

Fatality Rates and Regulatory Policies in Bituminous Coal Mining, United States, 1959–1981

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Abstract: In the eleven years prior to the passage of the Federal Coal Mine Health and Safety Act of 1969, fatality rates changed little for underground miners and were increasing for surface miners. Following implementation of the 1969 Act, both rates decreased.

Beginning in 1979, and continuing into the first six months of 1982, both rates increased. These associations suggest that current relaxation of regulations and policies for coal mine safety are unwarranted. (*Am J Public Health* 1983; 73:1278–1280.)

Introduction

Underground coal mining is one of the most dangerous occupations in which large numbers of people are engaged. Since the beginning of this century, over 100,000 miners have been killed in coal mine accidents and more have succumbed to occupational respiratory disease induced by coal mine dust. In 1981, for example, the fatality rate for underground coal mining was 11.1 fatalities per 10,000 full-time workers, while in heavy construction, the next most hazardous industry, the fatality rate was 4.3. The average rate for manufacturing industries in the United States in 1981 was 0.5 fatalities per 10,000 full-time workers.

Moreover, fatality rates in US coal mines are consistently higher than those in other advanced industrial countries. In the period 1975–77, for example, the fatality rate in the US mines was 45 deaths per 100 million employee hours worked while in the United Kingdom, West Germany, and France, the rates were 15, 38, and 32, respectively.¹

In the first half of this century, there was little government attention to safety or health hazards in coal mining. The Bureau of Mines, US Department of the Interior, organized in 1910, had authority to investigate mine safety hazards, but it was not until 1941 that the Bureau had authority to inspect mines. Even then, there were neither mandatory standards nor penalties. In 1952, the Bureau acquired the authority to inspect and to close dangerous mines, but these powers were limited to mines with more than 15 workers and were designed primarily to prevent major disasters. Amendments in 1966 extended coverage to smaller mines. Health hazards were not considered, nor were surface mines covered.

The Federal Coal Mine Health and Safety Act of 1969² represented a significant increase in government regulatory intervention. This Act created comprehensive safety and health standards, provided for mandatory inspections (four times each year for underground mines and twice each year for surface mines) and established a variety of sanctions, including mine closure, that could be imposed for noncompliance. The Mine Safety and Health Act of 1977, which supersedes the 1969 Act, consolidated coal and other mining enforcement activities in a new agency, the Mine Safety and Health Administration (MSHA) located in the US Depart-

ment of Labor, and retained the basic structure and regulations formed in response to the 1969 Act.

There have been few rigorous efforts to evaluate the effects of the 1969 Act. Recent reports^{1,3} identifying characteristics that distinguish safe from unsafe mines were not designed to evaluate the effects of regulation per se since both safe and unsafe mines operate in what should be a uniform regulatory environment. Unpublished work by Boden* applies econometric and crime and punishment models to evaluate the effects of regulations and concluded, among other findings, that in the period 1973–75, inspections by the Mine Enforcement and Safety Administration (MESA, the predecessor agency to MSHA) led to a decrease in injuries and fatalities.

The purpose of the present report is to present and discuss underground and surface bituminous coal mine fatality rates for equal periods of time before and after the passage of the 1969 Act.

Fatality rates are relatively free from reporting and classification bias. Furthermore, reporting criteria have been consistent over the period under consideration. This is not the case with non-fatal injuries. Factors other than regulation that are associated with mine safety—such as the age and experience of miners, the quality of training, the height of coal seams, mine size, the overall quality of mine management, and the quality of labor-management relations—are beyond the scope of this report.

Materials and Methods

We obtained data on the number of fatalities among underground and surface bituminous coal miners for each year from 1959 to 1980, and preliminary data for 1981 and for the first three quarters of 1982 from reports regularly issued by MSHA and its predecessor agencies.^{4,5} These reports also contain employee hours worked. For computing rates, we used total production employee hours reported at underground and surface mines.

We computed fatality rates for each year and performed a simple linear regression of fatality rates on years for both surface and underground miners for the periods from 1959–1969 and 1970–1980. The fatality rate is equal to the number of accidental deaths per 100 worker-years (200,000 employee hours). We consider whether the slopes of these lines are significantly different from zero by using a "t" statistic with 9 degrees of freedom.⁶ Regression lines for the period 1970 to

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*Boden LI: Coal Mine Accidents and Government Enforcement of Safety Regulations. Unpublished PhD dissertation, Massachusetts Institute of Technology, 1977; and Boden LI: Government Regulation of Occupational Safety: Underground Coal Mine Accidents, 1973–1975. Unpublished Manuscript.

TABLE 1—Simple Linear Regression of Fatality Rates on Years, 1959–69 and 1970–80 for Underground and Surface Bituminous Coal Mining, United States

	Slope	Intercept	r ²
<i>Underground Mining</i> (All Fatalities)			
1959–1969	-0.0002	0.251	0.0002
1970–1980	-0.0129*	1.081	0.69
(Non-disaster Fatalities)			
1959–1969	-0.0011	0.286	0.039
1970–1980	-0.0112*	0.947	0.73
<i>Surface Mining</i>			
1959–1969	0.0042	-0.167	0.48
1970–1980	-0.0078**	0.643	0.84

"t" test on the hypothesis that the slope equals 0.

*p < 0.01

**p < 0.001

Note: To facilitate calculations, 1,900 has been subtracted from the calendar year so that 1959 is taken as 59, etc.

1980 were used to predict 95 per cent upper confidence limits (two tailed) for the expected number of deaths for 1981.

Results

For the period from 1950 to 1969, there was no decline in fatality rates among underground miners. For the period from 1970 to 1980, there was a significant decline in fatality rates. (Table 1 and Figure 1.) The upper 95 per cent confidence limit for the predicted number of fatalities in 1981, given prior trends, is 89.3. There were, in fact, 121 fatalities among underground miners in 1981. Extrapolation to estimated number of deaths for 1982 is not warranted because the rate of decline in fatality rates may become non-linear as it approaches zero.

A large portion of the number of fatalities in 1981 was due to three disasters which resulted in 36 deaths.** Given that there were a total of seven disasters in the period from 1970 to 1980, (Table 2) three in one year is significantly more than would be expected by chance (p = 0.02, assuming a Poisson distribution).

We computed a second regression for this period considering only non-disaster fatalities. We obtained similar results. The decline in fatality rates from 1970 to 1980 is still apparent and the upper 95 per cent confidence limit for the number of non-disaster fatalities for 1981 is 81.6. There were 85 such deaths in 1981 (see Table 2).

For surface miners, there was a small rate of increase in fatality rates for the period from 1959 to 1969 followed by a small decrease from 1970 to 1980 (Table 2). Given the trends from 1970 to 1980, the upper 95 per cent confidence limit for the number of fatalities is 18.9 deaths for 1981. There were 22 such deaths in that year.

Discussion

In the 23-year period considered in this report, the most noteworthy change in the fatality rate of coal miners occurred following passage of the Coal Mine Health and Safety Act of 1969. The conclusion that the decline in fatality rates was a result of the passage and implementation of this Act is compelling. During this same period, however, other changes took place in the coal mining industry, including

**By convention, a disaster is any accident resulting in five or more deaths.

mine ownership, the composition of the labor force, and training of miners. A complete examination of the effects of regulation should include these and other factors. At the very least, the reduction in fatality rates is consistent with the intent of the Act.

Causes of the recent rise in fatality rates are more elusive. If enforcement of the regulations created in 1969 was responsible for the decline in death rates, it is logical to consider whether relaxation of regulatory enforcement is responsible for the increase. Establishing a relationship between the timing of the increase in rates and initiation of such relaxation is not clear-cut if only because there is not as discrete a product as the 1969 Act. Nevertheless, descriptive data are suggestive. For example, from 1978 to 1981, the number of coal mine enforcement personnel (inspectors and support staff) declined 13 per cent, from 1,940 to 1,684, and the coal mining enforcement budget of MSHA declined 7 per cent (in constant 1978 dollars) from \$52.8 million to \$49.3 million. During this same period, underground employee hours worked did not similarly decline but varied from year to year, averaging 235 million hours.

Enforcement policies have changed as well. A recent decision by the Federal Mine Safety and Health Review Commission⁷ creating more stringent criteria for issuing "significant and substantial" (S&S) citations has limited the severity of sanctions that MSHA can impose. Prior to this decision, any violation that was not a housekeeping error was considered S&S; this included approximately 80 per cent of all citations. Six months after this decision, less than 30 per cent of all citations were so classified.

Another illustration of recent policy and attitudinal changes is contained in a speech given by Assistant Secretary of Labor for Mine Safety and Health, Ford B. Ford, in February 1982. In describing a reorganization of the agency to the MSHA field managers, Secretary Ford warned against issuing citations for "nit-picking" violations of safety standards and advised against conducting inspections that "... look under every rock and behind every door."

In 1981, the total and non-disaster fatality rates among underground miners were 0.11 and 0.076 deaths for every 100 workers, respectively, the highest total rate since 1973. These elevated rates persisted into 1982. In surface mining,

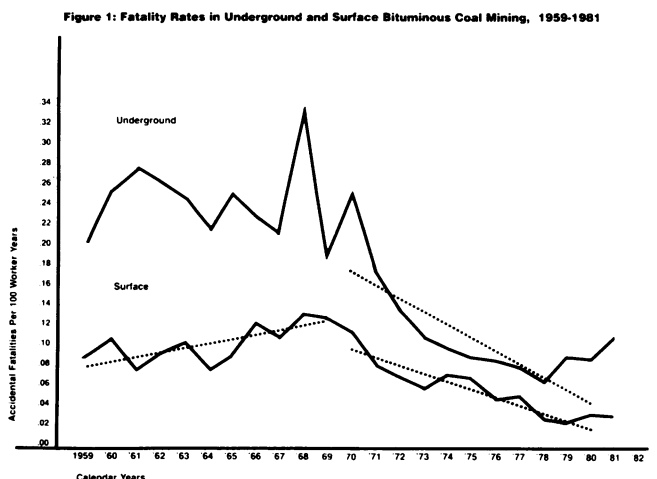


FIGURE 1—Fatality Rates in Underground and Surface Bituminous Coal Mining, United States, 1959–1981

TABLE 2—Fatality Rates in Underground and Surface Bituminous Coal Mining, United States, 1959–1982

Year	Underground Mining				Surface Mining				
	Total Fatalities	Non-Disaster Fatalities	Disaster Fatalities (N)*	Employee Hours ($\times 1,000$)	Fatality Rates***		Fatalities	Employee Hours ($\times 1,000$)	Fatality*** Rate
					Total	Non-Disaster			
1959	227	206	21 (2)	223,504	.2031	.1843	19	43,156	.0881
1960	267	249	18 (1)	213,667	.2499	.2331	23	43,408	.1060
1961	260	238	22 (1)	192,647	.2699	.2471	15	40,224	.0746
1962	245	197	48 (2)	186,683	.2625	.2110	18	41,583	.0895
1963	230	199	31 (2)	188,842	.2436	.2108	22	43,294	.1016
1964	202	202	0 (0)	189,253	.2135	.2135	16	42,784	.0748
1965	232	211	21 (3)	188,753	.2458	.2236	19	43,860	.0888
1966	197	185	12 (2)	172,997	.2278	.2139	25	41,263	.1212
1967	178	178	0 (0)	171,517	.2076	.2076	23	41,868	.1099
1968	275	188	87 (2)	165,555	.3322	.2271	28	41,993	.1334
1969	155	155	0 (0)	168,122	.1844	.1844	28	44,014	.1272
1970	219	181	38 (1)	181,083	.2419	.2000	31	52,507	.1181
1971	148	148	0 (0)	170,915	.1732	.1732	25	59,101	.0846
1972	127	113	14 (2)	186,563	.1361	.1211	19	51,846	.0733
1973	104	104	0 (0)	187,693	.1108	.1108	17	57,138	.0595
1974	95	95	0 (0)	190,736	.0996	.0996	26	72,867	.0714
1975	111	111	0 (0)	233,195	.0952	.0952	34	96,280	.0706
1976	109	86	23 (1)	241,067	.0904	.0713	24	102,556	.0468
1977	91	82	9 (1)	229,870	.0792	.0713	28	117,888	.0475
1978	76	71	5 (1)	216,708	.0701	.0655	17	127,938	.0266
1979	114	114	0 (0)	256,225	.0890	.0890	15	134,615	.0223
1980	99	94	5 (1)	247,885	.0799	.0758	23	133,449	.0345
1981	121	85	36 (3)	223,317	.1084	.0761	20	128,745	.0311
1982**	81	74	7 (1)	174,377	.0929	.0849	17	93,193	.0365

*N is the number of disasters.

**First 9 months of 1982 (preliminary data).

***Number of accidental deaths per 100 employees per year.

the rate for the first nine months of 1982 was slightly higher than the 1981 rate.

While it is currently popular to criticize government regulations designed to protect workers' health and safety as being too costly, we do not share this view. On the contrary, the experience in coal mining has been that regulations initiated in 1969 have resulted in a significant decline in the risk of accidental death for underground and surface coal miners. This association, combined with fatality rates rising and staying elevated at the same time that regulatory activity is falling, suggests that relaxation of regulatory enforcement is unwarranted and that current policies have increased the risk of death for coal miners.

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Epidemiological Research

Epidemiology is medical detective work. Starting with little more than the fact that a disease exists, the epidemiologist tries to identify every factor that might explain why it affects some people but not others. . . . When epidemiological research is done carefully and unemotionally, valuable information is often forthcoming.

—In: Stephen Lock and Tony Smith: *The Medical Risks of Life*. New York: Penguin Books, 1976, p 10.