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The relationship of occupational injury and use of mental health care

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ABSTRACT

Introduction: Symptoms of depression and anxiety are a common consequence of occupational injury regardless of its cause and type. Nevertheless, mental health care is rarely covered by workers' compensation systems. The aim of this study was to assess the use of mental health care post-injury. **Methods:** We used a subsample of patient-care workers from the Boston Hospital Workers Health Study (BHWHS). We matched one injured worker with three uninjured workers during the period of 2012–2014 based on age and job title (nurse or patient-care associate) and looked at their mental health care use pre- and post-injury using medical claims data from the employer sponsored health plan. We used logistic regression analysis to assess the likelihood of mental health care use three and six months post-injury controlling for any pre-injury visits. Analyses were repeated separately by job title. **Results:** There were 556 injured workers between 2012 and 2014 that were matched with three uninjured workers at the time of injury ($n = 1,649$). Injured workers had a higher likelihood of seeking mental health care services than their uninjured counterparts during the six months after injury (OR = 1.646, 95% CI: 1.23–2.20), but not three months post-injury (OR = 0.825, 95% CI: 0.57–1.19). Patient-care associates had a higher likelihood to seek mental health care post-injury, than nurses (OR: 2.133 vs OR: 1.556) during the six months period. **Conclusions:** Injured workers have a higher likelihood to experience symptoms of depression and anxiety based on their use of mental health care post-injury and use is more predominant among patient-care associates; however, our sample has a small number of patient-care associates. **Practical Applications:** Treating depression and anxiety as part of the workers' compensation system has the potential of preventing further physical ailment and improving the return to work process regardless of nature of injury.

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1. Background

Depression is a common consequence of occupational injury across different industries and regardless of the nature of injury (Carnide et al., 2016; Franche, Carnide, Bültmann, Severin, & Krause, 2009a; Keogh, Nuwayhid, Gordon, & Gucer, 2000; Kim, 2013). Some studies report that 25–45% of workers injured at work

develop symptoms of depression as early as one month after injury, setting a trajectory of depressive symptoms 6–12 months after injury as well as poorer outcomes in return to work (Carnide et al., 2016; Franche et al., 2009a).

In the United States, injured workers have access to the workers' compensation (WC) system, an insurance system that provides wage replacement and medical benefits for rehabilitation to recover from occupational injury or illness. Even with these protections in place, some studies showed evidence that work-related injury and illness may result in spillover costs in group health insurance (Asfaw & Souza, 2012; Galizzi & Zagorsky, 2009a; Lipscomb, Dement, Silverstein, Cameron, & Glazner, 2009; Williams et al., 2017), suggesting that the WC system does not

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cover all health care related to the injury or that workers seek further care for an unrecognized comorbidity of the injury.

Occupational injuries have a large toll on workers in different aspects of their lives. Work-related injuries may further impair physical function by disrupting sleep and work and home activities (Keogh et al., 2000). They represent a financial burden by loss of wealth and earnings as WC only partially replaces lost wages (Galizzi & Zagorsky, 2009b) and new evidence suggests that it partially covers health care costs shown by increased costs on group health insurance after an injury (Asfaw & Souza, 2012; Galizzi & Zagorsky, 2009b; Williams et al., 2017). Additionally, work-related injury impacts social life as it causes tension in family relations and dynamics and also limits injured workers' participation in their usual social activities and responsibilities, such as child care (Dembe, 2001).

Failing to treat mental illness as a result of work injury has detrimental consequences for both employees and employers alike. Depressive symptoms after an occupational injury are associated with negative outcomes in return to work (RTW) (Anderson et al., 2015; Cancelliere et al., 2016) including poorer outcomes in a sustainable RTW (Anderson et al., 2015). They also have a negative impact on work participation and functioning by prolonging work disability and decreasing work productivity (Lagerveld et al., 2010). Consequently, longer periods of time to RTW increase the likelihood of suffering depressive symptoms (Franche, Carnide, Bültmann, Severin, & Krause, 2009b), which may create a cycle that inhibits and delays recovery from injury. Pre-injury characteristics and circumstances of workers also play a role as they may predispose workers to increased risk of depressive symptoms and anxiety after injury. A lower education level and worker contributions toward family income are risk factors of post-injury depression (Lin et al., 2014). However, care for psychological distress and consideration of aspects of vulnerability are rarely taken into account when designing a RTW plan (Briand, Durand, St-Arnaud, & Corbière, 2008).

The aim of this study was to examine the use of mental health care services for depression and anxiety that occur outside of the WC system after an occupational injury. We hypothesized that patient-care workers who suffered an occupational injury had more symptoms of depression and anxiety, as measured by their mental health care visits and prescriptions after injury than their counterparts who did not suffer an occupational injury. This study was conducted with data from nurses and patient-care associates (PCAs). In the United States, PCAs offer support to registered nurses in their care for patients, they have lower wages, and some studies have shown differences between nurses and PCAs in terms of injury rates (Pompeii, Lipscomb, Schoenfisch, & Dement, 2009) and effectiveness of interventions aiming at reducing musculoskeletal injuries (Sabbath et al., 2019). In both cases, PCAs are the disadvantaged group: they experience higher injury rates (Pompeii et al., 2009) and interventions aimed at reducing musculoskeletal injuries for patient-care workers reduced injuries in nurses but not in PCAs (Sabbath et al., 2019). Authors gave several hypotheses for these differentials. Nurses and PCAs differ in their nature of work, social capital and their engagement in the implementation of the intervention (Sabbath et al., 2019). These differentials led us to formulate our second hypothesis: there would be differences in post-injury patterns of mental health care use between nurses and PCAs as there are differences in their nature of work, their wages and their social capital.

2. Methods

This study was conducted through the Harvard T.H. Chan School of Public Health Center for Work, Health and Well-being and was

approved by the Institutional Review Board of Harvard T.H. Chan School of Public Health.

2.1. Study design and sample

We used a subset of data from the Boston Hospital Workers Health Study (BHWHS). The BHWHS has integrated data from administrative databases and worker surveys from a cohort of patient-care workers in two large academic hospitals in the Boston metropolitan area (Sabbath et al., 2018). For this study, we used the following integrated data: (a) the occupational health services database containing OSHA recordable injuries, defined as injuries that require medical attention beyond first aid or time away from work; (b) a human resource database containing demographic information; and (c) a health utilization database from the employer's sponsored health plan. All these databases were integrated at the individual level using secure study ID numbers.

We used a matched cohort study design to assess the relationship of mental health and occupational injury in patient-care workers, similar to the design used by Williams et al. (2017). We identified work-related injuries that occurred between January 1st, 2012 and December 31st, 2014. Each injured worker (case) was randomly matched with replacement with three workers who did not report an injury (controls) at the time of the case's injury. Matches were done by age and job title. We included workers who had been working for the hospitals at least one year and enrolled in the employer-sponsored health plan at least one year, to avoid any new employee characteristics that may bias results, such as health care use related to the acquisition of a new health plan.

2.2. Data variables

Workers injured between 2012 and 2014 were identified using the hospitals' occupational health database that contains all OSHA recordable injuries. The database contains information about type of injury, body part injured and resulting days away from work. Using the human resource database, eligible workers were identified and matched to their uninjured counterparts. Using the health utilization database, we extracted medical claims with Current Procedural Terminology (CPT) codes for diagnostic interview examination (90801), outpatient and inpatient interactive psychotherapy (90804–90807, 90812, 90816, 90818, 90833, 90834, 90837) and other psychotherapy services (e.g., family/group psychotherapy) (90846, 90847, 90853 and 90862). From these CPT codes, we filtered out claims that were classified to have as medical conditions: depression and anxiety. We also captured claims for prescription drugs. Claims in this study include the following prescription drugs: benzodiazepines, anticonvulsant (misc), antidepressant (Psychotherapy), Antipsychotic (Psychotherapy), barbiturates and anxiolytics for both injured and uninjured workers. We observed the presence of any mental health care utilization (visits and drug prescriptions) three and six months before and after the date of injury for injured workers. For uninjured workers, we used the date of their injured counterparts' injury as a proxy date from which to test for the presence of mental health claims three and six months before and after the matched injury date.

We also included information on type of group health insurance plans. There were three kinds of plans available for workers: (a) a "value plan," with greater cost-sharing and lower premiums; (b) the "premium plan" with lower cost-sharing and higher premiums; and (c) the "grandfathered plan" with higher deductibles and co-pays and lower premiums.

2.3. Analyses

Using logistic regression, we examined the association of occupational injury and use of mental health services after injury for the three months and six months after injury. Analyses for post-injury utilization were controlled for type of health plan, any pre-injury visit during the three or six months before the injury and unit type according to expected workloads: Emergency Department (ER), Operating Room (OR), Adult Medical/Surgical, Adult intensive care (ICU), step-down, Pediatric Medical/Surgical, Pediatric/Neonatal intensive care, Psychiatry, Obstetrics (OB)/Post-partum, Ambulatory units and Orthopedics. Regression models were conducted for all workers, and then separately by job position: nurses and patient-care associates. We considered a *p*-value of <0.05 as statistically significant.

3. Results

The sample consisted of 556 injured workers and 1,649 uninjured workers. Descriptive statistics are presented in Table 1. Most injuries were of musculoskeletal and sharps related, common in this working population (Boden et al., 2012). About one third of injuries (154 injuries) were of diverse types: burns, bites, concussions, skin conditions, and pain. The mean age of workers was 45 (SD = 11) and 75% of the sample was White (*n* = 1,634). There were no ethnicity differences between injured and uninjured workers. The sample included 1,704 (77%) nurses and 501 patient-care associates (23%); the proportions are the same among injured and uninjured workers given that cases were matched with three controls based on age and job position. Most workers were under the premium health plan (90%) offered by their employer and there were no differences in health plan type between injured and uninjured workers.

Descriptive statistics show that a higher proportion of injured workers used mental health services at least once in both periods of time before the injury: 25% three months (*p*-value = 0.011) and 30% six months before (*p*-value = 0.003) the injury. There were no differences in mental health care utilization between injured

and uninjured three months post-injury (*p*-value = 0.830), but there were differences in the six month post-injury period (32% among injured workers vs. 23% among uninjured workers, *p*-value < 0.001).

Logistic regression models using data from all patient-care workers showed that use of mental health care for injured workers in the three months after injury was not significantly different from that of uninjured workers (OR = 0.825, 95% confidence interval: 0.57–1.19). Results for six months after injury show that injured workers have a higher likelihood to use mental health care (OR = 1.646, 95%CI: 1.23–2.20) than uninjured workers (Table 2).

Descriptive statistics stratified by job position (not shown) show that among nurses and among patient-care associates separately, the proportion of injured and uninjured workers who sought mental health care was very similar (nurses: 11% of injured and 12% of uninjured, *p*-value: 0.759; patient-care associates: 3% of injured and 3% of uninjured, *p*-value: 0.930). In the six-month period post-injury, we observed differences between mental health care utilization of nurses and patient-care associates. Among nurses, 36% of injured workers versus 26% of uninjured workers sought mental health care (*p* < 0.001). Conversely, among patient-care associates, 21% of injured workers versus 12% of uninjured workers sought mental health care (*p* = 0.020). Of note, some cells in this analysis were small, with 27 injured workers and 46 uninjured patient-care associates seeking mental health care post-injury.

Logistic regression models conducted separately by job position show similar results. Among both nurses and patient-care associates, there are no significant differences between injured and uninjured workers on use of mental health care during the three months after injury (OR for nurses = 0.787, 95% CI: 0.53–1.16; OR for patient-care associates = 0.908, 95%CI: 0.27–3.10; Table 3). As in Table 2, results for the six month period after injury show that both patient-care associates and nurses have higher odds of use of mental health care, but the increase in mental health care use by patient-care associates (OR = 2.133, 95%CI: 1.09–4.18) was greater than for nurses (OR = 1.556, 95% CI: 1.13–2.14).

Table 1
Demographic and health care use characteristics of workers in the sample.

	All workers (<i>n</i> = 2,205)		Injured (<i>n</i> = 556)		Uninjured (1,649)		<i>p</i> -value
	N (%)	Mean (SD)	N (%)	Mean (SD)	N (%)	Mean (SD)	
Age		45 (11)		45 (11)		45 (11)	0.774
Job title							
Nurse	1,704 (77)		426 (77)		1,278 (77)		0.667
PCA	501 (23)		130 (23)		371 (23)		
Ethnicity							
White	1,634 (74)		409 (74)		1,225 (74)		0.533
Black	356 (16)		85 (15)		271 (16)		
Hispanic	129 (6)		39 (7)		90 (6)		
Other	86 (4)		23 (4)		63 (4)		
Type of injury							
Musculoskeletal			280 (50)				
Sharps			122 (22)				
Other			154 (28)				
Health Plan							
Premium Plan	1,976 (90)		492 (89)		1,484 (90)		0.402
Value Plan	71 (3)		16 (3)		55 (3)		
Grandfathered Plan	153 (7)		45 (8)		108 (7)		
Mental health care use (at least once)							
3 months pre-injury	475 (22)		141 (25)		334 (20)		0.011
6 months pre-injury	562 (25)		168 (30)		394 (24)		0.003
3 months post-injury	213 (10)		55 (10)		158 (10)		0.830
6 months post-injury	553 (25)		179 (32)		374 (23)		<0.001

We considered *p*-value under <0.05 as statistically significant.
Bold values are statistically significant (<0.05).

Table 2

Logistic regression models for at least one visit post-injury to mental health care services during the 3 months and 6 months after injury for all workers (nurses and patient care associates). Models were controlled for any visit during the 3 and 6 months prior to the injury or proxy date, unit type and type of health plan.

	3-months post-injury			6-months post-injury		
	Odds ratio	SE	95% Confidence Interval	Odds ratio	SE	95% Confidence Interval
Injured	0.825	0.155	0.57–1.19	1.646*	0.242	1.23–2.20
<i>Health plan</i>						
Value Plan	0.4281	0.271	0.12–1.48	0.646	0.259	0.29–1.42
Grandfathered Plan	2.839 ^{**}	0.829	1.6–5.03	0.697	0.195	0.4–1.21

We considered *p*-value under <0.05 as statistically significant.

* *p* < 0.05.

** *p* < 0.001.

Table 3

Logistic regression models for at least one visit post-injury to mental health care services during the 3 and 6 months after injury separated by job title and controlled for 3 and 6 months visits prior to the injury or proxy date, unit type and type of health plan.

	Model 1: Nurses only			Model 2: Patient-care associates only		
	Odds ratio	SE	95% Confidence Interval	Odds ratio	SE	95% Confidence Interval
3-months after injury						
Injured	0.787	0.156	0.53–1.16	0.908	0.569	0.27–3.10
<i>Health plan</i>						
Value Plan	0.163	0.171	0.02–1.27	2.876	2.480	0.53–15.59
Grandfathered Plan	2.476 ^{**}	0.733	1.39–4.42			
6-months after injury						
Injured	1.556*	0.254	1.13–2.14	2.133*	0.732	1.09–4.18
<i>Health plan</i>						
Value Plan	0.609	0.315	0.22–1.68	1.032	0.669	0.29–3.68
Grandfathered Plan	0.645	0.182	0.37–1.12			

We considered *p*-value under <0.05 as statistically significant.

* *p* < 0.05.

** *p* < 0.001.

4. Discussion

Occupational injuries and illnesses produce functional impairment in both work and life activities and, as a result, represent a psychological burden. There are many challenges to claiming workers' compensation benefits for mental illness (Goldberg & Steury, 2001), even when there is a direct causal link to a work event (Lippel & Sikka, 2010). Hence, coverage of mental illness as a consequence of occupational injury may seem unlikely. However, findings from this study showed that injured workers have a higher likelihood of seeking mental health care services than their uninjured counterparts during the six months after injury ($OR = 1.646$, *p*-value <0.05). These findings support initial hypotheses. We also hypothesized that PCAs would experience more symptoms of depression and anxiety than nurses post-injury, given the burden that a work-related injury may represent to workers in a lower socioeconomic status. Analyses segregated by job position support our second hypothesis by showing that the relationship between injury and mental health care use is larger for patient-care associates ($OR = 2.133$, *p*-value <0.05) than for nurses ($OR = 1.556$, *p*-value <0.05), however among PCAs, the numbers to use mental health services are very low (27 injured and 46 uninjured workers) and differences should be interpreted carefully.

Our study contributes to the existing evidence that suggests that WC coverage for medical care resulting from an occupational injury may not be sufficient to treat all the consequences of an injury. Williams et al. (2017) found increased health care use and costs in employer sponsored health plan for injured workers for any type of care during the three and six month periods after injury. To our knowledge, only one study has focused on use and costs of mental health care after an occupational injury. Asfaw

and Souza (2012) found that, after a work-related injury, mental health care use and costs were higher for injured workers during the three months after injury. Similarly, our study focused on mental health care utilization, but not on costs, and our results showed that there is an increased likelihood of use during a six-month window, but not in a three-month window after injury. While we focused only on patient-care workers, Asfaw and Souza (2012) used a larger sample size ($n = 367,881$) with workers from five different industries, including transportation and manufacturing. These industries have different exposures profiles and injury risk factors compared with patient-care workers. Another study by Hunt et al. (2019) studied injury claimants for a longer period of three years and found that the use of anti-depressants, benzodiazepines, and opioids, separately after injury, increased overall medical cost. Their combination represented even higher costs (Hunt et al., 2019). These studies and our results provide insight into the potential consequences of work-related injury and related co-morbidities.

The lack of association between injury and mental health care use during the three-month window post-injury may be indicative of an existing lag between using health services for physical ailments first and then addressing mental health. It could also indicate that a frustrating experience of injury and health care use takes a toll on mental health later in the process. The present findings differ from Williams et al. (2017) in that their study found increased use of health care services three months post-injury. Our study only focused on mental health care and not on all health care. Previous studies have shown that people with higher levels of psychological distress and comorbid pain tend to have more healthcare visits, but are less likely to seek mental health care than individuals without pain (Bao, Sturm, & Croghan, 2003). These

findings may explain differences in our results as the relationship of musculoskeletal pain and psychological distress has been found in a sub-sample of workers from the BHWHS in an earlier study (Reme, Dennerlein, Hashimoto, & Sorensen, 2012).

Our findings also coincide with previous literature showing a relationship between injury and depression. Several types of injuries (spinal cord injuries, traumatic brain injuries) and chronic back pain have been associated with depression (Crisp, 2007; Franche et al., 2009a; Stice & Dik, 2009). Similarly, depression has been associated with occupational disability (Crisp, 2007; Crook, Milner, Schultz, & Stringer, 2002) and negative outcomes in return to work (Anderson et al., 2015). Our study shows a similar relationship using medical claims data instead of self-reported data. The use of medical claims makes our results conservative, as there are many barriers to seeking mental health care for the overall population such as stigma, time, lack of coverage (Hodgkinson, Godoy, Beers, & Lewin, 2017), and cost of care (Dedania & Gonzales, 2019). Furthermore, it has been found that racial-ethnic minorities have less access to proper mental health care (Cook, Trinh, Li, Hou, & Progovac, 2017; Dedania & Gonzales, 2019) and given the racial-ethnic composition of patient-care associates, this study may not be capturing the need for mental health care in this study sub-population.

The differences found between nurses and patient-care associates are not surprising in this study. Other studies conducted with the BHWHS have found differences in injury rates (Boden et al., 2012) and injury reporting between nurses and patient-care associates (Sabbath et al., 2017), both studies found poorer outcomes for patient-care associates. We hypothesized that these differences would be similar for depression symptoms as patient-care associates are a more vulnerable group given their financial status and the nature of their work, which requires more physical effort on a more frequent basis. Patient-care associates may also be a group that faces more financial distress and as a result an injury may represent a larger socioeconomic burden.

The findings of this study have implications for employees and employers alike. Depression and anxiety are a consequence of occupational injury, given the burden that it represents to workers in terms of physical impairment and socioeconomic burden. Nevertheless, mental care is rarely covered by workers' compensation systems, even in cases when there is a direct causality with work events (Lippel & Sikka, 2010). Treating depression and anxiety has the potential of preventing further physical ailment, improving the return to work process and saving costs to employers who sponsor group health plans as workers will not need further treatment outside WC.

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Conflict of interest

None declared.

References

Anderson, J. T., Haas, A. R., Percy, R., Woods, S. T., Ahn, U. M., & Ahn, N. U. (2015). Clinical depression is a strong predictor of poor lumbar fusion outcomes among workers' compensation subjects. *Spine*, 40(10), 748–756. <https://doi.org/10.1097/BRS.0000000000000863>.

Asfaw, A., & Souza, K. (2012). Incidence and cost of depression after occupational injury. *Journal of Occupational and Environmental Medicine/American College of Occupational and Environmental Medicine*, 54(9), 1086–1091. <https://doi.org/10.1097/JOM.0b013e3182636e29>.

Bao, Y., Sturm, R., & Croghan, T. W. (2003). A national study of the effect of chronic pain on the use of health care by depressed persons. *Psychiatric Services*, 54(5), 693–697.

Boden, L. I., Sembajwe, G., Tveito, T. H., Hashimoto, D., Hopcia, K., Kenwood, C., ... Sorensen, G. (2012). Occupational injuries among nurses and aides in a hospital setting. *American Journal of Industrial Medicine*, 55(2), 117–126. <https://doi.org/10.1002/ajim.21018>.

Briand, C., Durand, M. J., St-Arnaud, L., & Corbière, M. (2008). How well do return-to-work interventions for musculoskeletal conditions address the multicausality of work disability? *Journal of Occupational Rehabilitation*, 18(2), 207–217. <https://doi.org/10.1007/s10926-008-9128-1>.

Cancelliere, C., Donovan, J., Stockkendahl, M. J., Biscardi, M., Ammendolia, C., Myburgh, C., & Cassidy, J. D. (2016). Factors affecting return to work after injury or illness: Best evidence synthesis of systematic reviews. *Chiropractic & Manual Therapies*, 24(1), 32. <https://doi.org/10.1186/s12998-016-0113-z>.

Carnide, N., Franche, R. L., Hogg-Johnson, S., Côté, P., Breslin, F. C., Severin, C. N., ... Krause, N. (2016). Course of depressive symptoms following a workplace injury: a 12-month follow-up update. *Journal of Occupational Rehabilitation*, 26(2), 204–215. <https://doi.org/10.1007/s10926-015-9604-3>.

Cook, B. L., Trinh, N.-H., Li, Z., Hou, S. S., & Progovac, A. (2017). Trends in racial-ethnic disparities in access to mental health care, 2004–2012. *Psychiatric Services*, 68(1), 9–16. <https://doi.org/10.1176/appi.ps.201500453.Trends>.

Crisp, R. (2007). Depression and occupational disability in five diagnostic groups: A review of recent research. *Disability and Rehabilitation*, 29(4), 267–279. <https://doi.org/10.1080/09638280600835267>.

Crook, J., Milner, R., Schultz, I. Z., & Stringer, B. (2002). Determinants of occupational disability following a low back injury: A critical review of the literature. *Journal of Occupational Rehabilitation*, 12(4), 277–295. https://doi.org/10.1007/0-387-28919-4_9.

Dedania, R., & Gonzales, G. (2019). Disparities in access to health care among US-born and foreign-born US adults by mental health. *AJPH Research*, 109(S3), S221–27. <https://doi.org/10.2105/AJPH.2019.305149>.

Dembe, A. E. (2001). The social consequences of occupational injuries and illnesses. *American Journal of Industrial Medicine*, 40(4), 403–417. <https://doi.org/10.1002/ajim.1113>.

Frache, R., Carnide, N., Bültmann, U., Severin, C. N., & Krause, N. (2009). Course, diagnosis, and treatment of depressive symptomatology in workers following a workplace injury: A prospective cohort study. *The Canadian Journal of Psychiatry*, 54(8), 534–546.

Frache, R., Carnide, N., Bültmann, U., Severin, C. N., & Krause, N. (2009b). Symptomatology in workers following a workplace injury: A prospective cohort study, 54(8).

Galizzi, M., & Zagorsky, J. L. (2009). How do on-the-job injuries and illnesses impact wealth? *Labour Economics*, 16(1), 26–36. <https://doi.org/10.1016/j.labeco.2008.02.003>.

Goldberg, R. J., & Steury, S. (2001). Depression in the workplace: Costs and barriers to treatment. *Psychiatric Services*, 52(12), 1639–1643. <https://doi.org/10.1176/appi.ps.52.12.1639>.

Hodgkinson, S., Godoy, L., Beers, S., & Lewin, A. (2017). Improving mental health access for low-income children and families in the primary care setting. *Pediatrics*, 139(1), 1–9. <https://doi.org/10.1542/peds.2015-1175>.

Hunt, D. L., Artuso, R. D., Kalia, N., Leung, N., Bernacki, E. J., & Tao, X. G. (2019). Association of opioid, anti-depressant, and benzodiazepines with workers' compensation cost: A cohort study. *Journal of Occupational and Environmental Medicine*, 61(5). <https://doi.org/10.1097/JOM.0000000000001585>.

Keogh, J. P., Nuwayhid, I., Gordon, J. L., & Gucer, P. W. (2000). The impact of occupational injury on the injured worker and family. *American Journal of Industrial Medicine*, 38, 498–506.

Kim, J. (2013). Depression as a psychosocial consequence of occupational injury in the US working population: Findings from the medical expenditure panel survey. *BMC Public Health*, 13(1). <https://doi.org/10.1186/1471-2458-13-303>.

Lagerveld, S. E., Bültmann, U., Frache, R. L., Van Dijk, F. J. H., Vlasveld, M. C., Van Der Feltz-Cornelis, C. M., ... Nieuwenhuijsen, K. (2010). Factors associated with work participation and work functioning in depressed workers: A systematic review. *Journal of Occupational Rehabilitation*, 20(3), 275–292. <https://doi.org/10.1007/s10926-009-9224-x>.

Lin, K. H., Shiao, J. S. C., Guo, N. W., Liao, S. C., Kuo, C. Y., Hu, P. Y., ... Guo, Y. L. (2014). Long-term psychological outcome of workers after occupational injury: Prevalence and risk factors. *Journal of Occupational Rehabilitation*, 24(1), 1–10. <https://doi.org/10.1007/s10926-013-9431-3>.

Lippel, K., & Sikka, A. (2010). Access to workers' compensation benefits and other legal protections for work-related mental health problems: a Canadian overview. *Canadian Journal of Public Health = Revue Canadienne de Sante Publique*, 101(Suppl 1), S16–22.

Lipscomb, H. J., Dement, J. M., Silverstein, B., Cameron, W., & Glazner, J. E. (2009). Who is paying the bills? Health care costs for musculoskeletal back disorders, Washington state union carpenters, 1989–2003. *Journal of Occupational and Environmental Medicine*, 51(10), 1185–1192. <https://doi.org/10.1097/JOM.0b013e3181b68d0a>.

Pompeii, L. A., Lipscomb, H. J., Schoenfisch, A. L., & Dement, J. M. (2009). Musculoskeletal injuries resulting from patient handling tasks among hospital workers. *American Journal of Industrial Medicine*, 52, 571–578. <https://doi.org/10.1002/ajim.20704>.

Reme, S. E., Dennerlein, J. T., Hashimoto, D., & Sorensen, G. (2012). Musculoskeletal pain and psychological distress in hospital patient care workers. *Journal of Occupational Rehabilitation*, 22(4), 503–510. <https://doi.org/10.1007/s10926-012-9361-5>.

Sabbath, E. L., Boden, L. I., Williams, J. A. R., Hashimoto, D., Hopcia, K., & Sorensen, G. (2017). Obscured by administrative data? Racial disparities in occupational injury. *Scandinavian Journal of Work, Environment and Health*, 43(2), 155–162. <https://doi.org/10.5271/sjweh.3611>.

Sabbath, E. L., Hashimoto, D., Boden, L. I., Dennerlein, J. T., Williams, J. A. R., Hopcia, K., ... Sorensen, G. (2018). Cohort profile: The Boston Hospital Workers Health Study (BHWHS). *International Journal of Epidemiology*, 1–9. <https://doi.org/10.1093/ije/dyy164>.

Sabbath, E. L., Yang, J., Dennerlein, J. T., Boden, L. I., Hashimoto, D., & Sorensen, G. (2019). Paradoxical impact of a patient-handling intervention on injury rate disparity among hospital workers. *AJPH Open-Themed Research*, 109(4), 618–625. <https://doi.org/10.2105/AJPH.2018.304929>.

Stice, B. D., & Dik, A. E. B. J. (2009). Depression among injured workers receiving vocational rehabilitation: Contributions of work values, pain, and stress. *Journal of Occupational Rehabilitation*, 19, 354–363. <https://doi.org/10.1007/s10926-009-9190-3>.

Williams, J. A. R., Sorensen, G., Hashimoto, D., Hopcia, K., Wagner, G. R., & Boden, L. I. (2017). Impact of occupational injuries on nonworkers' compensation medical costs of patient-care workers. *Journal of Occupational and Environmental Medicine*, 59(6), e119–e124. <https://doi.org/10.1097/JOM.0000000000001047>.

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