Effect of Recall on Reporting of at-Work Injuries

DEBORAH D. LANDEN, MD, MPH
SCOTT HENDRICKS, MS

Dr. Landen is a Medical Epidemiologist and Mr. Hendricks is a Statistician, Analysis and Field Evaluations Branch, Division of Safety Research, National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention.

Tearsheet requests to Dr. Landen, Division of Safety Research, NIOSH, 1095 Willowdale Rd., Morgantown, WV 26505-2888; tel. 304-285-5994; FAX 304-284-5877.

Synopsis

Difficulty with recall of injuries can result in underestimates of injury incidence and bias in risk estimates in surveys based on self-reports. This study examined the effect of recall on estimates of at-work injury obtained from the 1988 Occupational Health Supplement of the National Health Interview Survey, which used a 12-month reference period for injury reporting.

Estimates of annual injury incidence were obtained from recall intervals of increasing time between injury date and interview date. A linear model was fitted to these data to estimate the incidence rate expected if all respondents had been interviewed within 4 weeks of injury.

The incidence rate for all at-work injuries adjusted for recall was 32 percent higher than the unadjusted rate. The percent increase in the estimates differed among demographic groups and by injury severity. Rate ratios comparing risk of injury between some demographic groups were also affected by adjustment for recall.

A 12-month or longer reference period is frequently used in injury surveys in order to obtain an adequate number of injuries for analysis. A shorter reference period is desirable to provide more accurate estimates; however this necessitates increasing the size of the sample used in the survey. This increased cost must be balanced against the need for accurate information on injury.

SEVERAL STUDIES have examined recall of injuries in interview surveys. Langley and coworkers compared self-report of injury with medical records in a birth cohort of 739 New Zealand children (*1*). When they were 13 years old, the children were interviewed about injuries resulting in visits to accident and emergency departments during the preceding 2 years; only 39 percent of visits were recalled. In a community-based study of falls among persons older than age 60, Cummings and colleagues reported that of 179 participants who sustained falls documented by a nurse visit, 13 percent did not recall the fall when interviewed at the end of a 1-year study (87 percent of falls were recalled) (*2*).

In a study of motor vehicle crashes in North Carolina, Cash and Moss compared self-report to accident reports for crashes known to have resulted in injury (*3*). Reporting of crashes declined as time between crash and interview increased. Of 119 respondents who were interviewed within 3 months of the crash, 115 (96.6 percent) reported that the crash had occurred. Of 143 respondents interviewed between 9 and 12 months after the crash, 104 (72.7 percent) reported the crash.

Massey and Gonzalez examined recall of injury in a supplement to the 1975 National Health Interview Survey that used a 6-month reference period for injury reporting. Total injuries estimated from the 6-month period were only 60 percent of the number of injuries estimated based on a 1-week reference period. Based on their analysis of recall intervals of varying length, they recommended a recall period of 2–4 weeks in the National Health Interview Survey as the best compromise between sampling variance and recall bias (*4*).

Most recently, Harel and coworkers (*5*) examined underreporting of injuries to children and adolescents in the 1988 Child Health Supplement to the Health Interview Survey, using a similar method. They found a significant decline in rates, from 24.4 per 100 for a 1-month reference period to 14.7 per 100 for a 12-month reference period.

Several factors may influence a respondent's ability to recall occurrence of any injury. Length of time between injury and interview is a primary consideration, but characteristics of the respondent, the circumstances in which the injury occurred, and the nature and severity of the injury may also be

important. Little research has addressed these factors.

Carlsson compared recall of injury by age, income, and social class in a study of injury among older Swedish men (*6*). During the 14-month study period, 50-year-old men recalled 63 percent of injuries recorded in a hospital registry; 60-year-old men recalled 60 percent. No difference was found in recall by income or social class. Massey and Gonzalez examined differences in injury reporting by age in the 1975 National Health Interview Survey. With a reference period of 6 months, those in the 17–24-year age group recalled the largest percentage of injuries, followed by those in the age groups 65 years and older, 45–64 years, 6–16 years, and those younger than 6 years. Poor reporting of injuries to children under the age of 17 years, however, may have been because of proxy respondents (*4*).

Langley and colleagues studied the effect of psychosocial factors on recall of injury among children. They found that injury underreporters had significantly more behavior problems, as reported by teachers, and lower reading scores. No effect on injury reporting was found, however, for a number of other standard developmental, family, and behavioral measures (*7*).

Although a number of studies have assessed the effect of injury severity on recall of injuries (*3–6*), definitions of severity differ among the studies. Severity may be based on external cause of injury, clinical nature of injury, consequences of injury with regard to restriction of activity or time lost from work or school, type of treatment (emergency room, hospital admission, physician's office), or some combination of these indicators. In general, using the definition of severity provided by the authors of the studies, more severe injuries were better recalled than less severe.

We analyzed data on at-work injuries from the 1988 Occupational Health Supplement (1988 OHS) to the National Health Interview Survey (NHIS). This survey used a 12-month reference period for injury reporting. We first adjusted injury rate estimates to a 4-week recall period, recommended by Massey and Gonzalez as the maximum reference period for injury reporting in the NHIS (*4*). We then compared our adjusted estimates with unadjusted estimates from the survey to assess how failure to recall injuries had affected the survey estimates.

Methods

The National Health Interview Survey (NHIS) is a continuous national survey of the health of civilians residing in households in the United States (*8*). The

'Underreporting of injuries differed by severity. Injuries without lost workdays were more underreported . . . than lost-workday injuries . . . Even the more severe lost-workday injuries, however, were greatly underreported among those in the 18–24-year group.'

1988 Occupational Health Supplement (1988 OHS) to the NHIS collected data on occupational injuries and illnesses from one randomly selected adult (age 18 years or older) in each sampled household in the NHIS. Households in the survey were selected with a pre-determined probability to allow computation of national estimates.

A total of 29,412 persons who had worked at some time during the preceding 12 months were interviewed on work injury. Respondents were asked to report the date and characteristics of episodes of injury that had occurred at work over the 12 months prior to interview. An episode of injury in the 1988 OHS was any event causing an injury for which the respondent had (*a*) sought medical attention, (*b*) been unable to perform some work activities, (*c*) lost consciousness, or (*d*) transferred to another job. In this report, the term injury will be used to refer to episodes of injury, and injury rate to the number of episodes of injury per 100 workers per year.

In the NHIS, the effect of recall on reporting of injuries can be assessed by examining the decrease in the number of injuries reported as time between reported date of injury occurrence and date of interview increases. This decrease represents only the effect of recall, and not seasonal differences in the occurrence of injuries, because interview dates in the NHIS are distributed evenly throughout the year, and each weekly sample interviewed is a random national sample.

We obtained crude estimates (Y_c) and standard errors (s_c) of the injury rate unadjusted for recall, for age, sex, and job class groups using the Survey Data Analysis (SUDAAN) program, version 5.30 (*A*). Job classes were defined as workers in the following occupational groups of the Bureau of Census (*9*): White collar—executive, administrative and managerial, professional specialty, technicians and related support, sales, and administrative support including clerical; blue-collar—precision product craft and repair, machine operators, assemblers and inspectors,

Table 1. Annual rates of at-work injury (per 100 workers) unadjusted for recall, by lost work status and worker characteristics, Occupational Health Supplement, National Health Interview Survey, 1988

Characteristics	Injuries with 1 or more lost workdays		Injuries with no lost workdays		All injuries	
	Rate	95 percent CI	Rate	95 percent CI	Rate	95 percent CI
All groups	3.92	3.62, 4.23	4.26	3.94, 4.59	8.55	8.08, 9.02
Sex:						
Men	5.09	4.61, 5.51	5.51	5.02, 6.00	11.05	10.32, 11.67
Women	2.55	2.22, 2.88	2.80	2.48, 3.12	5.61	5.13, 6.09
Age (years):						
18–24	5.20	4.32, 6.08	6.11	5.10, 7.11	11.86	11.11, 12.61
25–54	3.97	3.62, 4.31	4.16	3.79, 4.53	8.50	8.24, 8.76
55 and older	2.11	1.52, 2.67	2.47	1.93, 3.01	4.68	4.26, 5.10
Job class:						
Blue collar	8.00	7.57, 8.43	8.90	7.96, 9.84	17.23	15.96, 18.50
White collar	1.87	1.72, 2.02	2.53	2.21, 2.84	4.51	4.10, 4.93

NOTE: Rates are based on a 12-month recall period. CI = confidence interval.

transportation and material moving, handlers, equipment cleaners, helpers and laborers (except farm).

To adjust survey estimates of injury incidence for recall, first, the recall interval for each injury in the sample was calculated as the number of weeks between the week reported for the injury and the interview week. Injuries for which only the month of occurrence was reported were assigned to the midpoint of the month. Then the injuries were categorized by length of recall interval into 13 mutually exclusive groups. Each group consisted of injuries that had occurred during a 4-week time period. The length of the recall interval ranged from 1-4 weeks for injuries in the first group to 48-52 weeks for injuries in the 13th group. Annualized estimates (Y_i, $i=1, \ldots, 13$) of the number of injuries per 100 population were obtained for each group using SUDAAN.

To describe the effect of recall on estimates of the injury rate, the following model was fitted to the injury rates for the 13 recall intervals for age, sex, and job class groups:

$$E[Y_i] = \alpha + \beta\ (X_i) \qquad (1)$$

Transformations of recall ($X_i = i$) including linear, log, square root, and quadratic transformations were considered. Based on examination of residuals, we determined that the linear model was the most appropriate. Multivariate models including age, sex, and job class were not fit due to sparsity of data in some cross-classifications. Models were fit separately for injuries resulting in lost work days and injuries not resulting in lost work days, for each age, sex, and job class group.

To obtain an estimate adjusted for recall, we used the following equation:

$$\hat{Y}_A = \hat{Y}_1 = \bar{Y} + b\ (1 - \bar{X}) \qquad (2)$$

where Y_1 is the predicted value at the first recall period, $\bar{Y}$ is the mean of the dependent variable (rates), b is the estimate of the slope β from the linear model in equation 1, and $\bar{X} = 7$ is the mean of the independent variable representing the 13 groups.

For 10.4 percent of injuries (244 of 2,357), no date of injury occurrence was reported; these injuries were excluded in the regression. In order to include these injuries in the adjusted estimate, Y was replaced with the crude rate, Y_c, in equation 2. The final prediction equation was

$$\hat{Y}_A = Y_c - 6b \qquad (3)$$

Injury rates for lost-workday injuries, nonlost-workday injuries, and all injuries, adjusted for recall, were estimated for each demographic group using equation 3. Rate ratios were then calculated from the recall-adjusted rates for age groups, sex, and occupational class. For comparison, rate ratios were also calculated using the unadjusted estimates.

Results

Crude estimates and 95 percent confidence intervals for rates of at-work injury, unadjusted for recall, are shown in table 1. These estimates are based on the 12-month recall period used in the survey.

Table 2 compares rates unadjusted for recall, obtained directly from the survey, with estimates adjusted to a 4-week recall period, which were obtained using equation 3. For all injuries combined, the increase in the adjusted rate over the unadjusted was 32 percent. The increase in the adjusted estimate for women (35.8 percent) was slightly greater than

Table 2. Comparison of annual rates of at-work injury (per 100 workers) unadjusted and adjusted for recall, by lost work status and worker characteristics, Occupational Health Supplement, National Health Interview Survey, 1988

Lost work status	All groups	Sex		Age group			Job class	
		Men	Women	18–24	25–54	55 and older	Blue collar	White collar
1 or more lost workdays:								
Unadjusted rate	3.92	5.09	2.55	5.20	3.97	2.11	8.00	1.87
Adjusted rate	4.81	6.19	3.17	7.52	4.63	[1]2.29	9.69	[1]2.19
Percent increase	22.5	21.6	24.4	44.6	16.7	8.5	21.1	17.3
No lost workdays:								
Unadjusted rate	4.26	5.51	2.80	6.11	4.16	2.47	8.90	2.53
Adjusted rate	6.10	7.72	4.18	9.22	5.92	[1]3.06	12.79	3.61
Percent increase	43.0	40.1	49.2	51.0	42.2	23.8	42.7	43.6
Total (all injuries):								
Unadjusted rate	8.55	11.05	5.61	11.86	8.50	4.68	17.23	4.51
Adjusted rate	11.29	14.40	7.62	17.32	10.93	[1]5.50	22.89	5.86
Percent increase	32.0	30.3	35.8	46.0	28.6	17.5	32.8	30.0

[1]Test of $\beta > 0$ not significant ($P \geq .05$) for this group.

NOTE: Unadjusted rates are for a 12-month recall period; adjusted rates are adjusted to a 4-week recall period. Percent increase is the adjusted rate minus the unadjusted rate divided by the unadjusted rate multiplied by 100. Total rate is greater than the sum of rates for injuries with and without lost workdays because of missing lost workday information for some injuries.

that for men (30.3 percent). The greatest increase in the incidence estimate by age was for the 18–24-year age group, in which the adjusted estimate was 46 percent higher than the unadjusted. The smallest increase in the incidence estimate, 17.5 percent, was among those older than age 55. The increase for the 25–54-year age group was between that for the younger and older groups, at 28.6 percent. There was little difference in the increase in estimates between job classes (30 percent for white collar versus 32.8 percent for blue collar).

The increase in the incidence estimate for nonlost-workday injuries (43 percent) was greater than that for lost-workday injuries (22.5 percent). For both lost-workday and nonlost-workday injuries, the percentage increase in adjusted over unadjusted rates was greatest for the youngest age group, 18–24 years. When increases in the adjusted rate were compared by sex, the percentage increase in the rate for women was somewhat greater than that for men.

The effect of adjustment for recall on rate ratios comparing demographic groups is shown in table 3. This table shows rate ratios derived from unadjusted and recall-adjusted injury incidence estimates for all injuries, lost-workday injuries, and nonlost-workday injuries by sex, age group, and job class.

There was little difference between unadjusted and recall-adjusted rate ratio estimates for all injuries by sex. Unadjusted and recall-adjusted rate ratios differed little by job class for lost-workday injuries, nonlost-workday injuries, or all injuries.

The largest change between unadjusted and recall-adjusted rate ratio estimates was for the 18–24-year age group. Adjusted rate ratio estimates for all injuries, lost-workday injuries, and nonlost-workday injuries for this age group were 20–33 percent higher than unadjusted rate ratios.

Discussion

This analysis compared unadjusted estimates of at-work injury from the 1988 OHS with estimates adjusted to a 4-week reference period, the maximum period recommended by Massey and Gonzalez for injury reporting in the NHIS (*4*). Our recall-adjusted estimate of the overall incidence of at-work injury was 32 percent higher than the unadjusted estimate obtained from the survey data, and as high as 46 percent higher among those in the 18–24-years age group.

Underreporting of injuries differed by severity. Injuries without lost workdays were more underreported (43 percent) than lost-workday injuries (22.5 percent). Even the more severe lost-workday injuries, however, were greatly underreported among those in the 18–24-year group (44.6 percent).

Rate ratios comparing some, but not all, demographic groups were affected by adjustment for recall. Bias in rate ratios may not be eliminated by restricting injuries studied to the more severe; in this study, rate ratio estimates comparing risk of the more severe lost-workday injuries for age groups were biased by recall.

As noted previously by Harel and coworkers (*5*), the use of different reference periods for injury reporting can have a profound effect on estimates of injury obtained from national surveys. Although adjustment of survey data for recall is possible, it

Table 3. Comparison of rate ratios for at-work injury, unadjusted and adjusted for recall, by worker characteristics and lost work status, Occupational Health Supplement, National Health Interview Survey, 1988

Lost work status	Men[1]	Age group		Blue collar[3]
		18–24[2]	25–54[2]	
1 or more lost workdays:				
Rate ratio (unadjusted)	2.00	2.46	1.88	4.27
Rate ratio (adjusted)	1.95	3.28	2.02	4.42
No lost workdays:				
Rate ratio (unadjusted)	1.97	2.47	1.68	3.52
Rate ratio (adjusted)	1.84	3.01	1.93	3.54
Total (all injuries):				
Rate ratio (unadjusted)	1.97	2.53	1.82	3.82
Rate ratio (adjusted)	1.89	3.15	1.99	3.91

[1]Women are the reference group.
[2]55 and older are the reference group.
[3]White collar is the reference group.

NOTE: Rate ratios (unadjusted) are calculated from crude injury rates for a 12-month recall period. Rate ratios (adjusted) are calculated from injury rates adjusted to a 4-week recall period.

'Bias in rate ratios may not be eliminated by restricting injuries studied to the more severe; in this study, rate ratio estimates comparing risk of the more severe lost-workday injuries for age groups were biased by recall.'

permits only a limited analysis of the data. We were unable to use statistical tests to compare groups, because the design effect of the survey could not be included in the regression model that was used to adjust the rates for recall.

Many injury surveys have asked respondents to recall injuries over reference periods of 12 months or longer in order to obtain an adequate number of injuries for analysis. The use of shorter reference periods requires a larger sample size, which greatly increases the cost of the survey. This increased cost must be balanced against the need for accurate information on injury incidence. Harel and colleagues (*5*) have presented a compelling argument for the importance of accurate injury incidence data for planning public health interventions in childhood injury. The same is true for occupational injury.

For some subgroups and types of injuries, a recall period of 12 months may not be too long. For example, in our analysis we found that lost work-day injuries among older workers showed little recall bias with a 12-month recall period. For lost work-day injuries in young workers ages 18–24 years, however, a 12-month recall period resulted in an unacceptable degree of recall bias. For general surveillance studies of injury, the reference period of 2–4 weeks recommended by Massey and Gonzalez (*4*) remains a useful guideline. If longer recall periods are used, both date of injury and date of interview should be recorded so that some assessment can be made of the effect of recall.

References

1. Langley, J. D., Cecchi, J. C., and Williams, S. M.: Recall of injury events by thirteen year olds. Meth Inf Med 28: 24–27 (1989).
2. Cummings, S. R., Nevitt, M. C., and Kidd, S.: Forgetting falls. The limited accuracy of recall of falls in the elderly. J Am Geriatr Soc 36: 613–616 (1988).
3. Cash, W. S., and Moss, A. J.: Optimum recall period for reporting persons injured in motor vehicle accidents. Data evaluation and research methods, Series 2, No. 50. DHEW publication No. (HSM) 72-1050. National Center for Health Statistics, Rockville, MD, 1972.
4. Massey, J. T., and Gonzalez, J. F.: Optimum recall periods for estimating accidental injuries in the National Health Interview Survey. Social statistics section, proceedings of the annual meeting of the American Statistical Association, Boston, MA, Aug. 23–26, 1976, pp. 584–588.
5. Harel, Y., et al.: The effects of recall on estimating annual nonfatal injury rates for children and adolescents. Am J Public Health 84: 599–605 (1994).
6. Carlsson, G. S.: Validity of injury data collected by interview: a study of men born in 1913 and 1923. J Neurol Neurosurg Psychiatry 46: 818-823 (1983).
7. Langley, J. D., Silva, P. A., and Williams, S. M.: Absence of psychosocial bias in the under-reporting of unintentional injuries. J Epidemiol Community Health 42: 77–82 (1988).
8. Current estimates from the National Health Interview Survey, 1988. Vital Health Stat [10] No. 173. National Center for Health Statistics, Hyattsville, MD, 1989.
9. Bureau of the Census: 1980 occupational classification system. U.S. Government Printing Office, Washington, DC, 1982.

Equipment

A SUDAAN Version 5.30. Research Triangle Institute, Research Triangle Park, NC.