Massachusetts Department of Public Health

Evaluation of the Incidence of Prostate Cancer in Plymouth, MA

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Bureau of Environmental Health, Community Assessment Program

Introduction

In response to a request from a Plymouth resident, the Massachusetts Department of Public Health/Bureau of Environmental Health (MDPH/BEH) evaluated the incidence of prostate cancer in Plymouth, Massachusetts. The Community Assessment Program (CAP) within MDPH/BEH assessed prostate cancer incidence in the town of Plymouth as a whole as well as in its nine census tracts. This report summarizes the results of the CAP investigation.

Approach

To assess the pattern of prostate cancer in Plymouth, CAP obtained data from the Massachusetts Cancer Registry (MCR) for the period of 2004–2008. At the initiation of this assessment, these were the most recent cancer incidence data available. Since then, two additional years of cancer incidence data have become available. CAP staff evaluated these data as well. The MCR is a population-based surveillance system that monitors cancer incidence in the Commonwealth. All new diagnoses of invasive cancer, as well as certain in situ (localized) cancers, are required by law to be reported to the MCR. New diagnoses of cancer are reported to the MCR based on a person's residence at diagnosis.

Using a standardized incidence ratio (SIR), the reported or observed number of individuals diagnosed with prostate cancer in Plymouth was compared to the number of individuals that would be expected to be diagnosed based on the statewide experience. Specifically, an SIR is the ratio of the observed number of diagnoses in an area (i.e., community or census tract) to the expected number of diagnoses multiplied by 100. Age-specific statewide incidence rates were applied to the population distribution of Plymouth to calculate the number of expected cancer diagnoses. Comparison of SIRs between communities or census tracts is not possible because each of these areas has different population characteristics.

An SIR of 100 indicates that the number of cancer diagnoses observed in the population being evaluated is equal to the number of cancer diagnoses expected in the comparison or

"normal" population. An SIR greater than 100 indicates that more cancer diagnoses occurred than expected, and an SIR less than 100 indicates that fewer cancer diagnoses occurred than expected. Accordingly, an SIR of 150 is interpreted as 50% more diagnoses than the expected number; an SIR of 90 indicates 10% fewer diagnoses than expected.

Caution should be exercised, however, when interpreting an SIR. The interpretation of an SIR depends on both its size and the stability. Two SIRs may have the same size but not the same stability. For example, an SIR of 150 based on four expected diagnoses and six observed diagnoses indicates a 50% excess in cancer, but the excess is actually only two diagnoses. Conversely, an SIR of 150 based on 400 expected diagnoses and 600 observed diagnoses represents the same 50% excess in cancer, but because the SIR is based upon a greater number of diagnoses, the estimate is more stable. It is very unlikely that 200 excess diagnoses of cancer would occur by chance alone. As a result of the instability of incidence rates based on small numbers of diagnoses, SIRs are not calculated when fewer than five diagnoses were observed for a particular cancer type.

To help interpret or measure the stability of an SIR, the statistical significance of an SIR can be assessed by calculating a 95% confidence interval (CI) to determine if the observed number of diagnoses is "statistically significantly different" from the expected number or if the difference may be due solely to chance. Specifically, a 95% CI is the range of estimated SIR values that have 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. "Statistically significantly different" means there is less than a 5% percent chance that the observed difference (either increase or decrease) in the rate is the result of random fluctuation in the number of observed cancer diagnoses.

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

diagnoses. Similarly, if the confidence interval does not include 100 and the interval is below 100 (e.g., 45-96), then the number of cancer diagnoses is statistically significantly lower than expected. If the confidence interval range includes 100, then the true SIR may be 100. In this case, it cannot be determined with certainty whether the difference between the observed and expected number of diagnoses reflects a real cancer increase or decrease or is the result of chance. It is important to note that statistical significance alone does not necessarily imply public health significance. Determination of statistical significance is just one tool used to interpret cancer patterns.

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, such as 103-115, allows a fair level of certainty that the calculated SIR is close to the true SIR for the population. A wide interval, for instance 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. Again, due to the instability of incidence rates based on small numbers of diagnoses, statistical significance is not assessed when fewer than five diagnoses are observed.

Findings

Figure 1 is a map of Plymouth and its nine census tracts. Table 1 presents prostate cancer incidence data for Plymouth and each census tract. The incidence of prostate cancer in the town of Plymouth as a whole was statistically significantly elevated during 2004–2008, with 288 diagnoses observed compared to approximately 210 diagnoses expected. Elevations were observed in 6 of the 9 census tracts in the town. In two census tracts (5305 and 5307), statistically significant elevations were seen. In census tract 5305, there were 39 individuals diagnosed with prostate cancer compared to approximately 25 diagnoses that would be expected. In census tract 5307, 32 individuals were diagnosed with prostate cancer compared to approximately 15 that would be expected. One other census tract (5304) had an elevation of borderline statistical significance where 38

diagnoses were observed compared to approximately 28 expected. In the remainder of the census tracts, no statistically significant differences between the incidence of prostate cancer and the statewide experience were seen.

The town-wide elevation in prostate cancer incidence was largely spread throughout the town and was not concentrated in any one area or neighborhood, though two adjacent census tracts (5305 and 5307) had statistically significant elevations and one census tract (5304) had an elevation that approached statistical significance. Detailed maps of where men lived at the time of diagnosis were compared to population density maps of Plymouth. In general, the geographic distribution of residences at diagnosis followed the pattern of population density of Plymouth. In some areas of the town, individuals diagnosed with prostate cancer lived in close proximity to one another. In census tract 5307, closer examination of an area that appeared to have an unusual concentration revealed the presence of a community development attractive to adults over 55 and seniors; 34% of the individuals diagnosed with prostate cancer living in the census tract resided in this development which contains 22% of the census tract's population. Given the amenities in this development (such as golf courses and a country club), it would be expected to attract older adults near or in retirement.

Age at diagnosis and the subtypes of prostate cancer were also evaluated to determine if the pattern in Plymouth was consistent with the epidemiological literature. The pattern of age at diagnosis in Plymouth men was similar to what would be expected. Nationally, the average age at diagnosis is 67 years of age. The chance of developing prostate cancer increases rapidly after age 50. In Plymouth, the average age was 66 years. The average age within each of the nine census tracts varied slightly but was consistently in the 60s. No unusual patterns, such as a higher incidence in a younger age group than would be expected, was observed either in Plymouth or any of its census tracts.

Nationally, over 95% of prostate cancers are adenocarcinomas (cancers that arise in glandular cells). The distribution of subtypes of prostate cancer in Plymouth and each of

its census tracts was consistent with this pattern, with at least 95% of diagnoses consisting of adenocarcinomas.

Stage at diagnosis was evaluated to determine if men in Plymouth are being diagnosed at similar stages of prostate cancer as men statewide; staging describes the extent of spread of an individual's cancer. From a public health perspective, an earlier stage (local) reflects to some extent that men are possibly being screened regularly for prostate cancer whereas a later stage (distant; more progressive disease) may reflect a lack of access to screening. Men in Plymouth appear to be diagnosed at stages similar to men across the state with a slightly lower percentage diagnosed at the local stage compared to the state (79% versus 82%) and a slightly higher percentage diagnosed at the regional stage compared to the state (13% versus 10%). In the three census tracts with statistically significant or nearly statistically significant elevations, the percentage of men diagnosed at the local stage was similar to that statewide and ranged from 81 to 85%. The percentage of men diagnosed at the regional stage within CT 5305 (5%) was lower than that of the state whereas that of men diagnosed within CTs 5304 (18%) and 5307 (16%) was higher than that of the state.

As stated earlier, since CAP initiated the analysis of data for the time period of 2004–2008, two additional years of cancer incidence data have become available. These data have been reviewed and, in general, similar patterns were observed. The one exception was CT 5305; the elevation in prostate cancer in this census tract is no longer statistically significant for the 2006–2010 period.

According to the American Cancer Society, about 1 in 6 men will be diagnosed with prostate cancer during his lifetime. Prostate cancer seems to run in families, which suggests that there may be an inherited or genetic factor. Inherited mutations of the BRCA1 or BRCA2 genes (which increase the risk of breast and ovarian cancers) may also increase the risk of prostate cancer. The exact role of diet in prostate cancer is not clear. It's possible that a diet high in red meat and high-fat dairy products puts a man at

slightly higher risk while a diet high in vegetables, fruits, and legumes decreases a man's risk. Also, exposure to certain agricultural pesticides may be associated with an increased risk of prostate cancer among pesticide applicators. Farming is the most consistent occupational risk factor for prostate cancer.

Finally, high levels of arsenic in drinking water have been associated with an increased risk of prostate cancer. Data for the Plymouth municipal water supply from 2000–2013 were evaluated to check for exceedances of the drinking water standard for arsenic. No exceedances of the drinking water standard for arsenic have been reported for the Plymouth municipal drinking water during this time period.

It is important to keep in mind that identifying exposures that may contribute to cancer development can be difficult due to a long latency period for most types of cancer. The latency period refers to the time between exposure to a cancer causing agent and the appearance of clinical symptoms and/or diagnosis of the disease. As a solid tumor, prostate cancer is believed to have a long development period, estimated to be 10 to 30 years or more.

Summary

The incidence of prostate cancer in Plymouth was statistically significantly elevated during the 2004–2008 time period. In one area of Plymouth (census tract 5307), with the highest rate of prostate cancer, the elevation appears to be due, at least in part, to the presence of a community development attractive to older adults. The average age of diagnosis of prostate cancer is 67, although the chance of developing prostate cancer increases rapidly after age 50. In addition to age, other risk factors for prostate cancer include family history (including inherited genetic mutations) and possibly diet, occupational exposures to agricultural pesticides, and exposure to high levels of arsenic in drinking water. A review of drinking water sampling data for the Plymouth municipal water supply did not show any exceedances of the drinking water standard for arsenic. The MDPH will continue to monitor the incidence of prostate cancer in Plymouth

through the MCR's City/Town Supplement.

Figure 1

Census Tracts and Population Density
Plymouth, Massachusetts

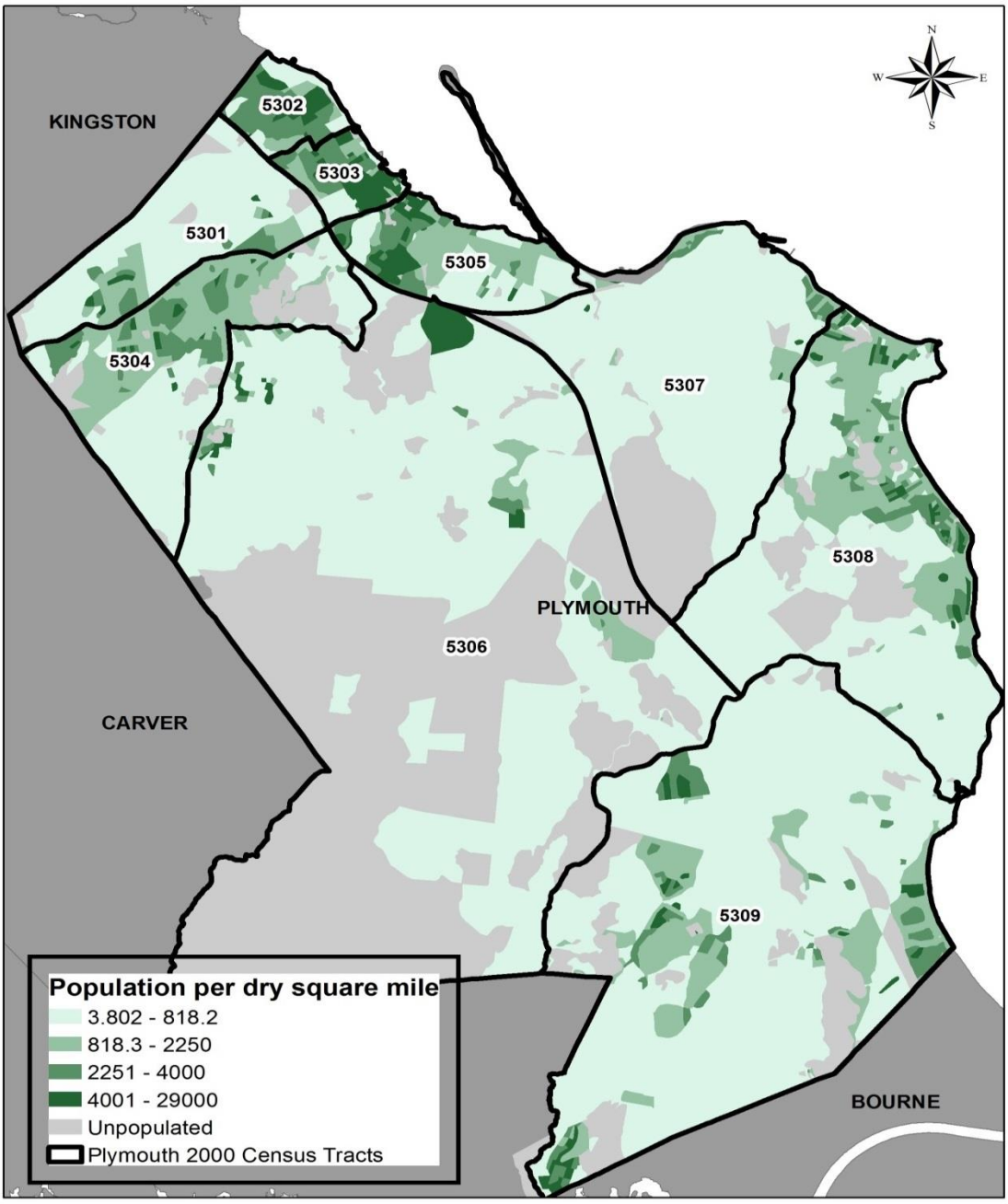

Table 1
Prostate Cancer Incidence
Plymouth, Massachusetts
2004-2008

Census Tract	Males					
	Obs	Exp	SIR	95% CI		
5301	17	12.7	134	78	--	215
5302	9	14.2	63	29	--	120
5303	19	16.5	115	69	--	180
5304	38	27.8	136	97	--	187
5305	39	24.7	158 *	112	--	216
5306	29	23.5	123	83	--	177
5307	32	15.2	210 *	144	--	296
5308	40	34.6	116	83	--	158
5309	43	40.9	105	76	--	142
Town Total†	288	210.1	137 *	122	--	154

† Cases for which census tract designation was not possible are included in the town total.

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

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

Data Source: Massachusetts Cancer Registry, Massachusetts Department of Public Health.