or low demands (median cut-point) based on degree of agreement with the following statement: *Your job required a lot of physical effort* [30, 37].

Covariates

Back problems (*yes*/*no*) were controlled for due to that the work-related MSK injury reported by any given nurse was an injury to the back. In addition, the survey did not allow distinction between back problems related to the MSK injury and those comorbid with the injury (56.2 % of the study sample reported experiencing back problems). Employment status (full-time, part-time) was included as covariate since part-time workers necessarily have fewer opportunities for work absence. Facility type (acute care, long-term care, community care or other) was included as a covariate since the prevalence of MSK injuries is known to differ by facility type [38, 39]. The remaining covariates were: unionization (with '*unionized*' including collective bargaining agreements), submission of worker's compensation claim (to control for injury severity), age, household income, and marital status.

Analyses

The relationship between work absence duration and worker-level factors, workplace factors and covariates was assessed using structural equation modeling (SEM). SEM is a regression modeling methodology that allows simultaneous assessment of the direct and indirect impacts of factors associated with work absence duration in a single model [38, 40]. Of particular benefit, this technique allows a variable to operate as both an independent and a mediating variable within the same model.

Initial descriptive analysis examined distributions of all variables to ensure requirements for SEM were met, and then a multistep model-building process was used. Initially, a theoretical model of worker-level health factors was constructed based on theoretical considerations (Supplementary Figure 1). This model served as a baseline for assessing the additional contributions of workplace factors, and included sociodemographics, employment status, claim submission and back problems as control variables. Direct paths from age, arthritis, migraine and depression to work absence duration were initially included in this model, but removed due to lack of significance; these pathways were re-evaluated in the final model once workplace factors of significance were identified.

A combined worker and workplace model was then built in a stepwise fashion. First, each workplace factor was added individually to the model shown in Supplementary Figure 1. Figure 1 illustrates the variables and pathways assessed in this model-building phase. Second, all workplace factors which were found to be significant when added individually to the worker health model were retained to create a combined worker health and workplace theoretical model. This final combined theoretical model was assessed for significance and optimized for model fit, using modification indices and theoretical considerations. Analyses were performed using Mplus Version 5.2 [41].

Results

Variable Distributions

Supplementary Table 2 presents the distributions and unadjusted effect of all assessed variables on work absence duration. In univariate analyses, age, back problems, arthritis, and pain-related work interference were significantly associated with work absence duration. Interestingly, arthritis appeared to be protective against prolonged work absence, while the other three worker health factors were associated with increased work absence. Work-related pain severity could not be assessed in univariate analyses due to the small cell sizes at each level of pain and work absence duration.

Among the workplace factors, emotional and physical abuse, both by a coworker and by a patient or visitor, was significantly associated with increased work absence duration in univariate analyses. In addition, employment status, job strain-work demands, control over practice, and workplace respect and support were associated with work absence duration. Unionization, safe lifting at work and facility type could not be assessed in univariate analyses due to cell size limitations.

Attrition Analyses

Attrition analyses compared respondents excluded for missing data on work variables (n = 214) to respondents with no missing data. There was no significant difference in the outcome, work absence duration, between nurses with and without missing data on work variables. In addition,

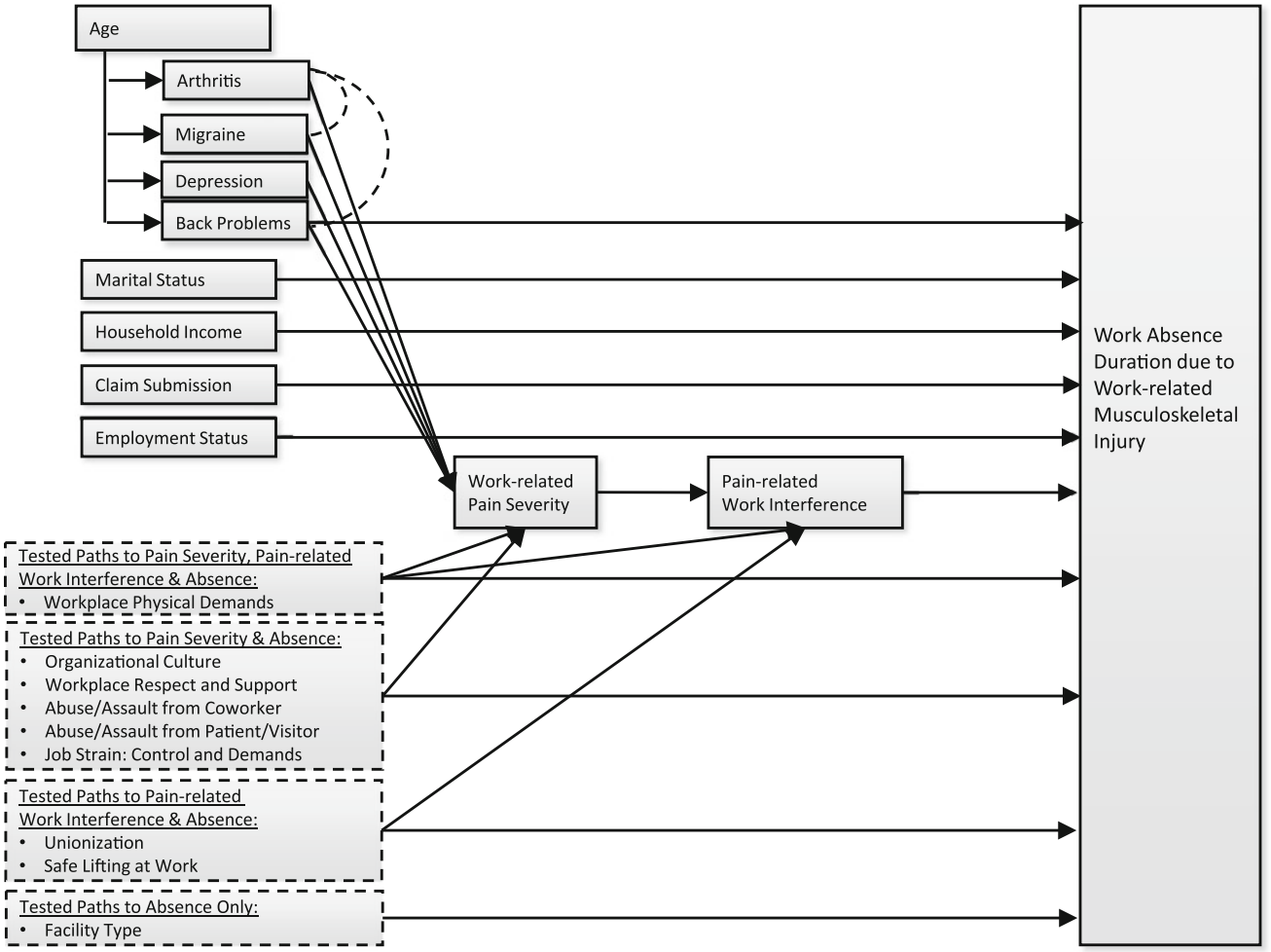

Fig. 1 Theoretical model showing all tested variables and pathways. *Dashed boxes* indicate workplace variables added individually in the model building phase, according to pathways tested. *Solid lines:* association paths; *Dashed lines:* correlated errors

there were no significant differences in age, prevalence of back problems, depression or migraine, or in pain intensity. Nurses missing data on work variables were somewhat more likely to be in the lowest income group compared to those without missing data (15.3 % for missing-data group versus 10.7 % for non-missing group), and were less likely to report arthritis (14.2 % for missing-data group versus 21.9 % for non-missing group). Finally, nurses who were missing data on work variables were somewhat more likely to be in the highest category of work-related pain severity (13.9 % for missing-data group versus 7.3 % for non-missing group).

Structural Model

A total of eleven variables demonstrated significant pathways when added individually to the worker health model and were retained to be evaluated in the final combined theoretical model of work absence duration (Supplementary Figure 2). These included the two pain variables; three other worker variables; two workplace variables; and four covariates. For the final stage of model building, the final combined theoretical model was assessed with the following pathways to work absence duration (Supplementary Figure 2): Direct pathways to absence duration from age, employment status, arthritis, migraine, depression, back problems and pain-related work interference; and indirect pathways from work-related pain severity, workplace physical demands, job strain—control, and unionization.

Variables not retained in the final theoretical model due to lack of significance were: (1) abuse/assault; (2) facility type; (3) household income; (4) job strain—demands; (5) marital status; (6) organizational culture; (7) safe lifting; (8) claims submission; and (9) respect and support.

Analysis of this final model identified pain-related work interference as the key variable in work absence duration

due to work-related MSK injuries (Fig. 2). Pain-related work interference and work-related pain severity mediated all significant pathways from workplace and worker health variables, except age. The direct effect of age (0.193) was considerably smaller than the effect of pain-related work interference (0.318); the estimated direct and indirect effects on work absence duration of all variables in the final model are reported in Table 1.

The association between pain severity and pain-related work interference was the largest effect size in the model (0.669; Fig. 2). This was three times as large as the largest significant effect of a workplace variable on any other variable (workplace physical demands on pain severity—0.211).

Depression was the only worker health factor with a significant association to work absence duration, mediated through work-related pain severity and pain-related work interference. The total effect of depression on work absence was not significant, but was larger than that of all workplace factors (0.057 for depression). Arthritis and migraine did not have statistically significant associations with absence duration, although arthritis showed a large non-significant negative (protective) effect on duration (−0.191); arthritis and migraine were retained in the final model due to correlations between these two variables and between arthritis and back problems. Presence of back problems, assessed as a covariate, was associated with work absence duration with a large effect size (0.151), but the relationship of this variable to the index MSK condition could not be assessed as the survey did not include information on body part injured [30]. Of the worker health variables, only arthritis was associated with age.

Workplace variables were associated with work absence duration, indirectly, through work-related pain severity (workplace physical demands and job strain—control) and pain-related work interference (unionization). Employment status was not significantly associated with work absence duration.

Model Fit

Fit statistics, presented in Table 2, indicated that the final model is a good fit for the data. Despite the good fit of the final model, this model explained only 14 % of the variance in total absence duration (Table 2). However, the model also explained 46.6 % of the variance in pain-related work interference, which had an important role mediating the effect of other worker health and workplace factors on work absence due to MSK injuries.

Discussion

The goal of our paper was to assess a model of work absence duration among female nurses with work-related MSK injuries, which incorporated both worker health and workplace factors, and proposed a central, mediating role for pain experiences. Our final model supports these roles for pain-related work interference and work-related pain severity. The effect of work-related pain severity on pain-related work

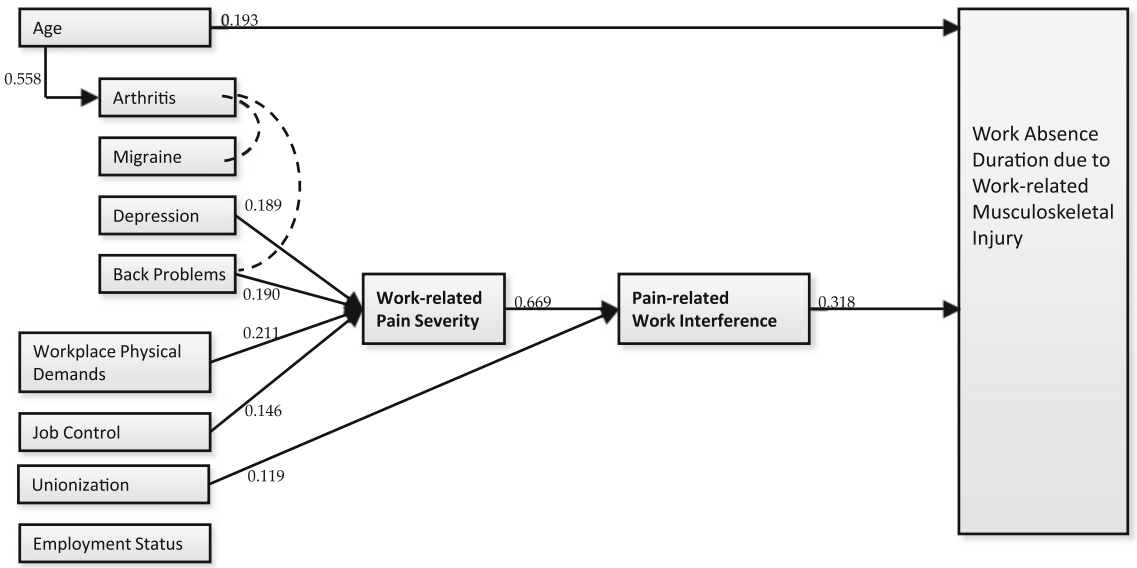

Fig. 2 Final combined model of worker and workplace factors associated with work absence duration due to work-related musculoskeletal injuries. Values presented are standardized regression coefficients for paths significant at the $p \leq 0.05$ level. Paths not significant at the $p \leq 0.05$ level are not shown. *Solid lines:* association paths; *Dashed lines:* correlated errors

Table 1 Standardized regression coefficients from the final model for direct, indirect and total effects of worker health and workplace factors on work absence duration due to work-related musculoskeletal injuries, controlling for employment status

Variable	Direct effect			Indirect effects			Total effects		
	b	*t* stat	*p* value	b	*t* stat	*p* value	b	*t* stat	*p* value
Sociodemographic factors									
Age	0.193	2.041	0.041†	−0.092	−1.296	0.195	0.101	1.548	0.122
Worker health factors									
Arthritis	−0.209	−1.623	0.105	0.018	1.023	0.306	−0.191	−1.494	0.135
Migraine	0.002	0.021	0.983	−0.008	−0.521	0.602	−0.006	−0.068	0.946
Depression	0.016	0.186	0.852	0.040	2.295	0.022	0.057	0.606	0.544
Back problems	0.110	1.218	0.223	0.040	2.158	0.031	0.151	1.616	0.106
Work-related pain severity	n/a			0.212	1.041	<0.00	0.212	1.041	<0.00†
Pain-related work interference	0.318	4.681	0.000†	n/a			0.318	4.681	0.000†
Workplace factors									
Employment status	−0.048	−0.763	0.445	0.000	999.0	<0.00	−0.048	−0.763	0.445
Job strain—control	n/a			0.031	2.278	0.023	0.031	2.278	0.023†
Physical demands	n/a			0.045	2.598	0.009	0.045	2.598	0.009†
Unionization status	n/a			0.038	2.511	0.012	0.038	2.511	0.012†

† Paths significant at $p < 0.05$

Table 2 Model fit statistics and R^2 values for the final model of work absence duration due to work-related musculoskeletal injuries

Statistic	Worker variables only	Final model
Chi square	40.191	43.192
Degrees of freedom	27	25
Comparative fit index (CFI)	0.959	0.959
Tucker-Lewis fit index (TFI)	0.947	0.941
Root mean square error of approximation (RMSEA)	0.023	0.028
R^2 for work absence duration	0.136	0.144
R^2 for pain-related work interference	0.452	0.466

interference was the strongest association in the model, followed by the effect of pain-related work interference on work absence duration. The total effect of pain severity on work absence duration was 0.212, compared to total effect sizes of 0.318 for pain-related work interference, and 0.045 for workplace physical demands (Table 1).

Hypothesis 1: The Relationship Between Workplace and Worker Health Factors and Work Absence Duration was Hypothesized to be Mediated by Pain Experiences

Our findings support hypothesis 1. Workers' pain experiences, namely work-related pain severity and pain-related work interference, emerged as key mediating factors of worker health and workplace factors. Pain-related work interference was the factor most strongly associated with more prolonged work absence. The model including both worker health and workplace factors explained nearly 50 % of the variance in pain-related work interference levels, indicating that these factors may be crucial for understanding and intervening in pain-related work interference.

The finding of strong effect of pain interference, which remains present even when considered in conjunction with multiple workplace factors and with comorbid conditions, represents a significant contribution to the current literature, as it highlights the centrality of pain experiences in the multifactorial nature of work absence.

Hypothesis 2: Pain-Related Multimorbidity and Depression were Hypothesized to be Positively Associated with Work Absence Duration in Workers with Work-Related MSK Injuries

Our findings only partially supported hypothesis 2. Depression was indirectly, and positively, associated with work absence duration. Multimorbidity was not directly assessed in the final analyses; rather, the impact of arthritis and migraines were assessed separately. This decision was based on initial exploratory analyses which suggested that the roles of these conditions differed, as well as on the inability to differentiate back problems related to the primary injury from those un-related to the primary injury.

The association between depression and absence duration was mediated through an increase in work-related pain severity and associated increase in pain-related work interference.

By contrast, arthritis and migraines were not significantly associated with work absence duration. Although arthritis appeared to have a large negative effect on work absence duration, this effect was not statistically significant. Furthermore, given the large sample size and the high prevalence of arthritis (22.1 %), the lack of significance cannot be attributed to insufficient power. However, in the univariate analyses (Supplementary Table 2) the relationship between arthritis and work absence duration was significant at the 5 % level, with nurses reporting arthritis less likely to report prolonged absences.

Our findings suggest that in workers with MSK injuries, those also experiencing pain-related conditions, such as arthritis and/or migraines, are not more vulnerable to prolonged absence than those without these conditions, and may even be less vulnerable. It is possible that these workers have well-developed coping or support systems that allow them to overcome any additional challenges posed by their other health conditions. This is an important finding, as it is sometimes believed that workers with additional health conditions are more likely to experience prolonged work absence following a work-related MSK injury [42]. As a result of this belief, workers with both MSK injuries and other conditions may experience challenges accessing compensation. Jurisdictions vary in how compensation levels are adjusted to distinguish costs and necessary care related to the MSK injury and those related to other health conditions; some, such as Ontario, Canada, make special provisions to cover the potential additional costs of health conditions which are not work-related [42]. Although workers may be able to appeal for additional coverage, such appeals may be challenging and time consuming, and negative experiences with institutional systems within the workplace have been found to be associated with prolonged work absence [43].

Hypothesis 3: Physical Work Factors were Hypothesized to be Positively Associated with Work Absence Duration in Workers with Work-Related MSK Injuries

Hypothesis 3 was partially supported by our findings. Of the workplace factors that remained significant in the final model, two were physical factors: workplace physical demands, and job strain—control. The effects on absence duration of these factors were mediated through work-related pain severity.

These findings suggest that interventions designed to reduce physical demands and improve job control may be successful in reducing pain, improving pain-related work interference, and ultimately reducing work absence.

Safe lifting at work, a variable which reflects both lifting and availability of lifting supports, was not significantly associated with absence duration. This finding is counter-intuitive. Use of mechanical ceiling lifts has been previously demonstrated to reduce the number of workers' compensation claims filed per year in long-term care facilities [44]. Safe lifting at work was expected to impact both pain severity and pain-related work interference, and in turn work absence duration; nurses whose jobs required lifting, but who did not have access to lifting equipment were expected to report greater severity and pain-related work interference, and longer absences. Interestingly, the lack of an effect of lifting was not due to inclusion of physical demands, since lifting was not significant when added alone to the worker model. However, there is considerable overlap in nurses reporting physically demanding jobs and those whose jobs require lifting; 92 % of nurses whose jobs require no lifting report their job is not physically demanding. Future analyses which assess frequency of lifting with or without mechanical devices may help clarify this variable.

Although job control was associated with pain experiences, job demands were not. Existing research supports the greater importance of job control in predicting stress and work absence [45] and musculoskeletal injury risk [21]. Several studies have found that highly demanding jobs are acceptable to employees when combined with high levels of control, while minimally demanding jobs are less acceptable when combined with limited control [45, 46]. However, both low control and high demands have been associated with increased days off work [47].

Surprisingly, no social workplace factors remained significant. The lack of significance of emotional abuse or physical assault is particularly surprising. Perhaps for workers with MSK injuries, the pain and mental health consequences of their injury outweigh any physical or mental negative effects of abuse or assault at work. As well, workers with MSK injuries may be offered safer work environments due to limitations from their injuries. Finally, it is possible that workers with mental health conditions are most vulnerable to negative consequences of abuse at work; only 16.1 % of our sample met the criteria for depression.

In addition to the above possible explanations for the absence of anticipated associations based on previous study findings, it is possible that the consideration of multiple factors allowed better control of confounding and led to the elimination of previously observed effects of variables, and to the identification of the most central variables associated to work absence duration.

Strengths and Weaknesses

Interpretation of our findings should consider limitations of study variables and design. Due to the focus of the dataset

on workplace issues, important non-workplace factors could not be assessed, such as detailed injury information, including body part affected, and return-to-work systems information, such as insurance or healthcare factors. In addition, the final model explained only a small proportion of the variance in absence duration, likely due to the absence of several key cognitive and psychological variables previously shown to be important in predicting MSK-related disability, such as self-efficacy to control the impact of pain [48], fear-avoidance [49], and fear of movement [50]. However, while previous models have demonstrated the importance of considering these factors when predicting absence due to pain levels, our model adds to the current state of knowledge by demonstrating the importance of worker health and workplace factors in explaining the degree of pain and pain-related work interference experienced by workers with MSK injuries.

Further, the NSWHN is a cross-sectional survey and, therefore, causal relationships and directionality should not be assumed. For most relationships in the model, reciprocal causality is possible. However, directionality of the modeled relationships is supported by previous research. In addition, cumulative days absent was modeled assuming the parallel lines assumption—that is, the relationships between associated factors and outcome categories could be modeled with a single coefficient.

This study also has several strengths. In particular, the large sample size and wide range of workplace factors available allowed the use of SEM analyses, allowing us to better understand the important role of pain severity and pain-related work interference as mediators in the relationship between worker and workplace factors and work absence duration.

Applied Implications of Findings

Our findings emphasize the importance of continuing to address pain and physical factors in workers with MSK conditions within the broader context of other factors, such as the workplace and insurer. Interventions which provide pain management in the context of the workplace, including providing coping skills to reduce work interference, may lead to a reduction in absence duration for workers with MSK conditions. In addition, work-focused interventions, which focus on reducing physical demands and increasing control, may also have positive effects by reducing pain severity and pain-related work interference. In addition, special attention should be given to workers with depression to ensure that the mental and physical aspects of pain of these workers are addressed. Finally, supervisors, insurers and policy-makers should be aware that workers with comorbid arthritis or migraines are no more likely to experience prolonged absence due to a work-related MSK injury than workers without these conditions. Measures should be taken to ensure that these conditions do not affect their ability to receive adequate modified work or other support options to reduce pain-related work interference caused by their injury.

Implications for Future Research

The main findings of our study, with respect to the central role of pain-related work interference, should be investigated in future prospective studies. As well, future research should explore what factors, including interventions, may mediate the impact of pain severity and pain-related interference on work absence. This should be done not only in the context of the workplace, but also in the insurer system and in interactions with the healthcare system, in order to achieve a comprehensive view of the factors associated with work absence duration.

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