

# Staffing and Worker Injury in Nursing Homes

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The health care industry is one of the most dangerous industries, ranking with construction, trucking, and meatpacking in nonfatal injury rates.<sup>1</sup> Because of the growing elderly population, nursing homes have become major care providers to the elderly within the health care industry.<sup>2</sup> About 1.5 million elderly and disabled Americans reside in nursing homes, and nursing assistants provide the majority of their care.<sup>3</sup> According to the Bureau of Labor Statistics, the rate of worker injuries within nursing and personal care facilities is second among all industries.<sup>4</sup> Nursing homes are among the top 10 industries for musculoskeletal problems, which is the major cause of worker absenteeism, workers' compensation claims, and worker injury and illness.<sup>1,4-7</sup> Higher rates of musculoskeletal injury have been reported among nursing home workers compared with rates among workers in other occupations.<sup>8,9</sup>

Nursing home employees working in direct-care facilities perform many physically taxing activities, such as lifting heavy loads, working in awkward postures, and transferring residents.<sup>6,10-14</sup> Additionally, manipulating the technology that supports patient care is physically straining. The increased worker injury rates likely result from increased exposure to hazardous conditions and diminished recovery time between exposures.<sup>15</sup>

Worker injuries in health care institutions associated with staffing levels and skill mix have been previously examined. Because health care institutions have been required to perform more efficiently, the resultant changes are lower staffing levels and higher patient loads, both of which have been shown to increase worker injury. In a study of 12 hospitals in the Minneapolis–St Paul, Minnesota, area that used data from 1990 to 1994, Shogren and Calkins<sup>16</sup> found that when registered nurse (RN) positions were decreased by 9%, work-related illnesses and injuries among nurses increased by 65%. A review of the impact of staffing on health

**Objectives.** We examined the relationship between nursing home staffing levels and worker injury rates in 445 nursing homes in 3 states.

**Methods.** We obtained First Reports of Injury and workers' compensation data from 3 states (Ohio, West Virginia, and Maryland) for the year 2000. We then linked these data to Medicare's Online Survey, Certification and Reporting system to obtain nursing home staffing details and organizational descriptors. We used ordinary least squares and log-transformed regression models to examine the association between worker injury rate and nursing home staffing and organizational characteristics.

**Results.** Total nursing hours per resident day were significantly associated with worker injury rates in nursing homes after we adjusted for organizational characteristics and state dummy variables ( $P=.0004$ ).

**Conclusions.** Our findings suggest that nursing home staffing levels have an important impact on worker health. These findings were supported for multiple facilities across different states; therefore, policies and resources that increase staffing levels in nursing homes are warranted. (*Am J Public Health*. 2005;95:1220-1225. doi:10.2105/AJPH.2004.045070)

care by the Institute of Medicine noted that there is empirical evidence that shows back injuries among nurses are associated with staffing levels.<sup>17</sup> Although the extent of worker injuries among resident care staff in nursing homes has been documented,<sup>18-20</sup> there have been few studies about the association between injuries and staffing.

The occurrence of these injuries has important implications for staff retention. Owen and Garg<sup>21</sup> found that 20% of nurses who reported they had back pain said they had made at least 1 job change in order to decrease the number of nursing home residents that had to be lifted and transferred. Turnover among unlicensed personnel was even higher,<sup>22</sup> with 23% annual turnover reported among nursing assistants in one facility.<sup>23</sup> In a statewide survey of nursing assistants, 30% reported they planned to quit their jobs.<sup>24</sup>

We used an ecological design that was based on administrative data to examine the association between staffing rates and worker injuries. To do this, we analyzed the association between staffing variables (total nursing care hours per resident day) and adverse worker outcomes (reported worker injuries) at the institutional level. Analyses were also

adjusted for resident acuity, profit status, nursing home size, and availability of nurse aide training.

## METHODS

### Study Design

Our descriptive correlational design used administrative data to examine the association between worker injuries and the organizational characteristics of nursing homes in Medicare-approved facilities in 3 states: Ohio, West Virginia, and Maryland. We used nursing homes listed in Medicare's Online Survey, Certification and Reporting (OSCAR) Year 2000 database as the sampling frame for our study.

### Data Sources and Measures

We obtained staffing and organizational descriptors from the OSCAR database. Our variables included number of beds, special services, RN and other personnel staffing, type of nursing home ownership, and resident acuity. These data are routinely collected by the Centers for Medicare and Medicaid Services (CMS) to support the survey and certification function and to monitor deficiencies and quality of care in US nursing homes that

receive Medicare or Medicaid funds. Because the OSCAR data are continually updated by overwriting the previous data, we purchased historical data and documentation from the Cowles Research Group.<sup>25</sup> OSCAR data for the 3 states in our sample were extracted from this large database.

We used First Report of Injury (FROI) databases for 2 of the states, Ohio and West Virginia, to measure worker injuries. This is believed to be the best source of injury reports because the process of filing workers' compensation claims has many systematic biases that can lead to suboptimal ascertainment of injury.<sup>26</sup> On the other hand, because workers' compensation claims tend to be filed for only the most severe injuries,<sup>27</sup> we felt it was also important to include worker injury data from these claims to examine the study question. Therefore, we also used workers' compensation claims data from Maryland to calculate worker injuries.

FROI and workers' compensation data were obtained from state agencies. The FROI data are comparable to Occupational Safety and Health Administration OSHA-200 log data, but they are obtainable at the state level for some states. Although injury data were obtained for individual workers, we aggregated injury data to the organizational level for the analyses. All reported injuries were included, regardless of type, although the overwhelming majority of injuries were musculoskeletal in origin (predominantly back injuries).

Worker injury rates by skilled nursing facility were calculated with formulas for injury incidence from the Bureau of Labor Statistics' *Occupational Safety and Health Definitions*.<sup>28</sup> To produce an overall rate, we aggregated the total number of nonfatal injuries among RNs, licensed practical nurses (LPNs), and aides for each facility and divided the aggregate by the sum of the full-time equivalents (FTE) for these 3 employee categories. Multiplying the rates by 100 allows reporting per 100 FTE.

Staffing variables were created with coding rules designed by Harrington et al.<sup>29</sup> FTE data were reported for a 14-day period, and we used the coding rules to convert staffing data to staffing hours per resident day by taking the total nursing staff FTEs reported for a

2-week period and multiplying by 70 work hours for the period. We divided the total staffing hours by the total number of residents and then by 14 days in the reporting period. In accordance with Harrington et al.,<sup>29</sup> we included all full-time, part-time, and contract positions for RNs; directors of nursing were excluded. We included all LPNs and licensed vocational nurses, and, for nursing aide staffing, we included all certified nursing assistants, nursing assistants in training, and medication aides.

### File Construction

We applied exclusion criteria to remove nursing homes from the database based on the recommendations by Harrington et al.<sup>29</sup>: (1) too small—those with fewer than 15 beds, (2) hospital based, (3) no RN hours—having 60 or more beds but no RN hours, (4) extra RN hours—more than 12 RN hours per resident day, (5) few nursing staff hours—less than 0.5 total nursing hours per resident day, and (6) excess nursing hours—more than 12 total nursing hours per resident day. We excluded skilled nursing facilities that had excess nursing hours to remove those facilities that function as acute care step-down facilities and therefore do not reflect the staffing patterns for long-term care providers. For example, in West Virginia, after we applied each of the exclusion criteria the original sample of 133 facilities decreased to 129 after deleting small facilities, to 103 after deleting hospital-based facilities, and to 102 after deleting facilities with excess nursing staff hours; only 77% of the original facilities remained.

Worker injury data required considerable cleanup. We culled the data received from the states to extract injuries that occurred in nursing homes during 2000. For the databases that included a Standard Industrial Code ([http://www.osha.gov/pls/imis/sic\\_manual.html](http://www.osha.gov/pls/imis/sic_manual.html)), nursing homes were identified with an 805 code (skilled nursing, intermediate nursing, and nursing and personal care facilities). Upon review of these codes, we determined that some facilities were not nursing homes (assisted living, temporary staffing agency, system corporate office) and deleted them. Through further analysis and recoding, we retained only those records that repre-

sented injuries to RNs, LPNs, and aides. To facilitate analysis and linkage of the databases, we assigned the CMS 6-digit provider number for each facility to each worker injury record. Because facility names in the injury database were written as text with abbreviations, common names, and corporation names, direct linkage to the OSCAR name was not always possible. In such cases, we used the CMS Nursing Home Compare database and other sources to match the nursing home with its address.

### Data Analysis

Statistical analyses were performed with SAS, version 8.2 (SAS Institute Inc, Cary, NC). We used descriptive statistics to examine the association between organizational characteristics and facility by state. We used multivariate regression to identify the independent effect of these organizational characteristics—particularly staffing—on worker injury rate. Because linked-facility sample sizes for West Virginia and Maryland were small, we combined nursing home data from all 3 states into 1 file ( $n=445$  linked facilities) to eliminate concerns about adequacy of power for these analyses. We included state dummy variables in regression models because of systematic differences across the states. Before we analyzed the association between worker injury rate and nursing home characteristics (acuity index, total residents, percentage of Medicaid, location, profit status, aide training, and nursing hours per resident day), we screened the data for normality, missing values, outliers, and multicollinearity. Acuity was measured with the Acuinex, which was developed as part of the work on the CMS Minimum Data Set. The Acuinex takes into account the proportion of residents with activities of daily living dependencies and the proportion requiring special treatments (e.g., suctioning, parenteral feeding). Because this measure reflects resident care burden, it also could influence worker injury rates across facilities. Therefore, we included acuity in our analysis to control for variation in case mix. We defined facilities with aide training as those facilities with an approved Nurse Aide Training and Competency Evaluation Program. Among predictors, the percentage of Medic-

**TABLE 1—Nursing Home Characteristics in Ohio, Maryland, and West Virginia: Online Survey, Certification, and Reporting System Database, 2000**

	Ohio (n = 778)	Maryland (n = 196)	West Virginia (n = 102)
Nurse Staffing, mean (SD)			
RN hours per resident day	0.57 (0.27)	0.54 (0.40)	0.35 (0.17)
LPN hours per resident day	0.76 (0.30)	0.62 (0.29)	0.80 (0.52)
Aide hours per resident day	2.16 (0.59)	2.30 (0.66)	2.14 (0.62)
Total nursing hours per resident day	3.49 (0.80)	3.46 (0.94)	3.29 (0.88)
Proportion RN hours out of total nursing hours per resident day	0.16 (0.07)	0.15 (0.08)	0.11 (0.05)
Acuity index, mean (SD)	10.33 (1.22)	11.05 (1.35)	10.74 (1.08)
Total residents, mean (SD)	87.76 (46.43)	113.29 (57.35)	89.48 (35.32)
Percentage residents enrolled in Medicaid, mean (SD)	68.12 (19.01)	59.68 (27.23)	75.84 (13.76)
Location, number (%)			
Urban	584 (75.1)	174 (88.8)	35 (34.3)
Rural	194 (24.9)	22 (11.2)	67 (65.7)
Ownership, number (%)			
Profit	606 (77.9)	127 (64.8)	82 (80.4)
Nonprofit/government	172 (22.1)	69 (35.2)	20 (19.6)
Aide training available, number (%)	289 (37.2)	73 (37.2)	65 (63.7)

Note. RN = registered nurse; LPN = licensed practical nurse.

aid residents was highly correlated with the acuity index in all 3 states. The percentage of Medicaid was then dropped from further multivariate analysis. Additionally, because injury rates were highly skewed, we modeled the log of total injuries.

## RESULTS

We examined the characteristics of nursing homes in the 3 states for the entire sample (Table 1). Ohio had the most nursing homes (n=778) of the 3 states sampled, followed by Maryland (n=196) and West Virginia (n=102). Staffing levels were less distinct across the states, with all 3 states having total nursing hours per resident day (sum of RN, LPN, and nursing aide staffing) that ranged from an average of 3.3 to 3.5 hours. However, West Virginia had a far lower average number of RN hours per resident day (0.35) compared with Maryland (0.54) and Ohio (0.57), which indicated a lower skill mix. Our analysis of the overall nursing home characteristics by state showed that while acuity was similar across states, total residents, percentage of Medicaid residents, profit status, aide training,

and location differed. Maryland facilities had more residents on average, a lower proportion of for-profit facilities, and the lowest percentage of Medicaid residents. In West Virginia, two thirds of the facilities were in rural areas, whereas in Ohio and Maryland, at least three fourths were in urban areas. The proportion of facilities with aide training was twice as high in West Virginia compared with Ohio and Maryland.

Many worker injury records were listed under a corporation and could not be linked to a specific facility; therefore, we used only the subset of nursing homes that could be linked in our analyses. To assess the impact of this reduced sample on the variables of interest, we compared the characteristics of the skilled nursing facilities included in the OSCAR sample with the sample that remained after we linked the OSCAR and worker injury data. As shown in Table 2, there were no large differences in the average staffing levels for the linked sample compared with the OSCAR sample. The organizational characteristics also were similar. We then compared the staffing means by state for the total OSCAR sample with the means

by state for the linked sample (Tables 1 and 3). Once again, there was little or no change in average staffing (nursing hours per resident day) by state, before and after linkage. As a result, we proceeded with the linked sample for our analysis.

Table 3 shows injury rates for the 3 states. We found that overall injury rates in Maryland were the lowest, which was expected because the injury rates were calculated from workers' compensation claims rather than from FROI data. However, the almost total lack of claims filed by nurse aides in Maryland was unexpected. We also found other differences in rates by state, which likely reflected differences in injury reporting and coding.

The results of the ordinary least squares regression showed that total nurse hours per resident day was significantly associated with worker injuries after we adjusted for acuity, profit status, aide training, total residents, and state ( $P=.0004$ ). Our analysis showed that 25% of the variance in worker injury was explained by the model (Table 4). For each additional hour increase in nursing care, injuries were predicted to decrease by 2.4 per 100 FTEs. The number of total residents also had a significant negative effect: as size increased, worker injuries decreased. To examine this further, we stratified nursing homes by number of residents and found that injury rates were lower in homes where there were more residents, although staffing did not vary. Because of the apparent underreporting of injury rates among nurse aides in Maryland, we reran the regression models and excluded Maryland. The results were the same (data not shown).

Because the injury rates were skewed, we regressed log-transformed injury rates on untransformed predictors. For the log-transformed rates, all relationships and parameter estimates that were significant in the untransformed model remained significant, although the elimination of positive skewness understandably increased the predictability of the model to 38% of total variance (Table 4). Each additional hour of nursing care decreased the injury rate by nearly 16%. Thus, for every unit increase in staffing (total hours of nursing care), worker injury rates decreased by 2 per 100 FTEs.

**TABLE 2—Characteristics of Skilled Nursing Facilities Included in Total Sample vs. Linked Facilities: Online Survey, Certification, and Reporting (OSCAR) System Database, 2000**

	Total OSCAR Sample for 3 States (n = 1076)	Sample After Linking OSCAR and Injury Data (n = 445)
Nurse staffing, mean (SD)		
RN hours per resident day	0.54 (0.30)	0.54 (0.27)
LPN hours per resident day	0.74 (0.33)	0.76 (0.38)
Aide hours per resident day	2.18 (0.60)	2.23 (0.61)
Total nursing hours per resident day	3.46 (0.83)	3.52 (0.85)
Proportion RN hours out of total nursing hours per resident day	0.16 (0.07)	0.15 (0.06)
Acuity index, mean (SD)	10.50 (1.26)	10.59 (1.28)
Total residents, mean (SD)	92.57 (48.66)	96.47 (51.82)
Percentage residents enrolled in Medicaid, mean (SD)	67.32 (20.78)	70.21 (19.17)
Location, number (%)		
Urban	793 (73.7)	333 (74.8)
Rural	283 (26.3)	112 (25.2)
Ownership, number (%)		
Profit	815 (75.7)	345 (77.5)
Nonprofit/government	261 (24.3)	100 (22.5)
Aide training available, number (%)	427 (39.7)	176 (39.6)

Note. RN = registered nurse; LPN = licensed practical nurse.

because of turnover, floating among health care workers, and multiple workers caring for a single resident. Examining injuries to all resident care workers who worked in long-term care facilities in 3 states (a total of more than 400 facilities) enhanced the generalizability of the findings.

The consistency of the association between staffing and injury across states and facilities is noteworthy and supports the credibility of the findings, although there are limitations to our study. The ecological design did not allow us to make inferences about individual workers.<sup>32</sup> Missing data from the injury databases hindered our ability to link across databases, and the presence of missing data in certain fields (e.g., occupation) also reduced the completeness of the data analysis. Despite these limitations, comparison of descriptors from nursing homes in the original OSCAR sampling frame with those in the linked frame showed surprisingly few differences.

As expected, state variables were highly significant, which underscores the importance of adjusting for them in a combined model. A minimal number of injuries were reported by nurse aides in Maryland. Although the exact reason for this is unknown, the injured aides in Maryland most likely did not file workers' compensation claims, probably owing to a lack of awareness; posting the law in the workplace is not required. Also, the injury definitions can reduce the likelihood of filing claims, e.g., back injuries in Maryland must have an acute onset to be claimable. Furthermore, claims in Maryland must be filed and signed by the injured employee—a provider or other party cannot initiate the claim—which may serve as a disincentive to file among those who have insecure jobs.

Profit status and acuity were not significantly associated with worker injury when state, size, and staffing were controlled. On the other hand, Banuszak-Holl and Hines<sup>22</sup> found that nursing turnover, a factor correlated with injuries, was higher among for-profit nursing homes, which also tended to have lower staffing ratios.<sup>33</sup> This was also true for our sample. The lack of impact of aide training was unexpected, because training has been associated with lower injury rates,<sup>17</sup> although we did not take into account the impact of staffing in these studies. Adjust-

**DISCUSSION**

We combined facility-level data from nursing homes in 3 states and found that worker injury rates were strongly associated with staffing levels. Findings were consistent across the 3 states despite differences in data collection, injury classifications, and reporting procedures. Additionally, a sizable

proportion of variance in worker injury was explained by staffing. These data support smaller studies of single nursing homes and hospitals, which have also shown this association.<sup>17,30</sup> Using an ecological framework allowed us to circumvent some of the limitations of individual-level research on working conditions.<sup>31</sup> Individual-level associations may be difficult if not impossible to ascertain

**TABLE 3—Mean Nursing Home Staffing and Injury Rates for Linked Sample, by State: Online Survey, Certification and Reporting System Database, 2000**

	Ohio (n = 323) Mean (SD)	Maryland (n = 76) Mean (SD)	West Virginia (n = 45) Mean (SD)
Nurse staffing			
RN hours per resident day	0.57 (0.27)	0.52 (0.29)	0.35 (0.19)
LPN hours per resident day	0.79 (0.33)	0.60 (0.30)	0.77 (0.68)
Aide hours per resident day	2.24 (0.66)	2.29 (0.39)	2.09 (0.47)
Total nursing hours per resident day	3.60 (0.80)	3.41 (0.70)	3.20 (0.82)
Injuries (per 100 FTE)			
RN	4.45 (8.63)	2.67 (8.06)	24.21 (22.78)
LPN	5.55 (11.54)	18.21 (20.42)	10.66 (17.92)
Aide	16.62 (21.35)	0.15 (0.59)	45.01 (96.31)
Total	11.60 (11.94)	3.09 (2.46)	26.83 (18.50)

Note. RN = registered nurse; LPN = licensed practical nurse; FTE = full-time equivalent.

**TABLE 4—Ordinary Least Squares Regression (OLS) and Log-Transformed Models of Worker Injury per 100 FTE on Staffing (nursing hours PRD), For-Profit ownership, Aide Training, Acuity, Total Residents and State: 2000 (N = 445)**

	OLS Model Worker injury/100FTE			Log-Transformed Model Worker Injury/100 FTE		
	$\beta$	SE( $\beta$ )	P ( $\beta$ )	$\beta$	SE( $\beta$ )	P ( $\beta$ )
Nursing hours PRD	-2.39	0.67	0.0004	-0.16	0.047	0.001
For-profit ownership	0.24	1.41	0.862	0.06	0.10	0.571
Aide training	-0.16	1.18	0.892	-0.01	0.08	0.933
Acuity (Acuindex)	-0.01	0.45	0.986	-0.03	0.03	0.385
Total residents	-0.03	0.01	0.003	-0.01	0.00	<.0001
West Virginia (reference = Maryland)	21.82	2.27	<.0001	2.04	0.16	<.0001
Ohio (reference = Maryland)	7.77	1.59	<.0001	1.03	0.11	<.0001

Note. FTE = full time equivalent; PRD = per resident day; SE = standard error. OLS model  $R^2 = 0.25$ ; log-transformed model  $R^2 = 0.38$ .

ing for differences in resident acuity removed case mix as a potential source of confounding, which was important because nursing homes with more dependent residents may have higher rates of worker injury. It is also possible that such homes have more assistive equipment that reduces injury risk to workers.<sup>22</sup> The current approaches to nursing home staffing are often made on the basis of staff-to-resident ratio or hours per resident day, with no accounting for differences in acuity. This is reflected in our data, wherein the acuity index from the OSCAR database was not correlated with staffing ( $r = 0.03$ ). Ongoing research is being conducted to examine the association between acuity and staffing in nursing homes.

The OSCAR data also have limitations. The Centers for Medicare and Medicaid Services performs edit checks on the OSCAR data to identify errors. Straker<sup>34</sup> compared 1995 OSCAR data with data from the Ohio Department of Health to examine consistency in several variables, including staffing. Staffing correlations per patient day were 0.61, although self-reports did not typically cover the same period reported as the OSCAR assessment. Another study examined actual payroll and found correlations less than 0.5 between the data reported in both the OSCAR and the payroll,<sup>35</sup> although these analyses had strict exclusion criteria.

As for the worker injury data, some injuries will be missed even with the use of

FROI data. For example, workers may seek injury care from their regular health provider and fail to mention that the injury is work-related.<sup>26</sup> Despite such limitations, FROIs are generally a more complete source of potentially claimable injuries to health care workers than workers' compensation data.<sup>27</sup> Ideally, the hours worked would exclude paid non-work time, although we had no way to remove this from our analysis. However, this time is minimal among nurses, who often skip breaks and lunches and perform uncompensated overtime because of short staffing.<sup>36,37</sup> Because injury data from the 3 states were treated similarly in our analysis, these distinctions should not affect the ability to associate injuries with staffing.

Despite our successful attempt at using different worker injury databases from multiple states in this analysis, there should be standardization of both reported data and definitions of worker injury.<sup>38</sup> Outcomes data reported at the facility level should be available even when facilities manage injuries at the corporate level to allow for analysis of staffing and related outcomes. The National Quality Forum now recommends that staffing and skill mix be examined as performance measures for evaluating health care quality.<sup>39</sup>

Our study has shown that the impact of staffing is also important for worker health. By improving staffing levels in nursing homes, both workers and residents will benefit. With the impending shortage of long-term care

workers, it is imperative that we promote the health of this essential group of care providers; they will be increasingly needed to care for an aging population. ■

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### Contributors

A.M. Trinkoff originated the study, supervised its implementation, and led the writing. M. Johantgen created the database and directed the data analysis. C. Muntaner assisted with the study, analysis of findings, and article preparation. R. Le assisted with the study and completed the analyses. All authors originated ideas, interpreted findings, and reviewed drafts of the article.

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### Human Participant Protection

The project was reviewed by the institutional review board of the University of Maryland and was determined to be exempt from the institutional review board approval process according to DHHS 45 CFR 46.101.b (4).

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