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Effect of Recall Period on the Reporting of Occupational Injuries Among Older Workers in the Health and Retirement Study

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Studies of injury morbidity often rely on self-reported survey data. In designing these surveys, researchers must chose between a shorter recall period to minimize recall bias and a longer period to maximize the precision of rate estimates. Using data from the Health and Retirement Study, which employed a recall period of 1 year, we examined the effect of the recall period on rates of occupational injuries among older workers as well as upon rate ratios of these injuries for nine risk factors. We fit a stochastic model to the occupational injury rates as a function of time before the interview and used this model to estimate what the injury rates would have been had we used a 4-week recall period. The adjusted occupational injury rate of 5.9 injuries per 100 workers per year was 36% higher than the rate based on a 1-year recall period. Adjustment for recall period had much less effect on rate ratios, which typically varied by <10%. Our work suggests that self-reported surveys with longer recall periods may be used to estimate occupational injury rates and also may be useful in studying the associations between occupational injuries and a variety of risk factors.

Key words: wounds and injuries, occupation, recall, aged, epidemiologic methods, bias (epidemiology)

INTRODUCTION

Since self-reported survery data play an important role in the study of occupational injury morbidity, we need to assess the validity of these data. Several studies have looked at the effect of recall period on estimates of injury rates for nonoccupational injuries [Cash and Moss, 1972; Massey and Gonzales, 1976; Carlson, 1983; Langley et al., 1988; Langley et al., 1989; Harel et al., 1994], but only recently have researchers begun to study the effect of recall period on estimates of occupational injury rates [Landen and Hendricks, 1995]. In addition to estimating injury rates, self-reported injury surveys are used to study the association between occupational

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injuries and a variety of injury risk factors. Unfortunately, it is not clear how recall bias affects the injury rate ratios comparing subgroups at different levels of risk.

In general, recall bias affecting injury rates increases as the length of the recall period increases [Massey and Gonzalez, 1976]. Based on a mean square error criterion, Massey and Gonzalez [1976] recommended using a 2–4-week recall period to minimize recall bias. However, using such a short recall period necessitates a large sample size to ensure a small standard error. For infrequent events such as occupational injuries, we would need sample sizes on the order of 30,000 as in the 1988 Occupational Health Supplement to the National Health Interview Survey to estimate injury rates precisely. For smaller, nationally representative samples, we must use a longer recall period to identify sufficient numbers of occupational injuries. Harel et al. [1994] and Landen and Hendricks [1995] have demonstrated that one can model injury rates as a function of the time between the injury and the interview and use this model to adjust estimates of injury rates using long recall periods to what they would have been had a 4-week recall period been used. Similarly, Van Dosselaar [1991] has shown that one can successfully use stochastic models to adjust rates of unemployment for recall bias. However, we still know very little about the effect of recall bias from using a longer recall period on injury rate ratios.

In this article, we use data from the Health and Retirement Study (HRS) [Juster and Suzman, 1994] to model the effect of recall period on estimates of occupational injury rates, to adjust injury rates based on a 1-year recall period to what they would have been had a 4-week recall period been used, and to assess the effect of recall bias on the injury rate ratios for age, sex, occupation, education, income, assets, depression, short-term memory, and urban or rural residence. These variables were chosen because we hypothesize that older, poorer, less educated workers might be less able to remember occupational injuries. However, we expect that the effect of recall bias on injury rate ratios would be smaller than on the injury rates themselves. Thus the HRS and similar data may be most useful for studying risk factors associated with occupational injuries.

MATERIALS AND METHODS

Study Population

The Health and Retirement Study was designed and carried out by the Institute for Social Research at the University of Michigan under a cooperative agreement with the National Institute on Aging to assess the relationship among health, economic factors, and patterns of retirement. The HRS cohort was selected over a 45-week period beginning in April 1992 from a multistage area probability sample of households in the continental United States. A household was considered age eligible if it contained one person born between 1931 and 1941, i.e., 51 to 61 years in 1992. In addition to the age-eligible respondent, the HRS included the respondent's spouse irrespective of age. Of the households with an age-eligible respondent, 82% agreed to participate, resulting in a total sample of 12,654 respondents. The HRS oversampled African-Americans (16.3%) and Hispanics (9.3%) to allow analysis of these ethnic minorities. This cohort was interviewed in-person and will be reinterviewed by telephone several times as they age. From the HRS cohort, we selected the 9,756 subjects, aged 51–61 years. Of these, we chose the 7.089 who were employed during the year preceding the interview and, therefore, at risk for occupational injuries.

Since we have the date only for the most recent injury, we excluded 37 subjects who had more than one occupational injury during the year preceding the interview. Including them and using only the information on their most recent injury would have artifactually increased the rates of injury over the most recent months. Finally, we excluded the three subjects who were missing the date of injury, resulting in a cohort of 7,049. The 40 excluded subjects represented 11% of the 355 injured subjects.

Variables

The HRS data were collected during an in-person interview. The HRS used three questions to define occupational injuries.

1. During the last 12 months, i.e., since (month) of 1991, have you had any injuries at work that required special medical attention or treatment or interfered with your work activities?
2. How many times have you been injured on the job during the past 12 months?
3. On what date did your most recent injury happen?

Unfortunately, no further data on the severity of injury or the length of disability were obtained.

In our analyses, we considered the following dichotomous variables as potential risk factors for occupational injuries:

1. Age: comparing those 56–61 years old with those 51–55 years old.
2. Sex: comparing males with females.
3. Education: comparing those with $\leq$ 12 years with those with $>$ 12 years.
4. Income: comparing those with less than $44,000 per year with those with more than $44,000. This cut point approximates the median income of the entire HRS cohort.
5. Financial assets: comparing those with $93,500 or less with those with more than $93,500. This cut approximates the median assets of the entire HRS cohort.
6. Job classification: comparing blue collar (Census Occupational Codes 001-400) [National Center for Health Statistics, 1992] with white collar (Census Occupational Codes 401 and over).
7. Residence: comparing rural with urban residents.
8. Depressive symptoms: comparing the 30% with the most symptoms with the 70% with the least, using the Center for Epidemiologic Studies—Depression Scale (CES-D) [Radloff, 1977].
9. Memory: using the number of words recalled from a list of 20 words after 5 minutes, comparing those remembering less than or equal to five with those remembering more than five [Groni-Huntley et al., 1986].

Data Analysis

To create a model of occupational injury rate as a function of time before the interview, we calculated 13 separate annualized incidence rates of occupational injury for the 13 four-week periods preceding the date of the interview. As numerators, we used the number of occupational injuries among our cohort during that 4-week period. As denominators, we used the number of people working at the time of the interview. For a first approximation, we assumed they worked the entire year. To annualize the rates, we multiplied each by 13. As suggested by Massey and Gonzalez [1976], we fit the rates with the following models:

Model 1. $E(y) = a \exp(-bx^2)$
Model 2. $E(y) = a \exp(-bx)$
Model 3. $E(y) = a + bx + cx^2$
Model 4. $E(y) = a + bx$

where E(y) is the expected value of the annualized incidence rate and x is the numbered 4-week period from 1–13. We estimated the parameters of each model using standard linear regression techniques. Since the models are not nested, we used the Akaike [1973] information criterion, as described in Jones [1993], to select the best model.

Using this best model, we calculated the annualized injury rate adjusted for a 4-week recall period, i.e., the annualized injury incidence rate that would have been expected if a recall period of 4 weeks had been used. To determine the effect of recall bias on estimates of rate ratios, we re-estimated the parameters of our best model for each of the subgroups defined by our nine dichotomous variables. For example, we fit our best model to the older workers and to the younger workers, to the richer workers and to the poorer workers, and so forth. Using these refit models, we calculated injury rates and adjusted for a 4-week recall period for each subgroup. Then, we calculated rate ratios for each dichotomous variable comparing the injury incidence among the younger workers with that among the older workers, and so forth. We calculated these rate ratios for both the injury incidence rates using a 4-year recall period, as well as for the injury incidence rates adjusted for a 4-week recall period. By comparing these two sets of rate ratios, we could assess the effect of recall bias on the rate ratios for each of our nine dichotomous variables.

Results were considered statistically significant at $p<0.05$. We used the PROC REG procedure of SAS software [SAS, 1989] for model building. In order to take account of the complex multistage sample structure in calculating the variances of the incidence rates, we used SUDAAN software [Shah et al., 1992].

RESULTS

Using the Akaike information criterion, we found that Model 4, a simple linear model, provided the best fit for the injury incidence rates. Figure 1 shows the annualized injury incidence rates for each of the 13 recall periods along with the linear model that accounted for 50% of the variance in injury incidence rate. This model suggests that if we had used a recall period of 4 weeks, we would have found an adjusted injury incidence rate of 5.9 injuries per 100 workers per year, 36% more than the 4.3 reported using a recall period of one year. The slope of the regression line was significantly different from zero ($p = .002$).

Table I reports the injury rates, both unadjusted and adjusted to a 4-week recall period, for the subgroups of workers defined by our nine dichotomous variables. These rates were generated by refitting Model 4 for each of the subgroups. The increase in the adjusted rate over the unadjusted rate varied from 28% to 50%, averaging 37.5%. For some variables, such as financial assets, the increase was

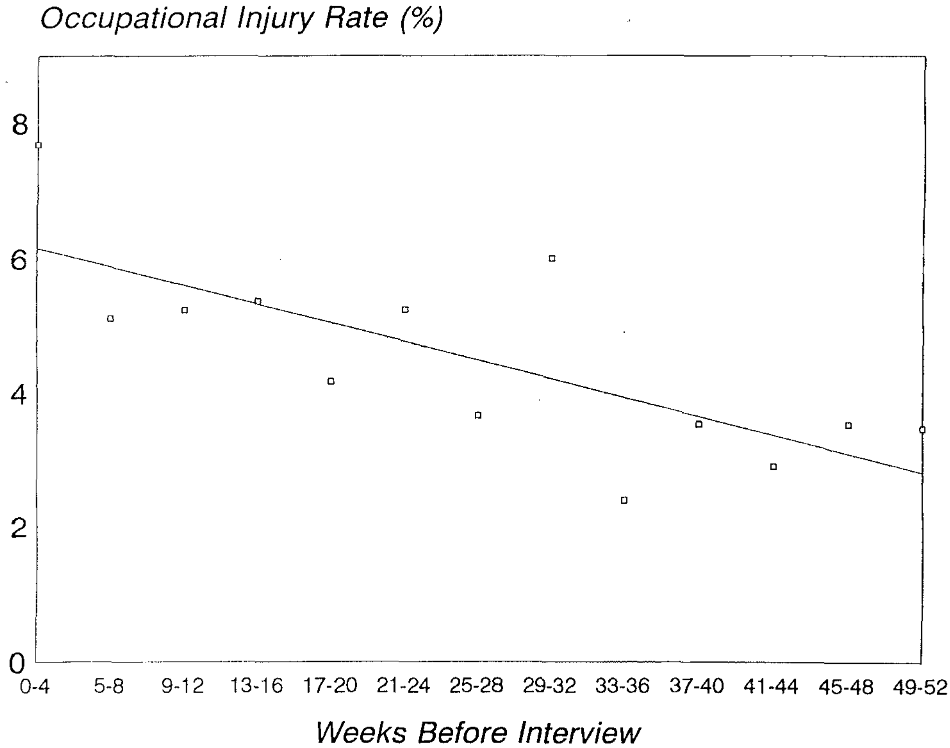

Fig. 1. Annualized injury incidence rates per 100 workers by time before interview.

virtually identical for the two subgroups; for others, such as age, there was a substantial difference between the increase for the two subgroups.

Table II shows the effect of adjusting for recall period on the rate ratios for each of the nine variables. Adjustment for recall period had less effect on the rate ratios than on the rates. The absolute value of the adjustment ranged from 2–15%, averaging 7.5%.

DISCUSSION

Using daa from the HRS, we have examined the effect of different recall periods on rates of occupational injuries, as well as on the rate ratios of these injuries among nine subgroups of the study population. In comparison with a recall period of 4 weeks, employing a recall period of 1 year led to a systematic under-estimation of injury rates, by 35.5% for the entire cohort and on the order of 30–40% for various subcohorts. In contrast, the rate ratios based on a recall period of 1 year differed from those based of a recall period of 4 weeks by less—on the order of 10%. Moreover, whereas the rate estimates based on a recall period of 1 year always underestimated those based on a 4-week recall period, the direction of the bias for the rate ratios varied for different subcohorts. Adjusting for the 1-year recall period decreased some rate ratios such as those for sex and education, but increased others such as those for age and income.

TABLE I. Rates of Occupational Injuries, Adjusted and Unadjusted for Recall Period, and the Percent Increase of Adjusted Over Unadjusted Rate, by Worker Characteristics (Health and Retirement Study, 1992)

			Unadjusted 95%	Adjusted for recall period		
	Number of subjects	Rate (%)	Confidence interval	Rate (%)	95% confidence interval	Percent increase
Total	7,049	4.3	3.7–4.9	5.9	4.9–6.8	35.9
Age (years)						
51–55	3,196	4.6	3.9–5.4	6.7	5.2–8.2	45.6
56–61	3,853	4.0	3.3–4.8	5.1	3.8–6.4	27.5
Sex						
Female	3,762	3.7	3.0–4.4	5.2	3.8–6.7	40.5
Male	3,287	4.8	3.8–5.8	6.3	4.9–7.8	31.3
Education (years)						
≤ 12	4,213	5.3	4.5–6.2	6.9	5.7–8.2	50.0
> 12	2,827	3.0	2.3–3.7	4.5	3.2–5.7	30.2
Income (dollars)						
<44,000	3,072	4.7	3.9–5.5	6.9	5.6–8.3	46.8
≥44,000	3,376	4.2	3.2–5.2	5.4	4.2–6.7	28.5
Assets (dollars)						
≤93,500	3,089	4.7	4.0–5.4	6.5	5.3–7.7	36.2
>93,500	3,556	3.9	3.0–4.8	5.3	4.0–6.5	35.8
Job classification						
White-collar	2,959	2.7	2.0–3.4	3.9	2.2–5.5	44.4
Blue-collar	2,443	6.6	5.5–7.8	9.1	7.1–11.2	37.9
Residence						
Urban	5,262	4.1	3.4–4.8	5.5	4.4–6.6	34.1
Rural	1,787	5.0	4.0–6.0	7.0	5.1–8.9	40.0
Depression						
Fewer symptoms	4,465	3.7	3.0–4.4	4.8	3.8–5.8	29.7
More symptoms	2,567	5.5	4.5–6.4	7.8	5.9–9.7	41.8
Memory at 5 min						
≤ 5 words	3,136	4.7	3.7–5.6	6.6	4.7–8.5	40.4
> 5 words	3,060	4.0	3.2–4.8	5.4	4.0–6.8	35.0

Whereas several studies have considered the effects of recall period on estimates of injury rates [Cash and Moss, 1972; Massey et al., 1976; Carlsson, 1983; Langley et al., 1988; Langley et al., 1989; Harel et al., 1994; Landen and Hendricks, 1995], only Landen and Hendricks [1995] have looked at this issue in the self-report of occupational injuries. In addition, only these authors looked at the effect of recall period on estimates of rate ratios among subgroups of the population, and their study considered only three subgroups (age, sex, and occupation). This report extends their work to consider the effect of recall period on estimates of rate ratios among nine separate subgroups of the HRS population. These subgroups were chosen because their injury rates seemed most likely to be affected by recall bias. Thus the 10% bias in rate ratios may represent the most that can be expected.

This study has several strengths. First, it uses a nationally representative sample of older American workers. Second, the wide variety of data collected on the HRS cohort allowed us to examine the effect of recall period on rates and rate ratios for important subgroups such as the poorer, less educated workers, as well as for depressed workers and those with poorer short-term memory, who might have been

TABLE II. Rate Ratios of Occupational Injuries, Adjusted and Unadjusted for Recall Period, and Percent Increase of Adjusted Over Unadjusted (Health and Retirement Study, 1992)

	Unadjusted	Adjusted	Percent change
Age (years)			
51–55	1.15	1.32	14.8
56–61	—	—	—
Sex			
Female	—	—	—
Male	1.30	1.21	−6.9
Education (years)			
≤ 12	1.77	1.53	−13.6
> 12	—	—	—
Income (dollars)			
≤ 44,000	1.12	1.21	8.0
> 44,000	—	—	—
Assets (dollars)			
≤ 93,500	1.21	1.23	1.7
> 93,500	—	—	—
Job classification			
White-collar	—	—	—
Blue-collar	2.44	2.33	−4.5
Residence			
Urban	—	—	—
Rural	1.22	1.27	4.1
Depression			
Fewer symptoms	—	—	—
More symptoms	1.49	1.63	9.4
Memory at 5 min			
≤ 5 words	1.18	1.22	3.4
> 5 words	—	—	—

expected to fail to recall more injuries than workers who are wealthier, more educated, less depressed with better short-term memory.

However, this study also has a number of limitations. First, because the HRS only asked the date of the most recent injury, we had to exclude from our cohort the 37 workers who had more than one injury in the last year. This group may have recalled their injuries differently than those who only had a single injury. Second, the size of the cohort made the estimates of injury rates for single months and for certain subgroups unstable. Perhaps the differences in size of adjustment of the injury rate between the older and younger and between the more depressed and less depressed might have been statistically significant in a larger cohort. Third, since this is a cross-sectional study and since correlates of occupational injuries may have occurred after the injury, one must be cautious about making causal inferences.

Studies of occupational injury morbidity often rely on self-reported data. Massey and Gonzalez [1976] have suggested that 2–4 four weeks is probably the ideal recall period to use in carrying out such surveys. However, for a relatively uncommon condition such as occupational injuries, such a short recall period requires a large and expensive sample to accumulate a sufficient number of injuries. Alternatively, researchers may use a longer recall period, but must then confront the issue of recall bias. This study suggests that if the date of injury is known relative to the interview date, one can adjust the injury rates to account for the longer recall period. For rate ratios, the magnitude of the recall bias was smaller, approximately 10%. Thus self-reported surveys with longer recall periods may be still be useful in studying the associations between occupational injuries and a variety of risk factors, at least among older workers.

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