Injuries Related to Shiftwork

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Objective: The purpose of this study was to review the relationship of shiftwork to industrial injuries, and possible methods of injury control.

Method: The primary method was a systematic review of the published literature. The Cochrane Collaboration protocol was used to conduct the literature search.

Selection Criteria: Studies were included if they addressed the issue of industrial injuries related to shiftwork.

Results: No controlled interventions were found. All studies were observational, and most were retrospective. The studies were not comparable with one another since they refer to different industrial settings.

Conclusions: Findings from the literature indicate that shiftwork should be avoided, but that if necessary, certain patterns and rest breaks appear to be associated with fewer injuries. More and better-focused research is needed in this field of study.

Medical Subject Headings (MeSH): accident prevention, fatigue, industry, intervention studies, occupational health, review literature, safety, workplace organization and administration (Am J Prev Med 2000;18(4S):33–36) © 2000 American Journal of Preventive Medicine

The risk of injury, including fatal injury, is a daily reality in the workplace. Some 120 million Americans work, and about 25% of men and almost 20% of women work some kind of shift pattern,[1] with increases in such work cycles over the past few years. Over 5 million injuries are work related, costing about $50 billion per year.

Prior studies of injuries and shiftwork have not arrived at a clear conclusion on the relationship between the two, and specifically, whether shiftwork results in a higher rate of injuries compared to nonshift work. It is also unclear whether a particular shift carries a greater risk of injury than another. This literature review was conducted to attempt to clarify the issues of shiftwork and risk of injuries, and the role fatigue may play in the risk of injury related to shiftwork. It was thought that the risk of injury would be higher among individuals holding more than one job.

Methods

Search Criteria

The search was conducted using the search strategy outlined by the Cochrane Collaboration[2] and detailed by Beahler et al.[3] Studies from peer-reviewed journals, technical reports, and government reports were sought using a systematic approach to literature searching. Due to the multidisciplinary nature of the research question, the search was conducted across disciplines, and included various databases and literature collections. The following databases were searched to capture all possible studies: MEDLINE, EMBASE, ERIC, PsychINFO, Sociofile, NIOSHTIC and Dissertation Abstracts. Briefly, the literature was searched using a broad set of keywords or subject headings related to shiftwork and occupational injuries. The basic search was some combination of the following keywords: shift, graveyard, swing, schedule, overtime, or irregular *and* injury, accident, or safety *and* work, job, and occupation or employment. Most words were truncated to pick up various forms of the word (e.g., occupation or occupational or occupations). In addition to database searching, other relevant information sources were identified by checking references and consulting experts in the field.

Types of Outcomes

Studies were sought that included data on the effect of shiftwork on risk of injury or injury severity. Personal outcome measures such as job satisfaction, family interactions, work stress or accuracy in performing jobs were excluded.

Selection Criteria

The goal was to find studies that addressed the issue of shiftwork and injury rates or injury severity. Motor vehicle crashes were excluded because these were believed to represent a broad topic in itself.

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Results

After reviewing 3489 citations and 79 articles, 7 were found suitable for analysis (see Table 1). These studies were not easily comparable since they refer to different industrial settings. No controlled interventions were found. All studies were observational, and most were retrospective.

In two of three studies that compared rate of injuries among shift workers vs. nonshift workers, workers on rotating shiftwork had a higher risk of injury than workers on fixed shifts.[4,5] Smith et al.[4] found some differences between rates of injury during fixed shifts but all were less than among those who worked rotating shifts. Ong et al.[5] found that rotating workers had a 3.7-fold greater risk of injury during the day shift than nonrotating workers on day shifts. However, it is unclear from this report whether the rotating shift workers did the same type of work as the nonshift workers. In contrast, Novak and Smolensky[6] compared injury rates in over 200 shift workers to nonshift workers at a southeastern Texas chemical manufacturing plant. The pattern of work was an 8-hour, 7-day backward rotation. No significant differences were found in injury rate or severity between shift and nonshift workers, nor were differences found according to time of day. The authors noted that their finding of the lowest overall injury incidence rate among night shift workers contradicted many findings in the scientific literature on this topic.

With regard to type of rotating shift, there appeared to be greater risk of injury from shifts that rotated more frequently than weekly. Bell and Telman[7] found that night-shift workers on a 2-day shift schedule had more than twice the rate of injuries of workers on a more commonly used 7-day rotating schedule. However, Barreto et al.[8] used a case–control design to study fatal injures among steelworkers and found that, after adjusting for other risk factors, the shift pattern did not affect the risk of fatal injury.

Other authors examined the risk of injury and the differences in the severity of the resultant injuries, by time of shift worked. Wagner[9] examined the severity of injuries suffered by ore miners on three shifts over a 10-year period. There was no rotation of workers, and the night crew was found to have the most severe injuries as measured by lost work time. The paper had several significant failings. Perhaps the most important is the strikingly different numbers of workers on each shift, suggesting that the nature of the work may change between shifts. Injuries seemed to occur just prior to meal breaks or just prior to the end of the shift. This pattern mirrors a well-appreciated phenomenon, at least in the mining industry, of significant injuries occurring during start-up after shutdown, or just prior to a major shutdown period when there appear to be increased external distractions. No comment is made as to the experience level of workers. Night-shift workers may well have been more inexperienced, although this is not addressed. The principal value of this study is its longitudinal nature.

Barsky and Dutta[10] used normalized data to examine the issues of age and shift in industrial accidents at two Canadian facilities employing approximately 8000 workers. There were three shifts with varying rotational patterns, and the age range for workers was 20 to 65. In contrast to Wagner,[9] they found that the rates of injury were similar among the different shifts, but in one facility the injuries occurring during the day shift were more severe. The authors acknowledge the specificity, rather than generalizability, of their data.

Discussion

There were several interesting outcomes with regard to this literature search. Three findings were of note: (1) few truly useful papers for analysis were found, (2) there had been no apparent research on people working multiple jobs or having minimum wage types of employment that might correspond to working multiple jobs, and (3) there were no papers specifically examining the issue of women in the workplace who traditionally have a second job ("shift") as family caretaker.

Even the few detailed studies examined point to the continuing discrepancies and uncertainties regarding research data in this field. Part of the problem appears to be the many disparate fields from which the researchers come; few were trained in traditional occupational epidemiology. In addition, outcome measures vary greatly across the studies.

The traditional methods of reducing hazards at the workplace (engineering controls, substitution) do not seem especially relevant to the issue of fatigue in shiftwork as they relate to injuries, except for the role of administrative controls. After doing all else to protect workers, reduction of risk for injury can perhaps be best achieved by administrative controls.

Conclusions

The issue of injuries related to shiftwork and potential fatigue are clearly complex and there is little definitive information available of sufficient quality to make meaningful recommendations. Perhaps the only generalizable statements after this extensive literature review are that in general: (1) fixed shifts are believed to be preferable to rotating shifts, (2) if rotating shifts are used, the general consensus in the literature favors rapid to slower rotations, (3) longer workdays, either 10- or 12-hour shifts, seem no more hazardous than the more usual 8-hour workday.

The complexity of this subject makes it difficult to isolate individual factors, and the findings in one industry or setting may not be easily generalizable.

Table 1. Characteristics of selected studies

Author, year	Location and industry	N	Design	Outcome measures	Results	Comment
Bell et al. (1980)[7]	Margarine factory in Turkey	25 workers	Before-after comparison of 2-day rotating shift schedule to 7-day rotating shift schedule	Minor injuries	2.6 injuries per nightshift on 2-day schedule compared to 1.2 per night shift on 7 day schedule	No clear definition of what is meant by minor injury; only compared 11 pm to 7 am shift; no comparison of other shifts
Wagner (1988)[9]	Iron mines in Minnesota and Michigan	Approx. 14,000	Comparison of the severity of injuries occurring on day, evening and night shifts; weekly rotation schedule	Days lost from injuries that resulted in work area being shut down for 30 minutes or longer; nearly all required medical care	Days lost per injury: 11.6 (day shift); 14.5 (evening shift); 15.4 (night shift)	Although the author reports ''there were no major differences in the type of work being done from hour to hour,'' the number of injuries on the three shifts varied greatly: 4095 on days, 1570 on evenings and 811 on nights
Barsky et al. (1992)[10]	Automotive facilities in Ontario, Canada	One company with 1000 workers; second with 2300	Cross-sectional comparison	Rate of injuries per 100 workers per shift	Rate of injuries was the same for each shift; in one facility injuries were more severe on day shift than on other shift; no differences in rate in other company.	No examination of different shift systems
Smith et al. (1982)[4]	Food processing workers in U.S.	1009 workers	Survey of workers comparing different shifts	Rate of injuries to workers in last 6 months	Rates of injuries per 6-month period for nonrotating male shift workers: 18% days, 26% evenings, 15% nights For rotating shift workers, rate was 38% No differences for female workers	
Barreto et al. (1997)[8]	Steelworkers in Brazil	37 fatal injuries and 140 controls	Case-control study	Risk factors for fatal injuries	No effect of work schedule when adjusted for other factors	
Ong et al. (1987)[5]	Iron and steel workers in Singapore	241 on day shift only 423 on weekly rotating shifts	Descriptive study comparing injury rates over a 5-year period	Injuries involving medical leave for more than one day	Rates per 10 hours Rotating workers: Day: 266 Eve: 142 Night: 107 Nonrotating workers: 72	Time loss per injury did not vary by shift
Novak et al. (1990)[6]	Chemical manufacturing workers in Texas	242 shift worker injuries 224 nonshift worker injuries	Historical retrospective study	Incidence rates of injury; severity of injuries	No significant differences found in injury rate, severity of injuries, or according to time of day	

Some recently summarized data[11] appear to support the relationship of fatigue and motor vehicle accidents, but this topic is not a major focus of this paper. With the recently announced major effort in the United States to combat fatigue-related motor vehicle accidents (which has been stated, at least in part, to be due to increasing amounts of shiftwork), there may be an opportunity to determine whether a successful intervention program can be mounted, with potential lessons for more traditional workplace injuries. Lastly, it should be evident that more and better-focused research is needed in this field of study.

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