

**Scientific Symposium**  
**The Health Effects of Shift Work**

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# **Shift work and the risk of work injury**

CA Mustard, A Chambers, PN Smith  
Institute for Work & Health, Toronto

C McLeod  
University of British Columbia, Vancouver



25% of Canadian full-time workers aged 19-64 work some form of non-traditional work schedule.

There is strong evidence that night, evening, rotating and irregular shifts are associated with an elevated risk of occupational injury.

These risks are generally understood to arise from the joint influence of worker fatigue (due to sleep disturbance or long work hours) and typically lower levels of supervision and co-worker support during non-daytime work schedules.



## Presentation Outline

- 1) a narrative review of the epidemiologic evidence for a relationship between exposure to shift work and work injury risk,
- 2) an assessment of the population attributable risk for work injury arising from exposure to shift work,
- 3) an overview of the research challenges in this field and
- 4) an assessment of opportunities to improve the surveillance of the risks of work injury associated with shift work.



## **Epidemiologic evidence: exposure to shift work and work injury risk**

Most recent review (Folkard and Tucker 2003) finds injury risks higher on evening and night shifts compared to regular day work schedules. Risk increases over successive nights of repeated shift work. Risk increases for all work schedules longer than 8 hours.

Challenge of distinguishing risk associated with shift schedule from risk associated with long duration work shifts



## **Epidemiologic evidence: exposure to shift work and work injury risk**

Most prominent research challenges:

Inconsistencies in shift schedules between studies; time of day, fixed vs rotating schedules, speed and direction of shift rotation, number of hours worked per week and number of consecutive shifts worked



## **Assessment of the population attributable risk for work injury arising from exposure to shift work**

Given that exposure to shift work schedules is common in the Canadian labour market, it is important to estimate the excess burden of work injury arising from shift work schedules

The Population Attributable Risk (PAR) is an epidemiologic measure that estimates the burden of injury or illness that can be attributed to a specific exposure



## **Assessment of the population attributable risk for work injury arising from exposure to shift work**

Estimating a PAR requires two pieces of information:

- 1) an estimate of the relative risk of work injury for persons exposed to shift work compared to persons working a regular daytime work schedule, and
- 2) an estimate of the prevalence of exposure to shift work



## **PAR estimate based on relative risk estimates from Dembe (US) and exposure estimates from the Survey of Labour and Income Dynamics (Canada)**

Relative risk estimates from National Longitudinal Survey of Youth. Subjects aged 22-30, self-reported incidence of work injury over period 1987-2000. Estimates adjusted for age, gender, occupation, industry and region.

Prevalence estimates from the Survey of Labour and Income Dynamics (Canada)

Two survey sources have comparable definitions of work shift schedules





## Table 1: PAR estimate, , 2007

based on relative risk estimates from Dembe (12) and exposure estimates from the Survey of Labour and Income Dynamics (53)

<b>Shift Schedule</b>	<b>Prevalence</b>	<b>Relative Risk</b>	<b>PAR (%)</b>
Evening	0.042	1.43	1.77%
Night	0.023	1.30	0.69%
Rotating	0.099	1.36	3.44%
Irregular	0.119	1.15	1.75%
<b>Total</b>	<b>0.283</b>		<b>7.65%</b>



## **PAR estimate based on relative risk estimates from the Canadian Community Health Survey and exposure estimates from the Survey of Labour and Income Dynamics**

Relative risk estimates based on respondents' self-report of a work injury in the previous 12 months 'serious enough to limit normal activities'. Estimates stratified by gender and adjusted for occupation, industry and region.

Prevalence estimates from the Survey of Labour and Income Dynamics (Canada)



## Table 2: PAR estimate, , 2003

based on relative risk estimates from the Canadian Community Health Survey, 2003 (56) and exposure estimates from the Survey of Labour and Income Dynamics (53)

Shift Schedule	Men			Women		
	Prevalence	OR	PAR (%)	Prevalence	OR	PAR (%)
Evening	0.042	0.98	-0.01%	0.042	1.49	2.03%
Night	0.026	1.78	1.99%	0.019	2.52	2.83%
Rotating	0.107	1.19	1.99%	0.091	1.66	5.65%
Irregular	0.130	1.15	1.91%	0.150	1.37	1.05%
<b>Total</b>	<b>0.305</b>		<b>5.90%</b>	<b>0.303</b>		<b>11.58%</b>



## **PAR estimate based on odds ratio estimates and exposure estimates from the Survey of Labour and Income Dynamics, 2006**

Odds ratio estimates based on respondents' self-report (or income tax record) of receipt of workers' compensation benefits in previous 12 months. Exposure estimate based on respondents' report of typical work schedule in previous 12 months. Estimates stratified by gender and adjusted for age, income, occupation and industry.

N=30,000 respondents



### Table 3: PAR estimate, 2006

based on odds ratio and exposure estimates from the Survey of Labour and Income Dynamics, 2006 (54)

Shift Schedule	Men			Women		
	Prevalence	OR	PAR (%)	Prevalence	OR	PAR (%)
Night	0.081	1.91	3.85%	0.073	2.04	3.72%
Rotating	0.113	1.15	1.47%	0.100	2.29	5.63%
Other	0.149	1.24	2.88%	0.167	1.43	5.02%
<b>Total</b>	<b>0.343</b>		<b>8.20%</b>	<b>0.340</b>		<b>14.37%</b>



## Summary: PAR estimates

Strong consistency in PAR estimates from the two different Canadian survey sources

Applying PAR estimates to the total count of lost time and no lost time injuries reported to the Ontario workers' compensation agency in 2007 (325,800) suggests that an excess of 13,000 compensated injuries to men and 20,000 compensated injuries to women can be attributed annually to the higher risk of injury associated with shift work schedules.



## Limitations: PAR estimates

PARs will be underestimated in contexts where the misclassification of exposure or outcome status results in an attenuation of the estimated relative risk relative to the true relative risk.

PARs may overestimate the proportion of work injuries attributed to non-regular work shifts where unmeasured characteristics of persons engaged in shift work differ from persons working regular day schedules.

PAR estimates are ideally be derived from relative risk estimates that have been adjusted for potential confounders.



## **Overview of the research challenges in the field**

Among the methodological shortcomings of many existing studies are:

small sample sizes,

restrictions to specific industries that limit the generalizability of study findings,

limitations in the precision with which work hours and work shift duration are measured

limited success in accounting for factors that may confound an observed relationship between work schedules and injury risk





## **Overview of the research challenges in the field**

Measurement of work hours and work shift durations for a complete labour force is exceedingly rare.

In Canada and the United States, labour market surveys conducted by national statistical agencies routinely measure hours of work, typically in the past week, for large, representative samples of labour force participants.

These survey sources, however, do not collect information on work hours relative to the 24 hour clock nor do these surveys consistently estimate shift work schedules over a 12 month period .



## Overview of the research challenges in the field

Measures of individual work demands for typical day, evening and night shifts is rarely measured. Between workplaces, shift work may be associated with work demands that are similar to, greater than or less than production schedules during regular daytime schedules.

In addition to measures of individual work demands, high quality studies would also measure the availability of supervisors and co-workers between daytime, evening and night shift schedules.



## **Overview of the research challenges in the field**

The importance of measuring the initial health status of workers in formal etiologic studies.

Persons working shift schedules may be healthier and less susceptible to adverse health effects of shift work than persons not exposed to shift work.

Persons who develop health problems may withdraw from shift work schedules.

Persons assigned to (or selecting) shift work schedules could have poorer pre-existing health status than persons who do not work shift schedules.



## **Opportunities to improve the surveillance of the risks of work injury associated with shift work**

Surveillance is a foundation for the design of prevention programs.

Currently in Canada, there is limited routine surveillance of work injury by shift schedule or time of day

Without information on the prevalence of shift work schedules and work injury risks, effective hazard control strategies cannot be designed and implemented.

The following section outlines options for addressing this surveillance gap.



## Four challenges in surveillance

1) identifying a reliable and valid information source describing the incidence of work injury by time of day and by industry (the numerator of a surveillance rate),

2) identifying an information source describing total hours of work, by time of day and by industry (the denominator of a surveillance rate),

3) demonstrating that estimates obtained from the surveillance system are consistent with estimates from rigorous etiologic studies

4) ensuring that both data sources are available on a regular basis, to support the monitoring of trends over time.



## **Surveillance Option 1**

### **Use of administrative data from workers' compensation schemes**

Information on the hour of work injury, measured across the 24 hour clock, can be obtained from workers' compensation lost-time claims in the province of Ontario. These records also contain information on the workers' age, gender, industry, occupation and information on the cause and nature of injury.

However, workers' compensation systems do not record collect information on the number of hours worked, by age, gender, occupation and industry over the 24 hour clock.



## Surveillance Option 1

### Use of administrative data from workers' compensation schemes

**A solution:** Information obtained from a number of regular surveys conducted by Statistics Canada can be integrated to create a 'synthetic' estimate of hours of work over the 24 hour clock, stratified by age, gender, industry and occupation.



## **Surveillance Option 2**

### **Use of administrative data from emergency department encounters**

In 2000, the province of Ontario mandated the reporting of all emergency department visits. Over a typical 12 month period, there are 5.3 million ER visits in Ontario.

In Ontario, the workers' compensation board is responsible for payment for work-related emergency department visits. In a typical 12 month period, there are 150,000 emergency department visits associated with the treatment of a work-related injury.





## **Surveillance Option 2**

### **Use of administrative data from emergency department encounters**

Respondents to Canadian health interview surveys (CCHS) report that approximately 50% of work injuries requiring medical attention present to a hospital emergency department.

There are 300,000 lost-time and no lost-time compensation claims reported annually to the Ontario workers' compensation board. 50% of 300,000 compensation claims would suggest 150,000 emergency department visits



## **Surveillance Option 2**

### **Use of administrative data from emergency department encounters**

Information on the hour of work injury, measured across the 24 hour clock, would be obtained from emergency department records (time of triage). Information is also available describing the age, gender and nature of injury (no information on occupation or industry).

Denominator information would be obtained from synthetic estimates obtained from Statistics Canada labour market surveys.



## **Surveillance Option 3**

### **Use of labour market panel surveys**

The Survey of Labour and Income Dynamics is a Canadian labour market panel survey, following 30,000 households in six year panels. The SLID measures information on shift schedules and collects information on the receipt of workers' compensation benefits and information on self-reported health status and activity limitations



## Limitations in the Surveillance Options

With the exception of the SLID, surveillance options do not provide information on cumulative exposure to shift work

Surveillance options do not provide information on the time of work injury relative to the start time and duration of a work shift

With the exception of the SLID, information is not available describing the health status of workers



## Conclusion

Research findings consistently document an elevated risk of work injury associated with non-regular work schedules

This presentation has outlined three approaches to improving the surveillance of work injury relative to shift schedule and time of day

Enhanced surveillance is a foundation for guiding prevention and for informing the design of etiologic research seeking to improve understanding of the specific mechanism of hazard associated with non-regular work hours



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