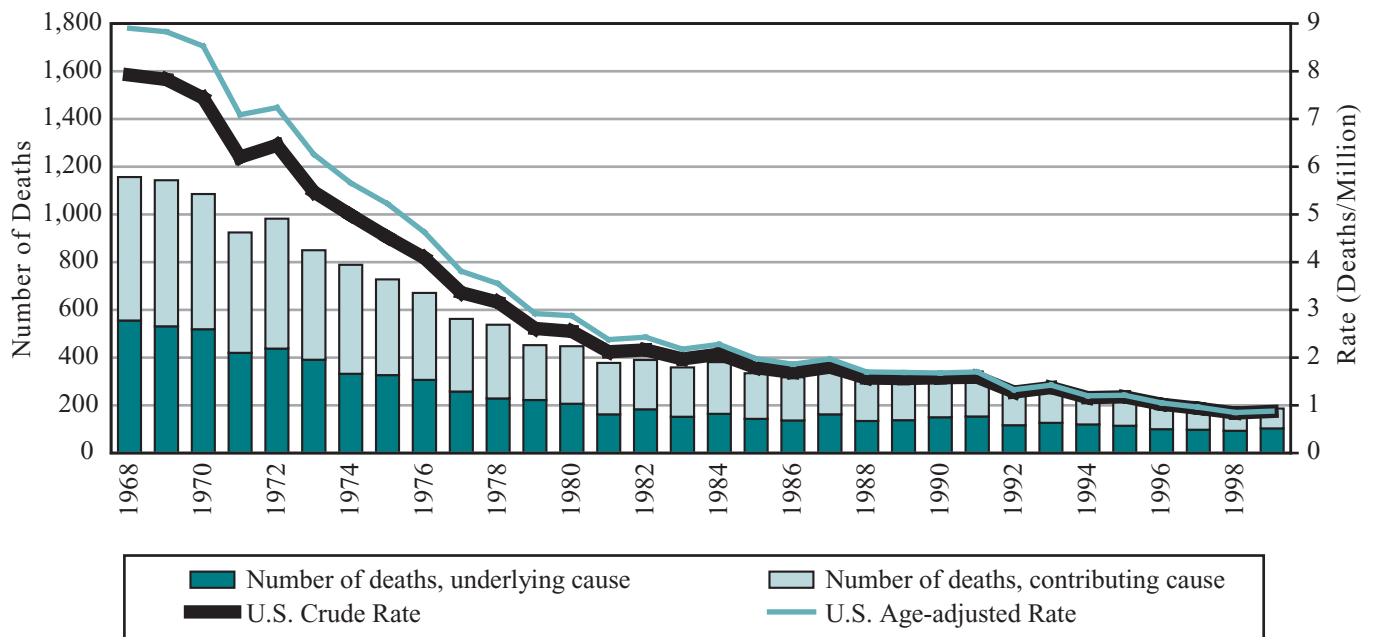

Section 3

Silicosis and Related Exposures

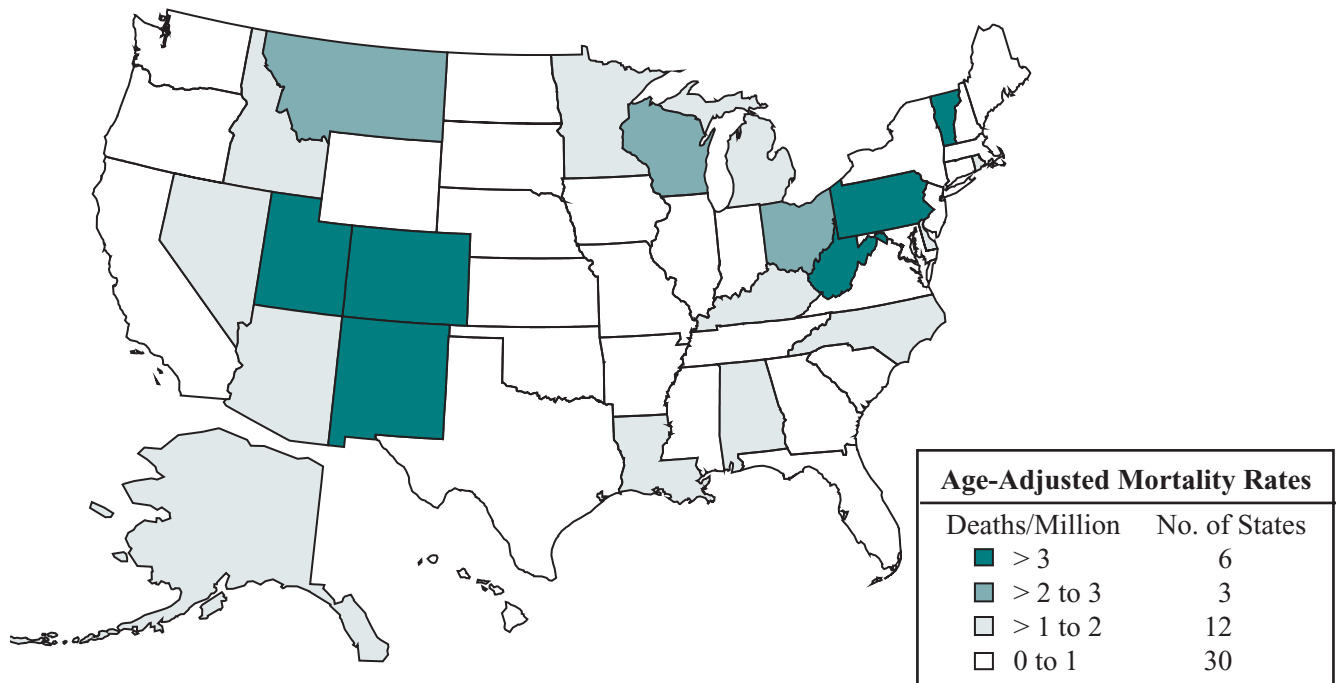
Figure 3-1. Silicosis: Number of deaths, crude and age-adjusted mortality rates, U.S. residents age 15 and over, 1968-1999



NOTE: See appendices for source description, methods, and ICD codes.

SOURCE: National Center for Health Statistics multiple cause of death data. Population estimates from U.S. Bureau of the Census.

Figure 3-2. Silicosis: Age-adjusted mortality rates by state, U.S. residents age 15 and over, 1990-1999



NOTE: See appendices for source description, methods, and ICD codes.

SOURCE: National Center for Health Statistics multiple cause of death data. Population estimates from U.S. Bureau of the Census.

Table 3-1. Silicosis: Number of deaths by sex, race, age, and median age at death, U.S. residents age 15 and over, 1990-1999

Year	No. of Deaths	Underlying Cause (%)	Sex		Race			Age Group (yrs)								Median Age (yrs)
			Male	Female	White	Black	Other	15-24	25-34	35-44	45-54	55-64	65-74	75-84	85+	
1990	308	48.7	298	10	261	46	1	-	2	6	11	46	81	125	37	75.0
1991	314	48.7	305	9	257	56	1	1	1	4	12	40	78	135	43	76.0
1992	255	45.9	240	15	212	39	4	-	1	3	8	36	79	96	32	75.0
1993	276	46.0	268	8	240	32	4	-	1	5	10	32	88	96	44	75.0
1994	235	51.1	222	13	206	27	2	-	-	1	7	35	59	100	33	77.0
1995	242	47.1	232	10	198	42	2	-	-	2	8	28	70	98	36	76.0
1996	212	47.2	206	6	184	26	2	-	1	2	7	25	54	83	40	76.0
1997	198	49.5	189	9	163	32	3	-	-	4	7	26	67	58	36	74.0
1998	178	52.2	174	4	158	18	2	-	-	5	9	17	47	68	32	76.0
1999	187	55.1	181	6	154	30	3	-	-	3	9	21	58	61	35	75.0
TOTAL	2,405	48.9	2,315	90	2,033	348	24	1	6	35	88	306	681	920	368	76.0

- indicates no deaths listed.

NOTE: See appendices for source description, methods, and ICD codes.

SOURCE: National Center for Health Statistics multiple cause of death data.

Table 3-2. Silicosis: Mortality rates (per million population) by race and sex, U.S. residents age 15 and over, 1990-1999

Year	Overall	White		Black		Other	
		Male	Female	Male	Female	Male	Female
Crude Mortality Rate							
1990	1.58	3.14	0.11	4.38	0.08	0.29	–
1991	1.59	3.08	0.09	5.28	0.08	0.28	–
1992	1.28	2.46	0.14	3.49	0.16	0.80	0.25
1993	1.37	2.85	0.07	2.78	0.16	1.04	–
1994	1.16	2.34	0.14	2.37	0.08	0.50	–
1995	1.18	2.27	0.09	3.59	0.15	0.49	–
1996	1.02	2.10	0.07	2.29	–	0.46	–
1997	0.94	1.82	0.09	2.68	0.07	0.68	–
1998	0.84	1.80	0.03	1.44	0.07	0.44	–
1999	0.87	1.72	0.05	2.42	0.07	0.64	–
1990-1999	1.17	2.34	0.09	3.01	0.09	0.56	0.02
Age-Adjusted Mortality Rate							
1990	1.68	4.01	0.09	7.15	0.09	0.50	–
1991	1.70	3.92	0.08	9.60	0.12	0.39	–
1992	1.33	2.99	0.12	6.74	0.19	1.59	0.55
1993	1.42	3.45	0.06	4.98	0.19	3.42	–
1994	1.20	2.87	0.11	4.00	0.08	1.02	–
1995	1.21	2.73	0.07	6.60	0.21	0.72	–
1996	1.05	2.57	0.05	3.86	–	1.00	–
1997	0.96	2.14	0.08	4.57	0.10	1.10	–
1998	0.85	2.10	0.03	2.44	0.07	0.84	–
1999	0.88	1.97	0.04	3.93	0.07	1.25	–
1990-1999	1.21	2.81	0.07	5.27	0.11	1.23	0.05

– indicates no deaths listed.

NOTE: See appendices for source description, methods, and ICD codes.

SOURCE: National Center for Health Statistics multiple cause of death data. Population estimates from U.S. Bureau of the Census.

Silicosis: Mortality

Table 3-3. Silicosis: Years of potential life lost to age 65 and to life expectancy by race and sex, U.S. residents age 15 and over, 1990-1999

Year	White		Black		Other		Total
	Male	Female	Male	Female	Male	Female	
Years of Potential Life Lost to Age 65							
1990	430	–	160	25	–	–	615
1991	415	50	90	–	5	–	560
1992	325	15	45	25	–	–	410
1993	325	5	115	25	–	–	470
1994	230	5	40	25	5	–	305
1995	220	5	65	15	5	–	310
1996	240	–	60	–	15	–	315
1997	225	35	75	–	–	–	335
1998	260	5	55	25	–	–	345
1999	180	–	110	25	–	–	315
TOTAL	2,850	120	815	165	30	–	3,980
Years of Potential Life Lost to Life Expectancy							
1990	2,758	92	557	37	14	–	3,458
1991	2,732	136	571	6	21	–	3,466
1992	2,278	188	348	46	37	9	2,906
1993	2,545	69	365	45	34	–	3,058
1994	2,044	127	279	37	29	–	2,516
1995	1,995	100	405	37	35	–	2,572
1996	1,875	57	301	–	36	–	2,269
1997	1,758	132	371	9	43	–	2,313
1998	1,737	39	204	38	23	–	2,041
1999	1,643	41	385	37	35	–	2,141
TOTAL	21,365	981	3,786	292	307	9	26,740

– indicates no deaths listed.

NOTE: See appendices for source description, methods, and ICD codes.

SOURCE: National Center for Health Statistics multiple cause of death data.

Table 3-4. Silicosis: Number of deaths by state, U.S. residents age 15 and over, 1990-1999

State	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Total
Alabama	3	9	3	1	3	4	3	1	8	4	39
Alaska	1	-	-	1	-	-	-	-	-	-	2
Arizona	5	2	1	4	7	6	3	3	3	4	38
Arkansas	-	2	1	1	-	3	1	2	2	3	15
California	15	16	12	13	9	14	13	5	4	6	107
Colorado	10	15	9	11	6	9	10	7	6	7	90
Connecticut	2	2	3	5	4	2	3	1	4	1	27
Delaware	1	-	1	-	-	1	1	1	-	1	6
District of Columbia	1	-	1	-	-	1	-	1	-	-	4
Florida	12	7	4	5	6	6	5	6	6	5	62
Georgia	4	3	3	3	3	6	4	4	3	2	35
Hawaii	-	-	-	-	-	-	-	-	-	-	-
Idaho	2	-	2	3	-	2	3	2	1	-	15
Illinois	10	8	11	9	6	5	7	8	7	5	76
Indiana	8	4	4	4	4	1	2	5	5	5	42
Iowa	2	2	2	4	1	2	1	4	4	1	23
Kansas	-	1	1	1	2	3	-	1	1	1	11
Kentucky	6	2	6	3	5	5	3	4	5	2	41
Louisiana	6	5	2	8	2	2	2	2	1	5	35
Maine	2	2	-	2	2	-	1	-	-	1	10
Maryland	3	4	1	2	2	2	4	1	3	5	27
Massachusetts	4	3	1	1	4	2	2	5	3	1	26
Michigan	12	9	14	15	7	12	16	5	9	6	105
Minnesota	5	3	9	5	5	6	6	5	-	4	48
Mississippi	3	1	1	-	-	1	1	3	1	2	13
Missouri	5	7	4	2	7	6	3	5	3	3	45
Montana	2	-	3	2	-	2	2	1	1	2	15
Nebraska	-	3	1	-	-	-	1	-	-	1	6
Nevada	3	-	-	3	4	2	-	1	-	-	13
New Hampshire	1	2	1	-	1	-	-	2	-	-	7
New Jersey	10	11	5	5	5	3	3	4	4	3	53
New Mexico	6	4	5	3	8	4	1	5	2	2	40
New York	15	18	6	13	12	9	10	6	8	8	105
North Carolina	5	14	8	11	7	12	6	9	5	6	83
North Dakota	-	-	-	-	-	-	1	-	-	-	1
Ohio	33	35	24	23	21	20	16	12	16	23	223
Oklahoma	4	4	5	1	3	-	-	1	-	5	23
Oregon	3	3	3	2	2	2	2	-	1	5	23
Pennsylvania	61	53	53	54	44	43	38	33	24	20	423
Rhode Island	1	-	2	-	-	-	2	3	-	2	10
South Carolina	5	3	1	3	3	-	3	2	1	2	23
South Dakota	1	-	-	-	1	-	1	1	-	1	5
Tennessee	3	3	2	6	3	2	2	3	5	3	32
Texas	7	11	11	12	8	11	9	11	8	12	100
Utah	2	5	4	10	4	4	-	3	3	1	36
Vermont	5	1	4	1	1	-	1	2	2	1	18
Virginia	3	2	3	5	4	3	2	3	6	1	32
Washington	-	7	5	3	2	2	2	2	4	3	30
West Virginia	6	12	4	6	10	8	6	6	5	6	69
Wisconsin	10	16	9	10	7	14	10	6	4	6	92
Wyoming	-	-	-	-	-	-	-	1	-	-	1
TOTAL	308	314	255	276	235	242	212	198	178	187	2,405

- indicates no deaths listed.

NOTE: See appendices for source description, methods, and ICD codes.

SOURCE: National Center for Health Statistics multiple cause of death data.

Silicosis: Mortality

Table 3-5. Silicosis: Number of deaths, mortality rates (per million population), and years of potential life lost (YPLL) by state, U.S. residents age 15 and over, 1990-1999

State	No. of Deaths		Crude Mortality		Age-Adjusted Mortality		YPLL to Life Expectancy			
	Deaths	Rank	Rate	Rank	Rate	Rank	Total	Rank	YPLL/death	Rank
Alabama	39	19	1.18	16	1.20	19	515	19	13.2	15
Alaska	2	48	0.46	47	1.29	16	22	48	11.2	38
Arizona	38	20	1.17	17	1.23	17	439	23	11.6	31
Arkansas	15	35	0.78	33	0.72	42	308	29	20.5	1
California	107	3	0.44	48	0.54	44	1,284	5	12.0	27
Colorado	90	8	3.11	5	3.92	3	1,054	10	11.7	30
Connecticut	27	27	1.03	23	1.00	22	319	27	11.8	29
Delaware	6	44	1.06	21	1.23	17	52	47	8.6	49
District of Columbia	4	47	0.86	29	0.96	25	73	44	18.3	2
Florida	62	12	0.54	44	0.43	47	781	12	12.6	21
Georgia	35	22	0.63	41	0.80	36	404	25	11.5	34
Hawaii	-	-	-	-	-	-	-	-	-	-
Idaho	15	35	1.74	10	1.74	10	136	39	9.1	48
Illinois	76	10	0.82	31	0.84	32	1,086	8	14.3	11
Indiana	42	16	0.93	26	0.94	26	616	14	14.7	9
Iowa	23	30	1.04	22	0.89	28	296	31	12.9	19
Kansas	11	40	0.56	43	0.53	45	159	37	14.5	10
Kentucky	41	17	1.36	13	1.38	14	622	13	15.2	7
Louisiana	35	22	1.07	20	1.14	21	601	15	17.2	4
Maine	10	41	1.03	23	0.97	24	130	41	13.0	17
Maryland	27	27	0.68	39	0.83	33	299	30	11.1	39
Massachusetts	26	29	0.53	45	0.51	46	265	32	10.2	43
Michigan	105	4	1.42	12	1.52	12	1,222	6	11.6	31
Minnesota	48	14	1.36	13	1.34	15	581	18	12.1	26
Mississippi	13	38	0.64	40	0.64	43	232	34	17.8	3
Missouri	45	15	1.08	18	0.99	23	592	16	13.2	15
Montana	15	35	2.26	9	2.11	9	139	38	9.2	47
Nebraska	6	44	0.48	46	0.40	48	57	45	9.6	45
Nevada	13	38	1.08	18	1.42	13	135	40	10.4	42
New Hampshire	7	43	0.78	33	0.87	30	81	43	11.6	31
New Jersey	53	13	0.83	30	0.85	31	587	17	11.1	39
New Mexico	40	18	3.17	4	3.65	5	457	21	11.4	35
New York	105	4	0.73	36	0.73	40	1,307	4	12.4	24
North Carolina	83	9	1.45	11	1.57	11	1,035	11	12.5	23
North Dakota	1	49	0.20	50	0.16	50	6	50	6.1	50
Ohio	223	2	2.56	7	2.53	7	2,816	2	12.6	21
Oklahoma	23	30	0.91	27	0.83	33	252	33	11.0	41
Oregon	23	30	0.94	25	0.88	29	224	35	9.7	44
Pennsylvania	423	1	4.38	2	3.85	4	4,835	1	11.4	35
Rhode Island	10	41	1.25	15	1.17	20	128	42	12.8	20
South Carolina	23	30	0.81	32	0.94	26	318	28	13.8	14
South Dakota	5	46	0.91	27	0.73	40	57	45	11.4	35
Tennessee	32	24	0.77	35	0.78	37	474	20	14.8	8
Texas	100	6	0.71	37	0.83	33	1,636	3	16.4	5
Utah	36	21	2.69	6	3.44	6	434	24	12.0	27
Vermont	18	34	3.94	3	4.16	2	174	36	9.6	45
Virginia	32	24	0.61	42	0.74	39	452	22	14.1	13
Washington	30	26	0.71	37	0.76	38	369	26	12.3	25
West Virginia	69	11	4.74	1	4.23	1	1,061	9	15.4	6
Wisconsin	92	7	2.32	8	2.23	8	1,193	7	13.0	17
Wyoming	1	49	0.28	49	0.29	49	14	49	14.3	11

- indicates no deaths listed.

NOTE: See appendices for source description, methods, and ICD codes.

SOURCE: National Center for Health Statistics multiple cause of death data. Population estimates from U.S. Bureau of the Census.

Table 3-6. Silicosis: Most frequently recorded industries on death certificate, U.S. residents age 15 and over, selected states and years, 1990-1999

CIC	Industry	Number of Deaths	Percent
060	Construction	118	13.4
040	Metal mining	86	9.8
041	Coal mining	69	7.8
270	Blast furnaces, steelworks, rolling and finishing mills	51	5.8
050	Nonmetallic mining and quarrying, except fuel	48	5.5
271	Iron and steel foundries	48	5.5
262	Miscellaneous nonmetallic mineral and stone products	44	5.0
392	Not specified manufacturing industries	33	3.8
331	Machinery, except electrical, n.e.c.	23	2.6
252	Structural clay products	20	2.3
	All other industries	317	36.0
	Industry not reported	23	2.6
	TOTAL	880	100.0

CIC - Census Industry Code

n.e.c. - not elsewhere classified

NOTE: Percentages may not total to 100% due to rounding. See appendices for source description, methods, and ICD codes, industry and occupation codes, and list of selected states and years.

SOURCE: National Center for Health Statistics multiple cause of death data.

Table 3-7. Silicosis: Most frequently recorded occupations on death certificate, U.S. residents age 15 and over, selected states and years, 1990-1999

COC	Occupation	Number of Deaths	Percent
616	Mining machine operators	138	15.7
889	Laborers, except construction	84	9.6
019	Managers and administrators, n.e.c.	34	3.9
633	Supervisors, production occupations	32	3.6
453	Janitors and cleaners	30	3.4
779	Machine operators, not specified	30	3.4
869	Construction laborers	26	3.0
719	Molding and casting machine operators	25	2.8
243	Supervisors and proprietors, sales occupations	18	2.1
804	Truck drivers	18	2.1
	All other occupations	423	48.1
	Occupation not reported	22	2.5
	TOTAL	880	100.0

COC - Census Occupation Code

n.e.c. - not elsewhere classified

NOTE: Percentages may not total to 100% due to rounding. See appendices for source description, methods, and ICD codes, industry and occupation codes, and list of selected states and years.

SOURCE: National Center for Health Statistics multiple cause of death data.

Silicosis: Mortality

Table 3-8. Silicosis: Proportionate mortality ratio (PMR) adjusted for age, sex, and race by usual industry, U.S. residents age 15 and over, selected states and years, 1990-1999

CIC	Industry	Number of Deaths	PMR	95% Confidence Interval	
				LCL	UCL
040	Metal mining	86	41.70	33.60	51.82
262	Miscellaneous nonmetallic mineral and stone products	44	30.72	22.26	41.23
261	Pottery and related products	17	29.35	17.06	46.96
050	Nonmetallic mining and quarrying, except fuel	48	29.27	21.52	38.82
271	Iron and steel foundries	48	21.14	15.55	28.04
252	Structural clay products	20	19.72	12.02	30.47
041	Coal mining	69	6.17	4.84	7.86
300	Miscellaneous fabricated metal products	18	5.71	3.38	9.02
251	Cement, concrete, gypsum, and plaster products	8	4.24	1.83	8.35
280	Other primary metal industries	9	3.48	1.59	6.60
270	Blast furnaces, steelworks, rolling and finishing mills	51	3.19	2.41	4.25
682	Miscellaneous retail stores	7	3.15	1.27	6.50
250	Glass and glass products	10	3.00	1.44	5.51
331	Machinery, except electrical, n.e.c.	23	2.48	1.57	3.73
392	Not specified manufacturing industries	33	1.55	1.07	2.18
060	Construction	118	1.26	1.05	1.51

CIC - Census Industry Code n.e.c. - not elsewhere classified LCL - lower confidence limit UCL - upper confidence limit

NOTE: See appendices for source description, methods, and ICD codes, industry and occupation codes, and list of selected states and years.

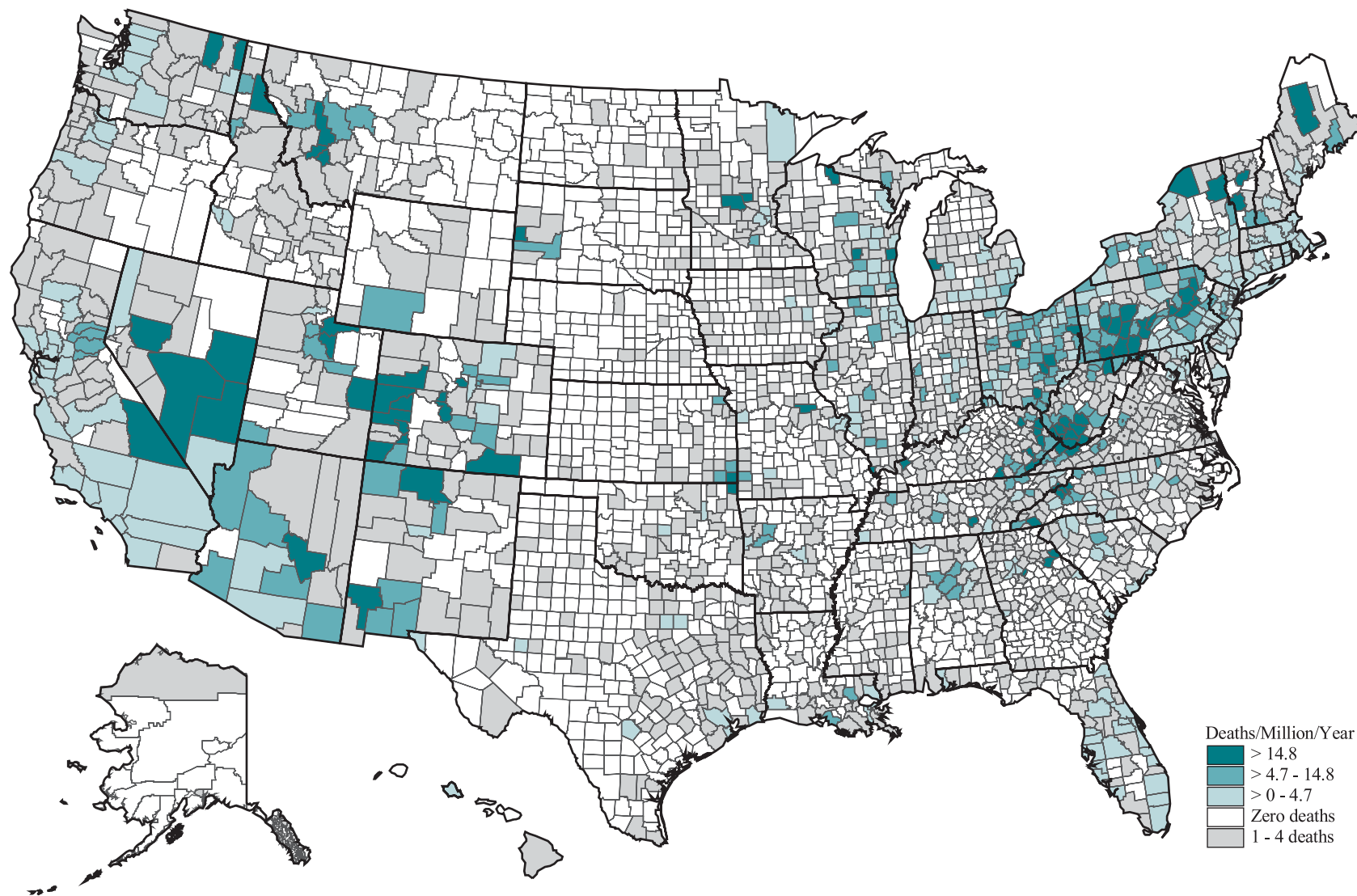
SOURCE: National Center for Health Statistics multiple cause of death data.

Table 3-9. Silicosis: Proportionate mortality ratio (PMR) adjusted for age, sex, and race by usual occupation, U.S. residents age 15 and over, selected states and years, 1990-1999

COC	Occupation	Number of Deaths	PMR	95% Confidence Interval	
				LCL	UCL
725	Miscellaneous metal and plastic processing machine operators	10	92.71	44.57	170.42
787	Hand molding, casting, and forming occupations	8	41.97	18.09	82.61
675	Hand molders and shapers, except jewelers	14	38.91	21.26	65.28
768	Crushing and grinding machine operators	16	31.12	17.78	50.52
719	Molding and casting machine operators	25	19.36	12.49	28.55
617	Mining occupations, n.e.c.	8	15.86	6.84	31.22
616	Mining machine operators	138	13.08	11.04	15.51
613	Supervisors, extractive occupations	7	12.86	5.17	26.52
599	Construction trades, n.e.c.	8	6.77	2.92	13.33
766	Furnace, kiln, and oven operators, except food	11	5.23	2.62	9.36
709	Grinding, abrading, buffing, and polishing machine operators	7	4.53	1.82	9.34
849	Crane and tower operators	9	3.87	1.78	7.35
544	Millwrights	8	3.49	1.50	6.87
779	Machine operators, not specified	30	2.94	1.99	4.20
844	Operating engineers	15	2.31	1.29	3.82
889	Laborers, except construction	84	2.19	1.76	2.73
579	Painters, construction and maintenance	14	2.16	1.18	3.62
633	Supervisors, production occupations	32	1.77	1.21	2.50
869	Construction laborers	26	1.56	1.02	2.28

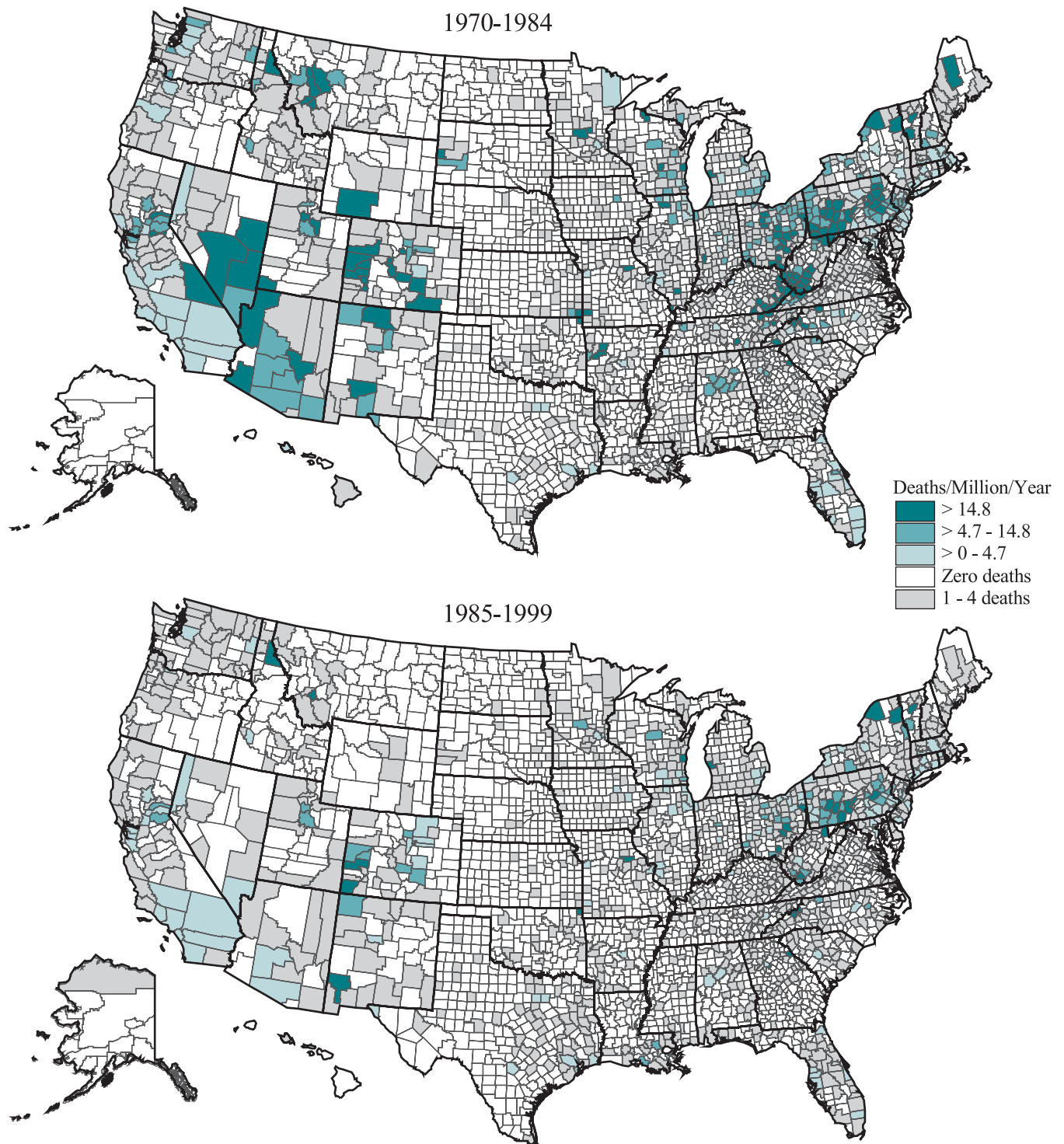
COC - Census Occupation Code n.e.c. - not elsewhere classified LCL - lower confidence limit UCL - upper confidence limit
 NOTE: See appendices for source description, methods, and ICD codes, industry and occupation codes, and list of selected states and years.
 SOURCE: National Center for Health Statistics multiple cause of death data.

62 **Figure 3-3. Silicosis: Age-adjusted mortality rates by county, U.S. residents age 15 and over, 1970-1999**



NOTE: Age-adjusted rates are not calculated for those counties with 1-4 deaths. See appendices for source description, methods, and ICD codes.
SOURCE: National Center for Health Statistics multiple cause of death data. Population estimates from U.S. Bureau of the Census.

Figure 3-4. Silicosis: Age-adjusted mortality rates by county, U.S. residents age 15 and over, 1970-1984 and 1985-1999



NOTE: Age-adjusted rates are not calculated for those counties with 1-4 deaths. See appendices for source description, methods, and ICD codes.
SOURCE: National Center for Health Statistics multiple cause of death data. Population estimates from U.S. Bureau of the Census.

Silicosis: Mortality

Table 3-10. Silicosis: Counties with highest age-adjusted mortality rates (per million population), U.S. residents age 15 and over, 1985-1999

County	State	Age-Adjusted Rate	Crude Rate	Number of Deaths	% Female
Mitchell County	North Carolina	62.5	84.5	15	0.0
Silver Bow County	Montana	44.7	56.7	23	0.0
Shoshone County	Idaho	41.8	55.9	9	0.0
Yancey County	North Carolina	40.3	51.9	10	0.0
Montrose County	Colorado	35.3	44.4	13	0.0
Elbert County	Georgia	35.1	41.1	9	0.0
Huntingdon County	Pennsylvania	33.9	35.4	19	5.3
Avery County	North Carolina	32.1	33.0	6	0.0
Perry County	Ohio	31.6	32.8	12	25.0
Montezuma County	Colorado	29.8	32.6	7	0.0
Washington County	Vermont	26.8	27.6	18	0.0
Grant County	New Mexico	26.0	28.2	9	0.0
Audrain County	Missouri	25.7	36.3	10	0.0
Muskegon County	Michigan	24.4	24.4	45	0.0
Morgan County	West Virginia	23.1	32.3	5	20.0
Essex County	New York	22.3	24.7	11	0.0
Jackson County	Ohio	21.8	24.9	9	0.0
Preston County	West Virginia	21.0	20.5	7	0.0
Schuylkill County	Pennsylvania	19.9	28.1	53	0.0
Cambria County	Pennsylvania	18.9	25.9	51	0.0
Sheboygan County	Wisconsin	18.4	21.3	26	0.0
Rockdale County	Georgia	17.9	10.4	7	0.0
Columbiana County	Ohio	16.8	19.4	25	12.0
St. Lawrence County	New York	16.6	15.6	21	0.0
Muskingum County	Ohio	16.5	17.7	17	29.4
Indiana County	Pennsylvania	16.2	16.5	18	0.0
Ottawa County	Oklahoma	15.8	22.0	8	0.0
Bedford County	Pennsylvania	15.5	17.4	10	0.0
Mifflin County	Pennsylvania	15.4	18.1	10	0.0
Wyoming County	West Virginia	15.0	14.9	5	0.0
Stearns County	Minnesota	14.7	12.3	17	5.9
San Juan County	New Mexico	14.5	10.3	10	0.0
Somerset County	Pennsylvania	14.2	15.0	14	7.1
Armstrong County	Pennsylvania	13.7	18.1	16	0.0
Delta County	Colorado	12.6	18.9	5	0.0
Mesa County	Colorado	11.6	13.2	15	0.0
Fremont County	Colorado	11.0	15.0	6	0.0
Marion County	Ohio	11.0	10.7	8	0.0
McDowell County	West Virginia	11.0	12.8	5	0.0
St. Mary Parish	Louisiana	10.8	9.6	6	0.0
Coshocton County	Ohio	10.5	12.2	5	0.0
Logan County	West Virginia	10.0	10.0	5	0.0
Surry County	North Carolina	9.9	10.4	8	0.0
Rutland County	Vermont	9.7	10.7	8	0.0
Clearfield County	Pennsylvania	9.2	11.8	11	0.0
Carbon County	Pennsylvania	9.0	11.4	8	0.0
Steuben County	New York	8.4	8.7	10	0.0
Knox County	Ohio	8.4	8.7	5	0.0
Northumberland County	Pennsylvania	8.3	11.2	13	0.0
Nevada County	California	7.9	9.1	9	0.0
Overall United States		1.4	1.3	4,002	3.7

NOTE: Only counties with at least 5 deaths from the disease of interest are included. See appendices for source description, methods, and ICD codes.
SOURCE: National Center for Health Statistics multiple cause of death data. Population estimates from U.S. Bureau of the Census.

Table 3-11. Silicosis: Estimated number of discharges from short-stay nonfederal hospitals, 1970-2000

Year	Number of Discharges
1970	6,000
1971	7,000
1972	6,000
1973	5,000
1974	4,000
1975	4,000
1976	5,000
1977	4,000
1978	2,000
1979	3,000
1980	1,000
1981	2,000
1982	3,000
1983	2,000
1984	2,000
1985	3,000
1986	3,000
1987	3,000
1988	3,000
1989	2,000
1990	3,000
1991	4,000
1992	3,000
1993	1,000
1994	3,000
1995	3,000
1996	4,000
1997	3,000
1998	1,000
1999	1,000
2000	1,000

NOTE: Number of discharges has been rounded. NCHS recommends that, in statistical comparisons, estimates of less than 5,000 not be used and that estimates of 5,000 to 10,000 be used with caution. See appendices for source description and methods.
 SOURCE: National Center for Health Statistics National Hospital Discharge Survey.

Silicosis: SENSOR

Table 3-12. Silicosis: Number of cases by ascertainment source and state, 1989-1998

Source	Michigan		New Jersey		Ohio		Total	
	No.	%	No.	%	No.	%	No.	%
Health care professional report	123	20.9	18	9.4	22	5.5	163	13.8
Hospital discharge data	387	65.7	164	85.9	327	81.8	878	74.4
Death certificate data	23	3.9	5	2.6	19	4.8	47	4.0
Workers' compensation files	52	8.8	-	-	21	5.3	73	6.2
Other	4	0.7	4	2.1	11	2.8	19	1.6
TOTAL	589	100.0	191	100.0	400	100.0	1,180	100.0

- indicates no cases reported.

NOTE: Percentages may not sum to 100% due to rounding. See appendices for source description.

SOURCE: Provisional SENSOR surveillance data as of September 2002, aggregated by reporting source years, and reported by K Rosenman, MJ Reilly, and D Kalinowski (Michigan); D Valiante and D Schill (New Jersey); and E Socie and A Migliozi (Ohio).

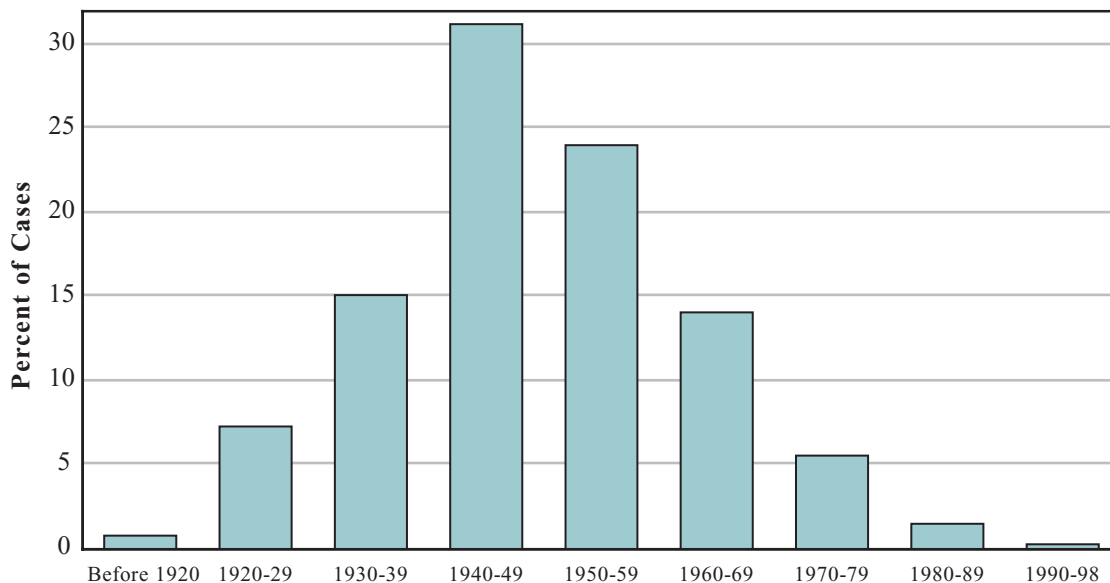
Table 3-13. Silicosis: Number of cases by duration of occupational exposure to silica and by state, 1989-1998

Years of Employment in Jobs with Potential Silica Exposure	Michigan		New Jersey		Ohio		Total	
	No.	%	No.	%	No.	%	No.	%
<10	41	7.0	19	9.9	23	5.8	83	7.0
10 to 20	112	19.0	44	23.0	71	17.8	227	19.2
21-30	194	32.9	46	24.1	84	21.0	324	27.5
>30	215	36.5	56	29.3	110	27.5	381	32.3
Unknown	27	4.6	26	13.6	112	28.0	165	14.0
TOTAL	589	100.0	191	100.0	400	100.0	1,180	100.0

NOTE: Percentages may not sum to 100% due to rounding. See appendices for source description.

SOURCE: Provisional SENSOR surveillance data as of September 2002, aggregated by reporting source years, and reported by K Rosenman, MJ Reilly, and D Kalinowski (Michigan); D Valiante and D Schill (New Jersey); and E Socie and A Migliozi (Ohio).

Figure 3-5. Silicosis: Decade of first exposure for 986 confirmed cases, 1989-1998



NOTE: Cases with unknown or missing values are excluded.

SOURCE: Provisional SENSOR surveillance data as of September, 2002, aggregated by reporting source years, and reported by K. Rosenman, MJ Reilly, and D Kalinowski (Michigan); D Valiante and D Schill (New Jersey); and E Socie and A Migliozi (Ohio).

Table 3-14. Silicosis: Primary industries associated with silica exposure of silicosis cases by state, 1989-1998

Industry (SIC Code)	Michigan		New Jersey		Ohio		Total	
	No.	%	No.	%	No.	%	No.	%
Mining	17	2.9	22	11.5	20	5.0	59	5.0
Mining and quarry of nonmetal minerals except fuel (14)	1	0.2	17	8.9	15	3.8	33	2.8
Metal mining (10)	15	2.5	4	2.1	-	-	19	1.6
All others (12,13)	1	0.2	1	0.5	5	1.3	7	0.6
Construction	33	5.7	16	8.4	20	5.0	69	5.9
Construction, special trade contractors (17)	24	4.1	8	4.2	16	4.0	48	4.1
Heavy construction other than building construction (16)	4	0.7	8	4.2	4	1.0	16	1.4
All others (15)	5	0.8	-	-	-	-	5	0.4
Manufacturing	526	90.2	149	78.0	351	88.0	1,026	87.5
Primary metal industries (33)	454	77.1	45	23.6	187	46.8	686	58.1
Stone, clay, glass, and concrete products (32)	28	4.8	82	42.9	88	22.0	198	16.8
Fabricated metal products except machinery and transportation equipment (34)	9	1.5	6	3.1	31	7.8	46	3.9
Transportation equipment (37)	20	3.4	4	2.1	10	2.5	34	2.9
Industrial and commercial machinery and computer equipment (35)	5	0.8	1	0.5	20	5.0	26	2.2
Chemicals and allied products (28)	2	0.3	5	2.6	5	1.3	12	1.0
All others (22,25,26,29,30,36,38,39)	8	1.4	6	3.1	10	2.5	24	2.0
Transportation (40,41,42,46,49)	4	0.7	2	1.0	-	-	6	0.5
Wholesale trade (50)	1	0.2	-	-	1	0.3	2	0.2
Finance, insurance, and real estate (65)	-	-	-	-	1	0.3	1	0.1
Services (75,76,80)	2	0.3	2	1.0	2	0.5	6	0.5
Public administration (92)	-	-	-	-	1	0.3	1	0.1
Nonclassifiable (99)	6	1.0	-	-	3	0.8	9	0.8
TOTAL	589	100.0	191	100.0	400	100.0	1,180	100.0

- indicates no cases reported.

SIC - 1987 Standard Industrial Classification

NOTE: Percentages may not sum to 100% due to rounding. See appendices for source description.

SOURCE: Provisional SENSOR surveillance data as of September 2002, aggregated by reporting source years, and reported by K Rosenman, MJ Reilly, and D Kalinowski (Michigan); D Valiante and D Schill (New Jersey); and E Socie and A Migliozi (Ohio).

Silicosis: SENSOR

Table 3-15. Silicosis: Primary occupations associated with silica exposure of silicosis cases by state, 1989-1998

Occupation (COC)	Michigan		New Jersey		Ohio		Total	
	No.	%	No.	%	No.	%	No.	%
Managerial and professional specialty	1	0.2	4	2.1	3	0.8	8	0.7
Technical, sales, and administrative	5	0.8	2	1.0	1	0.3	8	0.7
Service	4	0.7	1	0.5	3	0.8	8	0.7
Precision production, craft, and repair	142	24.1	50	26.2	73	18.3	265	22.5
Hand molders and shapers, except jewelers (675)	55	9.3	3	1.6	5	1.3	63	5.3
Supervisors, production (628)	20	3.4	9	4.7	13	3.3	42	3.6
Brickmasons and stonemasons (563)	12	2.0	7	3.7	12	3.0	31	2.6
Construction trades, n.e.c. (599)	6	1.0	4	2.1	12	3.0	22	1.9
Mining machine operators (616)	6	1.0	6	3.1	3	0.8	15	1.3
Millwrights (544)	9	1.5	-	-	2	0.5	11	0.9
Mining occupations, n.e.c. (617)	5	0.8	2	1.0	4	1.0	11	0.9
All others	29	4.9	19	9.9	22	5.5	70	5.9
Operators, fabricators, and laborers	360	61.1	107	56.0	301	75.3	768	65.1
Laborers, except construction (889)	123	20.9	15	7.9	66	16.5	204	17.3
Molding and casting machine operators (719)	59	10.0	7	3.7	39	9.8	105	8.9
Grinding, abrading, buffing, and polishing machine op. (709)	49	8.3	3	1.6	24	6.0	76	6.4
Crushing and grinding machine operators (768)	9	1.5	10	5.2	35	8.8	54	4.6
Miscellaneous metal and plastic processing machine op. (725)	19	3.2	8	4.2	22	5.5	49	4.2
Furnace, kiln, and oven operators, excluding food (766)	11	1.9	5	2.6	18	4.5	34	2.9
Miscellaneous machine operators, n.e.c. (777)	10	1.7	4	2.1	17	4.3	31	2.6
Hand molding, casting, forming occupations (787)	3	0.5	14	7.3	12	3.0	29	2.5
Miscellaneous hand working occupations (795)	19	3.2	1	0.5	1	0.3	21	1.8
Mixing and blending machine operators (756)	4	0.7	5	2.6	8	2.0	17	1.4
Machine operators, not specified (779)	3	0.5	2	1.0	12	3.0	17	1.4
Welders and cutters (783)	9	1.5	3	1.6	4	1.0	16	1.4
Construction laborers (869)	2	0.3	6	3.1	4	1.0	12	1.0
Production inspectors, checkers, and examiners (796)	5	0.8	2	1.0	4	1.0	11	0.9
Crane and tower operators (849)	5	0.8	2	1.0	4	1.0	11	0.9
Painting and paint spraying machine operators (759)	-	-	7	3.7	3	0.8	10	0.8
All others	30	5.1	13	6.8	28	7.0	71	6.0
Unclassifiable and miscellaneous unemployed	77	13.1	27	14.1	19	4.8	123	10.4
Occupation not reported	77	13.1	27	14.1	19	4.8	123	10.4
TOTAL	589	100.0	191	100.0	400	100.0	1,180	100.0

- indicates no cases reported.

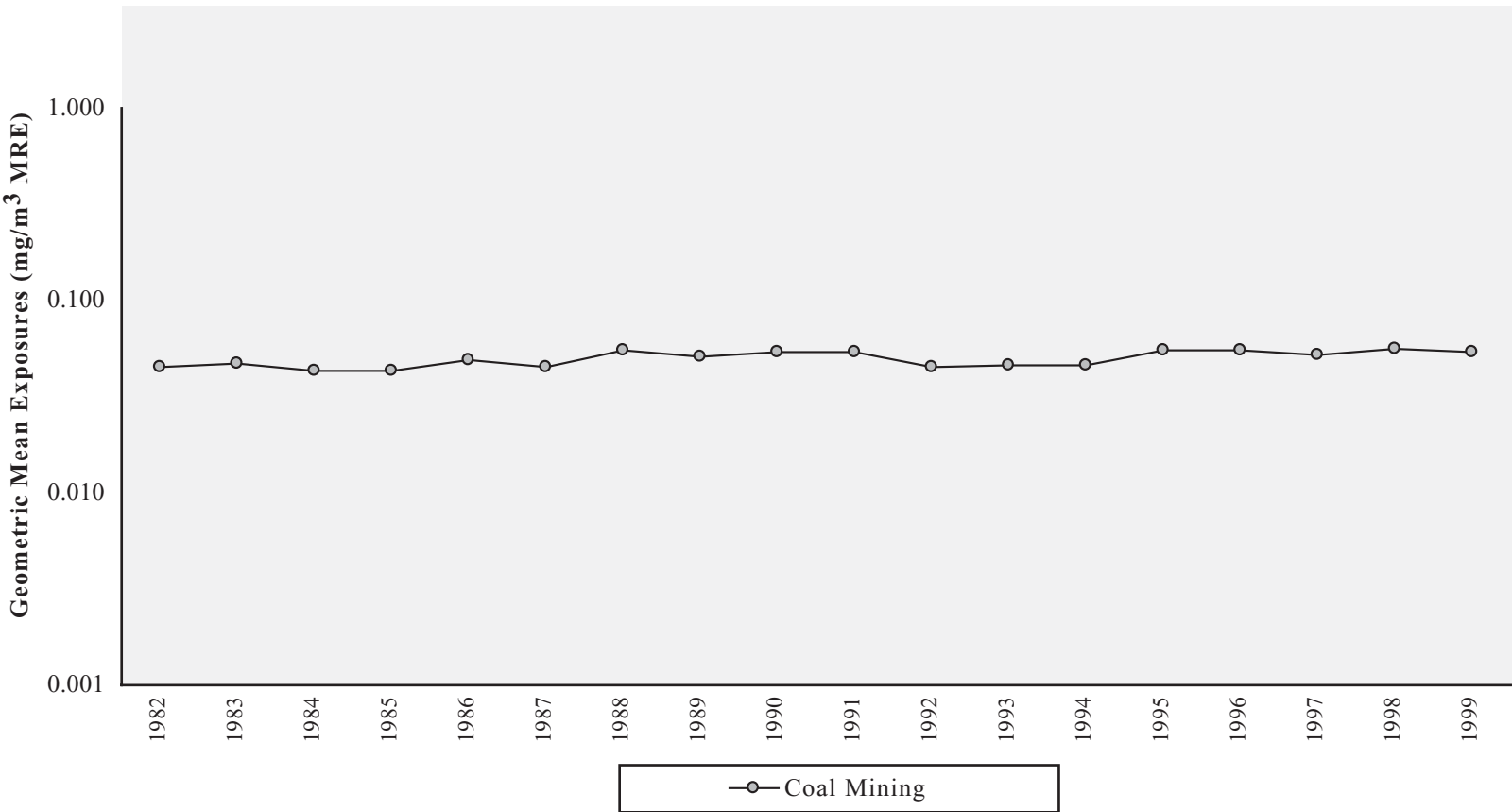
COC - 1990 Census Occupation Code

n.e.c. - not elsewhere classified

NOTE: Percentages may not sum to 100% due to rounding. See appendices for source description.

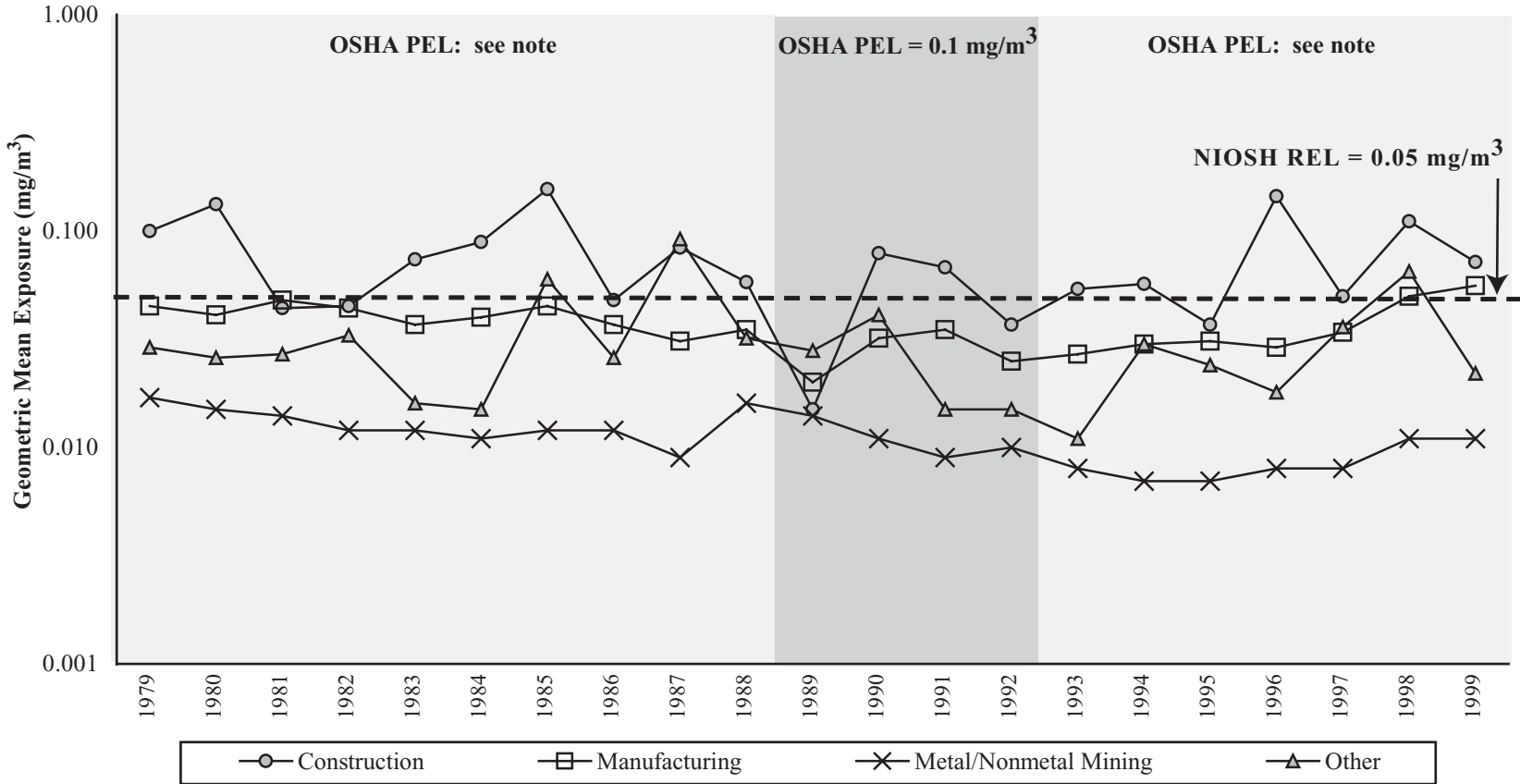
SOURCE: Provisional SENSOR surveillance data as of September 2002, aggregated by reporting source years, and reported by K Rosenman, MJ Reilly, and D Kalinowski (Michigan); D Valiante and D Schill (New Jersey); and E Socie and A Migliozi (Ohio).

Figure 3-6a. Respirable quartz: Geometric mean exposures in coal mining, MSHA inspector and mine operator samples, 1982-1999



PEL - permissible exposure limit REL - recommended exposure limit mg/m³ - milligrams per cubic meter MRE - Mining Research Establishment
 NOTE: For coal mining, the MSHA PEL is [(10 mg/m³ MRE) / (% quartz)] for respirable dust containing greater than 5 percent quartz. The MSHA respirable coal mine quartz exposure data and the NIOSH REL for respirable quartz cannot be compared to each other because they are based on different sampling criteria. See appendices for source description, methods, and agents.
 SOURCE: Mine Safety and Health Administration (MSHA) coal mine inspector and mine operator quartz data.

Figure 3-6b. Respirable quartz: Geometric mean exposures by major industry division, MSHA and OSHA samples, 1979-1999



PEL - permissible exposure limit REL - recommended exposure limit mg/m³ - milligrams per cubic meter
 NOTE: Before March 1, 1989 and after March 22, 1993, the OSHA PEL is [(10 mg/m³) / (% quartz + 2)], for respirable dust containing at least 1 percent quartz. From March 1, 1989 to March 22, 1993, the OSHA PEL was 0.1 mg/m³ for respirable quartz. For metal/nonmetal mining, the MSHA PEL is [(10 mg/m³) / (% quartz+2)] for respirable dust containing at least 1 percent quartz. See appendices for source description, methods, and agents.
 SOURCE: Mine Safety and Health Administration (MSHA) metal/nonmetal data. Occupational Safety and Health Administration (OSHA) Integrated Management Information System.

Table 3-16a. Respirable quartz: Geometric mean exposures and percent exceeding designated occupational exposure limits in coal mining, MSHA inspector and mine operator samples, 1982-1999

Industry Division		1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Coal Mining SIC 11, 12	GM (mg/m ³ MRE)	0.045	0.047	0.043	0.043	0.049	0.045	0.055	0.051	0.054	0.054	0.045	0.046	0.046	0.055	0.055	0.052	0.056	0.054
	No. of samples	2,682	4,962	4,613	4,242	4,731	4,556	5,238	4,566	4,524	5,816	8,692	7,668	7,557	8,090	6,332	8,560	10,613	12,790
	% > PEL	38.5	40.1	40.8	36.8	39.7	37.9	38.1	39.0	36.9	35.4	28.4	27.9	29.3	32.3	30.7	29.1	29.7	27.4

- indicates incalculable field

SIC - Standard Industrial Classification

PEL - permissible exposure limit

REL - recommended exposure limit

GM - geometric mean

mg/m³ - milligrams per cubic meter

MRE - Mining Research Establishment

NOTE: For coal mining, the MSHA PEL is [(10 mg/m³ MRE) / (% quartz)] for respirable dust containing greater than 5 percent quartz. The MSHA respirable coal mine quartz exposure data and the NIOSH REL for respirable quartz cannot be compared to each other because they are based on different sampling criteria. See appendices for source description, methods, and agents.

SOURCE: Mine Safety and Health Administration (MSHA) coal mine inspector and mine operator quartz data.

Table 3-16b. Respirable quartz: Geometric mean exposures and percent exceeding designated occupational exposure limits by major industry division, MSHA and OSHA samples, 1979-1999

Industry Division	OSHA PEL: see note											OSHA PEL = 0.1 mg/m ³				OSHA PEL: see note						
	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	
Construction SIC 15-17	GM (mg/m ³)	0.100	0.133	0.044	0.045	0.074	0.089	0.156	0.048	0.084	0.058	0.015	0.079	0.068	0.037	0.054	0.057	0.037	0.145	0.050	0.111	0.072
	No. of samples	24	71	26	36	56	44	57	33	42	35	15	36	43	65	29	21	31	56	103	138	165
	% > PEL	50.0	59.2	38.5	27.8	41.1	45.5	59.6	36.4	47.6	45.7	13.3	33.3	32.6	23.1	34.5	38.1	25.8	50.0	34.0	51.4	47.3
	% > REL	58.3	67.6	50.0	44.4	64.3	52.3	64.9	39.4	64.3	51.4	20.0	52.8	39.5	35.4	55.2	61.9	29.0	62.5	47.6	63.0	58.2
Manufacturing SIC 20-39	GM (mg/m ³)	0.045	0.041	0.048	0.044	0.037	0.040	0.045	0.037	0.031	0.035	0.020	0.032	0.035	0.025	0.027	0.030	0.031	0.029	0.034	0.050	0.056
	No. of samples	745	1,394	1,269	1,298	1,065	852	1,075	715	744	644	527	641	595	606	422	346	299	277	400	606	653
	% > PEL	30.3	30.8	33.2	30.5	26.9	31.9	34.3	27.3	26.5	30.7	16.1	20.1	22.2	13.5	18.2	24.3	24.7	23.8	26.0	37.8	38.3
	% > REL	49.1	47.5	50.9	48.7	42.4	46.8	50.3	39.9	38.4	42.9	28.1	39.2	42.0	32.2	30.1	39.0	36.8	30.7	36.0	52.1	56.4
Metal/ Nonmetal Mining SIC 10, 14	GM (mg/m ³)	0.017	0.015	0.014	0.012	0.012	0.011	0.012	0.012	0.009	0.016	0.014	0.011	0.009	0.010	0.008	0.007	0.007	0.008	0.008	0.011	0.011
	No. of samples	9,038	6,001	6,299	2,553	6,048	7,118	6,002	6,625	6,069	7,062	8,307	10,512	12,495	12,244	10,382	15,940	12,594	16,253	7,893	4,615	4,974
	% > PEL	11.7	11.1	11.7	11.1	10.5	10.2	10.2	10.3	7.7	17.7	14.7	11.1	9.4	9.2	7.3	5.6	5.5	6.2	6.4	6.7	8.0
	% > REL	17.3	17.7	17.8	16.8	16.5	15.4	15.4	16.5	11.5	26.6	22.1	16.7	14.2	14.7	11.3	8.6	8.4	9.2	10.2	12.7	15.9
Other SIC 1-9, 13, 40-99	GM (mg/m ³)	0.029	0.026	0.027	0.033	0.016	0.015	0.060	0.026	0.092	0.032	0.028	0.041	0.015	0.015	0.011	0.030	0.024	0.018	0.036	0.065	0.022
	No. of samples	36	36	15	15	30	46	26	39	71	62	56	31	48	40	22	33	26	41	29	26	49
	% > PEL	13.9	16.7	13.3	20.0	10.0	13.0	38.5	28.2	52.1	30.6	28.6	38.7	6.3	7.5	4.5	15.2	26.9	12.2	20.7	30.8	20.4
	% > REL	36.1	22.2	26.7	26.7	20.0	21.7	61.5	35.9	60.6	40.3	33.9	41.9	22.9	12.5	9.1	27.3	26.9	19.5	27.6	57.7	24.5

SIC - Standard Industrial Classification PEL - permissible exposure limit REL - recommended exposure limit GM - geometric mean mg/m³ - milligrams per cubic meter
NOTE: Before March 1, 1989 and after March 22, 1993, the OSHA PEL is [(10 mg/m³) / (% quartz + 2)], for respirable dust containing at least 1 percent quartz. From March 1, 1989 to March 22, 1993, the OSHA PEL was 0.1 mg/m³ for respirable quartz. For metal/nonmetal mining, the MSHA PEL is [(10 mg/m³) / (% quartz+2)] for respirable dust containing at least 1 percent quartz. The NIOSH REL is 0.05 mg/m³. See appendices for source description, methods, and agents.
SOURCE: Mine Safety and Health Administration (MSHA) metal/nonmetal mine data. Occupational Safety and Health Administration (OSHA) Integrated Management Information System.

Table 3-17. Respirable quartz: Number of samples, geometric mean exposures, and percent exceeding designated occupational exposure limits by industries with elevated silicosis mortality, MSHA inspector and mine operator and OSHA samples, 1990-1999

Silicosis Mortality, Selected States and Years, 1990-1999				Number of Samples	GM (mg/m ³)	% > PEL	% > REL
CIC	Industries with elevated PMRs and most frequently recorded on death certificates	Number of Deaths	PMR				
040	Metal mining	86	41.70	8,382	0.013	12.4	19.4
262	Miscellaneous nonmetallic mineral and stone products	44	30.72	391	0.041	30.2	47.3
050	Nonmetallic mining and quarrying, except fuel	48	29.27	99,529	0.008	7.0	11.1
271	Iron and steel foundries	48	21.14	1,766	0.047	29.3	50.8
252	Structural clay products	20	19.72	213	0.045	32.9	51.6
041	Coal mining	69	6.17	80,642	0.052*	30.1	- [†]
270	Blast furnaces, steelworks, rolling and finishing mills	51	3.19	44	0.011	2.3	6.8
331	Machinery, except electrical, n.e.c.	23	2.48	204	0.046	32.4	48.0
392	Not specified manufacturing industries	33	1.55	0	-	-	-
060	Construction	118	1.26	687	0.070	40.6	53.0
	All other industries	317		2,562	0.026	19.9	30.2
	TOTAL (excluding CIC 041)			113,778	0.009	8.4	13.2

- indicates incalculable field

* MRE equivalent

[†] The MSHA respirable coal mine quartz exposure data and the NIOSH REL for respirable quartz cannot be compared to each other because they are based on different sampling criteria.

CIC - Census Industry Code PEL - permissible exposure limit REL - recommended exposure limit PMR - proportionate mortality ratio

GM - geometric mean mg/m³ - milligrams per cubic meter MRE - Mining Research Establishment n.e.c. - not elsewhere

classified

NOTE: Before March 1, 1989 and after March 22, 1993, the OSHA PEL is [(10 mg/m³) / (% quartz + 2)], for respirable dust containing at least 1 percent quartz. From March 1, 1989 to March 22, 1993, the OSHA PEL was 0.1 mg/m³ for respirable quartz. For coal mining, the MSHA PEL is [(10 mg/m³ MRE) / (% quartz)] for respirable dust containing greater than 5 percent quartz; for metal/nonmetal mining, the MSHA PEL is [(10 mg/m³) / (% quartz + 2)] for respirable dust containing at least 1 percent quartz. The NIOSH REL is 0.05 mg/m³. See appendices for source description, methods, ICD codes, industry codes, agents, and list of selected states and years for which usual industry has been reported.

SOURCE: Mine Safety and Health Administration (MSHA) metal/nonmetal and coal mine inspector and mine operator quartz data. Occupational Safety and Health Administration (OSHA) Integrated Management Information System. National Center for Health Statistics: multiple cause of death data.

Table 3-18 (page 1 of 2). Respirable quartz: Geometric mean exposures and percent exceeding designated occupational exposure limits by MSHA coal mine district and state, MSHA inspector and mine operator samples, 1982-1999

MSHA Coal Mine District	All years		1982 - 1988			1989 - 1992			1993 - 1999		
	No. of Samples	GM (mg/m ³)	No. of Samples	GM (mg/m ³)	% > PEL	No. of Samples	GM (mg/m ³)	% > PEL	No. of Samples	GM (mg/m ³)	% > PEL
District 1 (Anthracite coal mining regions in Pennsylvania)	1,274	0.027	321	0.025	41.4	184	0.024	39.7	769	0.028	26.4
District 2 (Bituminous coal mining regions in Pennsylvania)	13,802	0.043	4,123	0.043	34.7	2,564	0.041	25.7	7,115	0.044	20.8
District 3	12,214	0.036	3,867	0.032	28.8	1,923	0.040	23.5	6,424	0.036	19.6
Maryland	761	0.042	128	0.056	39.8	46	0.037	4.3	587	0.040	16.9
Ohio	4,334	0.040	1,962	0.040	33.3	823	0.040	24.5	1,549	0.042	21.8
Northern West Virginia	7,119	0.032	1,777	0.025	23.1	1,054	0.040	23.5	4,288	0.034	19.1
District 4 (Southern West Virginia)	21,177	0.060	7,130	0.053	40.3	4,338	0.058	38.1	9,709	0.068	36.9
District 5 (Virginia)	14,293	0.062	4,492	0.057	45.1	3,341	0.061	39.0	6,460	0.066	34.4
District 6 (Eastern Kentucky)	15,255	0.061	2,845	0.050	40.7	2,748	0.066	41.5	9,662	0.064	33.6
District 7	17,116	0.059	2,991	0.066	49.7	3,762	0.055	36.9	10,363	0.058	32.4
Central Kentucky	15,102	0.059	2,463	0.068	51.2	3,152	0.056	37.3	9,487	0.058	32.4
North Carolina	0	-	0	-	-	0	-	-	0	-	-
South Carolina	0	-	0	-	-	0	-	-	0	-	-
Tennessee	2,014	0.057	528	0.057	42.4	610	0.053	34.8	876	0.060	32.3
Northern Georgia	0	-	0	-	-	0	-	-	0	-	-
District 8	7,297	0.046	2,122	0.047	33.8	1,567	0.042	22.0	3,608	0.048	27.1
Illinois	6,160	0.045	1,719	0.046	32.8	1,399	0.041	20.9	3,042	0.045	24.5
Indiana	1,042	0.061	342	0.051	38.0	156	0.056	32.1	544	0.070	41.5
Iowa	54	0.024	39	0.023	38.5	9	0.027	22.2	6	0.022	0.0
Michigan	0	-	0	-	-	0	-	-	0	-	-
Minnesota	0	-	0	-	-	0	-	-	0	-	-
Northern Missouri	41	0.051	22	0.071	40.9	3	0.031	0.0	16	0.036	31.3
Wisconsin	0	-	0	-	-	0	-	-	0	-	-

See footnotes at end of table.

Table 3-18 (page 2 of 2). Respirable quartz: Geometric mean exposures and percent exceeding designated occupational exposure limits by MSHA coal mine district and state, MSHA inspector and mine operator samples, 1982-1999

MSHA Coal Mine District	All years		1982 - 1988			1989 - 1992			1993 - 1999		
	No. of Samples	GM (mg/m ³)	No. of Samples	GM (mg/m ³)	% > PEL	No. of Samples	GM (mg/m ³)	% > PEL	No. of Samples	GM (mg/m ³)	% > PEL
District 9	5,372	0.036	1,403	0.041	42.3	1,357	0.031	33.8	2,612	0.036	23.9
Alaska	12	0.017	10	0.014	10.0	2	0.051	50.0	0	-	-
Arizona	42	0.056	6	0.023	33.3	12	0.056	41.7	24	0.070	20.8
Arkansas	9	0.082	6	0.120	66.7	1	0.009	100.0	2	0.077	50.0
California	1	0.025	0	-	-	0	-	-	1	0.025	0.0
Colorado	1,678	0.037	447	0.041	45.0	425	0.033	36.0	806	0.036	21.5
Hawaii	0	-	0	-	-	0	-	-	0	-	-
Idaho	0	-	0	-	-	0	-	-	0	-	-
Kansas	24	0.061	9	0.115	66.7	7	0.027	0.0	8	0.061	12.5
Louisiana	10	0.009	0	-	-	2	0.038	0.0	8	0.006	0.0
Southern Missouri	42	0.068	16	0.114	62.5	4	0.077	25.0	22	0.046	18.2
Montana	97	0.042	36	0.038	38.9	14	0.051	42.9	47	0.042	29.8
Nebraska	0	-	0	-	-	0	-	-	0	-	-
Nevada	0	-	0	-	-	0	-	-	0	-	-
New Mexico	299	0.048	117	0.050	34.2	48	0.050	35.4	134	0.046	23.1
North Dakota	47	0.012	29	0.012	13.8	15	0.010	20.0	3	0.026	0.0
Oklahoma	382	0.080	162	0.121	62.3	84	0.068	39.3	136	0.055	29.4
Oregon	0	-	0	-	-	0	-	-	0	-	-
Texas	133	0.041	52	0.098	57.7	25	0.016	24.0	56	0.028	23.2
Utah	2,031	0.033	338	0.033	38.8	608	0.028	32.9	1,085	0.036	25.2
Washington	21	0.028	2	0.016	0.0	9	0.019	0.0	10	0.044	20.0
Wyoming	544	0.021	173	0.017	28.3	101	0.020	31.7	270	0.025	25.2
District 10 (Western Kentucky)	4,515	0.023	1,156	0.021	26.0	951	0.023	19.6	2,408	0.025	17.4
District 11	3,917	0.056	574	0.058	40.2	863	0.063	36.8	2,480	0.053	27.5
Alabama	3,917	0.056	574	0.058	40.2	863	0.063	36.8	2,480	0.053	27.5
Central and Southern Georgia	0	-	0	-	-	0	-	-	0	-	-
Florida	0	-	0	-	-	0	-	-	0	-	-
Mississippi	0	-	0	-	-	0	-	-	0	-	-
Puerto Rico	0	-	0	-	-	0	-	-	0	-	-
Virgin Islands	0	-	0	-	-	0	-	-	0	-	-
TOTAL	116,232	0.050	31,024	0.047	38.9	23,598	0.050	33.8	61,610	0.052	29.3

- indicates incalculable field PEL - permissible exposure limit REL - recommended exposure limit GM - geometric mean mg/m³ - milligrams per cubic meter
 NOTE: All geometric means are reported in MRE (Mining Research Establishment) equivalents. For coal mining, the MSHA PEL is [(10 mg/m³ MRE) / (% quartz)] for respirable dust containing greater than 5 percent quartz. The MSHA respirable coal mine quartz exposure data and the NIOSH REL for respirable quartz cannot be compared to each other because they are based on different sampling criteria. See appendices for source description, methods, and agents.
 SOURCE: Mine Safety and Health Administration (MSHA) coal mine inspector and mine operator quartz data.

Table 3-19 (page 1 of 2). Respirable quartz: Geometric mean exposures and percent exceeding designated occupational exposure limits by MSHA metal/nonmetal mine district and state, MSHA samples, 1979-1999

MSHA Metal/Nonmetal Mine District	All years		1979 - 1988				1989 - 1992				1993 - 1999			
	No. of Samples	GM (mg/m ³)	No. of Samples	GM (mg/m ³)	% > PEL	% > REL	No. of Samples	GM (mg/m ³)	% > PEL	% > REL	No. of Samples	GM (mg/m ³)	% > PEL	% > REL
Northeast	26,788	0.011	8,979	0.015	12.4	19.4	6,060	0.011	9.9	16.1	11,749	0.009	6.5	10.9
Connecticut	718	0.013	285	0.027	26.3	38.2	156	0.013	13.5	23.1	277	0.006	2.5	5.1
Delaware	91	0.005	17	0.006	0.0	0.0	33	0.005	0.0	3.0	41	0.004	4.9	0.0
District of Columbia	0	-	0	-	-	-	0	-	-	-	0	-	-	-
Maine	623	0.012	199	0.025	16.6	24.6	169	0.009	3.0	7.7	255	0.009	4.3	9.8
Maryland	1,440	0.008	518	0.009	4.2	8.1	314	0.007	2.9	7.0	608	0.007	2.6	6.3
Massachusetts	1,280	0.013	476	0.025	17.4	28.6	250	0.010	9.6	16.0	554	0.008	3.6	7.0
New Hampshire	497	0.014	131	0.028	15.3	33.6	133	0.010	7.5	16.5	233	0.012	7.7	12.9
New Jersey	2,524	0.012	992	0.020	17.5	27.5	623	0.012	12.4	20.1	909	0.007	4.2	8.0
New York	6,153	0.010	1,875	0.014	11.4	17.0	1,649	0.009	6.2	11.8	2,629	0.008	5.6	9.7
Pennsylvania	6,344	0.012	2,324	0.014	9.3	15.2	1,212	0.014	13.8	20.5	2,808	0.010	8.1	12.5
Rhode Island	201	0.018	57	0.030	22.8	36.8	35	0.014	8.6	25.7	109	0.015	16.5	25.7
Vermont	1,435	0.016	372	0.019	22.0	31.5	334	0.013	19.2	26.3	729	0.016	19.5	29.8
Virginia	4,009	0.008	1,126	0.011	6.6	12.0	808	0.009	8.5	13.2	2,075	0.007	4.2	7.4
West Virginia	1,473	0.013	607	0.018	17.5	24.4	344	0.015	13.7	19.8	522	0.009	6.9	10.5
Southeast	37,427	0.008	13,902	0.010	7.5	12.4	9,250	0.008	8.2	12.8	14,275	0.007	4.9	8.2
Alabama	3,246	0.007	1,034	0.007	4.2	6.6	876	0.007	8.0	11.9	1,336	0.007	6.3	9.6
Florida	2,998	0.005	830	0.006	3.7	7.1	827	0.005	2.2	5.0	1,341	0.004	1.3	2.3
Georgia	6,163	0.010	2,464	0.014	11.0	19.6	1,567	0.010	10.6	15.3	2,132	0.007	5.3	7.7
Kentucky	2,424	0.008	943	0.009	7.5	10.4	480	0.008	9.4	11.0	1,001	0.006	3.7	5.7
Mississippi	1,690	0.008	273	0.007	4.4	6.6	476	0.007	5.5	8.2	941	0.009	7.0	11.8
North Carolina	8,090	0.008	3,347	0.010	6.4	11.4	2,166	0.008	6.7	11.1	2,577	0.006	3.8	6.9
Puerto Rico	1,237	0.005	586	0.004	0.9	0.2	29	0.007	3.4	10.3	622	0.005	3.1	3.1
South Carolina	4,011	0.009	1,054	0.016	17.3	27.6	1,130	0.009	9.7	16.1	1,827	0.007	3.6	7.7
Tennessee	7,490	0.009	3,327	0.009	6.3	9.9	1,698	0.010	10.5	16.3	2,465	0.009	7.8	13.8
Virgin Islands	78	0.006	44	0.004	0.0	0.0	1	0.010	0.0	0.0	33	0.011	3.0	9.1
North Central	35,491	0.009	12,515	0.011	9.3	13.8	8,549	0.011	10.8	15.8	14,427	0.008	5.2	8.9
Illinois	6,542	0.011	2,796	0.014	16.3	21.0	1,387	0.011	13.0	19.3	2,359	0.007	4.7	8.3
Indiana	4,021	0.007	1,174	0.007	2.9	3.3	917	0.007	4.5	6.0	1,930	0.006	3.0	5.0
Iowa	2,118	0.006	675	0.007	4.9	5.0	570	0.006	5.3	4.9	873	0.005	1.5	1.8
Michigan	5,112	0.011	1,397	0.012	8.4	15.3	1,459	0.013	14.3	19.9	2,256	0.009	6.8	11.3
Minnesota	6,982	0.010	3,402	0.010	5.7	10.6	1,475	0.012	10.5	17.0	2,105	0.008	5.4	8.7
Ohio	6,034	0.010	1,361	0.013	13.2	19.2	1,710	0.010	9.0	14.4	2,963	0.008	6.7	11.8
Wisconsin	4,682	0.010	1,710	0.011	8.8	13.3	1,031	0.013	14.9	20.5	1,941	0.008	5.6	9.9

See footnotes at end of table.

Table 3-19 (page 2 of 2). Respirable quartz: Geometric mean exposures and percent exceeding designated occupational exposure limits by MSHA metal/nonmetal mine district and state, MSHA samples, 1979-1999

MSHA Metal/Nonmetal Mine District	All years		1979 - 1988				1989 - 1992				1993 - 1999			
	No. of Samples	GM (mg/m ³)	No. of Samples	GM (mg/m ³)	% > PEL	% > REL	No. of Samples	GM (mg/m ³)	% > PEL	% > REL	No. of Samples	GM (mg/m ³)	% > PEL	% > REL
South Central	31,305	0.009	7,465	0.013	13.0	17.6	9,403	0.009	9.5	13.7	14,437	0.007	5.5	7.9
Arkansas	2,396	0.015	544	0.038	31.6	45.8	660	0.017	16.7	28.5	1,192	0.009	7.9	13.8
Louisiana	2,421	0.006	279	0.007	7.2	11.8	716	0.005	4.2	6.3	1,426	0.006	4.3	7.6
Missouri	7,486	0.010	2,347	0.013	13.0	16.4	2,008	0.011	11.6	15.1	3,131	0.007	5.0	7.5
New Mexico	3,729	0.013	1,013	0.014	14.4	19.7	1,059	0.015	13.1	21.1	1,657	0.011	11.9	16.0
Oklahoma	4,890	0.009	1,570	0.011	9.9	13.2	1,340	0.011	10.9	16.6	1,980	0.007	4.3	7.7
Texas	10,383	0.007	1,712	0.011	10.0	14.1	3,620	0.007	6.4	8.4	5,051	0.006	4.0	4.4
Rocky Mountain	31,645	0.015	15,364	0.017	14.5	22.2	5,927	0.017	16.7	26.2	10,354	0.012	10.5	16.6
Arizona	5,176	0.017	2,380	0.023	18.0	27.1	717	0.019	18.8	29.0	2,079	0.011	9.8	15.3
Colorado	6,090	0.015	3,459	0.014	12.5	19.9	1,168	0.019	17.4	27.6	1,463	0.017	12.5	23.3
Kansas	2,713	0.011	1,280	0.013	12.3	14.1	542	0.011	9.8	12.5	891	0.009	7.2	8.3
Montana	2,930	0.014	1,370	0.012	10.4	15.3	667	0.023	22.5	33.7	893	0.013	11.8	19.6
Nebraska	780	0.006	53	0.006	5.7	5.7	254	0.006	2.8	4.7	473	0.005	1.9	2.5
Nevada	3,649	0.020	1,224	0.025	24.4	33.7	1,032	0.021	20.4	31.8	1,393	0.017	15.9	25.8
North Dakota	527	0.010	194	0.014	12.9	18.6	72	0.009	1.4	11.1	261	0.008	2.3	7.7
South Dakota	2,536	0.015	1,597	0.018	13.2	23.0	281	0.013	9.3	16.0	658	0.010	8.1	12.8
Utah	4,183	0.015	2,083	0.014	12.6	20.0	889	0.020	18.1	30.4	1,211	0.013	9.7	18.3
Wyoming	3,061	0.014	1,724	0.020	15.1	26.4	305	0.013	13.8	21.0	1,032	0.008	12.5	11.0
Western	16,368	0.011	4,590	0.016	13.5	20.7	4,369	0.013	12.1	19.1	7,409	0.008	6.0	9.2
Alaska	326	0.016	88	0.024	21.6	28.4	33	0.053	24.2	39.4	205	0.011	8.3	15.6
California	7,453	0.013	2,326	0.018	15.2	23.3	2,425	0.014	12.0	21.0	2,702	0.009	7.9	11.7
Hawaii	265	0.004	11	0.005	0.0	0.0	57	0.005	3.5	1.8	197	0.004	1.0	1.0
Idaho	2,609	0.015	912	0.022	15.9	26.1	534	0.017	17.0	27.2	1,163	0.010	7.6	14.3
Oregon	2,685	0.006	413	0.007	4.1	6.3	698	0.007	7.4	8.0	1,574	0.005	1.9	1.8
Washington	3,030	0.009	840	0.011	10.1	13.8	622	0.011	13.3	17.8	1,568	0.007	6.0	8.5
TOTAL	179,024	0.010	62,815	0.013	11.3	17.3	43,558	0.011	10.8	16.5	72,651	0.008	6.3	10.0

- indicates incalculable field

PEL - permissible exposure limit REL - recommended exposure limit GM - geometric mean mg/m³ - milligrams per cubic meter

NOTE: For metal/nonmetal mining, the MSHA PEL is [(10 mg/m³) / (% quartz+2)] for respirable dust containing at least 1 percent quartz. The NIOSH REL is 0.05 mg/m³. See appendices for source description, methods, and agents.

SOURCE: Mine Safety and Health Administration (MSHA) metal/nonmetal mine data.

Table 3-20 (page 1 of 3). Respirable quartz: Geometric mean exposures and percent exceeding designated occupational exposure limits by OSHA region and state, OSHA samples, 1979-1999

OSHA Region	All years		1979 - 1988 OSHA PEL: see note				1989 - 1992 OSHA PEL=0.1 mg/m ³				1993 - 1999 OSHA PEL: see note			
	No. of Samples	GM (mg/m ³)	No. of Samples	GM (mg/m ³)	% > PEL	% > REL	No. of Samples	GM (mg/m ³)	% > PEL	% > REL	No. of Samples	GM (mg/m ³)	% > PEL	% > REL
Region 1	1,376	0.032	980	0.034	25.8	40.2	144	0.018	9.7	22.2	252	0.034	26.6	40.9
Connecticut	446	0.023	344	0.027	19.2	33.7	55	0.014	3.6	16.4	47	0.015	8.5	21.3
Maine	22	0.034	19	0.033	36.8	42.1	0	-	-	-	3	0.038	33.3	33.3
Massachusetts	468	0.038	296	0.041	31.4	46.3	58	0.022	15.5	24.1	114	0.041	30.7	46.5
New Hampshire	227	0.029	143	0.033	23.8	39.9	30	0.020	10.0	30.0	54	0.027	24.1	37.0
Rhode Island	213	0.044	178	0.039	29.8	42.7	1	0.007	0.0	0.0	34	0.084	41.2	55.9
Vermont	0	-	0	-	-	-	0	-	-	-	0	-	-	-
Region 2	1,587	0.041	904	0.043	33.2	48.5	232	0.025	15.9	32.8	451	0.047	36.4	49.2
New Jersey	443	0.035	283	0.041	32.5	45.9	103	0.027	13.6	34.0	57	0.027	19.3	26.3
New York	1,131	0.044	619	0.044	33.3	49.4	125	0.025	18.4	32.8	387	0.052	39.5	53.5
Puerto Rico	9	0.021	2	0.914	100.0	100.0	3	0.007	0.0	0.0	4	0.007	0.0	0.0
U.S. Virgin Islands	4	0.007	0	-	-	-	1	0.007	0.0	0.0	3	0.007	0.0	0.0
Region 3	2,622	0.047	1,996	0.047	30.1	49.2	259	0.034	22.8	39.8	367	0.058	37.3	52.0
Delaware	20	0.020	17	0.014	5.9	11.8	0	-	-	-	3	0.117	66.7	66.7
District of Columbia	0	-	0	-	-	-	0	-	-	-	0	-	-	-
Maryland	215	0.038	123	0.034	29.3	37.4	60	0.037	36.7	51.7	32	0.059	28.1	43.8
Pennsylvania	1,912	0.048	1,406	0.048	29.2	51.1	180	0.032	17.8	36.1	326	0.057	37.4	52.5
Virginia	247	0.041	246	0.040	27.6	41.5	0	-	-	-	1	0.412	100.0	100.0
West Virginia	228	0.061	204	0.062	42.2	55.9	19	0.049	26.3	36.8	5	0.051	60.0	60.0
Region 4	2,523	0.034	1,449	0.039	30.2	43.8	419	0.030	21.0	35.1	655	0.028	20.3	33.3
Alabama	479	0.033	323	0.037	32.2	45.8	98	0.037	23.5	44.9	58	0.015	12.1	20.7
Florida	88	0.037	58	0.034	29.3	37.9	22	0.027	22.7	27.3	8	0.148	62.5	62.5
Georgia	636	0.045	470	0.044	34.5	49.1	73	0.026	19.2	30.1	93	0.072	29.0	53.8
Kentucky	338	0.033	157	0.044	33.1	44.6	64	0.047	29.7	43.8	117	0.018	15.4	17.9
Mississippi	106	0.050	74	0.046	33.8	48.6	22	0.030	13.6	22.7	10	0.295	60.0	90.0
North Carolina	360	0.025	155	0.026	12.3	26.5	25	0.023	16.0	28.0	180	0.024	20.0	31.7
South Carolina	144	0.022	49	0.021	26.5	26.5	40	0.017	15.0	22.5	55	0.027	23.6	29.1
Tennessee	372	0.033	163	0.040	27.6	44.8	75	0.028	18.7	34.7	134	0.027	15.7	35.8

See footnotes at end of table.

Table 3-20 (page 2 of 3). Respirable quartz: Geometric mean exposures and percent exceeding designated occupational exposure limits by OSHA region and state, OSHA samples, 1979-1999

OSHA Region	All years		1979 - 1988 OSHA PEL: see note				1989 - 1992 OSHA PEL=0.1 mg/m ³				1993 - 1999 OSHA PEL: see note			
	No. of Samples	GM (mg/m ³)	No. of Samples	GM (mg/m ³)	% > PEL	% > REL	No. of Samples	GM (mg/m ³)	% > PEL	% > REL	No. of Samples	GM (mg/m ³)	% > PEL	% > REL
Region 5	5,121	0.041	2,819	0.048	35.3	52.7	1,013	0.027	15.8	35.7	1,289	0.039	30.6	42.9
Illinois	947	0.041	538	0.043	34.2	47.8	147	0.030	17.7	33.3	262	0.045	35.1	46.9
Indiana	410	0.032	262	0.037	31.3	45.0	84	0.018	8.3	23.8	64	0.039	37.5	43.8
Michigan	765	0.016	27	0.014	0.0	3.7	262	0.012	2.7	12.6	476	0.019	10.3	20.6
Minnesota	93	0.051	71	0.048	50.7	54.9	9	0.029	0.0	44.4	13	0.098	46.2	46.2
Ohio	1,638	0.047	1,191	0.047	32.3	50.1	229	0.034	20.5	39.7	218	0.069	42.2	57.3
Wisconsin	1,268	0.061	730	0.061	42.3	64.9	282	0.052	25.9	58.5	256	0.074	51.6	67.6
Region 6	1,215	0.040	885	0.036	29.8	41.4	171	0.037	28.7	43.3	159	0.087	44.0	53.5
Arkansas	118	0.031	93	0.023	23.7	31.2	14	0.084	64.3	64.3	11	0.098	63.6	63.6
Louisiana	91	0.064	68	0.056	41.2	64.7	11	0.032	27.3	36.4	12	0.240	41.7	58.3
New Mexico	18	0.073	11	0.041	54.5	54.5	1	0.007	0.0	0.0	6	0.306	100.0	100.0
Oklahoma	198	0.036	153	0.034	19.6	37.3	10	0.044	30.0	50.0	35	0.045	28.6	48.6
Texas	790	0.040	560	0.037	31.8	41.1	135	0.034	25.2	41.5	95	0.089	44.2	50.5
Region 7	1,050	0.033	720	0.035	25.3	38.9	181	0.023	14.4	33.1	149	0.040	33.6	42.3
Iowa	579	0.030	336	0.031	22.6	32.7	116	0.022	14.7	30.2	127	0.038	34.6	41.7
Kansas	105	0.038	75	0.033	25.3	36.0	19	0.051	31.6	68.4	11	0.049	27.3	63.6
Missouri	289	0.040	242	0.046	30.6	50.0	43	0.017	7.0	23.3	4	0.021	25.0	25.0
Nebraska	77	0.027	67	0.023	19.4	32.8	3	0.055	0.0	66.7	7	0.076	28.6	28.6
Region 8	737	0.039	493	0.032	23.7	35.5	122	0.032	25.4	39.3	122	0.107	54.9	70.5
Colorado	458	0.030	321	0.026	20.9	30.8	74	0.025	17.6	32.4	63	0.079	46.0	63.5
Montana	78	0.059	64	0.044	25.0	35.9	11	0.250	72.7	81.8	3	0.141	66.7	66.7
North Dakota	94	0.070	56	0.041	23.2	50.0	2	0.069	50.0	50.0	36	0.161	69.4	80.6
South Dakota	57	0.065	27	0.033	33.3	44.4	10	0.102	70.0	70.0	20	0.132	55.0	75.0
Utah	45	0.043	20	0.142	60.0	60.0	25	0.017	8.0	28.0	0	-	-	-
Wyoming	5	0.022	5	0.022	0.0	20.0	0	-	-	-	0	-	-	-

See footnotes at end of table.

Table 3-20 (page 3 of 3). Respirable quartz: Geometric mean exposures and percent exceeding designated occupational exposure limits by OSHA region and state, OSHA samples, 1979-1999

OSHA Region	All years		1979 - 1988 OSHA PEL: see note				1989 - 1992 OSHA PEL=0.1 mg/m ³				1993 - 1999 OSHA PEL: see note			
	No. of Samples	GM (mg/m ³)	No. of Samples	GM (mg/m ³)	% > PEL	% > REL	No. of Samples	GM (mg/m ³)	% > PEL	% > REL	No. of Samples	GM (mg/m ³)	% > PEL	% > REL
Region 9	374	0.045	235	0.057	43.4	55.3	77	0.028	29.9	32.5	62	0.031	27.4	32.3
American Samoa	0	-	0	-	-	-	0	-	-	-	0	-	-	-
Arizona	49	0.036	31	0.060	45.2	61.3	10	0.010	0.0	10.0	8	0.024	25.0	25.0
California	186	0.026	115	0.025	22.6	36.5	30	0.017	13.3	16.7	41	0.036	29.3	36.6
Guam	0	-	0	-	-	-	0	-	-	-	0	-	-	-
Hawaii	8	0.008	5	0.008	0.0	0.0	0	-	-	-	3	0.007	0.0	0.0
Nevada	131	0.117	84	0.191	73.8	82.1	37	0.056	51.4	51.4	10	0.030	30.0	30.0
Region 10	501	0.041	130	0.046	33.1	40.8	85	0.034	21.2	31.8	286	0.041	25.9	42.0
Alaska	7	0.100	2	0.152	50.0	50.0	5	0.085	60.0	80.0	0	-	-	-
Idaho	42	0.041	18	0.055	50.0	55.6	21	0.040	14.3	42.9	3	0.007	0.0	0.0
Oregon	175	0.029	107	0.046	30.8	39.3	4	0.010	0.0	0.0	64	0.015	12.5	18.8
Washington	277	0.050	3	0.007	0.0	0.0	55	0.032	21.8	25.5	219	0.057	30.1	49.3
TOTAL	17,106	0.039	10,611	0.042	31.1	46.5	2,703	0.028	18.7	35.3	3,792	0.041	31.0	43.8

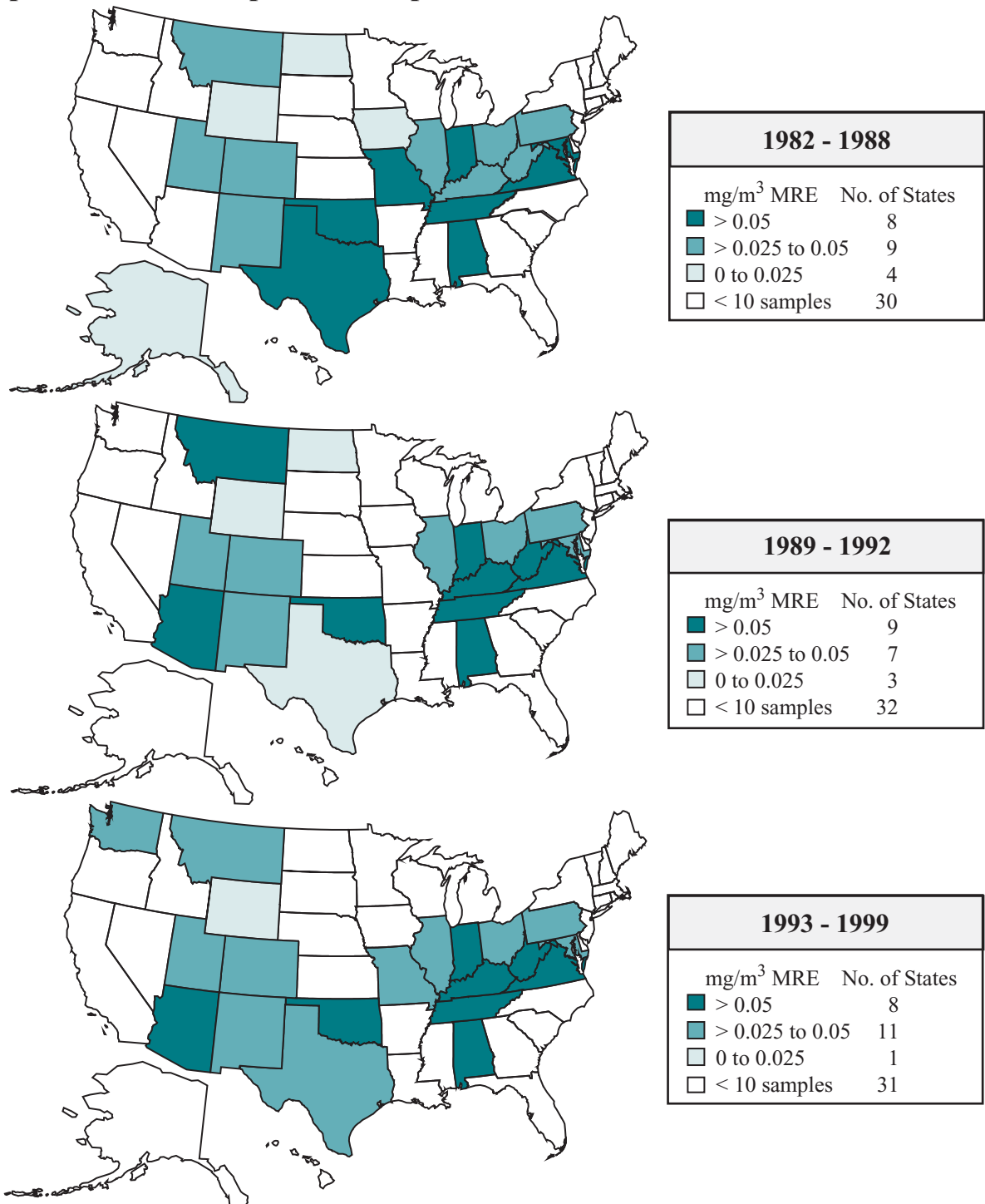
- indicates incalculable field

PEL - permissible exposure limit REL - recommended exposure limit GM - geometric mean mg/m³ - milligrams per cubic meter

NOTE: Before March 1, 1989 and after March 22, 1993, the OSHA PEL is [(10 mg/m³) / (% quartz + 2)] for respirable dust containing at least 1 percent quartz. From March 1, 1989 to March 22, 1993, the OSHA PEL was 0.1 mg/m³ for respirable quartz. The NIOSH REL is 0.05mg/m³. See appendices for source description, methods, and agents.

SOURCE: Occupational Safety and Health Administration (OSHA) Integrated Management Information System.

Figure 3-7. Respirable quartz: Geometric mean coal mining exposures by state, MSHA inspector and mine operator samples, 1982-1999



PEL - permissible exposure limit REL - recommended exposure limit mg/m³ - milligrams per cubic meter

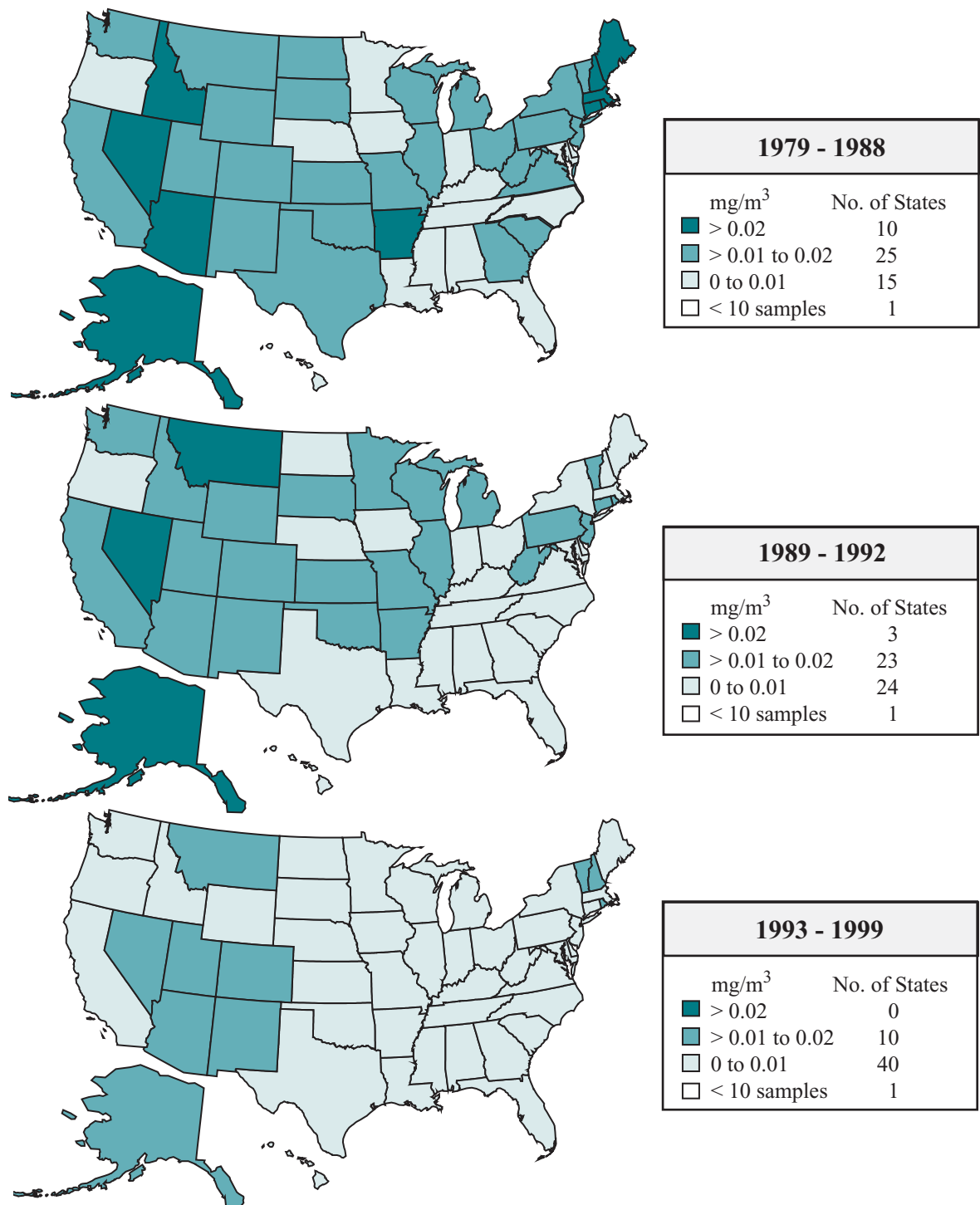
MRE - Mining Research Establishment, not comparable to NIOSH REL

NOTE: For coal mining, the MSHA PEL is [(10 mg/m³ MRE) / (% quartz)] for respirable dust containing greater than 5 percent quartz. The MSHA respirable coal mine quartz exposure data and the NIOSH REL for respirable quartz cannot be compared to each other because they are based on different sampling criteria. See appendices for source description, methods, and agents.

SOURCE: Mine Safety and Health Administration (MSHA) coal mine inspector and operator quartz data.

Silicosis: Respirable Quartz Exposures

Figure 3-8. Respirable quartz: Geometric mean metal/nonmetal mining exposures by state, MSHA samples, 1979-1999

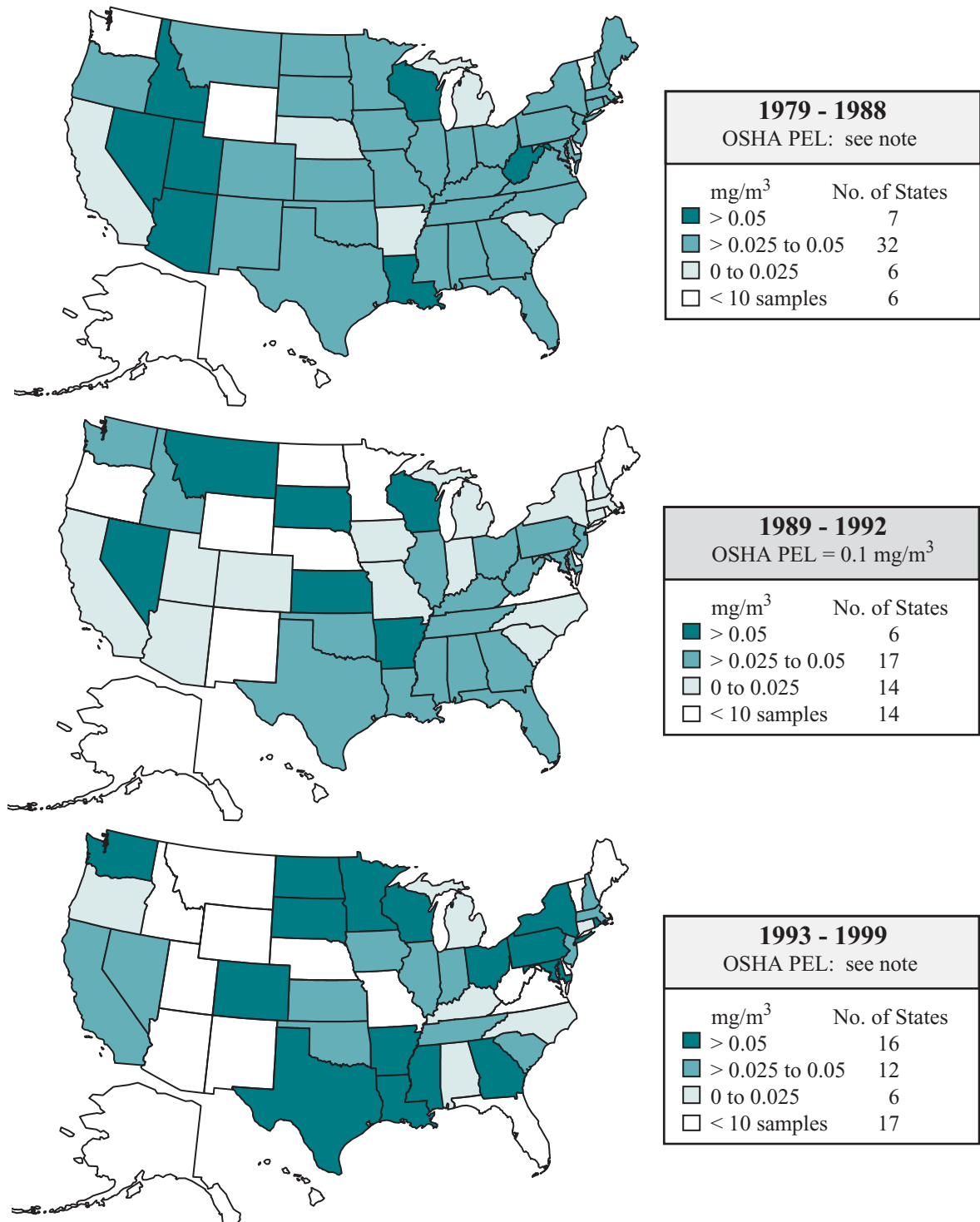


PEL - permissible exposure limit REL - recommended exposure limit mg/m³ - milligrams per cubic meter

NOTE: For metal/nonmetal mining, the MSHA PEL is $[(10 \text{ mg/m}^3) / (\% \text{ quartz} + 2)]$ for respirable dust containing at least 1 percent quartz. The NIOSH REL is 0.05 mg/m³. See appendices for source description, methods, and agents.

SOURCE: Mine Safety and Health Administration (MSHA) metal/nonmetal mine data.

Figure 3-9. Respirable quartz: Geometric mean exposures by state, OSHA samples, 1979-1999



PEL - permissible exposure limit REL - recommended exposure limit mg/m³ - milligrams per cubic meter

NOTE: Before March 1, 1989 and after March 22, 1993, the OSHA PEL is [(10 mg/m³) / (% quartz + 2)] for respirable dust containing at least 1 percent quartz. From March 1, 1989 to March 22, 1993, the OSHA PEL was 0.1 mg/m³ for respirable quartz. The NIOSH REL is 0.05 mg/m³. See appendices for source description, methods, and agents.

SOURCE: Occupational Safety and Health Administration (OSHA) Integrated Management Information System.

Table 3-21. Respirable cristobalite: Geometric mean exposures and percent exceeding designated occupational exposure limits, MSHA and OSHA samples, 1979-1999

	OSHA PEL: see note										OSHA PEL = 0.05 mg/m ³				OSHA PEL: see note						
	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Cristobalite, respirable - MSHA																					
GM (mg/m ³)	0.056	0.050	0.031	0.055	0.037	0.035	0.024	0.025	0.032	0.027	0.032	0.037	0.028	0.020	0.031	0.065	0.033	0.020	0.030	0.015	0.010
No. of samples	12	53	21	5	34	26	23	10	14	22	28	19	13	22	23	12	3	12	7	5	1
% > PEL	58.3	54.7	42.9	100.0	44.1	23.1	26.1	10.0	14.3	31.8	28.6	52.6	46.2	9.1	30.4	66.7	0.0	8.3	28.6	0.0	0.0
% > REL	50.0	43.4	28.6	60.0	23.5	15.4	13.0	10.0	14.3	22.7	21.4	36.8	30.8	0.0	26.1	50.0	0.0	8.3	28.6	0.0	0.0
Cristobalite, respirable - OSHA																					
GM (mg/m ³)	0.033	0.020	0.022	0.022	0.027	0.020	0.024	0.021	0.022	0.020	0.021	0.021	0.021	0.021	0.020	0.032	0.024	0.021	0.021	0.020	0.023
No. of samples	26	193	101	84	26	62	112	78	52	61	101	90	51	154	48	52	39	26	47	26	37
% > PEL	19.2	0.0	3.0	4.8	7.7	0.0	8.0	2.6	1.9	1.6	0.0	2.2	2.0	1.9	0.0	19.2	7.7	7.7	6.4	0.0	8.1
% > REL	19.2	0.0	3.0	4.8	7.7	0.0	7.1	2.6	1.9	1.6	0.0	2.2	2.0	1.9	0.0	19.2	7.7	0.0	2.1	0.0	8.1

– indicates incalculable field

PEL - permissible exposure limit

REL - recommended exposure limit

GM - geometric mean

mg/m³ - milligrams per cubic meter

NOTE: Before March 1, 1989 and after March 22, 1993, the OSHA PEL is [(5 mg/m³) / (% cristobalite + 2)], for respirable dust containing at least 1 percent cristobalite. From March 1, 1989 to March 22, 1993, the OSHA PEL was 0.05 mg/m³ for respirable cristobalite. For metal/nonmetal mining, the MSHA PEL is [(5 mg/m³) / (% cristobalite + 2)] for respirable dust containing at least 1 percent cristobalite. The NIOSH REL is 0.05 mg/m³. See appendices for source description, methods, and agents.

SOURCE: Mine Safety and Health Administration (MSHA) metal/nonmetal mine data. Occupational Safety and Health Administration (OSHA) Integrated Management Information System.