Title
The rising long-term trend in occupational injury rates

Permalink
https://escholarship.org/uc/item/8q124992

Journal
AJPH, 78(3)

ISSN
1541-0048

Author
Robinson, James C

Publication Date
1988-03-01

Peer reviewed
The Rising Long-Term Trend in Occupational Injury Rates

JAMES C. ROBINSON, PhD, MPH

Abstract: Establishment survey data for the United States as a whole and workers’ compensation data for the State of California were used to document long-term trends in occupational injury and acute illness rates. After declining throughout the first half of the century, national rates of disabling injuries in manufacturing, construction, and the trade sector have risen sharply in recent decades. Injury rates in mining show no strong trend either up or down since 1960. Increases over recent years have been especially pronounced for strains and sprains, cuts, lacerations and punctures, bone fractures, and acute illnesses. Injury rates in the manufacturing sector are strongly influenced by general economic conditions—rising sharply with business upsurges and declining during recessions. Increases in the rate of unemployment, which decrease worker and labor union bargaining power, are associated with increases in injury rates within manufacturing. (Am J Public Health 1988; 78:276–281.)

Introduction

Data from a number of independent sources indicate that age-adjusted rates of occupational disability have been rising steadily among the working-age population in the United States since the late 1950s. It is not clear, however, what proportion of these increasing disability rates is due to changes in rates of workplace injuries and illness. This study examined long-term trends in work-related injuries and acute illnesses, using federal data from annual establishment surveys and state data from the California Workers’ Compensation reporting system. Rates were calculated both by industry and by type of injury.

Methods

Injury rate data were obtained from two independent but complementary sources. Rates of disabling injuries for the United States as a whole were obtained for manufacturing, construction, mining, and wholesale and retail trade industries from annual establishment surveys conducted by the Bureau of Labor Statistics. Rates of disabling injuries for the State of California were obtained from the State Workers’ Compensation reporting system for all industries except agriculture and the public sector.

US Data by Industry

Prior to the passage of the Occupational Safety and Health (OSH) Act in 1970, consistent series of injury rates for the United States as a whole are available for four major industrial sectors: manufacturing, construction, mining, and trade. These injury rates consist of the number of disabling injuries per million hours worked per year, with a disabling injury defined as one that causes at least one day lost from work (but also includes permanent disability). Rates for manufacturing are available beginning in 1926, for mining beginning in 1931, and for construction and trade beginning in 1949. These data were collected by the Bureau of Labor Statistics (BLS) and the Bureau of Mines based on voluntary and confidential reporting by employers. While the data have been criticized as seriously underrepresenting the true volume of industrial injuries, they provide a consistent series, with only minor methodological changes in 1937 and 1941. While flawed as measures of the true degree of risk faced by US workers at any one point in time, they do reflect the trends over time.

California Data by Industry

Under California law, employers must report to the State Workers’ Compensation system any work-related injury or illness resulting in at least one day lost from work. Numbers of injuries by industry are available from 1914, but the employment data necessary for computation of rates are not available for the years prior to 1939. Rates for manufacturing, construction, and mining were calculated beginning in 1939. The classification system underwent substantial changes in 1946. As these changes affected data for the remainder of the State’s economy, rates for the other private industrial sectors (wholesale and retail trade; transportation and public utilities; finance, insurance, and real estate; service industries) were calculated beginning in 1947. Data for the year 1946 are not available for any industries.

To make the California injury rates comparable with the national figures, they were calculated on the basis of million

Address reprint requests to James C. Robinson, PhD, MPH, Assistant Professor of Health Policy, Department of Social and Administrative Health Sciences, School of Public Health, University of California, Berkeley, CA 94720. This paper, submitted to the Journal March 24, 1987, was revised and accepted for publication August 17, 1987.

hours worked rather than per 1,000 employees (the form in which they were published). For the years prior to 1948, the injury data were taken from annual reports of the Industrial Accident Commission, as published in California Safety News.\textsuperscript{11} For the years beginning with 1948, the injury figures are taken from annual issues of California Work Injuries\textsuperscript{13} and, subsequently, California Work Injuries and Illnesses.\textsuperscript{13} These data include acute illnesses along with injuries. Employment data were obtained for 1939–85 from the California Employment Development Department.\textsuperscript{14}

The California Workers’ Compensation reporting system did not undergo any changes in 1970–72 and therefore this independent reporting system provides a check on the comparability of the national data system before and after the 1970 OSH Act. In comparing data from the two reporting systems it would be desirable to control for the mix of firms within each major industrial sector since this differs in the two systems. For the years 1972–84, data from California’s state occupational safety and health program (CAL/OSHA) are available based upon the establishment survey methodology mandated by the 1970 OSH Act.\textsuperscript{15} Rates of lost work-day injuries by industry from this third data source were calculated, also in terms of million hours worked per year.

California Data by Nature of Injury

The California Workers’ Compensation data classify work-related injuries and illnesses according to the nature of the injury.\textsuperscript{16} The classification system in California was extensively revised in 1946 and again to a lesser degree during the next six years. A consistent classification system was then used for 1953–76. In 1977, additional changes were made, but these consist solely of reassigning certain subcategories of injuries among the major injury categories. Since raw data on subcategories as well as major categories are available back to 1953, the pre-1977 data could be fitted into the post-1977 categories, thereby creating a consistent series.

The match between pre- and post-1977 classifications is not perfect, however. The seven major classifications used in 1977 and later years account for 83.7 per cent of all injuries and illnesses in 1985, but only 78.2 per cent of all injuries and illnesses in 1953. The residual categories in each case are “miscellaneous” and “nature not stated.” Most of the difference is due to a decline in the “nature not stated” category from 14.0 per cent of all events in 1953 to 10.9 per cent of all events in 1985. A portion of the recorded changes in injuries and illnesses over the 1953–85 period are thus due to changes and improvements in the classification process.

The seven categories, in order of 1985 volume of cases, are:

1. strains, sprains, dislocations, and hernias;
2. cuts, lacerations, punctures, and eye injuries;
3. crushing injuries, contusions, and bruises;
4. bone fractures;
5. acute illnesses;
6. burns; and
7. amputations.

US Data on Economic Fluctuations

Data were collected on three important measures of business cycle activity for the manufacturing sector. Comparable data are not available for non-manufacturing industries, nor are they available for California independent of the rest of the nation.

Three causal hypotheses have been suggested by economists interested in cyclical fluctuations in injury rates. Most attention has been focused on the rate of hiring, given the widespread evidence that inexperienced workers are substantially more likely than more experienced workers to suffer an injury on the job.\textsuperscript{17–19} The average annual rate of accessions in manufacturing industries was obtained for 1948–81 from Bureau of Labor Statistics publications.\textsuperscript{20,21} A second hypothesis concerns the tradeoff between safe working conditions and high productivity. When the business cycle is in an upswing, orders increase and the rate of production is typically increased beyond the level accountable for by any new hiring. Output per worker hour increases but working conditions are likely to deteriorate as safety rules are ignored.\textsuperscript{22,23} The Bureau of Labor Statistics index of output per employee hour in manufacturing for 1948–84, adjusted to control for inflation in product and factor prices,\textsuperscript{24} and unpublished Bureau data for 1985 were obtained to account for this factor.

A third hypothesis focuses on injury rates as influenced by relative bargaining power on the part of labor and management, with injury rates increasing in periods of rising management power and decreasing in periods of rising labor power. The rate of unemployment among manufacturing workers was obtained for 1948–85 from federal publications to measure fluctuations in relative bargaining power.\textsuperscript{25} It should be noted that, while the first two hypotheses predict that injury rates should increase during a business upswing, this third hypothesis predicts those rates should increase during a business downswing, when worker concerns for employment security dominate concerns for health and safety.

While the output per hour and unemployment measures are available for the entire period from 1948–85, the accession rate is not available for years after 1981, due to cutbacks in federal data gathering in that year. In order to be able to examine cyclical fluctuations in injury rates in the most recent years, a predicted accession rate measure was developed for the years 1982–85. This variable was calculated based on the estimated coefficients from a multivariate regression of the accession rate on the output per hour rate and unemployment rate for 1948–81, plus the values of the output per hour and unemployment variables for 1982–85.

To analyze the influence of cyclical business fluctuations on injury rates, the manufacturing injury rate for the years 1948–85 was regressed on the accession rate, the rate of output per worker hour, and the unemployment rate simultaneously. All variables were measured in logarithmic scale. Least squares coefficients thus are interpretable as measuring the percentage change in the injury rate that results from a percentage change in the values of the associated independent variables.

Results

Injury Rates by Industry

Figure 1 presents the manufacturing rate of disabling injuries per million hours worked, beginning in 1926 for the national data and in 1939 for the California data. The two time series follow each other closely, revealing similar long-term and cyclical trends, but with the California series exceeding the national average at all times. The figures reveal a strong U-shaped trend, with rates declining for most years up through 1958 and then increasing for most years after that.

Injury rates have fluctuated within these two basic periods. The figures include the high rates experienced in World War II and the fall in rates during the sharp recession of the early 1980s.

Figure 2 presents comparable rates for disabling injuries for the construction sector. A U-shaped trend is again observed, but one that is flatter than the manufacturing sector. Figure 3 presents disabling injury rates for mineral
extraction industries. The national and state figures reveal a similar general trend, but the fit is not as close as in manufacturing and construction. This is not surprising, given the prominence of underground coal mining in the national data and of oil and gas exploitation in the California state data. National and state rates of disabling injuries for the wholesale and retail trade sector are presented in Figure 4. A very pronounced U-shaped pattern is again observed.

A common characteristic of Figures 1–4 is that the California injury rates are consistently above the national figures, with some exceptions for the mining industries. California state data collected using the establishment survey method underlying the national figures are available for the years 1972–84. A comparison of these figures for all four industrial sectors with both the national data and the California Workers’ Compensation data revealed that the relatively high California rates pictured in Figures 1–4 are due to differences between California and the nation as a whole in injury rates themselves, rather than to the different methodologies employed. For the years 1972–84, the CAL/OSHA figures are similar to the California Workers’ Compensation figures and consistently higher than the national figures.

Injury rates per million hours worked are available from the California Workers’ Compensation system for three industrial sectors for which national data are not available.

While not presented here, these three sectors manifested patterns since 1947 broadly similar to the sectors documented in Figures 1–4.

Injury Rates by Nature of Injury

Table 1 presents rates of disabling injuries and acute illnesses by type of injury, based on California Workers’ Compensation records. These figures indicate that the increases in industry injury rates depicted in Figures 1–4 were not restricted to only a few types of events, but rather that all major categories of injuries have witnessed increases. The pattern varies considerably by type of injury, however.

Strains, sprains, dislocations, and hernias registered a mild decline from 1953 to 1971. These rates rose from 1972 to 1979, declined in the early 1980s, and then rose again up to 1985. This category of injuries, by far the largest among the seven used by the Workers’ Compensation reporting system, increased as a percentage of all injuries from 33.5 per cent in 1953 to 42.9 per cent in 1985.

Rates for cuts, lacerations, punctures, and eye injuries reveal the same basic pattern. This category has declined as a share of all injuries, from 15.6 per cent in 1953 to 13.6 per cent in 1985.
Rates of injuries resulting in crushed body parts, contusions, and bruises reveal a somewhat different pattern. These injuries increased throughout most of the period, although with a sharp fall in the late 1960s, up to a high in 1974, then declined by 50 per cent to 1982, before rising again up through 1985. As a fraction of all injuries and illnesses, this category declined from 10.1 per cent in 1953 to 8.1 per cent in 1985.

Bone fractures per million hours worked present a strong U-shaped pattern. After falling steadily from 1953 to a low point in the period between 1975–77, fractures increased up through 1985, the highest rate since the first year data are available. As a fraction of all injuries and illnesses, this category remained almost constant over the 1953–85 period as a whole, accounting for 9.8 per cent in 1953 and 9.4 per cent in 1985.

Acute work-related illnesses show a U-shaped pattern with a strong rising trend in the past 15 years. This category of events contains a very mixed group of acute illnesses reported to the California Workers’ Compensation system. In order of relative volume in 1985, reported occupational illnesses were composed of: 1) diseases of the circulatory system; 2) systemic poisonings; 3) anxiety and mental disorders; 4) dermatitis; 5) eye disease; 6) infective or parasitic disease; 7) inflammation or irritation of bones, joints, tendons, or muscles; 8) radiation effects, including welder’s flash; and 9) serum and toxic hepatitis. As a fraction of all injuries and illnesses in California, this category has increased from 4.5 per cent in 1953 to 7.1 per cent in 1985.

The trend in burn cases declined from a high in 1953 to a low in 1971, followed by a steep rise to 1978, followed by an equally steep fall through 1985. The trend in amputations is generally downward, from a high in 1953 to a low in 1985, with ups wings in the mid-1960s and late 1970s. As fractions of all injuries and illnesses, burns and amputations declined from 3.4 per cent and 1.3 per cent, respectively, in 1953 to 2.5 per cent and 0.3 per cent, respectively, in 1985.

### Business Cycle Effects

The data pictured in Figures 1–4 reveal distinct cyclical fluctuations that are associated with fluctuations in economic activity. Multivariate regression techniques used with the 1948–85 national manufacturing sector data depicted in Figure 1 were able to distinguish three separate, albeit related, business cycle effects on the rate of disabling injuries in that sector. Table 2 presents regression coefficients and standard errors, where all variables are measured in logarithmic scale. The general association between injury rates and business activity was strongly positive. A 10 per cent increase in the rate of new hires raised injury rates by 10.4 per cent (95 per cent confidence intervals [CI] 6.0, 14.7), controlling for the effects of output per hour and unemployment. A 10 per cent increase in output per hour increased injury rates by 1.8 per cent (95 per cent CI 1.4, 2.2). A countercyclical pattern, possibly reflecting changes in relative labor and management bargaining power, was also measured. A 10 per cent increase in the unemployment rate, such as would occur in a normal
TABLE 2—Business Cycle Effects on Manufacturing Injury Rates 1948–85

<table>
<thead>
<tr>
<th></th>
<th>Logarithm of New Hires Rate</th>
<th>Logarithm of Output per Employee Hour</th>
<th>Logarithm of Manufacturing</th>
<th>Unemployment Rate</th>
<th>Intercept</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.036 (0.217)</td>
<td>0.178 (0.019)</td>
<td>0.202 (0.084)</td>
<td>0.430 (0.445)</td>
<td>0.73</td>
<td></td>
</tr>
</tbody>
</table>

Note: Dependent Variable: logarithm of disabling injuries per million hours worked

business downturn, would occasion a 2.2 per cent increase in the manufacturing injury rate (95 per cent CI = 0.3, 3.7).

Although variations in the three explanatory variables do explain over two-thirds of the variance in the manufacturing injury rate over the 1948–85 period (R-square = 0.73), they do not account for the strong overall U-shaped trend observed over the period. A plot of the regression residuals continued to reveal a distinct U-shape.

**Discussion**

A number of studies have pointed out the rise in injury rates within the manufacturing sector during the 1960s and 1970s.

This paper has reported on research that documented equivalent increases in nonmanufacturing sectors and in each specific category of injury. Injury rates in manufacturing, construction, and the trade sector have fluctuated over recent years around levels not witnessed since the 1940s and 1950s or even earlier. Figures from the California Workers' Compensation system indicate that these increases extend across the entire private nonagricultural economy, and across almost every major type of injury. This suggests that a not insignificant fraction of the total increase in disability among the working-age population documented by Chirikos is due to injuries and acute illnesses associated with the working environment itself.

It is interesting to consider the relevance of the trends reported here for the economic literature on occupational safety, since this literature has been cited in support of policy proposals to reduce governmental regulatory activities—such as OSHA (Occupational Safety and Health Administration) enforcement—and Workers' Compensation benefit levels. The conventional economic model of risk-related activities predicts that injury rates should fall as a society grows richer, since more revenues become available for prevention activities. The increased availability and generosity of disability programs and, especially, of Workers' Compensation programs could partially or even totally offset this effect of rising wealth, however. A number of economists have argued that increases in benefit levels in many state Workers' Compensation programs since the early 1970s have themselves caused reported injury rates to rise.

This effect on reported rates could be due to the encouragement that generous benefit levels give to mildly injured workers to take time off when they otherwise would not, thereby increasing reported rates relative to true rates, and by increasing true injury rates themselves through a reduction of the economic cost of injuries to the worker.

While it is unlikely that raises in benefit levels themselves induce workers to be careless with their safety, it is quite possible that those increased benefit levels have increased the proportion of injured workers who take time off work. (Indeed, this was one of the purposes of the benefit increases.) In support of this possibility, one should note that the rate of work-related fatalities, where no compensation-related reporting effects would occur, has decreased steadily throughout the century. The rate of fatalities per million hours worked in California fell from 1.27 in 1939 to 0.18 in 1985. Work-related fatalities are, however, only poorly related to less serious work injuries. In 1984, for example, the majority of work fatalities in California were due to highway motor accidents (28.7 per cent), cardiovascular disease (12.7 per cent), and shootings, stabbings, and assaults (10.9 per cent). Less than 3 per cent of nonfatal injuries during that year were caused by highway motor accidents. (Data are not available on the per cent of nonfatal injuries caused by cardiovascular disease and shootings, stabbings, and assaults.)

While increased Workers' Compensation benefit levels may have contributed to the rise in occupational injury rates reported in this paper, they clearly cannot explain the entire increase. Injury rates in manufacturing increased throughout the 1960s whereas the major improvements in benefit levels occurred in the 1970s. Indeed, by serving as a major cause of increased concern for occupational safety, and hence of the passage of the 1970 OSH Act and the subsequent reform in state Workers' Compensation systems, the upward trend in injury rates may have been as much the cause as the effect of increased benefit levels. The major economic study of the matter finds a substantial upward trend in injury rates in the mid-1970s even after controlling for Workers' Compensation changes.

Bias in recorded injury rates can perhaps be attributed to changing social awareness of and attitudes toward job-related injuries and illnesses. Over the past several decades workers and employers have become more willing to ascribe injuries due to chronic conditions to occupational causes even if those factors were not the sole cause of the events. This is particularly true for back strains and mental stress, two categories of events that have manifested substantial increases in incidence rates. Injuries occurring on employer property are now commonly compensated even if they occur in the parking lot, the cafeteria, or other situations aside from an employee's work station. In California, workers have gained the right to consult their personal physicians in the event of a disputed injury or acute illness, rather than being restricted to the services of a physician chosen by the employer. While both Workers' Compensation and establishment survey data used in this study are based on employer reporting (i.e., not directly on compensation claims filed by employees), the ability to choose a more sympathetic physician could influence whether a particular injury or illness was diagnosed as work-related.

It will be essential to monitor changes in occupational injury rates over coming years. Unfortunately, serious concerns have arisen that the quality of the federal data is deteriorating. Over the past few years OSHA has been using employer reports of workplace injuries as the basis for determining priority of inspection activities, thereby giving strong incentives for employers to underreport. This has generated substantial criticism from labor and public interest groups, in turn prompting the BLS to investigate the degree of underreporting. The BLS claims to have uncovered major cases of underreporting on the part of prominent corporate employers, including Union Carbide, Chrysler, and Fina Oil and Chemical. The 1985 injury rate data are particularly suspect for this reason. Rather than continuing the sharp upward trend of the previous year, rates in 1985 flattened out.
In releasing the 1985 data, the BLS outlined a number of steps to be taken in monitoring and improving data quality. An increased focus on the epidemiology of occupational injuries should be accompanied by an increased focus on the prevention of these events. The strong association between industrial injury rates and measures of business activity, reported in Table 2, suggest that a considerable fraction of work-related injuries and acute illnesses are easily preventable. The particularly strong positive influence of the hiring rate on injuries points to the importance of worker training. This is consistent with the current focus in the area of occupation-related disease on the workers’ “right to know” about hazard exposures. The positive association between injury rates and output per worker hour reveals the effect of production speedups on working conditions. The tendency for injury rates to rise with the rate of unemployment, controlling for the rates of hiring and output per hour, suggests the strong influence of economic insecurity on workers’ willingness to pursue improvements in health and safety.

ACKNOWLEDGMENTS

This paper was supported by research funds from the Northern California Occupational Health Center. Valuable help in collecting the historical data was obtained from Joanna Omi and Glenn Shor, John Mendeloff, PhD, Robert Spear, PhD, and M. Donald Whorton, MD, provided insightful comments on an earlier draft of the paper.

REFERENCES


Maternal and Child Health Resources Guide Issued

A 167-page publication, Starting Early: A Guide to Federal Resources in Maternal and Child Health, has been issued recently by the Health Resources and Services Administration (HRSA). It was compiled by the National Center for Education in Maternal and Child Health under a grant from HRSA’s Office of Maternal and Child Health. Single copies are available gratis from the National Maternal and Child Health Clearinghouse, 38th and R Streets, NW, Washington, DC 20057, telephone (202) 625-8410.