

# Waterborne Fluorides and Mortality

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CAREFUL ANALYSIS of specific mortality data from communities with fluoride-free and fluoride-bearing water supplies will provide indirect evidence about the relationship between the prevalence of certain diseases and exposure to trace amounts of fluoride. A study was therefore designed to examine the relationship between mortality from heart diseases, cancer, intracranial lesions, nephritis, and cirrhosis of the liver in communities with and without fluoride in their drinking water. The first four of these diseases are listed among the leading causes of death in the United States.

Similar studies have been done in the past but were confined to limited geographic areas (1, 2). They failed to show a difference in mortality between cities using fluoride and those using nonfluoride water supplies. Following one such study (1), the State health department publication stated, ". . . it is highly improbable that local physicians in these [fluoride] areas would not be sharply aware of these conditions and highly voluble in making the situation known." Now, however, in view of the widespread interest in water fluoridation, it seems of value to go even further in analyzing and presenting pertinent data from fluoride and nearby nonfluoride communities in the

United States for which water fluoride analyses are available.

## Materials and Methods

The plan of this study is to compare the mortality experience of 32 pairs of fluoride and non-fluoride cities (fig. 1). A community is classified as a "fluoride city" when the majority of the analyses of its water supply indicate the presence of fluoride in concentrations of 0.70 p.p.m. or more. Conversely, a city is classified as "nonfluoride" when, according to these reports, its water supply contains 0.25 p.p.m. or less (3-17). Cities, with a population of 10,000 or more, according to the 1950 census, were included in this study (18). The total population considered in this study is 892,625 persons in fluoride cities and 1,297,500 in non-fluoride cities.

After the States and the fluoride cities within each State were arrayed alphabetically, each fluoride city in order was paired with the nearest nonfluoride city not previously paired. An exception to this method of pairing was required in Texas and New Mexico because fluoride cities outnumber nonfluoride cities. The eight nonfluoride cities were arrayed alphabetically and paired with the nearest fluoride city. Each city was used only in one comparison. Therefore, 13 fluoride cities in Texas and 3 in New Mexico were not included because no nearby nonfluoride cities were available.

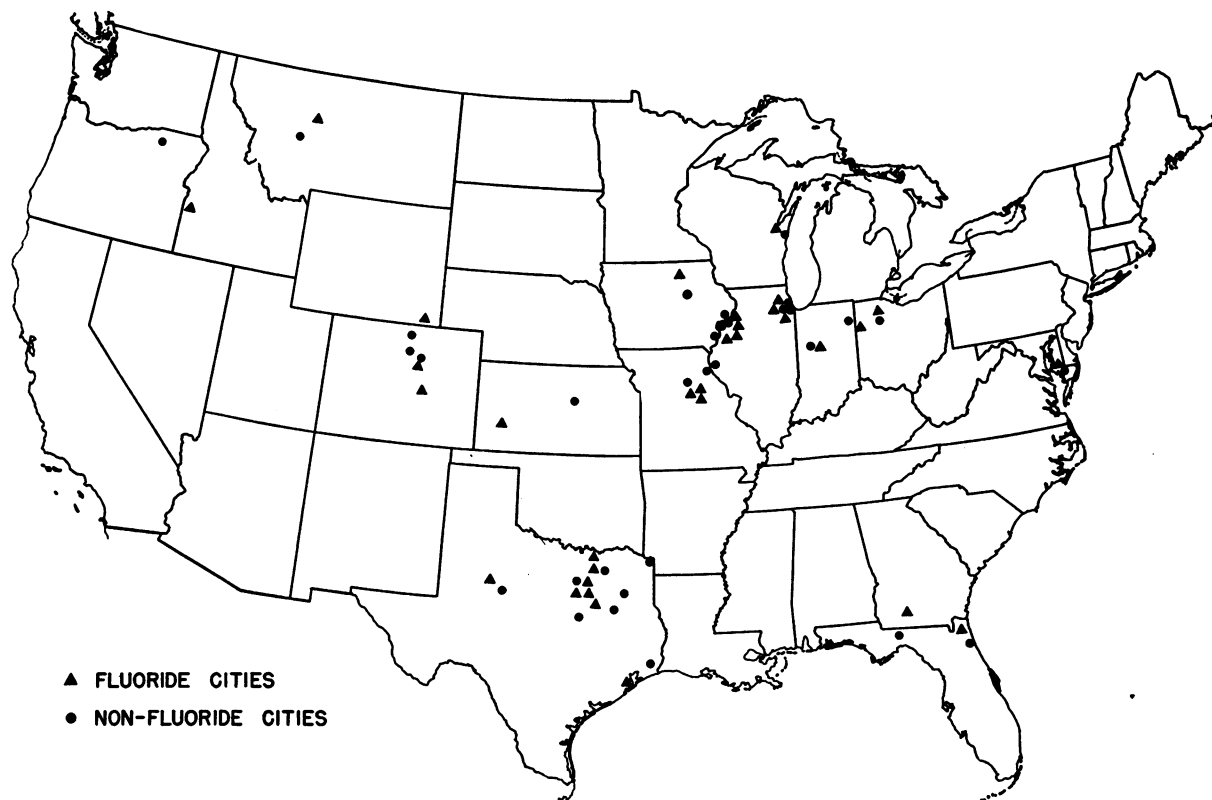
Mortality rates for each city were based on an average of the number of deaths occurring in 1949 and in 1950 wherever data for both years were available (19). The use of 2-

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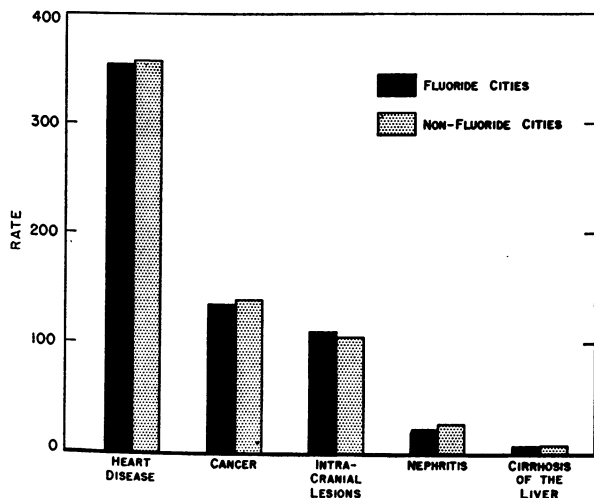
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**Figure 1. Location of the 32 paired fluoride and nonfluoride cities in 16 States of the United States.**



year average rates tends to reduce sampling variation in the analysis of vital data of this type (20). Mortality data of 1949 were not available for cities whose population passed

**Figure 2. Deaths from selected causes in 32 paired fluoride and nonfluoride cities in 16 States of the United States.**



the 10,000 mark during the decade 1940-49. Hence, only the number of deaths for 1950 were used in these instances. The rates were adjusted for age, race, and sex by the indirect method, using the 1950 United States population as a standard (21).

The population of State chronic disease hospitals was deducted from the city population in each instance in which the number of patients in such hospitals exceeded 1 percent of the population of the city concerned. This procedure was followed because the National Office of Vital Statistics allocates death in these institutions to the city of residence of the deceased and inclusion of the institutional population would bias the data for certain communities (22, 23).

### Findings

Table 1 shows mortality rates for all causes and for the selected causes of death. Thirty-two pairs of all causes and disease-specific mortality rates have been arrayed, each pair com-

**Table I. Adjusted mortality rates for all causes and for selected causes per 100,000 population in 32 paired fluoride and nonfluoride cities in the United States, 1949-50**

Paired fluoride and nonfluoride cities	Heart disease (410-443) <sup>1</sup>	Cancer (140-205) <sup>1</sup>	Intra-cranial lesions (330-334) <sup>1</sup>	Nephritis (590-594) <sup>1</sup>	Cirrhosis of liver (581) <sup>1</sup>	All causes
Average: <sup>2</sup>						
Fluoride.....	354.8	135.4	111.5	21.9	6.6	1,010.6
Nonfluoride.....	357.4	139.1	104.8	26.7	8.2	1,005.0
Fluoride: Colorado Springs, Colo. <sup>3</sup> .....	340.5	151.8	87.2	15.7	8.4	1,034.6
Nonfluoride: Aurora, Colo.....	350.4	99.9	21.0	0.0	14.6	912.5
Fluoride: Englewood, Colo. <sup>4</sup> .....	410.9	148.2	94.3	13.8	12.4	1,185.5
Nonfluoride: Boulder, Colo.....	322.0	151.1	91.1	9.6	5.3	971.1
Fluoride: Jacksonville, Fla. <sup>4</sup> .....	338.6	148.3	136.9	23.2	11.8	1,139.0
Nonfluoride: St. Augustine, Fla.....	397.8	135.3	117.2	15.3	0.0	1,155.6
Fluoride: Moultrie, Ga. <sup>4</sup> .....	435.2	123.5	176.7	38.6	0.0	1,226.1
Nonfluoride: Tallahassee, Fla.....	313.2	98.3	111.5	22.4	7.8	900.7
Fluoride: Nampa, Idaho <sup>4</sup> .....	314.2	109.8	120.6	31.4	9.0	888.8
Nonfluoride: Pendleton, Oreg.....	405.9	172.5	105.9	20.3	0.0	1,164.3
Fluoride: Aurora, Ill. <sup>4</sup> .....	374.9	160.5	118.1	25.7	6.8	1,028.4
Nonfluoride: Downers Grove, Ill.....	359.6	174.4	87.3	20.6	0.0	1,042.3
Fluoride: East Moline, Ill. <sup>4</sup> .....	343.4	122.4	109.8	28.9	8.2	969.6
Nonfluoride: Moline, Ill.....	361.6	151.5	95.6	14.3	10.2	974.0
Fluoride: Elmhurst, Ill. <sup>3</sup> .....	333.1	143.0	69.6	17.4	6.6	846.5
Nonfluoride: Melrose Park, Ill.....	515.4	169.1	117.8	49.5	20.9	1,181.8
Fluoride: Galesburg, Ill. <sup>3</sup> .....	408.6	130.3	127.4	13.2	8.0	1,013.7
Nonfluoride: Rock Island, Ill.....	374.2	139.4	104.2	16.6	12.0	1,024.2
Fluoride: Joliet, Ill. <sup>4</sup> .....	458.6	178.4	110.3	29.1	15.0	1,241.6
Nonfluoride: Blue Island, Ill.....	452.8	159.0	93.1	38.7	10.6	1,105.2
Fluoride: Kewanee, Ill. <sup>4</sup> .....	322.6	175.2	120.6	55.0	7.3	1,028.4
Nonfluoride: Davenport, Iowa.....	339.4	146.0	121.4	21.1	6.6	978.8
Fluoride: Monmouth, Ill. <sup>5</sup> .....	412.8	188.1	125.2	0.0	0.0	1,067.0
Nonfluoride: Burlington, Iowa.....	335.3	121.0	134.9	33.5	8.4	967.6
Fluoride: Frankfort, Ind. <sup>4</sup> .....	356.0	133.1	135.1	9.4	0.0	1,048.9
Nonfluoride: Lafayette, Ind.....	362.8	157.3	143.8	11.0	16.5	1,038.8
Fluoride: Charles City, Iowa <sup>4</sup> .....	378.7	169.4	139.9	9.1	0.0	995.7
Nonfluoride: Waterloo, Iowa.....	310.2	97.1	125.6	20.9	5.3	848.4
Fluoride: Garden City, Kans. <sup>4</sup> .....	353.6	83.2	73.8	44.5	0.0	1,006.7
Nonfluoride: Salina, Kans.....	287.6	143.8	113.5	33.7	9.2	975.4
Fluoride: Cambridge, Md. <sup>4</sup> .....	469.6	169.8	129.2	17.1	0.0	1,182.3
Nonfluoride: Salisbury, Md.....	461.7	128.5	150.2	45.8	12.9	1,167.7

prising the rates for a fluoride city and the rates for a nearby nonfluoride city.

The average mortality rate for all causes of death was 1,005.0 per 100,000 population in nonfluoride cities and 1,010.6 in fluoride cities. In 16 pairs the rate was higher in nonfluoride cities, and for 16 pairs it was higher in the fluoride cities. There is no statistically significant difference between the mortality rates for all causes of death in fluoride and nonfluoride cities. The significance of the differences was determined from the differences between the pairs.

This similarity of mortality experience is true for the five causes of death selected for study (fig. 2). The mortality rate from heart diseases for all nonfluoride cities was 357.4 per 100,000 population as compared with 354.8 per

100,000 in fluoride cities. In 17 of the comparisons the rate was higher in the nonfluoride cities; in 15 pairs the rate was higher in the fluoride cities.

Cancer deaths occurred at the rate of 139.1 per 100,000 population in nonfluoride cities and 135.4 per 100,000 in fluoride cities. In half of the 32 pairs the rates were lower in the fluoride cities.

Intracranial lesions were the cause of death in 104.8 per 100,000 population in nonfluoride cities and 111.5 in fluoride cities, with the rate higher in nonfluoride cities for 13 of the 32 pairs.

The nephritis death rate was 26.7 per 100,000 in the nonfluoride cities and 21.9 in the fluoride cities. In 19 pairs the rates were higher in the nonfluoride cities.

**Table 1. Adjusted mortality rates for all causes and for selected causes per 100,000 population in 32 paired fluoride and nonfluoride cities in the United States, 1940-50—Continued**

Paired fluoride and nonfluoride cities	Heart disease (410-443) <sup>1</sup>	Cancer (140-205) <sup>1</sup>	Intra cranial lesions (330-334) <sup>1</sup>	Nephritis (590-594) <sup>1</sup>	Cirrhosis of liver (581) <sup>1</sup>	All causes
Fluoride: Columbia, Mo. <sup>4</sup> .....	241.1	96.6	130.9	33.6	4.4	817.7
Nonfluoride: Moberly, Mo.....	307.9	128.6	82.1	33.1	2.8	950.6
Fluoride: Fulton, Mo. <sup>4</sup> .....	390.7	111.6	94.9	21.6	0.0	1,106.7
Nonfluoride: Hannibal, Mo.....	431.7	125.2	115.0	38.9	8.2	1,104.6
Fluoride: Mexico, Mo. <sup>4</sup> .....	362.2	154.9	40.3	27.8	0.0	941.3
Nonfluoride: Quincy, Ill.....	423.9	147.8	127.5	29.1	5.9	1,090.6
Fluoride: Great Falls, Mont. <sup>4</sup> .....	341.9	161.3	80.7	21.2	19.6	1,016.8
Nonfluoride: Helena, Mont.....	416.1	140.5	92.6	44.5	13.2	1,055.6
Fluoride: Bowling Green, Ohio <sup>4</sup> .....	325.2	101.2	147.7	9.6	10.2	906.7
Nonfluoride: Findley, Ohio.....	336.0	148.6	101.6	17.7	5.4	937.3
Fluoride: Van Wert, Ohio <sup>3</sup> .....	331.8	88.2	33.8	40.3	8.3	787.8
Nonfluoride: Fort Wayne, Ind.....	370.5	160.6	113.2	25.1	9.0	1,046.6
Fluoride: Texas City, Tex. <sup>4</sup> .....	399.1	83.8	91.4	0.0	19.2	923.1
Nonfluoride: Beaumont, Tex.....	331.7	139.1	82.7	29.0	9.5	968.4
Fluoride: Grand Prairie, Tex. <sup>3</sup> .....	342.0	145.1	82.4	13.2	11.0	925.9
Nonfluoride: Fort Worth, Tex.....	344.0	138.9	107.5	18.2	9.6	976.5
Fluoride: McKinney, Tex. <sup>4</sup> .....	454.3	137.4	128.5	31.6	0.0	1,235.6
Nonfluoride: Greenville, Tex.....	323.4	136.2	105.4	30.2	12.3	1,025.4
Fluoride: Corsicana, Tex. <sup>4</sup> .....	255.1	98.5	134.9	22.9	0.0	962.4
Nonfluoride: Palestine, Tex.....	390.3	141.4	68.5	58.1	11.1	1,032.1
Fluoride: Snyder, Tex. <sup>4</sup> .....	240.5	120.3	91.6	14.0	0.0	887.8
Nonfluoride: Sweetwater, Tex.....	314.9	125.5	97.5	24.1	4.2	1,095.0
Fluoride: Sherman, Tex. <sup>4</sup> .....	363.5	154.4	113.4	15.5	9.7	979.4
Nonfluoride: Texarkana, Tex.....	346.6	148.9	136.3	32.0	8.6	1,023.3
Fluoride: Waxahachie, Tex. <sup>3</sup> .....	323.7	147.7	130.3	34.0	9.1	976.2
Nonfluoride: Tyler, Tex.....	321.9	103.3	108.7	17.5	7.5	837.8
Fluoride: Cleburne, Tex. <sup>4</sup> .....	304.1	133.0	138.0	6.3	3.3	966.8
Nonfluoride: Waco, Tex.....	301.9	129.4	90.6	16.7	6.8	913.3
Fluoride: Green Bay, Wis. <sup>3</sup> .....	299.2	123.2	123.4	18.9	9.5	946.7
Nonfluoride: Two Rivers, Wis.....	311.5	167.2	114.6	39.2	4.6	923.7
Fluoride: Cheyenne, Wyo. <sup>4</sup> .....	327.8	140.8	130.3	19.7	14.1	1,057.6
Nonfluoride: Fort Collins, Colo.....	213.6	127.1	75.6	27.7	3.0	770.6

<sup>1</sup> Code numbers from the Sixth Revision of the International List of Causes of Death.

<sup>2</sup> Average of the 32 respective averages for fluoride and nonfluoride cities listed below.

<sup>3</sup> Cities in which fluoride content ranges from 1.4-2.5 p.p.m.

<sup>4</sup> Cities in which fluoride content ranges from 0.7-1.3 p.p.m.

<sup>5</sup> Cities in which fluoride content ranges from 2.6-4.0 p.p.m.

For cirrhosis of the liver the mortality rate per 100,000 population was 8.2 for nonfluoride cities and 6.6 for fluoride cities and the rates were higher for nonfluoride cities in 17 pairs.

### Summary

1. This report presents an analysis of mortality from all causes and from five selected causes—heart disease, cancer, intracranial lesions, nephritis, and cirrhosis of the liver—in 64 cities in 16 States, and compares rates in those cities in which water analyses show the fluoride content to be 0.25 p.p.m. or less with those cities where the fluoride content is 0.70 p.p.m. or more.

2. These data show no statistically significant

difference between the mortality rates of fluoride and nonfluoride cities for all causes or for heart disease, cancer, intracranial lesions, nephritis, or cirrhosis of the liver.

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