Received: 6 November 2020 | Revised: 28 January 2021 | Accepted: 29 January 2021

DOI: 10.1002/ajim.23237

RESEARCH ARTICLE

AMERICAN JOURNAL OF INDUSTRIAL MEDICINE WILEY

Workers' compensation costs for healthcare caregivers: Home healthcare, long-term care, and hospital nurses and nursing aides

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Funding information
Ohio Bureau of Workers' Compensation

Abstract

Background: Healthcare workers (nurses and nursing aides) often have different exposures and injury risk factors depending on their occupational subsector and location (hospital, long-term care, or home health care).

Methods: A total of 5234 compensation claims for nurses and nursing aides who suffered injuries to their lower back, knee, and/or shoulder over a 5-year period were obtained from the Ohio Bureau of Workers' Compensation and analyzed. Injury causation data was also collected for each claim. The outcome variables included indemnity costs, medical costs, total costs, and the number of lost work days. The highest prescribed morphine equivalent dose for opioid medications was also calculated for each claim.

Results: Home healthcare nurses and nursing aides had the highest average total costs per claim. Hospital nurses and nursing aides had the highest total claim costs, of $5 million/year. Shoulder injuries for home healthcare nursing aides (HHNAs) had the highest average total claim costs ($20,600/injury) for all occupation, setting, and body area combinations. Opioids were most frequently prescribed for home healthcare nurses (HHNs) and nursing aides (18.9% and 17.7% having been prescribed opioids, respectively). Overexertion was the most common cause for HHN and nursing aide claims.

Conclusions: With the rapidly expanding workforce in the home healthcare sector, there is a potential health crisis from the continued expansion of home healthcare worker injuries and their associated costs. In addition, the potential for opioid drug usage places these workers at risk for future dependence, overdose, and prolonged disability. Future research is needed to investigate the specific and ideally reversible causes of injury in claims categorized as caused by overexertion.

KEYWORDS
musculoskeletal disorders, opioids, overexertions

1 | INTRODUCTION

Home healthcare is the fastest-growing sector within the healthcare industry.[1] Home healthcare is defined as providing healthcare services in the home of the patient. This is due to the overall aging of the United States population, with the large population of "baby boomers" reaching retirement age, and the increased healthcare needs of the elderly relative to the rest of the population. The expected employment growth in the home healthcare sector is expected to outpace that of the entire workforce, especially for nursing aides (an expected increase of 41% or 1.2 million jobs from 2016 to 2026).[1] In the state of Ohio, the expected growth rate for home healthcare services is 44.5% over the next 5 years.[2]

A recent review by Davis and Kotowski[3] revealed a limited number of studies investigating common musculoskeletal disorders (MSDs) of the low back—14, shoulder—8, and knee—4 for home healthcare nurses (HHNs) and nursing aides. There has been even less research on the actual reported injuries either through company records or compensation systems (one study for low back only). Each year, nurses and nursing aides continue to be at the highest risk of MSDs (higher than material handlers, construction workers, and garbage collectors) according to the Bureau of Labor and Statistics.[4] Other workers' compensation studies reported that the healthcare sector had the second-highest number of claims and fifth-highest rate.[5] In 2015, at the national level, nursing aides in hospitals had the highest MSD annual incidence rate (180 injuries per 10,000 full-time workers) with nurses in hospitals having a yearly rate of 48 per 10,000 full-time workers.[2] Home health nursing aides are also one of the top occupations that suffer MSDs (47.7 per 10,000 full-time workers per year).[4] In another state compensation system (Washington State), home nursing workers had a significantly higher annual injury (of all types) incidence rate (160% higher, 1375 injuries per 10,000 full-time workers) than general industry (862 injuries per 10,000 full-time workers).[6] The Washington State injury incidence rates were significantly higher than the national home health nurse's aides' injury data due to the inclusion of all injuries in the Washington data, while the national data only included MSDs. Thus, HHNs and nursing aides are at higher risk for injury claims, specifically, MSD claims, compared with other professions, but more research in this area is needed.

Opioid prescriptions associated with compensation claims have been previously evaluated (2008–2009), and found some staggering levels of morphine equivalent dosage (MED) levels; 19.2% of Ohio compensation claims involved opioid use.[7] This percentage was lower than other workers' compensation systems (31.8%) but slightly higher than non-compensation claims (17.9%).[7] Recent trends in prescriptions may have affected the usage of opioid drugs in the years of the current study (2010–2014).

The current study compared the number of injuries reported to a state compensation system (Ohio Bureau of Workers' Compensation [OBWC]) for nurses and nursing aides in three settings: home healthcare, hospital care, and long-term care. The focus was to determine how injuries afflicting home healthcare providers differed by work setting for these workers with respect to prevalence, costs (indemnity and medical), lost days of work, and opioid prescription usage. The coded causes of injuries for these six categories of healthcare nurses and nursing aides were also compared. There are several factors that may increase the risk of MSD claims for home healthcare caregivers: (1) limited resources, such as no handling equipment,[8] (2) variability in the workplace environment, (3) increasing age of the workforce,[9] and (4) many unique exposures.[10–12]

2 | METHODS

A database of all claims for nurses and nursing aides in home healthcare, long-term care, and hospital care who suffered low back, knee, and/or shoulder injuries was constructed from data provided by the OBWC. The claims were recorded over a 5-year period (beginning of 2010 to the end of 2014). Claims were initiated in this 5-year period with costs recorded until 2016 (e.g., all claims matured until 2016 when censored). All costs were actual costs and not reserves. No adjustments were done to the costs with respect to inflation or salary differences. The claims were limited to the public and private organizations that enroll in the OBWC system. All information was deidentified and assigned an anonymous identification claim number to ensure single person claims. A total of 5234 nurse and nursing aide claims were found in the healthcare occupation injury claim database.

2.1 | Independent variables

In most cases, the classification of the occupations was performed by using the occupation description, which was provided by OBWC combined with National Council on Compensation Insurance (NCCI) manual numbers.[13] In some cases, the manual number was replaced by 2018 standard occupation codes (SOC).[14] The following was the breakdown for the NCCI manual numbers in home health: 8835, long-term care: 8829, 8825, 8826, and hospital: 8833. These categories were then combined with the occupation description (e.g., "nurse," "nursing aides," any others) to complete the classification. The SOC codes defined the occupation as nursing aide (5236, 5233) or nurse (2900, 3660). For example, occupational entry oftentimes coded as "nurse" or "RN" combined with manual code of 8835 resulted in the coding of HHN. Another example is a "CNA" or "STNA" occupational entry and 8835 for manual code indicated a home healthcare nursing aide (HHNA). Classification of the body region was based on the ICD-9 codes for back, knee, shoulder, and for claims with multiple areas (involving the low back only, a knee only, a shoulder only, or multiple areas of the body). The claim was classified by the ICD-9 codes allowed in the claim and categorized as multiple when more than one area of the body was involved in these allowed ICD-9 codes. Table 1 provides the actual

TABLE 1 ICD-9 codes used to classify the injuries for knee, back, and shoulder body regions and ICD-9-CM codes to classify cause of injury[13]

Body region	ICD-9 code
Knee	717, 717.1, 717.2, 717.3, 717.4, 717.41, 717.42, 717.43, 717.49, 717.5, 717.6, 717.81, 717.82, 717.85, 717.89, 717.9, 726.6, 726.69, 736.6, 836.0, 836.1, 836.2, 836.5, 836.59, 836.6, 836.69, 844.0, 844.1, 844.2, 844.3, 844.8, 844.9, 924.11, 916.0, 924.1, 715.36, 717.7
Back	335.1, 335.19, 349.2, 349.31, 353.1, 353.4, 720.1, 721.3, 721.42, 721.8, 722.1, 722.32, 722.52, 722.83, 722.93, 724.02, 724.03, 724.09, 724.2, 724.3, 724.4, 724.5, 724.8, 724.9, 738.5, 739.3, 846.0, 847.2, 847.9, 907.3, 922.31, 952.2, 952.4, 953.2, 953.5, 953.8, 953.9
Shoulder	711.41, 711.81, 711.91, 715.11, 715.21, 715.31, 715.91, 716.11, 716.61, 716.81, 716.91, 718.01, 718.11, 718.21, 718.31, 718.41, 718.51, 718.81, 718.91, 719.01, 719.11, 719.41, 719.51, 719.61, 719.81, 719.91, 726.0, 726.1, 726.11, 726.12, 726.13, 726.19, 726.2, 727.61, 727.62, 730.01, 730.11, 730.21, 730.81, 730.91, 831.0, 831.04, 831.09, 831.1, 831.14, 831.19, 840.0, 840.1, 840.3, 840.4, 840.5, 840.6, 840.7, 840.8, 840.9, 923.0, 923.03, 923.09, 955.7, 955.8, 955.9, 959.2
Injury cause	E800.0, E800.8, E801.0, E802.2, E802.8, E804.0, E804.9, E810.0, E810.8, E811.0, E811.1, E811.2, E811.3, E811.4, E811.5, E811.7, E811.8, E811.9, E812.0, E812.1, E812.2, E812.3, E812.4, E812.7, E812.8, E812.9, E813.0, E813.1, E813.2, E813.3, E813.4, E813.6, E813.7, E813.8, E813.9, E814.0, E814.1, E814.2, E814.7, E814.8, E814.9, E815.0, E815.1, E815.2, E815.4, E815.5, E815.7, E815.8, E815.9, E816.0, E816.1, E816.2, E816.4, E816.5, E816.8, E816.9, E817.0, E817.1, E817.7, E817.9, E818.0, E818.1, E818.4, E818.7, E818.8, E818.9, E819.0, E819.1, E819.3, E819.7, E819.9, E820.0, E820.4, E821.0, E821.1, E821.2, E821.3, E821.5, E821.7, E821.8, E821.9, E822.0, E822.1, E822.2, E822.3, E822.4, E822.5, E822.7, E822.8, E822.9, E823.0, E823.1, E823.2, E823.3, E823.7, E823.8, E823.9, E824.0, E824.1, E824.7, E824.8, E824.9, E825.0, E825.1, E825.2, E825.7, E825.8, E825.9, E826.1, E827.0, E828.0, E828.2, E829.0, E829.4, E829.8, E829.9, E834.8, E836.0, E837.8, E840.0, E840.2, E840.5, E840.9, E843.2, E844.2, E844.9, E846, E847, E848, E849.9, E850.0, E855.9, E858.2, E863.8, E869.0, E870.2, E876.9, E880.0, E880.1, E880.9, E881.0, E881.1, E882, E883.0, E883.1, E883.2, E883.9, E884.0, E884.1, E884.2, E884.3, E884.4, E884.5, E884.6, E884.9, E885.0, E885.1, E885.3, E885.4, E885.9, E886.0, E886.9, E887, E888.0, E888.1, E888.8, E888.9, E890.8, E890.9, E891.0, E891.2, E891.3, E891.8, E891.9, E893.0, E893.1, E893.8, E894, E896, E897, E898.1, E899, E900.9, E901.0, E901.9, E903, E905.3, E905.4, E906.0, E906.3, E906.5, E906.8, E906.9, E908.1, E908.3, E909.0, E909.3, E909.8, E913.0, E913.8, E914, E915, E916, E917.0, E917.1, E917.2, E917.3, E917.4, E917.5, E917.6, E917.7, E917.8, E917.9, E917. 9, E918, E919.0, E919.1, E919.2, E919.3, E919.4, E919.6, E919.7, E919.8, E919.9, E920.0, E920.1, E920.3, E920.4, E920.5, E920.8, E920.9, E921.8, E921.9, E922.0, E922.4, E922.9, E923.0, E923.2, E923.8, E923.9, E924.0, E924.1, E924.2, E924.8, E924.9, E925.0, E925.1, E925.2, E925.8, E925.9, E927.0, E927.0, E927.1, E927.2, E927.3, E927.4, E927.8, E927.9, E928.0, E928.2, E928.3, E928.4, E928.5, E928.7, E928.8, E928.9, E929.0, E929.3, E929.5, E929.8, E929.9, E937.0, E938.3, E950.0, E957.1, E957.9, E959, E960.0, E965.0, E966, E968.0, E968.1, E968.2, E968.4, E968.5, E968.7, E968.8, E968.9, E973, E975, E976, E977, E981.0, E986, E987.0, E987.1, E987.2, E987.9, E988.1, E988.9, E989, E990.9, E995.9, E998.9

codes for the three body regions. The number of previous claims in the 5-year period and drugs prescribed in the claim were also used in the analysis. The causes of the claim were classified by ICD-9-CM codes (Table 1) with categories based on typical causes of MSDs as defined by the Bureau of Labor Statistics (BLS).[15] The ICD-9-CM code was decoded using the ICD9data.com website that links to the 2015 ICD-9-CM database.[16] If no code was present, it was labeled as missing. All codes were converted by the lead author and replaced throughout the database.

2.2 | Dependent variables

The dependent variables included costs associated with the claim including indemnity costs, medical costs, and total costs, number of days off the job, and the number of light duty days as well as opioid prescriptions in the claim. Based on the prescription data, an MED was calculated based on equivalent daily milligram dose of morphine to the daily dose of a given opioid (e.g., hydrocodone 10 mg three times a day has an MED of 30, oxycodone 10 mg three times a day has an MED of 45).[17] The highest prescribed dose in the claim (MaxMED) and the number of days for which opioids were prescribed were calculated for each claim. All drugs prescribed with a morphine equivalent were utilized to calculate the MED. All prescriptions were entered into ScopiaRx Analytics software tool which determines the MED level and drug description for all claims. A cut-off of 80 MED was identified as the level of opioid exposure that was a significant dosage and risk of adverse health outcomes.

2.3 | Data and statistical analysis

Frequency (prevalence) and mean (*SD*) were used to summarize categorical and numerical variables for each of occupational groups, HHN, HHNA, long-term care nurse (LTN), long-term care nursing aide (LTNA), hospital nurse (HN), and hospital nursing aide (HNA) as well as body regions (back, knee, shoulder, and multiple). Statistical analysis consisted of univariate analysis of variance (ANOVA) with post-hoc Tukey tests to determine the source of any significant effects among occupations. The ANOVAs were blocked on the body region as well as across all claims. Statistical significance was determined at the $p < 0.05$ level (conducted with SAS statistical software).

3 | RESULTS

HHN claims had the highest per claim costs (about $6200 for medical and about $8900 for indemnity; $p < 0.0001$; resulting in the highest total per claim costs, about $15,100; $p < 0.05$) while LTNA claims had the lowest (about $3500, $2500, and $6000 for medical, indemnity, and total costs, respectively, $p < 0.05$; Figure 1). While the differences between the other nursing groups were not statistically significantly different, HHNA had the second-highest total costs per claim (about $10,750), followed by HN (about $10,000), which were greater than LTN (about $8200), and HNA (about $7200).

When the costs were categorized by body part, the HHN and HHNA claim groups had the highest medical costs (Figure 2) for back, knee, and shoulder. Medical costs (ranged from $4300 to $8400; $p < 0.05$) with HHN having the highest indemnity costs (Figure 3) across all body part categories (ranged from $6700 to $12,300, $p < 0.05$). Although, the HHNA indemnity costs per claim for back claims were not statistically significant than HHN, the HHN total claim costs were the highest for back, knee, and shoulders and second-highest for multiple ($12,500 to $20,600; $p < 0.05$). Average total claim costs were lowest for LTNAs (ranging from $3600 to $17,700 depending on body area in the claim; $p < 0.05$; Figure 4). The total claim costs for HHNs and nursing aides were the highest of the three work settings ($p < 0.05$; Figure 4).

Overexertion was the major coded causal factor/contributor to back and shoulder injuries for all healthcare nurses and nursing aides (Table 2). Overexertion was the cause of 43.5%–64.5% of back injuries and 44.1%–65.5% of shoulder injuries, across the six studied occupation groups (Table 1). HHN had the lowest percentage of overexertion-related back injuries, compared with all other nurses (about 10%–20% less). Overexertion also contributed to about 25% of knee injuries and multiple body area injuries for nursing aides in all three settings, while overexertion in these body areas was the coded cause of injury in nurses around 15% of the time. Falls caused the highest number of knee (41.6%–59.6% across occupation groups) and multiple body area (36.0%–75.0% across occupation groups) injuries. About 10% of all HHN and HHNA injuries had motor vehicle accidents (MVA) as a cause. This percentage was about two to three times higher than the MVA-caused injury claims in long-term or HNs and nursing aides.

Nurses in all occupational settings were, on average, 5 years older when injured than the nursing aides (Table 3). The HHNs were the oldest (about 50 years old) when injured, while HN and LTNs were the youngest (about 35 years old). Back injuries in nurses and nursing aides occurred at a younger age than injuries to other body areas (about 2–3 years sooner). In contrast, knee and multiple body area injuries tended to occur at more advanced ages than injuries involving the back and shoulder (about 3–4 years later). The individuals who reported claims were also mainly female (HHNA: 95.3%, HHN: 93%, HNA: 93.4%, HN: 91.6%, LTNA: 95%, and LTN: 94.4%). The marital status of the healthcare worker varied by occupation category: HHN had the highest divorce rate (19.5%) as compared with other nurses and nursing aides (around 10.4%–15.6%); living together was about 3.5% across all groups; nurses had the highest percentages of being married (approximately 55% for HHN, HN, and LTN) while nurse aides' percentage was 35%; nursing aides were mostly single (48%), and nursing and nursing aides were widowed at 2%.

Home health nurses had the highest average number of workers' compensation claims from before the injury date in the claims in this study (2.4 prior claims). The average number of previous claims averaged about 2.1 for HHN, HNA, and HHNA (as a group not significant), and this was significantly higher than the average of 1.8 previous claims for HHNA, HN, LTN, and LTNA, who had the lowest

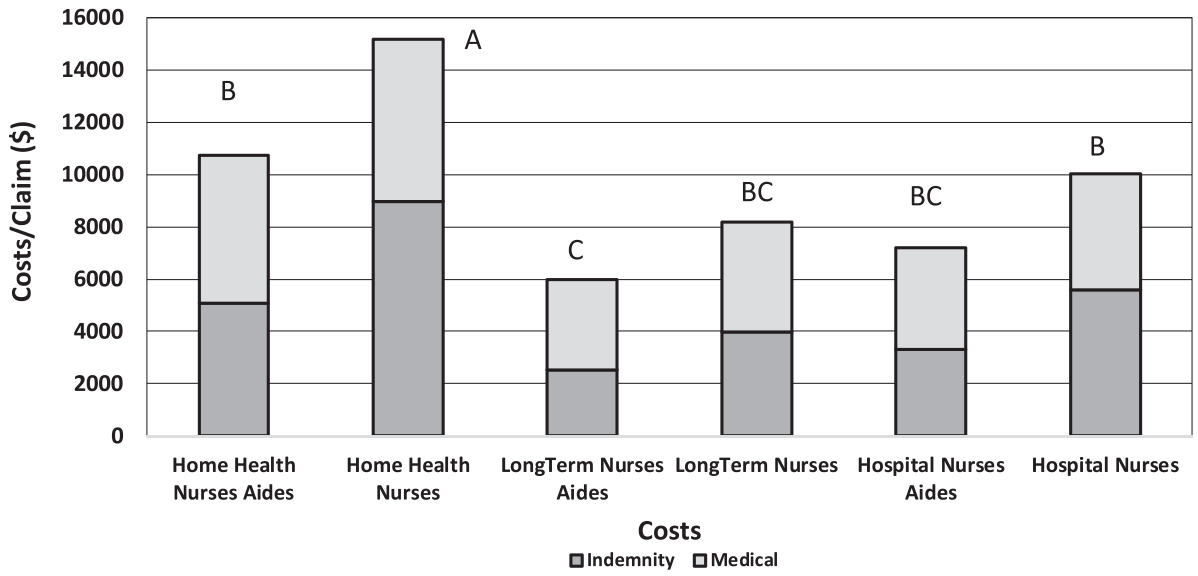

FIGURE 1 Overall medical, indemnity, and total costs per claim for home healthcare, long-term care, and hospital care for nurses and nursing aides. Different alphabetical characters indicate significant difference

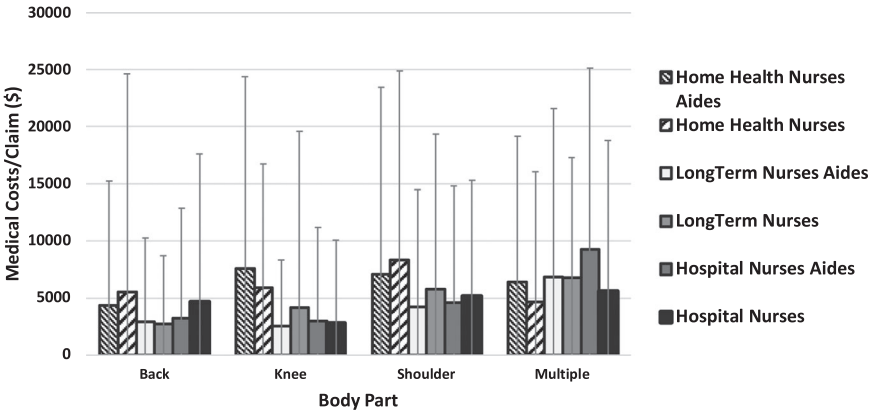

FIGURE 2 Medical costs per claim for injuries in the specific body part (back, knee, shoulder, multiple) for home healthcare, long-term care, and hospital care for nurses and nursing aides

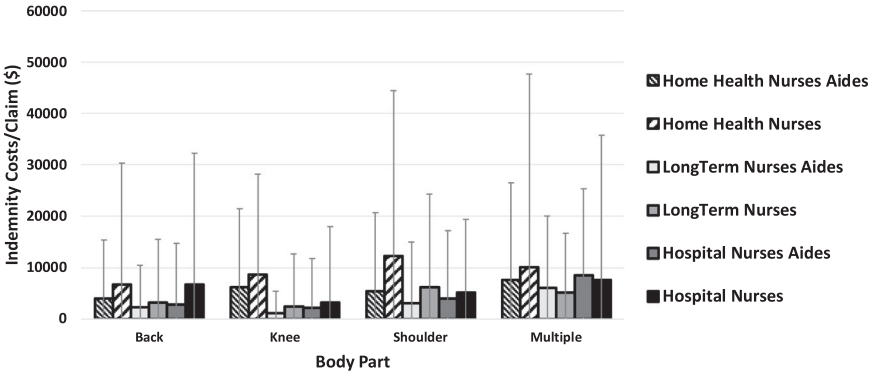

FIGURE 3 Indemnity costs per claim for injuries in the specific body part (back, knee, shoulder, multiple) for home healthcare, long-term care, and hospital care for nurses and nursing aides

number of previous claims (Table 3). Similar trends were found across the individual body regions with respect to the previous reporting of claims and occupational group. Overall, HHN had the most previously reported claims (2.2–2.8 across body areas of injury) with LTNA, LTN, and HN having the least number of prior claims (1.5–2.5 across body areas of injury; significant at $p < 0.05$). Multiple body area claims had the highest average number of prior claims (2.3–2.8 across occupational groups).

HHNs and HHNAs had the most lost days per claim (about 86 days and 68 days, respectively) as compared with other healthcare nurses and nursing aides. LTNs and LTNAs had the lowest number of lost days per claim (both about 30 days; $p < 0.05$; Table 4). Although the number of days away from the job due to injury varied somewhat across the types of body area injury claims, these trends for occupational groups generally held. There was no difference across the caregiver occupational group categories for light duty days ($p > 0.05$).

Table 5 provides a summary of the prescriptions associated with claims for the different healthcare groups. HHNA and HHN had the highest frequency of prescriptions associated with the claims (23.2% and 22.2%, respectively) as compared with HNA (19.8%), HN (16.1%), LTNA (19.5%), and LTN (21.4%) (not significant at $p > 0.05$). About 80% of the home healthcare worker claims with prescription medications had opioids prescribed (the highest percentage of any occupational group). HHNA, HHN, and HN had the greatest percentage of claims (between 24% and 27%) with prescription medications that had a MaxMED ≥ 80 MED. As most claims did not have

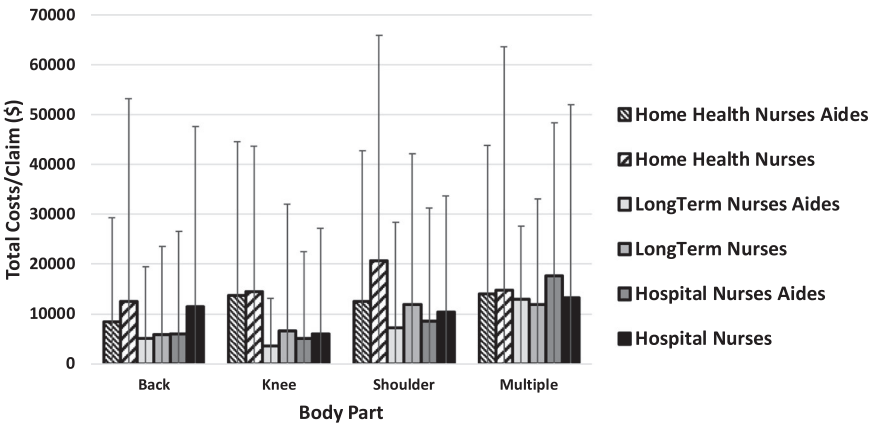

FIGURE 4 Total costs per claim (medical and indemnity) for injuries in the specific body part (back, knee, shoulder, multiple) for home healthcare, long-term care, and hospital care for nurses and nursing aides

TABLE 2 Number of claims (percentage of injury category) for each body part as a function of healthcare group (HHN, HHNA, LTN, LTNA, HN, and HNA)

	HHNA				HHN			
	Back	Knee	Shoulder	Multiple	Back	Knee	Shoulder	Multiple
Motor vehicle	42 (8.6%)	15 (8.8%)	11 (6.0%)	10 (9.5%)	15 (13.9%)	1 (2.1%)	4 (6.7%)	3 (10.7%)
Falls	83 (17.0%)	74 (43.5%)	41 (22.5%)	50 (47.6%)	20 (18.5%)	28 (59.6%)	17 (28.3%)	18 (64.3%)
Striking/struck by	10 (2.1%)	21 (12.4%)	12 (6.6%)	6 (5.7%)	1 (0.9%)	2 (4.3%)	2 (3.3%)	0 (0.0%)
Overexertion	276 (56.7%)	38 (22.4%)	100 (54.9%)	24 (22.9%)	47 (43.5%)	5 (10.6%)	28 (46.7%)	3 (10.7%)
Assault	8 (1.6%)	1 (0.6%)	5 (2.7%)	3 (2.9%)	1 (0.9%)	2 (4.3%)	4 (6.7%)	0 (0.0%)
Animal bite	0 (0.0%)	1 (0.6%)	1 (0.5%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
N/A	68 (14.0%)	20 (11.8%)	12 (6.6%)	12 (11.4%)	24 (22.2%)	9 (19.1%)	5 (8.3%)	4 (14.3%)
Total	487	170	182	105	108	47	60	28
	HNA				HN			
	Back	Knee	Shoulder	Multiple	Back	Knee	Shoulder	Multiple
Motor vehicle	22 (2.2%)	9 (3.0%)	5 (1.1%)	3 (2.6%)	8 (2.5%)	4 (2.1%)	8 (4.1%)	0 (0.0%)
Falls	88 (8.7%)	123 (41.6%)	46 (9.7%)	48 (41.0%)	50 (15.8%)	103 (54.8%)	32 (16.4%)	36 (49.3%)
Striking/struck by	26 (2.6%)	26 (8.8%)	17 (3.6%)	6 (5.1%)	11 (3.5%)	13 (6.9%)	17 (8.7%)	8 (11.0%)
Overexertion	649 (64.5%)	75 (25.3%)	310 (65.5%)	34 (29.1%)	172 (54.4%)	33 (17.6%)	86 (44.1%)	13 (17.8%)
Assault	14 (1.4%)	7 (2.4%)	14 (3.0%)	1 (0.9%)	9 (2.8%)	3 (1.6%)	19 (9.7%)	6 (8.2%)
Animal bite	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
N/A	207 (20.6%)	56 (18.9%)	81 (17.1%)	25 (21.4%)	66 (20.9%)	32 (17.0%)	33 (16.9%)	10 (13.7%)
Total	1006	296	473	117	316	188	195	73
	LTNA				LTN			
	Back	Knee	Shoulder	Multiple	Back	Knee	Shoulder	Multiple
Motor vehicle	24 (3.9%)	7 (3.5%)	6 (2.0%)	5 (5.8%)	3 (3.6%)	0 (0.0%)	3 (6.0%)	1 (5.0%)
Falls	60 (9.9%)	92 (46.0%)	29 (9.8%)	31 (36.0%)	7 (8.3%)	20 (47.6%)	14 (28.0%)	15 (75.0%)
Striking/struck by	15 (2.5%)	23 (11.5%)	14 (4.7%)	2 (2.3%)	2 (2.2%)	1 (2.4%)	3 (6.0%)	0 (0.0%)
Overexertion	383 (62.9%)	38 (19.0%)	178 (59.9%)	32 (37.2%)	54 (64.3%)	14 (33.3%)	23 (46.0%)	3 (15.0%)
Assault	11 (1.8%)	5 (2.5%)	16 (5.4%)	2 (2.3%)	0 (0.0%)	0 (0.0%)	3 (6.0%)	0 (0.0%)
Animal bite	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
N/A	116 (19.0%)	35 (17.5%)	54 (18.2%)	14 (16.3%)	18 (21.4%)	7 (16.7%)	4 (8.0%)	1 (95.0%)
Total	609	200	297	86	84	42	50	20

Abbreviations: HHN, home healthcare nurse; HHNA, home healthcare nursing aide; HN, hospital nurse; HNA, hospital nursing aide; LTN, long-term care nurse; LTNA, long-term care nursing aide.

medications prescribed, only roughly 6% of the claims for HHNA and HHN had MaxMED levels of 80 MED or above. Average MaxMED levels in claims with prescription medications were also found to be the greatest for HHN (77.8 MED; significant at $p < 0.05$).

4 | DISCUSSION

While other studies have reported higher injury rates for HHNs and nursing aides, the current workers' compensation database highlight several key results. First, HHNs and HHNAs have the highest total costs/claim (around $15,000/claim). While the number of employees may vary between the occupational group and some occupations have are underrepresented (e.g., many private healthcare companies are not in the Ohio compensation system), total costs provide the expected burden on the state for compensation costs. Total costs over the 5 years associated with home healthcare worker claims were $10.1 million as compared with $21.3 million for hospitals and $8.7 million for long-term care. Hospital nurses and nurse aides have more claims but lower costs per claim. Given that HNs and even to a lesser extent long-term facility have higher salaries (about three times as great) as home health nursing aides[18] it was surprising that

TABLE 3 Demographic information: Average (*SD*) age as a function of specific body part (back, knee, shoulder, multiple) and healthcare group (HHN, HHNA, LTN, LTNA, HN, and HNA) and gender and marriage status breakdown

Occupation group	All	Back	Knee	Shoulder	Multiple
HHNA	42.6 (13.2)	40.7 (12.9)	44.3 (13.0)	44.7 (13.5)	45.1 (12.9)
HHN	47.8 (10.5)	46.7 (9.8)	50.7 (10.2)	46.2 (11.3)	50.8 (10.7)
LTNA	36.2 (13.1)	34.4 (12.1)	40.8 (14.1)	35.2 (12.8)	41.2 (14.6)
LTN	42.3 (12.9)	40.3 (11.4)	44.0 (13.0)	42.5 (14.5)	46.8 (13.7)
HNA	35.9 (12.4)	34.3 (12.0)	39.0 (12.7)	36.2 (12.4)	38.7 (13.2)
HN	44.1 (11.6)	42.1 (11.6)	47.2 (11.5)	43.0 (11.2)	47.5 (11.3)

Occupation group	Male	Female	Single	Married	Divorced	Live together	Widowed
HHNA	44	894	318	358	136	32	29
HHN	17	226	52	124	45	6	4
LTNA	59	1123	531	382	113	44	17
LTN	11	184	53	93	21	6	6
HNA	124	1761	859	619	200	69	21
HN	64	70	167	403	104	17	10

Abbreviations: HHN, home healthcare nurse; HHNA, home healthcare nursing aide; HN, hospital nurse; HNA, hospital nursing aide; LTN, long-term care nurse; LTNA, long-term care nursing aide.

HHN and HHNA had the greatest costs. With increasing utilization of home healthcare,[1] these more expensive home healthcare injury claims will be more frequent and potentially a larger burden on the compensation system.

Second, shoulder injuries for HHNA have the highest total costs/claim out of all claim groups studied ($20,600 per injury). The fact that shoulder injuries had the highest costs was somewhat surprising given that back injuries were not the highest costs injuries based on previous Ohio workers' compensation claims from 1999 to 2004 (back: $7151 and shoulders: $5375) for the entire healthcare sector.[19] There may be multiple reasons for the lower costs for back injuries for HHNA, including (1) lower rates of back surgery (not reported but was found) that may have resulted from a greater focus on conservative care comparing the different time periods studied, (2) this estimation from Dunning et al.[19] was for all healthcare nurses and nursing aides, and (3) the higher shoulder injury costs for HHNA could be from more severe shoulder injuries (e.g., surgery required and total lost days) related to unique risk factors not seen in the other occupations and settings. There was a larger percentage of HHNA claims with a surgery for a shoulder (9.9%) and knee (9.6%) than for the back (1.7%). Freeman et al.[20] reported 12% of all knee, shoulder, and low back claims (across all industries) had surgeries, so HHNAs were just below the overall average. HHNAs may have more severe shoulder injuries (perhaps from lifting or positioning patients without the help of a team member) which will need to be further investigated, as the current data does not provide this level of clarity.

Third, the causes of injury for claims for the healthcare nurses and nursing aides studied were most commonly coded as "overexertion" (overall—50%, HHNA—46.4%, HHN—34.2%, LTNA—52.9%, LTN—48.0%, HN—56.4%, and HNA—39.4%; Figure 5). Overexertion injuries accounted for about $5 million in total costs from both home healthcare and long-term care claims and for over $11.6 million in total costs for hospital worker claims during this 5-year time frame in our study group. Patient handling may be a major contributor to overexertion injuries,[5,6,21–25] but OBWC data does not provide a breakdown of the specific type of overexertion activity. More research to better understand injuries caused by the nonspecific overexertion category is needed. There were two noteworthy results with regard to overexertion injuries: (1) nursing aides had a higher percentage of claims caused by overexertion in the home health and long-term settings compared with all nurses and nursing aides studied and (2) nurses in hospitals had the highest percentage of overexertion injuries. The former may represent a lack of mechanical assist equipment.[6] The later result was similar to the results found by Latha et al.[21] where nurses had more back injuries than nursing aides in hospitals.

Fourth, in our study group, falls were the second most frequent causal contributor for claims (21.5% for all claims) with the fall-caused percentages for HHNA, HHN, LTN, and HN claims representing 26.3%, 34.2%, 28.6%, and 28.6%, respectively (Figure 4). Over the study period, the total costs for falls in HHNs and nursing aides studied was 1.3 times that of the HNs and nursing aides and 2.4 times that of LTNs and nursing aides ($4.8 million vs. $3.8 million vs. $2.1 million, respectively). Other researchers have found slips, trips, and falls to be a large contributor to compensation claims in Ohio.[26] There may be many reasons for the high level of fall claims and costs in home health including egressing/ingressing homes, poor lighting, more tripping hazards, and the presence of animals.[10–12] However, future research is needed to better understand the underlying contributing factors for falls, specifically in the home healthcare sector.

Fifth, two causes for injuries more specific to HHNs and nursing aides were MVAs (HHNA—8.3% and HHN—9.5% vs. <4% for non-home healthcare nurses and nursing aides studied) and animal bites (HHNA—0.2%, with no other occupation-setting group having any).

TABLE 4 Previous number of workers compensation claims per claim, total number of days off work per claim, and light duty days per claim as a function of specific body part (back, knee, shoulder, multiple) and healthcare group (HHN, HHNA, LTN, LTNA, HN, and HNA)

	All			Back			Knee	
Occupation group	Previous claim	Total days	Light duty days	Previous claim	Total days	Light duty days	Total days	Light duty days
HHNA	941	941	941	487	487	487	156	156
	9	67.9	9.1	1.8	50.1	7.9	94.1	12.5
	(2.6)	(216.2)	(49.9)	(2.7)	(178.5)	(41.8)	(254.2)	(56.7)
HHN	243	243	243	108	108	108	47	47
	2.4	85.7	4.5	2.2	68.1	7.8	82.6	0.5
	(2.7)	(268.2)	(35.2)	(2.3)	(245.9)	(48.6)	(229.0)	(3.5)
LTNA	1192	1192	1192	609	609	609	200	-
	1.7	30.8	3.3	1.5	24.9	2.8	17.9	
	(2.6)	(134.4)	(28.7)	(2.4)	(119.6)	(26.4)	(93.2)	
LTN	196	196	196	84	84	84	42	42
	1.8	27.1	9.3	1.6	21.2	5.3	17.8	4.0
	(2.2)	(96.5)	(73.9)	(2.1)	(93.7)	(21.1)	(84.9)	(25.9)
HNA	1892	1892	1892	1006	1006	1006	296	296
	2.1	35.4	5.2	1.8	29.6	3.0	22.1	3.7
	(2.8)	(147.0)	(39.3)	(2.5)	(146.9)	(28.2)	(88.7)	(43.4)
HN	772	772	772	316	316	316	188	188
	1.8	47.9	2.5	1.6	60.7	2.0	28.1	3.3
	(2.4)	(206.4)	(22.7)	(2.1)	(256.4)	(18.5)	(128.7)	(28.0)

	Shoulder			Multiple		
Occupation group	Previous claim	Total days	Light duty days	Previous claim	Total days	Light duty days
HHNA	193	193	193	105	105	105
	2.0	76.4	12.5	2.3	95.9	3.6
	(2.3)	(228.5)	(69.5)	(2.4)	(278.5)	(25.0)
HHN	60	60	60	28	28	-
	2.4	118.4	3.6	2.8	88.6	
	(3.1)	(292.6)	(27.3)	(3.1)	(354.7)	
LTNA	297	297	297	86	86	86
	2.1	38.4	6.7	2.5	77.0	2.5
	(2.9)	(149.0)	(42.2)	(3.2)	(227.5)	(16.9)
LTN	50	50	50	20	20	20
	1.6	37.1	20.1	2.4	46.2	10.4
	(1.9)	(107.2)	(136.2)	(2.7)	(105.3)	(46.3)
HNA	473	473	473	117	117	117
	2.2	41.9	6.3	2.6	92.5	23.3
	(2.9)	(149.6)	(39.6)	(3.4)	(223.4)	(82.0)
HN	195	195	195	73	73	73
	1.7	42.8	1.9	2.3	56.3	4.0
	(2.4)	(120.4)	(17.2)	(2.6)	(289.9)	(34.4)

Note: These outcomes were averaged across the individual claims and values represent the averages in each occupation group/body region.

Abbreviations: HHN, home healthcare nurse; HHNA, home healthcare nursing aide; HN, hospital nurse; HNA, hospital nursing aide; LTN, long-term care nurse; LTNA, long-term care nursing aide.

The total costs associated with MVAs for HHN/HHNAs were 3.2 times that of either the combined HN/HNA or LTN/LTNA groups ($1.3 million vs. $400,000). Another occupation that has seen similar percentages for compensation claims for MVAs was private ambulance drivers (12.3% of all claims).[27] Recent research[10–12] into the perceived hazards of HHNs and nursing aides identified several unique exposures: (1) secondhand smoke, (2) exposure to pets (e.g., animal bites and trip hazards), (3) pests (e.g., bed bugs and

TABLE 5 Breakdown of prescription and opioid prescription as a function of healthcare group (HHN, HHNA, LTN, LTNA, HN, and HNA)

Occupation	Number of claims	Percent on meds	Percent with opioids	Percent with opioids if on meds	Percent MaxMED[a] (≥80 just claims with meds)	Percent MaxMED[a] (≥80 all claims)	Avg. MaxMED[a] (just claims with meds)	Avg. MaxMED[a] (all claims)
HHNA	218	23.2	18.9	81.7	24.3	5.6	56.3 (73.5)	13.0 (42.6)
HHN	54	22.2	17.7	79.6	25.9	5.8	77.8 (113.5)	17.3 (62.2)
LTNA	232	19.8	14.7	74.1	20.8	4.1	40.6 (81.2)	8.0 (42.0)
LTN	42	16.1	11.9	74.2	27.4	4.4	37.4 (110.5)	6.0 (50.6)
HNA	375	19.5	13.3	68.1	15.9	3.1	53.6 (54.4)	10.4 (28.8)
HN	124	21.4	13.8	64.3	19.0	4.1	67.0 (42.0)	14.4 (24.6)
All		20.0	14.8		21.4	4.3		

Abbreviations: HHN, home healthcare nurse; HHNA, home healthcare nursing aide; HN, hospital nurse; HNA, hospital nursing aide; LTN, long-term care nurse; LTNA, long-term care nursing aide.

[a]MaxMED is the morphine equivalent dose which was calculated based on equivalent daily milligram dose of morphine to the daily dose of a given opioid.

cockroaches), (4) egress/ingress homes multiple times a day, (5) driving motor vehicles, and (6) handling patients with no equipment. Potentially, the causes indicated for the current claims may be explained by these unique exposures for home healthcare but research will be needed to delineate whether these are true contributors to the injuries.

Sixth, prescriptions of opioids were the highest for HHN and HHNA. For home healthcare, several opioid-related outcomes were at the top among the health sector occupations (18.9% of claims included at least some prescription opioid, 81.7% of claims with prescriptions included opioid prescriptions, 24.3% of claims with some prescription medications had a MaxMED ≥ 80, and the average MaxMED in claims with some prescription medications was above 55 MED). These levels are concerning, may relate to general physician opioid prescription patterns during the years of the study with injuries in 2010–2014 and followed into late 2016. These levels of opioid prescription (14.8%) in this period were slightly lower than the general industry in 2008–2009, which was found to be only at 19.2%.[7] Home healthcare nurses (18.9%) and nursing aides (17.7%) did have a percentage of opioid prescriptions close to 19%. These researchers also found only 10% had MaxMED > 120.[7] One other consideration is that workers with injuries were five times as likely to

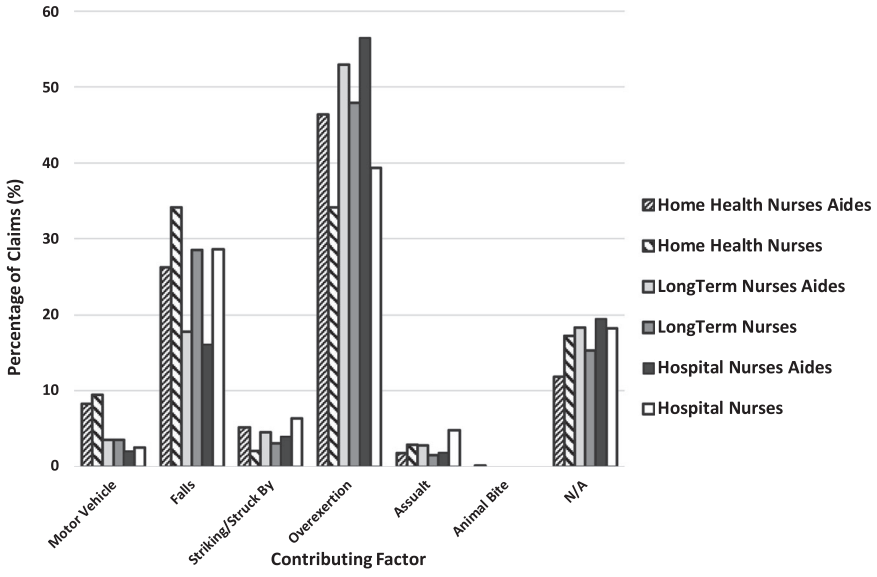

FIGURE 5 Percentage of claims for each contributing cause for home healthcare, long-term care, and hospital care for nurses and nursing aides

receive opioid prescriptions from their general health insurance, which may not be accounted for in these results.[28] During this timeframe, the opioid prescription patterns of physicians treating OBWC patients were similar to the patterns of both US physicians as a whole and Ohio physicians treating Medicaid patients.[29,30]

The national BLS incidence numbers[4] show that HHNs and nursing aides suffer from the most MSDs in the healthcare industry. HHNs and HHNAs represent the healthcare occupation at the highest risk of multiple exposures including patient handling by themselves, pests and pets, poor environmental factors, and egressing/ingressing challenges.[6,10–12]

With Ohio being in the top five states in the United States for drug overdose deaths (24.6 deaths per 100,000 people),[31] these findings among injured nurses and nursing aides are even more concerning as much of this usage of opioids may lead to potential overdoses. Cheng et al.[32] identified that 57% of the overdose deaths in Utah in 2008–2009 had a prior work-related injury. Prescribing opioids for the treatment of work-related injuries put workers at the risk of overdoses and other significant complications from opioid use (e.g., sedation, dizziness, nausea, vomiting, constipation, etc.). Fortunately, recent national prescribing trends, including recent changes in OBWC opioid prescription guidelines,[33] appear to be resulting in the less frequent use of opioids in the treatment of injuries.

There are several considerations when interpreting the results in this study. First, the claims represent reported cases to OBWC system. While Ohio is the largest state with a state-run workers' compensation insurer, other states have varying workers' compensation policies and procedures, and these differences have to be considered when generalizing Ohio results to other states.[5] Second, researchers have identified that nurses and nursing aides often fail to report injuries,[33] with nurses and nursing aides being notorious underreporters of work-related injuries.[34] Third, incidence rates of Ohio nurses' and nursing aides' injuries during the study period are not known, as there is no direct knowledge of the total number of nurses and nursing aides (exposed) in each occupational category. As many of the large hospitals and long-term care agencies are privately owned and self-insured, estimates for these occupations could be biased toward small facilities. Furthermore, Wurzelbacher et al.[35] reported that for the private healthcare industry, long-term care facilities had 9.29 per 100 full-time equivalent (FTE) and home healthcare had 4.08 per 100 FTE, which provides additional perspective on the current trends. These rates were developed from FTE estimates from BLS Labor, Productivity, and Costs data. Wurzelbacher et al.[35] certainly provided the most detailed estimates of injury rates. However, the estimates require an extensive effort and required additional data about the companies that were not easily available. Fourth, claims costs were based on the current values at the time data were exported (November 2016) and this likely censor some ongoing claims. The database was thoroughly evaluated for inconsistencies and potential outliers by two researchers. Fifth, some types of injury categories may have been left out although they likely were small categories. The OBWC was not able to provide data from all claims with injuries to the specific body areas, so the investigators provided the OBWC with ICD-9 codes in Table 1 that were specific to the knee, shoulder, and lumbar, and they return claims data with at least one allowed condition on that list of ICD-9 codes. In our preliminary data analysis, we examined the frequencies of each of the ICD-9 codes from the 1200+ allowed conditions in the claims data. All of ICD-9 allowed condition codes that occurred more than 10 times in the data of 140,000+ claims were evaluated, and none were specific knee, shoulder, or lumbar conditions. Some back, shoulder, and knee claims may have been missed, but it appears it would only have been through ICD-9 codes that did not overlap much with the ones that were selected. Overall, the research team is confident that the errors were limited and typical of workers' compensation data.

5 | CONCLUSION

With the rapidly expanding workforce in home health care, several of the results from this study should prompt action from the healthcare industry. Overall, HHNs and nursing aides had the costliest injuries among the HCWs studied. If the trends for expansion of home health care continue, injuries in this healthcare sector will result in even more substantial costs, which are already $10 million for the 5-year period of study. The home health care claims' medical and indemnity costs were not only higher, but they were also associated with more opioid prescriptions. Hospital nurses and nursing aides' claims remain high compared with the general industry but slightly below home health care. Overexertion was the most commonly coded causal contributor to the claims in all studied sectors of health care (50% of claims). Future research needs to investigate the true contributors within this nonspecific classification of injury cause. The second most frequently coded cause was falls which were most often documented for home healthcare personnel (26% for HHNA and 34% for HHN) and nurses in long-term and hospitals (~28%). Home healthcare nurses and nursing aides had two other unique contributing factors—MVAs and animal bites. The bottom line is that healthcare personnel in all three sectors (home healthcare, hospitals, and long-term care) have significant injuries and associated costs, but the exact causes of injury are unclear. Future work needs to better identify the underlying factors of the major contributors to the injuries such as overexertions, falls, and traffic accidents. Given the high costs and the significant number of injuries, particularly in home healthcare, the development of interventions for traditional exposures (including overexertion, falls) as well as unique exposures (such as traffic vehicle accidents, pests, and pets) is paramount.

ACKNOWLEDGEMENTS

We would like to thank the OBWC for partially funding this study and providing the claims data for analysis.

CONFLICTS OF INTEREST

The authors declare that there are no conflicts of interest.

DISCLOSURE BY AJIM EDITOR OF RECORD

John D. Meyer declares that he has no conflict of interest in the review and publication decision regarding this article.

AUTHOR CONTRIBUTIONS

Drs. Davis, Freeman, Ying, and Huth undertook all aspects of this project including data analyses, manuscript writing and editing, and completion of the study.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the Ohio Bureau of Workers' Compensation. Restrictions apply to the availability of these data, which were used under license for this study. Data are available from the authors with the permission of Ohio Bureau of Workers' Compensation.

ETHICS APPROVAL AND INFORMED CONSENT

As the data were extant workers' compensation data supplied without personal identifiers, the University of Cincinnati's Institutional Review Board determined that the study was exempt from human subjects research requirements.

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How to cite this article: Davis KG, Freeman AM, Ying J, Huth JR. Workers' compensation costs for healthcare caregivers: Home healthcare, long-term care, and hospital nurses and nursing aides. *Am J Ind Med*. 2021;64:369–380. https://doi.org/10.1002/ajim.23237