



The Commonwealth of Massachusetts
Executive Office of Health and Human Services
Department of Public Health
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May 9, 2006

Mary Lampert

Dear Ms. Lampert:

This letter is a response to your recent email to Bob Knorr at the Massachusetts Department of Public Health (MDPH) requesting child health statistics. Enclosed are data on childhood cancer and low birthweight in Duxbury, Kingston, Marshfield and Plymouth around the Pilgrim Nuclear Power Station. Dr. Knorr forwarded your inquiry to the Community Assessment Program (CAP), a division within the Center for Environmental Health (CEH) at the MDPH, which responds to requests such as yours. Enclosed with this letter please find eight tables that summarize the data we are able to provide to you.

Tables 1-3 summarize the incidence of all childhood cancers in four communities (Duxbury, Kingston, Marshfield and Plymouth) during three separate time periods (1982-1988, 1989-1995 and 1996-2002). Childhood cancer is defined as all invasive, primary cancers diagnosed in children aged 0 to 19 years at diagnosis. [For an explanation of how the Standardized Incidence Ratio (SIR) was calculated and how to interpret it, please see the attachment entitled *Explanation of a Standardized Incidence Ratio (SIR) and 95% Confidence Interval*.] Tables 4-7 are a summary of the different cancer types diagnosed in each time period by town. In a March 2003 MDPH Center for Health Statistics, Research and Evaluation report entitled *Childhood Cancer in Massachusetts 1990-1999*, the three most common cancers among all Massachusetts children and adolescents less than 20 years old were leukemia (23.8%), lymphomas (18.6%, which include Hodgkin's disease and other lymphomas), and central nervous system cancers (17.4%, which include brain cancer and other CNS tumors). Similarly, in a 1999 federal report entitled *Cancer Incidence and Survival among Children and Adolescents: United States SEER Program 1975-1995*, the highest childhood cancer rates were for leukemia, lymphomas, and brain/CNS cancers.

Table 8 summarizes the percentage of low birthweight babies out of the total number of births in each of the same four communities along with the overall percentage of low birthweight babies for the state for comparison. Low birthweight is defined as any newborn who weighted less than 2500 grams (5 lbs. 8 oz.) at birth.

The following is a summary based upon a review of these data:

- For 1982-1988, with two exceptions, the number of observed diagnoses of childhood cancers was less than the number expected. In Marshfield there were five diagnoses of childhood cancer observed in males compared to four expected and in Kingston there were two diagnoses observed in females compared to one expected; however, the differences were not statistically significant.
- For 1989-1995, in each of the four communities, in some instances, the number of observed diagnoses exceeded the number expected; the differences, however, were not statistically significant. In Duxbury females, three diagnoses of childhood cancer were observed versus approximately two expected. In Kingston among males and females combined, six diagnoses of childhood cancer were observed versus approximately three expected. In Marshfield, more females were diagnosed with childhood cancer than expected (6 observed versus 3.1 expected) and fewer males were diagnosed than expected (1 observed versus 4.1 expected). In Plymouth, the number of overall childhood cancers slightly exceeded the number expected (16 observed versus 15.3 expected).
- For 1996-2002, for the three communities of Duxbury, Kingston, and Marshfield, the number of observed diagnoses of childhood cancer was consistently lower than the number expected. In Plymouth males and females, childhood cancer rates were higher for both males and females. However, the differences were not statistically significant.
- As seen in Tables 4-7, the types of childhood cancers diagnosed during 1982-2002 were generally consistent with state and national trends, with the most common diagnoses of leukemia, Hodgkin's disease, and brain/CNS cancers being consistent with state and national trends. There were a few exceptions. As seen in Table 4, no childhood diagnoses of brain/CNS cancer were reported in Duxbury over the 21-year time period whereas two diagnoses of bone cancer were reported over a 14-year time period. Also, as seen in Table 6, four diagnoses of bone cancer occurred in Marshfield over the 21-year time period. Finally, as seen in Table 7, three diagnoses of thyroid cancer occurred in Plymouth during the 1996-2002 period. Due to the observation of three thyroid diagnoses in Plymouth during the latest seven-year time period, we evaluated the geographic distribution of their place of residence. The three individuals with thyroid cancer resided approximately six to 12 miles apart. One individual diagnosed resided in the north of Plymouth, one in the east, and one in the southern portion of Plymouth.

If you have any questions regarding the information that is enclosed in this letter, please feel free to contact me at (617) 624-5757.

Sincerely,

A handwritten signature in cursive script that reads "Jan Sullivan".

Jan Sullivan, Director
Community Assessment Program
Center for Environmental Health

Enclosures

CC: Suzanne Condon, Associate Commissioner, MDPH
Martha J. Steele, Deputy Director, CEH
Bob Knorr, Director, Environmental Epidemiology, CEH

TABLE 1
Childhood Cancer Incidence
Duxbury, Kingston, Marshfield & Plymouth, MA
1982-1988

Town	Total				Males				Females			
	Obs	Exp	SIR	95% CI	Obs	Exp	SIR	95% CI	Obs	Exp	SIR	95% CI
Duxbury	3	4.5	NC	NC -- NC	1	2.4	NC	NC -- NC	2	2.0	NC	NC -- NC
Kingston	2	2.7	NC	NC -- NC	0	1.5	NC	NC -- NC	2	1.2	NC	NC -- NC
Marshfield	7	7.3	96	39 -- 199	5	4.0	126	41 -- 295	2	3.3	NC	NC -- NC
Plymouth	8	13.6	59	25 -- 116	4	7.4	NC	NC -- NC	4	6.2	NC	NC -- NC

Note: SIRs are calculated based on the exact number of expected cases.
 Expected number of cases presented are rounded to the nearest tenth.
 SIRs and 95% CI are not calculated when observed number of cases < 5.

Obs = Observed number of cases 95% CI = 95% Confidence Interval
 Exp = Expected number of cases NC = Not calculated
 SIR = Standardized Incidence Ratio * = Statistical significance

Data Source: Massachusetts Cancer Registry, Center for Health Information, Statistics, Research and Evaluation, Massachusetts Department of Public Health.

TABLE 2
Childhood Cancer Incidence
Duxbury, Kingston, Marshfield & Plymouth, MA
1989-1995

Town	Total				Males				Females			
	Obs	Exp	SIR	95% CI	Obs	Exp	SIR	95% CI	Obs	Exp	SIR	95% CI
Duxbury	4	4.7	NC	NC -- NC	1	2.6	NC	NC -- NC	3	2.0	NC	NC -- NC
Kingston	6	3.0	199	73 -- 432	4	1.7	NC	NC -- NC	2	1.3	NC	NC -- NC
Marshfield	6	7.2	97	39 -- 200	1	4.1	NC	NC -- NC	6	3.1	191	70 -- 416
Plymouth	16	15.3	104	60 -- 169	10	8.6	116	56 -- 214	6	6.7	89	33 -- 194

Note: SIRs are calculated based on the exact number of expected cases.
Expected number of cases presented are rounded to the nearest tenth.
SIRs and 95% CI are not calculated when observed number of cases < 5.

Obs = Observed number of cases 95% CI = 95% Confidence Interval
Exp = Expected number of cases NC = Not calculated
SIR = Standardized Incidence Ratio * = Statistical significance

Data Source: Massachusetts Cancer Registry, Center for Health Information, Statistics, Research and Evaluation, Massachusetts Department of Public Health.

TABLE 3
Childhood Cancer Incidence
Duxbury, Kingston, Marshfield & Plymouth, MA
1996-2002

Town	Total				Males				Females			
	Obs	Exp	SIR	95% CI	Obs	Exp	SIR	95% CI	Obs	Exp	SIR	95% CI
Duxbury	3	5.1	NC	NC -- NC	1	2.7	NC	NC -- NC	2	2.4	NC	NC -- NC
Kingston	2	3.9	NC	NC -- NC	0	2.1	NC	NC -- NC	2	1.8	NC	NC -- NC
Marshfield	5	8.2	61	20 -- 143	4	4.4	NC	NC -- NC	1	3.8	NC	NC -- NC
Plymouth	20	16.6	120	74 -- 186	11	8.9	124	62 -- 221	9	7.7	117	53 -- 222

Note: SIRs are calculated based on the exact number of expected cases.
 Expected number of cases presented are rounded to the nearest tenth.
 SIRs and 95% CI are not calculated when observed number of cases < 5.

Obs = Observed number of cases
 Exp = Expected number of cases
 SIR = Standardized Incidence Ratio
 95% CI = 95% Confidence Interval
 NC = Not calculated
 * = Statistical significance

Data Source: Massachusetts Cancer Registry, Center for Health Information, Statistics, Research and Evaluation, Massachusetts Department of Public Health.

TABLE 4
Number of Different Cancer Types
Duxbury
1982-2002

Cancer	Time Period			Totals
	1982-1988	1989-1995	1996-2002	
Leukemia	1	-	-	1
Hodgkins	1	-	-	1
Bone	-	1	1	2
Ovarian	-	-	1	1
Testicular	-	-	1	1
Melanoma	-	1	-	1
All Other Types	1	2	-	3

TABLE 5
Number of Different Cancer Types
Kingston
1982-2002

Cancer	Time Period			Totals
	1982-1988	1989-1995	1996-2002	
Leukemia	1	1	-	2
Brain/CNS	-	2	-	2
Hodgkins	-	1	-	1
Bone	-	-	1	1
Ovarian	-	-	1	1
Melanoma	-	1	-	1
Stomach	1	-	-	1

TABLE 6
Number of Different Cancer Types
Marshfield
1982-2002

Cancer	Time Period			Totals
	1982-1988	1989-1995	1996-2002	
Leukemia	1	-	-	1
Brain/CNS	1	1	1	3
Hodgkins	-	1	1	2
Bone	2	1	1	4
Thyroid	-	-	1	1
Testicular	1	-	-	1
Kidney	-	1	-	1
All Other Types	1	3	1	5

TABLE 7
Number of Different Cancer Types
Plymouth
1982-2002

Cancer	Time Period			Totals
	1982-1988	1989-1995	1996-2002	
Leukemia	2	3	4	9
Brain/CNS	1	3	4	8
Hodgkins	2	2	1	5
Bone	-	1	-	1
Thyroid	-	-	3	3
Ovarian	1	-	-	1
Oral/Pharynx	-	1	1	2
NHL	-	1	1	2
Kidney	-	-	1	1
Larynx	-	1	-	1
Colon/Rectum	1	-	-	1
All Other Types	1	4	5	10

TABLE 8
Percentage of Low Birthweight Babies (<2500 grams) in Total Births
Duxbury, Kingston, Marshfield, and Plymouth, MA
1989-2003

Year					
	Duxbury	Kingston	Marshfield	Plymouth	Massachusetts
1989	3.1	N/A [†]	4.2	3.2	5.9
1990	5.1	5.2	4.8	5.7	5.8
1991	7.0	6.3	3.2	5.4	5.9
1992	5.4	6.3	2.9	4.4	5.9
1993	5.3	5.2	4.0	5.1	6.2
1994	5.0	3.4	4.1	5.3	6.4
1995	3.6	4.2	3.1	4.6	6.3
1996	3.7	4.5	3.0	5.8	6.4
1997	5.2	4.7	5.4	6.2	7.0
1998	N/A [†]	3.6	3.7	4.7	7.0
1999	5.2	8.3	4.7	4.2	7.1
2000	6.9	5.1	5.9	5.9	7.0
2001	4.4	8.6	5.8	5.2	7.2
2002	7.5	3.9	5.3	8.1	7.5
2003	5.6	3.4	4.0	6.3	7.6

[†]N/A: Not Available due to small numbers and protection of confidentiality.

Data Source: MassCHIP, Center for Health Information, Statistics, Research and Evaluation, Massachusetts Department of Public Health.

Explanation of a Standardized Incidence Ratio (SIR) And 95% Confidence Interval

In order to evaluate cancer incidence a statistic known as a standardized incidence ratio (SIR) was calculated for each cancer type. An SIR is an estimate of the occurrence of cancer in a population relative to what might be expected if the population had the same cancer experience as some larger comparison population designated as "normal" or average. Usually, the state as a whole is selected to be the comparison population. Using the state of Massachusetts as a comparison population provides a stable population base for the calculation of incidence rates. As a result of the instability of incidence rates based on small numbers of cases, SIRs were not calculated when fewer than five cases were observed.

Specifically, an SIR is the ratio of the observed number of cancer cases to the expected number of cases multiplied by 100. An SIR of 100 indicates that the number of cancer cases observed in the population evaluated is equal to the number of cancer cases expected in the comparison or "normal" population. An SIR greater than 100 indicates that more cancer cases occurred than expected and an SIR less than 100 indicates that fewer cancer cases occurred than expected. Accordingly, an SIR of 150 is interpreted as 50% more cases than the expected number; an SIR of 90 indicates 10% fewer cases than expected.

Caution should be exercised, however, when interpreting an SIR. The interpretation of an SIR depends on both the size and the stability of the SIR. Two SIRs can have the same size but not the same stability. For example, an SIR of 150 based on 4 expected cases and 6 observed cases indicates a 50% excess in cancer, but the excess is actually only two cases. Conversely, an SIR of 150 based on 400 expected cases and 600 observed cases represents the same 50% excess in cancer, but because the SIR is based upon a greater number of cases, the estimate is more stable. It is very unlikely that 200 excess cases of cancer would occur by chance alone.

To determine if the observed number of cases is significantly different from the expected number or if the difference may be due solely to chance, a 95% confidence interval (CI) was calculated for each SIR. A 95% CI assesses the magnitude and stability of an SIR. Specifically, a 95% CI is the range of estimated SIR values that has a 95% probability of including the true SIR for the population. If the 95% CI range does not include the value 100, then the study population is significantly different from the comparison or "normal" population. "Significantly different" means there is less than 5% percent chance that the observed difference is the result of random fluctuation in the number of observed cancer cases.

For example, if a confidence interval does not include 100 and the interval is above 100 (e.g., 105-130), then there is statistically significant excess in the number of cancer cases. Similarly, if the confidence interval does not include 100 and the interval is below 100 (e.g., 45-96), then the number of cancer cases is statistically significantly

lower than expected. If the confidence interval range includes 100, then the true SIR may be 100, and it cannot be concluded with sufficient confidence that the observed number of cases is not the result of chance and reflects a real cancer increase or decrease. Statistical significance is not assessed when fewer than five cases are observed.

In addition to the range of the estimates contained in the confidence interval, the width of the confidence interval also reflects the stability of the SIR estimate. For example, a narrow confidence interval (e.g., 103--115) allows a fair level of certainty that the calculated SIR is close to the true SIR for the population. A wide interval (e.g., 85--450) leaves considerable doubt about the true SIR, which could be much lower than or much higher than the calculated SIR. This would indicate an unstable statistic.