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The Impact of Shift Work on the Risk and Severity of Injuries for Hospital Employees:

An Analysis using Oregon Workers' Compensation Data

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Abstract

Background: While past research on health care workers has found that shift work can lead to negative physiological and psychological consequences, few studies have assessed the extent to which it increases the risk of specific work related injuries, nor quantified and compared associated types, severity and costs.

Aims: This study aimed to derive and compare the rates, typologies, costs, and disability time of injuries for various hospital worker occupations by day, evening and night shift.

Methods: This study used Oregon workers' compensation data from 1990-1997 to examine the differences in hospital employee claims (n = 7,717) for day, evening and night shifts in aggregate and by occupation, and data from the Current Population Survey (CPS) to provide the baseline for assessing relative risks.

Results: It was found that relative to day shift workers, the risk of sustaining an occupational injury was greater for evening shift workers (OR = 1.84) and night shift workers (OR = 1.58). The risk of injuries due to violence was also found to substantially increase for workers on the evening shift (OR = 3.70) and night shift (OR = 1.95). Workers on the night shift took about a week longer in disability leave for injuries (46.1 days) compared to the overall average (38.9 days).

Conclusion: Evening and night shift hospital employees were found to be at greater risk of sustaining an occupational injury than day shift workers, with those on the night shift reporting injuries of the greatest severity as measured by disability leave.

Key Words: shift work; shiftworkers; workers' compensation; health; occupational injury; health care workers; staffing; hospitals; work schedules.

Introduction

The use of late shift employment has received considerable attention from occupational health researchers as evidence supports that such work schedules are potentially detrimental to the safety and well-being of employees. It has been found that shift work can disrupt human circadian rhythms which are normally acclimated to daytime wakefulness and nighttime rest.[1-2] At the physiological level, medical investigations have demonstrated that circadian desynchronization can lead to changes in hormonal levels, increase the risk of cardiovascular disease, produce sleep-cycle disturbances, and result in significant fatigue.[3-12] In turn, these outcomes (in particular fatigue) have been found to become manifested in decreased levels of cognitive functioning, inferior job performance, increased feelings of stress, and a greater number of work-related accidents.[13-18] Studies that have demonstrated such effects have included performance tests in laboratory settings, and research on such occupations as offshore workers, security guards, textile workers, teleprinter operators, and navy personnel.[19-24]

Of the various occupational categories examined for shift work effects, health care workers have been among those receiving the most attention. While in part this may be due to the convenient access that medical investigators have to this particular occupational group, there are several traits that make these employees a desirable population to study in shift work research. First, providing treatment and administering care to patients requires 24-hour staffing. Second, it has been estimated that about 36% of all health care workers engage in shift work in various capacities, and are thus an

employment population where a large number of shift workers can be sampled.[25] Third, as the job demands of these workers are highly varied, ranging from active engagement and high cognitive processing (such as making diagnoses and administering critical care/emergency treatment), to physically intense activities (such as lifting patients, moving equipment and dealing with physically aggressive patients), to routine activities (such as dispensing medications and performing administrative functions), the effects of shift work on multifaceted job characteristics can be thoroughly assessed. Indeed, studies on various health care employee segments have provided a greater understanding of some of the detrimental effects engendered by shift work. For example, shift work has been associated with decreased cognitive functioning in resident physicians, errors in task performance, complications following surgery by sleep-deprived residents, job dissatisfaction, and turnover of emergency medical personnel.[26-32] Similarly research on nurses have found that shift work is correlated with high levels of stress, problems in concentration, increases in psychosomatic complaints, and inferior quality of job performance.[33-36]

Unfortunately, in spite of the extensive research that has been conducted on shift work and health care workers, the overall impact that such scheduling has on their overall risk of sustaining on-the-job injuries has not been estimated. Although previous investigations have demonstrated that fatigue can increase the likelihood of susceptibility to medical conditions, or generally increase the chances of accidents, such as in the case of assembly line workers, little work has been conducted to assess the risk that may be engendered specifically by health care workers stemming from shift work. [37] One exception was a

study of Massachusetts nurses which found that those on rotating shifts were almost twice as likely to report errors or accidents related to fatigue.[38] However, because the study focused exclusively on nurses, combined occupational injuries with on-the-job procedural errors, and did not elucidate on the type of injuries or nature of severity experienced by the nurses in the sample, the results do not generalize to the larger population of hospital workers and detailed information on the injuries sustained is unknown. Thus, there still remains an important need for continued research on the nature of occupational risks faced by health care employees from shift work schedules.

This study aims to extend upon past findings, by using workers' compensation data of all workers in general medical and surgical hospitals from the state of Oregon for the period of 1990 to 1997 to assess whether shift work affects health care workers' risk of on-the-job accidents and injuries. Workers' compensation data is particularly useful in assessing health conditions arising out of the course of employment, and has been used by occupational safety investigators in the past to examine such concerns as carpal tunnel disease, latex allergy, arm pain, burns, and workplace violence.[39-47] Because Oregon records the time of day when injured employees work, it contains particularly valuable information for examining accidents by shift. Additionally, because of the extensive coverage that the Oregon system provides its workers, as well as the state's maintaining of detailed records, the use of Oregon workers' compensation data offers a valuable means by which the effect of shift work can be quantified and assessed for specific occupations within the broader group of health care workers.

Materials and Methods

This study used workers' compensation claim data that were provided by the Oregon Department of Consumer and Business Information and Management Division for the period 1990 – 1997. Records were kept for all claims that were disabling or potentially disabling (i.e. those that involved either potential or actual lost work time), although the records were available for some claims that did not actually result in disability. For this study only accepted claims from the hospital industry (SIC 806) were analyzed.

The data set included information on claimant occupation and industry, claimant demographics (e.g. age, gender), claimant work schedules, nature of reported injury, body part affected, compensated days of lost work by claimant and claimant cost. Claims costs were tracked through 1999 and the cost data reflect accumulated claim costs through this time. By the end of the observation period 96.2% of all accepted claims used in this study were closed and for these claims the cost data was complete.

The workers' compensation data from Oregon recorded information on the hour that a claimant began work. In order to investigate work injuries by shift of work, we defined day, evening and night shifts as follows: Individuals who reported starting work between 4 a.m. and 11 a.m. they were classified as day shift workers, individuals who reported starting work between 12 p.m. and 7 p.m. the were classified as evening shift workers, and individuals who reported starting work between 8 p.m. and 3 a.m. they were classified as night shift workers.

Because the Oregon workers' compensation data contains no information on employment levels we estimated employment levels for different categories of hospital employees using survey data from the United States Bureau of Census' May 1991 and May 1997 Current Population Surveys. The CPS is a monthly random survey of approximately 50,000 households of the non-institutionalized population in the United States that is used by the United States government to assess, among other things, monthly unemployment rates. Each monthly survey contains demographic and individual employment information. In the May 1991 and 1997 surveys, supplemental questions were asked about an individual's work schedule. Only individuals in these work schedule supplements who reported working in the hospital industry (SIC 806) were included in the analysis. Since only 38 of the 4395 of these hospital employees reported residing in Oregon, in order to increase the precision of our estimates, we used the entire sample of hospital employees when estimating employee shift work fractions by different categories of hospital employees. Such estimates are valid when the characteristics of Oregon hospital employees and US hospital employees do not differ. The fraction of hospital employees working the evening and night shift estimates based on the Oregon sub sample were not significantly different from estimates based on the entire sample although with the latter sample the estimates were more precise.

The CPS hospital employment rate estimates were combined with the Oregon workers' compensation claim data to calculate an odds ratio (OR) estimate of the risk of injury for evening and night shift workers as compared to day shift workers for different

categories of hospital employees and different types of injuries. To calculate the odds ratio estimate of a type of injury for evening (night) shift workers as compared to a day shift workers, two ratios were initially constructed: the fraction of these types of injuries that occurred during the evening (night) shift divided by the estimated fraction of hospital employees that worked the evening (night) shift and the fraction of these types of injuries that occurred during the day shift divided by the estimated fraction of hospital employees that worked the day shift. The OR estimate was then computed by dividing the former ratio by the latter ratio. Since the OR calculations are based on sample estimates from the CPS, 95% confidence interval estimates were also calculated using the delta method. To examine whether age confounds the relationship between shift and risk of injury, we also calculated separate relative risk estimates for hospital employees under 40 years of age and hospital employees 40 years of age and older.

Analysis of variance (ANOVA) analysis was performed to investigate cost and lost workdays differences by shift, occupation, nature of injury and cause of injury. Chi-square tests were calculated to investigate differences in the distribution of nature and cause of injury by shift. All statistical analysis was performed using Stata version 7.0 software.

Results

Between 1990 and 1997 there were 7,717 compensable workers' compensation claims filed by hospital employees in the state of Oregon, averaging about 965 claims annually. Of the total claims, nursing aides and orderlies comprised the highest claimant group with 1,953 (25.0%) claims, followed by registered nurses with 1,772 (23.0%), maids and housemen with 641 (8.3%), licensed practical nurses with 278 (3.6%), health technicians with 246 (3.2%), janitor and cleaners with 198 (2.6%), and clinical laboratory technicians with 110 (1.4%). The remaining 35.7% of claimants were comprised of numerous occupations such as doctors, pharmacists, librarians and clergy, which individually constituted small numbers of claims, and thus not detailed in this work. Among all injury claims, 4,789 (62.1%) were made by employees who were injured during the day shift, while 2,194 (28.4%) were made by employees injured during the evening shift, and 734 (9.5%) were made by employees injured during the night shift. Estimates from the CPS data showed that 83.1% of hospital employees worked day shifts, 12.5% worked evening shifts, and 4.5% worked night shifts. When the fraction of claims in each shift were compared to the fraction of employees working each shift it was found that the number of claims made by hospital employees working both the evening shift and night shift were disproportionably high.

An analysis of the claimant demographics found that 80.3% were female with an average age of 40.4 years (SD = 10.6). The gender composition varied little between

shifts, with females comprising 80.0% of day shift claimants, 76.7% of evening shift claimants, and 83.1% of night shift claimants. Likewise, the average age of claimants between shifts were similar, with the average age of day, evening and night shift claimants being 41.0, 39.0, and 40.4 years respectively. Further, because past research on the hours of shift length produced mixed evidence that longer shift hours may be associated with physical and psychological well-being,[49] the hours of shift length worked by claimants was examined to see if the results were possibly affected due to differences in longer average working hours between the employees on the various shifts. For all hospital claimants, the average shift length worked by claimants was 8.3 hours (SD = 1.3), with day shift claimants averaging 8.4 hours (SD = 1.4), evening shift claimants averaging 8.3 hours (SD = 1.3) and night shift claimants averaging 8.3 hours (SD = 0.9). Thus, the length of shift did not appear to be a confounding factor in the proclivity to experience injury among the claimant population.

Claim and employment proportions by shift were used to compute odds ratio estimates of injuries of evening and night shift workers as compared to day shift workers for all hospital employees. In doing so, it was found that the OR estimate for evening shift workers was 1.84 and OR estimate for night workers was 1.58, and hence indicating that hospital workers working these shifts have a considerably higher risk of injury than those working day shifts.

Because previous literature suggests older individuals may be more susceptible to sleep disorders and other physiological conditions, age may an influential factor affecting

the risk of injury from shift work scheduling.[48, 10] To examine for this possibility, evening and night shift OR estimates were also calculated separately for hospital employees that were 40 years of age or older and for those that were under 40 years of age. It was determined that the OR estimate of evening shift employees was substantially higher than that of night shift employees for the older group of hospital employees while the OR estimate of night shift employees was slightly higher than that of evening shift employees for the younger group of hospital employees. A detailed breakdown of the OR estimates and associated 95% confidence interval (CI) estimates for shifts and shifts by age and are presented in Table 1.

Insert Table 1 About Here

Odds ratio estimates were calculated for injuries with different primary natures both for all hospital employees and by age group. As shown in Table 1, the odds ratio estimates for bruises, strains and sprains and fractures were significantly greater than 1.0 for evening shift and night workers of both age groups. The evening and night shift odds ratio estimates for dislocation injuries, however, were significantly greater than one only for the younger group of hospital employees. Odds ratio estimates for Carpal Tunnel syndrome injuries were less than one except for older evening shift workers.

Table 1 also presents the odds ratio estimates for all compensable injury claims for different occupational groups of hospital employees by shift. With the exception of

Licensed Practical Nurses (LPN's), the evening shift odds ratio estimates were significantly greater than one for all age-occupation groups. For LPN's the odds ratio estimate for evening shift workers was not statistically different from one for either age group. For night shift workers, these estimated odds ratios were significantly greater than one for all age-occupation groups except Nursing Aides and Orderlies and LPN's 40 years of age and older and Nursing Aides and Orderlies under 40 years of age.

Table 2 presents evening and night shift OR estimates by cause of injury for all hospital employees, hospital employees younger than 40 years of age, and hospital employees older than 40 years of age. The evening shift OR estimates were significantly greater than one for all injury causes except for repetitive motion injuries which were less than one for both hospital employees younger than 40 and hospital employees 40 and older. The OR estimates for hospital employees working the night shift were qualitatively similar to the OR estimates for evening shift employees except for injuries caused by a fall or jump which was less than one for night shift employees 40 and older.

Insert Table 2 About Here

An ANOVA analysis of the amount of lost work compensated by total temporary disability (TTD) benefits by shift shows that the severity of injuries claimed by

employees differed significantly by shift (p-value=0.01). For all hospital employees, the average amount of lost workdays equaled 38.9 days (SD = 81.3). Day shift employees filing claims lost an average of 38.0 (SD = 80.0) days of work, evening shift employees lost an average of 38.6 (SD = 81.2) days of work, and night shift employees lost an average of 46.1 (SD = 89.5) days of work, which was about a week longer than the overall average for all workers. It should be noted that the large standard deviations in indemnity time are typical of large workers' compensation samples, as the severity of injuries sustained tend to vary greatly between individuals and type of accidents that were reported. In some cases, no time off was required for injury reported. Compensated lost workdays due to injury also varied by the nature of injury (p-value < 0.001), cause of injury (p-value < 0.001), and occupation of injured employee (p-value < 0.001).

Insert Table 3 About Here

The costs associated with the types and sources of injuries were also analyzed both in aggregate and by shift. For all hospital employee claims, the average total amount per claim amounted to $6,213 (SD = $13,382), of which the average medical expenses constituted $2,833 and accounted for 45.6% of the total average claim cost. Dislocations were found to be the most expensive injury type, having the highest average claim amount of $16,692 (SD = $20,914), while bruises were the least expensive injury type having the lowest average claim amount of $4,673 (SD = $11,165). Of all causes of injuries, those stemming from repetitive motion resulted in the highest average claim amount of $7,254, while those in which injury causation was attributed to being struck by

an object had the lowest average claim cost of $4,638 (SD = $9,555). Examining claim cost differences by shift shows that those working night shift had the highest claim costs averaging $6,715 (SD = $12,856), with day and evening shift employee claim costs averaging $6,187 (SD = 12470) and $6,103 (SD = 15,338), respectively. For those occupations examined in detail, doctors had the highest average claim amounts of $9,656 (SD = $11,481), while maids/housemen had the lowest of $5,555 (SD = $10,877). An ANOVA analysis found only the nature of injury to be a statistically significant determinant ($p < 0.001$) for total claim costs. A complete breakdown of average total claim costs by shift is presented in Table 4.

Insert Table 4 About Here

Discussion

This study used workers' compensation data from Oregon for the period of 1990-1997 to examine whether hospital employees who worked on evening and night shifts demonstrated different levels of risk for occupational injuries relative to those who worked on day shifts. We found that hospital employees working the evening and night shift had substantially greater risks of injury than employees working the day shift. While some of this difference was a result of age and occupational differences across shift, evening and night employees were found to have had elevated risks of injury after controlling for these potential confounders. For example, for registered nurses under age 40, we found that evening and night shift employees were 1.67 and 2.52 times more likely to be injured than day shift employees.

While some of the increased injury incidence for evening and night shift employees may be due to the higher error and accidents rates that have been found in other studies for employees working these shifts, some of the increase may also be a consequence of the different tasks or staffing levels of evening and night shift employees. For example, the population data from the CPS on shift of work show that the staffing levels for registered nurses during the day shift are approximately twice as high as during the evening shift and over five times as high as during the night shift. Over the eight-year period covered by our data, however, we found that more injury claims due to violence were filed by evening shift registered nurses than day shift registered nurses. Whether this increase in violence injuries is due to an increase in aggressive behavior of patients

during these hours or due to the reduced staffing levels cannot be determined from our data but is an important topic for future research.

The severity of injuries associated with night shifts as measured by compensated lost work days were substantially higher than those associated with day and evening shifts. However, there were no significant shift differences in the overall cost of injury claims when controlling for nature of injury, injury event and employee occupation. The only important predictor for total cost of injury in our data was the nature of injury. A Chi-square test of differences in the nature of injury by shift, however, was statistically significant (p-value < 0.001). Therefore not only is the injury rate for evening and night shift employees higher, but the nature of injuries differ by shift with those associated with the most severe impairments occurring at night.

This study has several limitations that should be noted. First, while the administrative data contained information on employee job tenure it did not contain any information on the length of time that an employee worked a particular shift. Moreover, the CPS data contained no information about job tenure. So, we could not analyze the extent to which the increased incidence of injuries for evening and night shift employees were due to any job tenure differences by shift or whether injuries were more concentrated among employees who recently began working the evening or night shift.

Second, because for certain health care occupations there were so few injury claims recorded, a meaningful analysis of the risks of shift work could not be attained for these

groups. Third, while the length of hours of the shift worked when injury was experienced was examined, and did not appear to be a factor in the advent of injury, the data did not include information of cumulative hours worked during the week of the claim event. As previous research has indicated that employees that work significantly more hours per week (i.e. overtime) may be at higher risk of experiencing negative health outcomes and fatigue,[52] it is possible that some of the risk solely attributed to shift hours in this work may have in part been due to longer work schedules. Moreover, whereas it has been found that risks increase when employees engage in shift work in successive evenings and nights, [53] the workers' compensation data did not contain information on claimant sequential scheduling, and thus this moderator associated with shift risk could not be measured. Future research using workers' compensation data containing such information could thus be an area of future investigation. Fourth, while the CPS data indicated no statistically significant difference in the shift composition of Oregon hospital employees relative to the nation as a whole, the sample size for Oregon was small. So, to the extent that the shift distribution of Oregon's hospital employees differs from our national estimate based the CPS, the estimated odds ratios may be biased upwards or downwards. Last, because workers' compensation data contains information only on reported injuries, it is likely that some minor injuries that occurred from the performance of occupational duties were not reported. However as there is no reason to believe that the distribution of under-reporting would be different for these groups, we do not believe that our relative risk estimates would be materially different if all injuries were reported.

Overall, this study found that evening and night shift hospital workers have significantly higher risk of workplace injury than employees working the day shift, although the severity of injuries, once injury type is accounted for, does not appear to vary by shift. Our findings for the type and rate of injury by shift are consistent with explanations based on fatigue, staffing and task differences by shift. An important avenue for future research would be to analyze the relative importance of these different explanations.

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Table 1

Estimated Relative Risk of Workers' Compensation Claims for Evening and Night Shift Hospital Employees compared to Day Shift Hospital Employees: By Occupation and Nature of Injury

	Evening Shift		Night Shift	
	O.R.	**95% C.I.**	**O.R.**	**95%C.I.**
Age Unadjusted:				
Claimant Group				
All Hospital Claimants	1.84	(1.83,1.85)	1.58	(1.58.1.58)
Registered Nurses	1.45	(1.41,1.49)	1.78	(1.77,1.79)
Nursing Aides/Orderlies	1.42	(1.35,1.49)	0.81	(0.80,0.82)
Clinical Lab Technicians	1.32	(1.30,1.34)	2.75	(2.75,2.75)
Licensed Practical Nurses	0.95	(0.80, 1.10)	0.84	(0.80,0.88)
Nature of Injury				
Sprain & Strains	2.00	(1.99,2.01)	1.76	(1.76,1.76)
Bruises	1.88	(1.89,1.90)	1.27	(1.27,1.27)
Fractures	1.77	(1.76,1.78)	1.52	(1.52,1.52)
Dislocation	1.11	(1.11,1.11)	1.35	(1.35,1.35)
Carpal Tunnel Syndrome	0.95	(0.95,0.95)	0.75	(0.75,0.75)
Under 40 Years of Age:				
Claimant Group				
All Hospital Claimants	1.92	(1.91,1.93)	2.01	(2.01,2.01)
Registered Nurses	1.67	(1.59,1.75)	2.52	(2.51,2.53)
Nursing Aides/Orderlies	1.31	(1.21,1.41)	0.81	(0.79,0.83)
Clinical Lab Technicians	1.33	(1.30,1.36)	3.17	(3.17,3.17)
Licensed Practical Nurses	1.03	(0.75, 1.31)	1.89	(1.84,1.94)
Nature of Injury				
Sprain & Strains	2.07	(2.06,2.08)	2.23	(2.23,2.23)
Bruises	1.83	(1.82,1.85)	1.46	(1.46,1.46)
Fractures	2.73	(2.71,2.75)	1.70	(1.70,1.70)
Dislocation	1.29	(1.28,1.30)	2.15	(2.15,2.15)
Carpal Tunnel Syndrome	0.74	(0.74,0.74)	0.31	(0.31,0.31)
40 Years of Age and Older:				
Claimant Group				
All Hospital Claimants	1.83	(1.82,1.84)	1.26	(1.26,1.26)
Registered Nurses	1.37	(1.33,1.41)	1.34	(1.33,1.35)
Nursing Aides/Orderlies	1.60	(1.50,1.70)	0.83	(0.80,0.86)
Clinical Lab Technicians	1.35	(1.31,1.39)	2.24	(2.23,2.25)
Licensed Practical Nurses	0.95	(0.77, 1.13)	0.51	(0.44,0.58)
Nature of Injury				
Sprain & Strains	1.98	(1.97,1.99)	0.67	(0.67,0.67)
Bruises	2.01	(2.00,2.03)	0.88	(0.88,0.88)
Fractures	1.44	(1.43,1.45)	1.28	(1.28,1.28)
Dislocation	0.98	(0.98,0.98)	0.84	(0.84,0.84)
Carpal Tunnel Syndrome	1.19	(1.19,1.19)	0.88	(0.88,0.88)

Table 2

Odds Ratio Estimates of Injury Claims
Evening and Night Shift Hospital Employees compared to Day Shift Hospital Employees

	Evening Shift		Night Shift	
	O.R.	**95% C.I.**	**O.R.**	**95%C.I.**
Age Unadjusted:				
Type of Injury				
Fall or Jump	1.64	(1.63,1.65)	1.74	(1.74,1.74)
Strike/Rub Object	1.76	(1.75,1.77)	1.53	(1.53,1.53)
Overexertion	2.02	(2.01,2.03)	1.78	(1.78,1.78)
Repetitive Motion	0.78	(0.78,0.78)	0.52	(0.52,0.52)
Violence	3.70	(3.68,3.72)	1.95	(1.95,1.95)
Under 40 Years of Age:				
Type of Injury				
Fall of Jump	2.03	(2.01,2.05)	2.47	(2.47,0.94)
Strike/Rub Object	1.68	(1.67,1.69)	1.76	(1.76,1.76)
Overexertion	2.07	(2.05,2.09)	2.23	(2.23,2.23)
Repetitive Motion	0.73	(0.73,0.73)	0.64	(0.64,0.64)
Violence	3.15	(3.13,3.17)	2.36	(2.36,2.36)
40 Years of Age and Older:				
Type of Injury				
Fall or Jump	1.50	(1.50,1.50)	0.52	(0.41,0.69)
Strike/Rub Object	1.91	(1.90,1.92)	1.26	(0.99,1.68)
Overexertion	2.00	(1.99,2.01)	0.64	(0.51,0.86)
Repetitive Motion	0.88	(0.88,0.88)	1.34	(1.06,1.79)
Violence	4.57	(4.55,4.59)	0.64	(0.51,0.86)

Table 3

Average Days of Receipt of Total Temporary Disability (TTD) Benefits

	All Shifts	Day Shift	Evening Shift	Night Shift
Average TTD days: All Claims	38.9	38.0	38.6	46.1
Average TTD days: Occupation				
Registered Nurses	32.8	32.2	30.7	39.3
Nursing Aides/Orderlies	43.4	42.8	40.7	55.3
Licensed Practical Nurses	41.7	47.1	32.5	43.2
Maids/Housemen	41.1	43.7	37.8	33.7
Clinical Lab Technicians	45.7	37.6	85.8	15.7
Average TTD days: Nature of Injury				
Strains & Sprains	37.1	36.8	35.6	43.5
Bruises	32.8	33.7	29.5	37.8
Fractures	33.2	29.5	34.6	54.4
Dislocations	82.9	77.2	103.7	81.9
Carpal Tunnel Syndrome	48.7	41.6	55.6	122.9
Average TTD days: Type of Injury				
Fall or Jump	37.6	36.1	34.2	54.7
Strike/Rub Object	28.9	27.8	31.1	30.3
Overexertion	41.8	41.7	39.1	50.5
Repetitive Motion	41.7	39.0	62.4	17.6
Violence	47.3	47.1	50.3	33.4

***No claims recorded for given category

Table 4

Average Total Claim Costs

	All Shifts	Day Shift	Evening Shift	Night Shift
Average Claim Cost: All Claims	$6528.43	$6186.77	$6102.55	$6714.78
Average Claim Cost: Occupation				
Registered Nurses	$6614.76	$6833.25	$5984.34	$7255.91
Nursing Aides & Orderlies	$5861.16	$5848.53	$5863.92	$5919.66
Licensed Practical Nurses	$6764.49	$7280.34	$6182.83	$6270.00
Maids/Housemen	$5554.87	$5672.06	$5474.67	$4795.33
Clinical Lab Technicians	$8145.25	$7404.82	$13183.35	$2259.00
Average Claim Cost: Nature of Injury				
Strains and Sprains	$5743.89	$5743.24	$5615.49	$6123.82
Bruises	$4673.36	$4847.04	$3880.64	$6273.35
Fractures	$6146.87	$5657.13	$6529.74	$8332.23
Dislocations	$16692.30	$15735.37	$18793.90	$19570.79
Carpal Tunnel Syndrome	$7803.35	$7448.35	$7732.82	$12932.67
Average Claim Cost: Type of Injury				
Fall or Jump	$6572.27	$6579.15	$5638. 49	$8779.50
Strike/Rub Object	$4637.60	$4584.99	$4582.12	$5157.49
Overexertion	$6404.58	$6384.86	$6288.09	$6856.93
Repetitive Motion	$7254.05	$7069.83	$8818.80	$4873.69
Violence	$6785.01	$6842.42	$7271.28	$4115.27

***No claims recorded within given category

References

1. Patkai P, Akerstedt T, & Pettersson, K. Field studies of shift work: I. Temporal patterns in psychophysiological activation in permanent night workers. *Ergonomics* 1977;20:611-619.

2. Rutenfranz J, Colquhoun W, Knauth, P, Ghata N. Biomedical and psychosocial aspects of shift work. A review. *Scand J Work Environ Health* 1977;3:165-82.

3. Knutsson A. Health disorders of shift workers. *Occup Med* 2003;53;103-108.

4. Midwinter M, Arendt J. Adaptation of the melatonin rhythm in human subjects following night-shift work in Antarctica. *Neurosci Lett* 1991;122: 195-98.

5. Goichot B, Weibel L, Chapotot, F, Gronfier C, Piquard F, Brandenberger G. Effect of the shift of the sleep-wake cycle on three robust endocrine markers of the circadian clock. *Am J Physiol* 1998;275:E243-E248.

6. Knutsson A, Akerstedt T, Johnsson B, Orth-Gomer K. (1986). Increased risk of ischemic heart disease in shift workers. *Lancet* 1986;2: 86-92.

7. Boggild H, Kuntsson A. Shift work, risk factors and cardiovascular disease [reviews]. *Scand J Work Environ Health* 1999;25(2): 85-99.

8. Tinley, AJ, Wilkinson RT, Warren PSG, Watson WB, Drud M. The sleep and performance of shift workers, *Human Factors* 1982;24:624-41.

9. Folkard S, Barton, J. Does the forbidden zone for sleep onset influence morning shift sleep duration?, *Ergonomics* 1993;36: 85-91.

10. Moneta GB, Leclerch A, Chastang J, Tran T, Goldberg M. Time-trend of sleep disorder in relation to night work: a study of sequential 1-year prevalences within the GAZEL cohort. *J Clin Epidiol* 1996;49:1133-41.

11. Akerstedt T. Sleepiness as a consequence of shift work. *Sleep* 1988;11:17-34.

12. Bohle P, Tilley AJ. The impact of night work on psychological well-being. *Ergonomics* 1989;32:1089-99.

13. Borland RG, Rogers AS, Nicholson, AN, Pascoe PA, Spencer MB. Performance overnight in shiftworkers operating a day-night schedule. *Avait Space Environ Med* 1986;57:241-49.

14. Robbins J, Gottlieb F. Sleep deprivation and cognitive testing in internal medicine house staff. *West J Med* 1990;152: 82-86.

15. American College of Emergency Physicians. Emergency physician shift work. *Ann Emerg Med* 1995;25: 864.

16. Parasuraman S, Drake BH, Zammuto RF. The effects of nursing care modalities and shift assignments on nurses' work experiences and job attitudes." *Nursing Research* 1982;31:364-67.

17. Keller KL, Koenig WJ. Sources of stress and satisfaction in emergency medicine. *J Emerg Med* 1989;7:293-99.

18. Smith L, Folkard S, Poole CJ. Increased injuries on night shift. *Lancet* 1994;344:1137-39.

19. Porcu S, Bellatreccia A, Ferrara M, Casagrande M. Sleepiness, alertness and performance during a laboratory simulation of an acute shift of the wake-sleep cycle. *Ergonomics* 1998;41:1192-1202.

20. Lauridsen O. & Tonnesen T. Injuries related to aspects of shiftworking. A comparison of different offshore shift arrangements. *J Occup Accidents* 1990;12:167-76.

21. Alfredsson L, Akerstedt T, Mattsson M, Wilborg B. Self-reported health and well-being amongst night security guards: a comparison with the working population. *Ergonomics* 1991;34:525-30.

22. Costa G, Apostoli P, Andrea F, Gaffuri, E. Gastrointestinal and neurotic disorders in textile shift workers. In: Reinberg A., Vieux, N., & Andlauer, P. eds. *Night and shift work: biological and social aspects*. Oxford: Pergamon Press, 1981.

23. Browne RC. The day and night performance of teleprinter switchboard operators. *Occup Psychol* 1949;23:121-26.

24. Goh VH, Tong TY, Lim C, Low EC, Lee LK. Circadian disturbances after night-shift work onboard a naval ship. *Military Med* 2001;165:101-5.

25. Flain PO. Work schedules of Americans: An overview of new findings. Monthly *Labor Review* 1986;109:3-6.

26. Dula DJ, Dula NL, Hamrick C, Wood GC. The effect of working serial night shifts on the cognitive functioning of emergency physicians. *Ann Emerg Med* 2001;38:152-55.

27. Smith-Coggins R, Rosekind MR., Buccino KR. The relationship of day versus night sleep to physician performance and mood. *Ann Emerg Med* 1994;24:928-34.

28. Jacques CHM, Lynch JC, Samkoff JS. The effects of sleep loss on cognitive performance of resident physicians. *J Fam Pract* 1990;30:223-29.

29. Storer JS, Floyd HH, Gill WL, Giusti CW, Ginsberg H. (1989). Effects of sleep deprivation on cognitive ability and skills of pediatric residents. *Academic Med* 1989;63:29-31.

30. Steele MT, Ma J, Watson, WA, Thomas HA. Emergency medicine residents' shiftwork tolerance and preference. *Acad Emerg Med* 2000;7:670-673.

31. Sawyer RG, Tribble CG, Newberg DS, Pruett TL, Minasi JS. Intern call schedules and their relationship to sleep, operating room participation, stress, and satisfaction. *Surgery* 1999;126:337-42.

32. Haynes DF, Schwedler M, Dyslin DC, Rice JC, Kerstein MD. Are postoperative complications related to resident sleep deprivation? *South Med J* 1995;88:283-89.

33. Barton J, Folkard S. The response of day and night nurses to their work schedules. *J Occup Psych* 1991;64:207-18.

34. Healy D. Blues in the night. *Nursing Times* 1997;93:26-28.

35. Coffey LC, Skipper JK, Jung FD. Nurses and shift work: effects on job performance and job related stress." *J Advanced Nursing* 1988;13:245-54.

36. Kandolin I. Burnout of female and male nurses in shiftwork. *Ergonomics* 1993;36 (1-3):141-47.

37. Smith L, Folkard S, Poole CJ. Increased injuries on night shift. *Lancet* 1994;344:1137-39.

38. Gold DR, Rogacz S, Bock N, et al. Rotating shiftwork, sleep and accidents related to sleepiness in hospital nurses. *Am J Pub Health* 1992;82:1011-14.

39. Yawn PM, Kurland RL, Kurland M, Yawn RA. Relationship of workers' compensation status and duration of carpal tunnel symptoms. *Minnesota Med* 2001;84(3):52-56.

40. Horwitz IB, Arvey RD. Workers' compensation claims from latex glove use: a longitudinal analysis of Minnesota 1988-1997. *J Occup Environ Med* 2000;42:932-38.

41 Horwitz IB, Kammeyer-Mueller JD. (2002). Natural Rubber Latex Allergy Claims: Washington State Healthcare Workers, 1991-1999. *Applied Occup Environ Hygiene* 2002;17:267-275.

41. Horwitz IB, Kammeyer-Mueller JD, Butler RJ. Workers' compensation claims as a measure of healthcare worker reaction to latex gloves in healthcare settings: Rhode Island 1992-1997. *J Workers' Compensation* 2000;10:49-59.

42. Horwitz IB, Kammeyer-Mueller JD, McCall BP. Assessing latex allergy among healthcare employees using workers' compensation data. *Minnesota Med* 2001;84:47-50.

43. Helfenstein M, Feldman D. The pervasiveness of the illness suffered by workers seeking compensation for disabling arm pain. *J Occup Environ Med* 2000;42:171-75.

44. Islam SS, Nambir AM, Doyle EJ, Velilla AM, Biswas RS, Ducatman AM. Epidemiology of work-related burn injuries: experience of a state managed workers' compensation system. *J Trauma-Injury Infect Crit Care* 2000;49:1045-51.

46. Hashemi L, Webster BS. Non-fatal workplace violence workers' compensation claims (1993-1996). *J Occup Environ Med* 1998;40:561-67.

47. LaMar WJ, Gerberich SG, Lohman WH, Zaidman B. (1998). Work-related physical assault. *J Occup Environ Med* 1988;40:317-24.

48. Harma MI, Ilmarian JE. Towards, the 24-hour society—new approaches for aging shift workers? *Scand J Work Environ Health* 1999;25 (6, special issue):610-15.

49. Smith L, Folkard S, Tucker P, Macdonald I. Work shift duration; a review comparing eight and 12 hour shift systems. *Occup Environ Med* 1998;55:217-229.

50. Shogren E, Calkins A, Wilburn S. Restructuring may be hazardous to your health. *Am J Nursing* 1996;96:64-66.

51. Totterdell P, Spelten E, Smith L, Barton J, Folkard S. Recovery from work shifts: how long does it take? *J Applied Psych* 1995;80:43-57.

52. Harrington JM. Shift work and health – a critical review of the literature on working hours. *Ann Academic Med* (Singapore) 1994;23:699-705

53. Folkard S, Tucker P. Shift work, safety and productivity. *Occup Med* 2003;53:95-101.