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A Report on Cancer and Infant Mortality in Whately, Massachusetts

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The Department of Public Health received a request to review cancer mortality statistics for the town of Whately, Massachusetts. The analysis is hampered by the small size of Whately, which had a population of 1145 in 1970 and 1341 in 1980. Among Whately residents, a total of 38 cancer deaths occurred for the 14 year period, 1969-1982, or an average of 2.7 cancer deaths per year. Such small numbers make it very difficult to determine whether cancer mortality rates are significantly elevated in Whately.

The data are analyzed in several different ways.

(1) The cancer mortality data for Whately are compared with Massachusetts cancer mortality data to see whether the rates for Whately are significantly different from the state as a whole.

(2) Cancer deaths in Whately are compared with cancer deaths in Massachusetts towns of similar size to Whately. These towns have many characteristics in common with Whately, such as being rural and predominantly agricultural.

(3) Cancer mortality rates in towns in the same area as Whately are compared to the Whately experience.

(4) Cancer deaths in Whately residents are reviewed to determine whether any specific type of cancer was significantly elevated during the period 1969-1982.

(5) Finally, neonatal and infant mortality statistics for Whately are reviewed. Adverse reproductive outcomes can represent a sensitive indicator of environmental exposures.

Cancer mortality data for the 14 year period 1969-1982 are reviewed in order to make the numbers as large as possible. The data were supplied by the Department's Division of Health Statistics and Research. Cancer mortality data for 1983 are not yet available.

I. Background on Statistical Significance

The Standardized Mortality Ratio (SMR) is used to compare cancer mortality in a town to the state as a whole. The SMR is calculated as follows:

$$\frac{\text{observed number of cancer deaths}}{\text{expected number of cancer deaths}} \times 100$$

An SMR of 100 indicates a town has experienced the same number of deaths as expected based on statewide rates. An SMR greater than 100 means more deaths were experienced than expected, while an SMR less than 100 means fewer deaths were experienced than expected.

The interpretation of an SMR depends on two things: its magnitude and its stability. Two SMRs may have the same magnitude but not the same stability. An SMR of 200 may represent 6 observed deaths and 3 expected deaths, or 600 observed deaths and 300 expected deaths. In the former case, the 100% excess of observed deaths represents 3 additional deaths over the expected number; one or two fewer observed deaths would change the SMR a great deal. In the second case, the 100% excess of observed deaths represents 300 additional deaths over the expected number; even if there were several fewer

observed deaths, the SMR would hardly change. When the observed and expected numbers of deaths are relatively small, their ratio is easily affected by one or two deaths. This means the SMR is not very stable, and interpretation of the SMR must be done cautiously. However, when the observed and expected deaths are relatively large, the value of the SMR is stable; its interpretation would remain roughly the same even if several fewer (or more) deaths had been observed.

A statistical test which assesses both the stability and size of the SMR is the chi square test. The chi square test measures the probability that the difference between the observed number of deaths and the expected number of deaths could occur due to chance. The standard convention in such a test is to call the difference between the observed and the expected deaths "significant" if the probability of the difference occurring due to chance is less than 5 in 100 (or 0.05). If the expected number is less than 5, the Poisson probability is calculated.

II. Whately vs. Massachusetts

During the 14 year period, 1969-1982, 38 cancer deaths occurred among Whately residents. Based on Massachusetts rates (adjusted for age and sex) during that period, 34 cancer deaths were expected. Thus, Whately had an SMR of of 112 for this time period, or 12% more deaths due to cancer than expected based on statewide rates. The difference, however, was not statistically sign-

ficant (p>0.50). Of the 38 cancer deaths, 21 occurred in females and 17 in males. This compared to 13.8 expected deaths in females, and 20.2 in males , or SMRs of 152 for females, and 84 for males. Neither value is significant. Table I provides a more detailed analysis of female cancer deaths.

TABLE I

Female Cancer Deaths In Whately, Massachusetts
(1969 -1982)

Years	Expected	Observed	SMR	Significance
1969-1973	4.4	10	227	+ (p=.015)
1974-1978	5.0	7	140	NS*
1979-1982	4.4	4	91	NS
	13.8	21	152	NS

*NS = Not Significant

The data in Table I illustrate that SMRs for female cancer deaths have been declining over the 14 year period. Most cancers have long latency periods, meaning 20-40 years may elapse from the time of exposure to the manifestation of the disease. The exposures, therefore, for the cancers occurring during the period 1969-1973 probably took place sometime during the period 1930-1955.

In conclusion, the overall cancer mortality experience in Whately did not differ significantly from the statewide experience. The only significant difference occurred in females during the 1969-1973 period.

III. Whately vs. Other Small Towns

Although Whately's cancer mortality rate did not differ from the state rate, we examined Massachusetts towns similar in size to Whately. All the towns chosen for comparison had populations within 200 of Whately's population in both the 1970 and the 1980 census. SMRs for the period 1969-1982 were calculated for each of these towns, based on the state rates. The results are shown in Table II.

Table II

SMRs for Towns Similar in Size to Whately, Massachusetts for the period 1969-1982

Town	Observed	Expected	SMR	Significance
Ashfield	41	38.4	107	NS*
Conway	28	27.5	102	NS
Egremont	27	42.4	64	+
Erving	39	41.0	95	NS
Gill	31	31.9	97	NS
Granville	23	29.1	79	NS
Leverett	15	25.5	59	+
New Marlborough	26	34.5	75	NS
Truro	44	45.6	96	NS
Whately	38	34.0	112	NS

* NS Not Significant

+ Significantly less than 100 ($p < 0.05$)

None of the SMRs were significantly elevated, and two towns, Egremont and Leverett, had SMRs significantly less than expected.

Table III shows the SMR values for the time periods 1969-1973, 1974-1978, and 1979-1982. It also illustrates the instability of the SMRs due to the small numbers. That is, a change in one or two deaths greatly affects the SMR. For example, in Conway for 1979-1982, if 10 deaths had occurred vs. the 8 deaths that did occur, the SMR would have changed from 88 to 110.

Table III

SMRs for Towns Similar in Size to Whately, Massachusetts for the Periods 1969-1973, 1974-1978, and 1979-1982

	1969 - 1973			1974-1978			1979 - 1982		
	Obs	Exp	SMR	Obs	Exp	SMR	Obs	Exp	SMR
Ashfield	15	12.7	118	13	13.8	94	13	11.9	109
Conway	6	8.4	71	14	10.0	140	8	9.1	88
Egremont	10	13.6	74	11	15.4	71	6	13.4	45
Erving	10	13.4	75	12	14.7	82	17	12.9	132
Gill	11	10.3	107	7	11.5	61	13	10.1	129
Granville	10	9.8	102	7	10.6	66	6	8.7	69
Leverett	4	7.9	51	7	9.3	75	4	8.3	48
New Marlboro	5	10.2	49	10	12.5	80	11	11.8	93
Truro	14	11.6	121	11	16.7	66	19	17.3	110
Whately	13	11.0	118	13	12.3	106	12	10.6	113

None of the SMRs in Table III were significantly elevated.

IV. Site-Specific Cancers in Whately

Deaths due to site-specific cancers were also examined to see whether any specific type of cancer was elevated. This is important since cancer is actually many different diseases with many different causes. For example, smoking and exposure to asbestos both increase the risk of getting lung cancer, benzene increases the risk of leukemia, and sunlight increases the risk of skin cancer. If there is a specific cancer-causing environmental agent to which a certain population is exposed, one would expect to see an increase in a certain type of cancer.

The only specific cancer where more than five cases occurred over the 14 year period was lung cancer. Eleven cases of this cancer occurred, six in males and five in females. Seven cases would have been expected based on statewide rates for that time period. The SMR is 157, but again, it is not significantly elevated. Table IV gives the breakdown of cancer deaths in Whately from 1969-1982. The distribution of types of cancer deaths in Whately approximates the national distribution of cancer deaths. Nationally, the leading causes of cancer deaths in males are lung, colon-rectum, and prostate cancers, while in females, they are breast, colon-rectum, and lung cancers.

Table IV

Cancer Deaths in Whately, Massachusetts
(1969-1982)

Type	Number of Deaths
Stomach	3
Colon & Rectum	4
Pancreas	1
Bronchus & Lung	11
Breast	3
Cervix	1
Ovary	2
Prostate	3
Kidney	1
Brain	1
Nervous System, unspecified	1
Unspecified Site	2
Lymphoid Tissue	1
Multiple Myeloma	1
Myeloid Leukemia	2
Other specified leukemia	1
Total	38

V. Regional Analysis

Finally, towns in the same area were reviewed to see whether any unusual elevations in cancer rates existed on a region-wide basis. These towns would presumably be similar in size, population characteristics, and environmental exposures. Towns within a 10 mile radius of Whately were reviewed. Northampton, Amherst, and Greenfield were not included in this analysis since those towns have much larger populations, and are therefore less rural. The towns analyzed are listed below:

Chesterfield

Deerfield

Goshen

Hadley

Hatfield

Montague

Sunderland

Williamsburg

The time periods for which SMRs were calculated are:

1969-1973

1974-1978

1969-1978

Data reviewed came from the Massachusetts Standardized Mortality Ratios: 1969-1978, published by the Department's Division of Health Statistics and Research.

The following observations were made:

a. None of the towns had a significant SMR value for overall cancers for any of the time periods.

b. The following towns had significant elevations in certain specific cancers:

Town	1969-1973	1974-1978	1969-1978
Deerfield	stomach (1.8 vs 6)*	-	-
Hadley	stomach (1.9 vs 8)	-	stomach (3.6 vs 12)
Hatfield	prostate (1.3 vs 5)	other female organs ** (1.5 vs 5)	other female organs (2.7 vs 8)
Montague	-	-	bladder-females (1.6 vs 5) kidney-females (1.2 vs 5)
Chesterfield	lung (1.4 vs 5)	-	-

* All numbers in parentheses are expected number of deaths due to the specific cancer noted vs. observed number of deaths due to that cancer.

** Cancer of the uterus, ovaries, and other female reproductive organs (not including cervical cancer)

c. Data were reviewed to see whether any of the specific cancers elevated in the 1969-1978 period were also elevated in the more recent 1979-1982 period. No elevation was seen for any of these specific cancers.

Therefore, on a regional basis, there does not appear to be an elevation in site-specific and cancer mortality, nor any consistent trends through time for any specific cancer.

VI. Neonatal Deaths in Whately

Adverse reproductive outcomes represent a sign of possible genetic damage. In Massachusetts, statistics are kept on neonatal and infant mortality. Neonatal mortality is defined as deaths of infants less than 28 days of age. Infant mortality is defined as deaths of infants less than 365 days of age. In Whately, 7 neonatal and infant deaths occurred during 1969-1982. Of these seven, five were neonatal deaths, and two were post-neonatal infant deaths. The five neonatal deaths were three triplets and two twins, all born prematurely. Thus, only two pregnancies over 14 years resulted in neonatal deaths. The two post-neonatal infant deaths were due to sudden infant death syndrome, and occurred in infants two months and three months of age. The numbers here are too small to evaluate statistically.

VII. Limitations

This investigation into cancer mortality in Whately is known as a descriptive investigation. Descriptive studies provide an initial evaluation of trends in mortality or morbidity to determine whether more detailed study is warranted. A number of limitations, however, are inherent in a study of this type.

(1) No information exists on individual risk factors, such as smoking and occupational exposures, which contribute to the incidence of disease.

(2) Due to the small number of cancer deaths in Whately, the statistical tests for significance lack power and stability. That is, the possibility of overlooking an excess in cancer mortality in Whately cannot be ruled out.

(3) Mortality data are based on the causes of death provided on death certificates. Physicians may record inaccurate information on the certificates.

(4) No information is known on the residential histories of the cases. Some cases may reside in a certain town at the time of death, but may have spent most of their lives in another town.

VIII. Conclusions

A review of cancer mortality data for the period 1969-1982 revealed that Whately did not have a significant elevation in overall cancer mortality rates compared to state rates. No specific type of cancer was significantly elevated in Whately. The only significant elevation occurred in total cancer mortality in females during the period 1969-1973. That difference was not apparent in 1974-1982.

No Massachusetts towns similar in size to Whately had significantly elevated SMRs.

A regional analysis was performed. No significant elevation in overall cancer mortality, nor any consistent elevations in any specific cancers were apparent in other towns in the vicinity of Whately.

The number of infant deaths in Whately for the period 1969-1982 was too small to evaluate statistically.

The available evidence summarized above indicates that Whately has not experienced an unusual elevation of cancer mortality during the period 1969-1982.