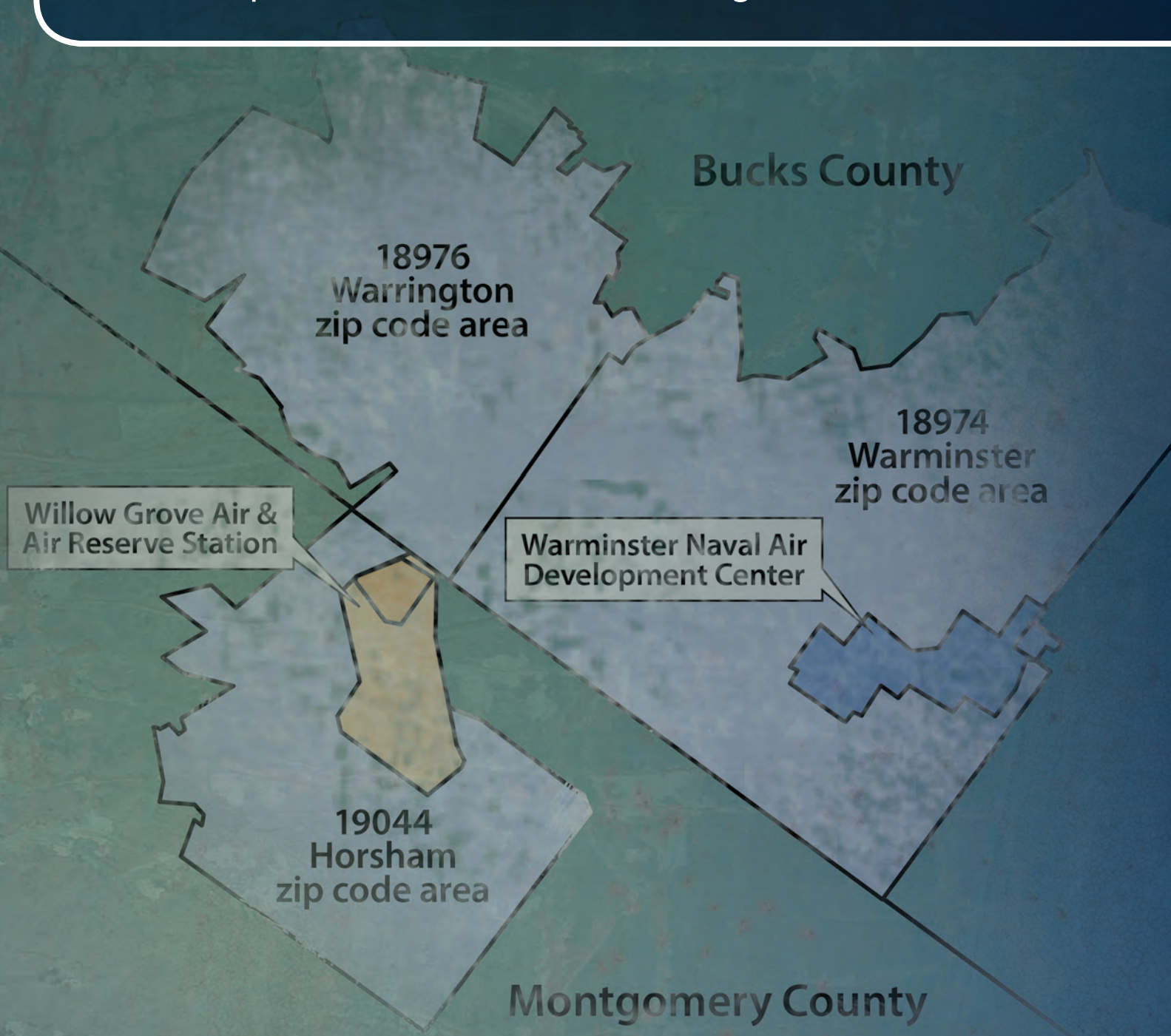


Cancer Data Review (1985–2013)

Selected Zip Codes of Warminster, Warrington, and Horsham, PA



Cancer Data Review (1985–2013)

Selected Zip Codes of Warminster, Warrington, and Horsham, PA

Summary

Key Messages

This cancer data review provides an inconclusive picture of cancer incidence rates in Horsham, Warminster, and Warrington zip codes. The cancer incidence information reviewed does not meet the definition of a cancer cluster at this time.

- Kidney and liver cancers were **within expected ranges** for all genders, time periods, and zip codes reviewed.
- Statistically significant **increases in cancer incidence** were found for bladder, myeloma, non-Hodgkin's lymphoma, and testis for different time periods, genders, and zip codes reviewed.
- Statistically significant **decreases in cancer incidence** were found for bladder and prostate for males in different time periods and zip codes reviewed.

Given these findings and the legacy of environmental contamination in this area, as new data or additional information become available, consideration will be given to updating and/or further study of this information.

Where Can I Learn More?

For more information on cancer clusters, see <http://www.cdc.gov/nceh/clusters/>.

For more information on PFAS at the Warminster site, see ATSDR's Letter Health Consultation for the Former Naval Air Warfare Center at http://www.atsdr.cdc.gov/HAC/pha/NavalAirWarfareCenter/Naval_Air_Warfare_Center_LHC_01-20-2016_508.pdf.

Who can I speak with if I have additional questions?

For questions about your health, we recommend you contact your physician.

For questions about the Pennsylvania Department of Health (PADOH) Cancer Registry, please contact Dr. Gene Weinberg, Director, Division of Community Epidemiology at (717) 787-3350 or gweinberg@pa.gov.

For questions related to ATSDR's work at the Warminster and Willow Grove sites, please contact Lora Werner, Regional Director, Region 3 at (215) 814-3141 or lkw9@cdc.gov, or Dr. Karl Markiewicz, Senior Toxicologist at (215) 814-3149 or kvm4@cdc.gov.

CDC defines a **cancer cluster** as a greater than expected number of cancer cases that occurs within a group of people in a geographic area over a defined period of time. As a group, cancers are very common. One of every four deaths in the United States is attributable to some form of cancer. Multiple factors affect the likelihood of developing cancer, including age, genetic factors, and such lifestyle behaviors as diet and smoking.

Evaluation

Purpose

The Agency for Toxic Substances and Disease Registry (ATSDR) and the Pennsylvania Department of Health (PADOH) developed this document to provide information about cancer incidence rates for communities living in zip codes surrounding the former Naval Air Warfare Center in Warminster, Bucks County, PA and the Willow Grove Naval Air and Air Reserve Station, Horsham, Montgomery County, PA (“the sites”) for the period 1985–2013.

Background

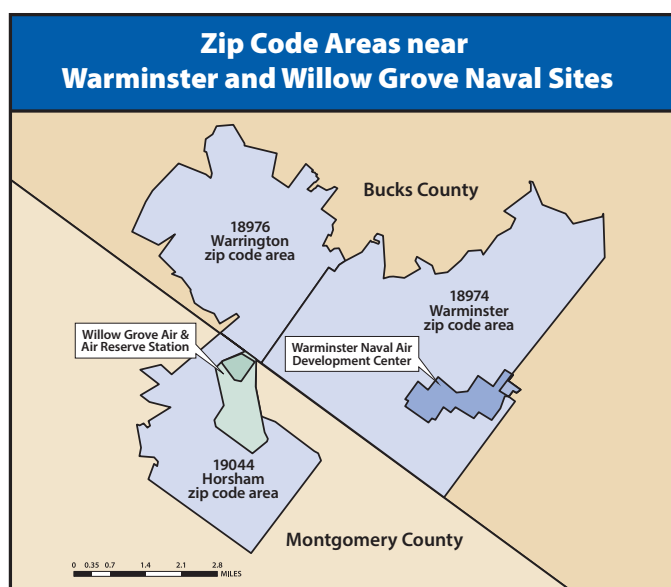
Residents have raised concerns about environmental contamination and health problems over the years in the Warminster and Willow Grove area. Specific contaminants detected in public and/or private drinking water in the area include:

- volatile chemicals such as tetrachloroethylene (PCE), trichloroethylene (TCE), 1,2-dichloroethene (1,2, DCE), and carbon tetrachloride) and, more recently,
- perfluoroalkyl substances (PFAS) such as perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA).

In 1979–1980, a team from the Bucks County Health Department, PADOH, and Centers for Disease Control and Prevention (CDC) conducted a study of exposures to TCE and cancer rates in Bucks and Montgomery Counties. This work included:

- two community-based screenings for TCE exposure that included sampling for TCE in drinking water and testing for TCE metabolites in urine;
- a death certificate review for cases of fatal liver tumors in Montgomery County;
- a health hazard evaluation of workers exposed to TCE at a local tube manufacturing plant in Montgomery County; and
- a review of cancer mortality rates for the digestive, respiratory, skeletal, lymphatic, hematopoietic, and genitorurinary systems from 1960–1978 in Montgomery County as compared to Pennsylvania rates.

Figure 1:



The team found that residents of both counties had measurable levels of TCE in their urine, but medical questionnaire and death certificate reviews did not reveal adverse health effects linked to TCE exposures in the community members included in this study. The team also studied workers living in this community who were known to be exposed to high levels of TCE in their workplace and found adverse health symptoms compatible with acute exposures to TCE.

Another early 1980s study by the Bucks County Health Department, PADOH, and CDC studied the rates of birth defects within Warminster Township, Northampton Township, Upper Southampton Township, and Ivyland Borough. At that time, it was found that birth defects in the area were within normal levels.

Cancer Data Review (1985–2013)

Selected Zip Codes of Warminster, Warrington, and Horsham, PA

In 2006, PADOH published a report reviewing cases of brain cancer in children and young adults under the age of 25 living in the Warminster area from 1993–2004. The information available at that time did not indicate a higher occurrence in the number of brain cancers among that age group in the Warminster area.

To address recent community concerns about cancer in the area, PADOH examined the occurrence of cancers in three zip codes surrounding these two sites: 18974 (Warminster), 18976 (Warrington), and 19044 (Horsham).

Methodology

A cancer incidence analysis is the primary tool used by PADOH to investigate the possibility of excess cancer in a community. For a cancer incidence analysis, PADOH calculates incidence rates using information reported to the Pennsylvania state cancer registry, and compares this information at the zip code level to state wide or county wide rates by calculating standardized incidence ratios. A cancer incidence analysis cannot determine that cancer was associated with or caused by environmental or other risk factors. Instead, the cancer incidence analysis is specifically intended to address the question, “Is there an excess of cancer in the area or population of concern?” PADOH follows guidelines recommended by CDC and the Council of State and Territorial Epidemiologists for investigating concerns about cancer clusters. In order to determine if an excess of cancer is occurring and if further investigation is recommended, further epidemiologic evidence, if available, and site specific circumstances are considered. PADOH must also factor in to consideration that excesses of cancer may occur by chance alone. PADOH and ATSDR selected the time periods that included 1985 to 1994, 1995 to 2004 and 2005 to 2013 to look for time trends in this information. PADOH also reviewed cancer incidence rates for the combined three zip codes over these time periods.

CDC defines a **cancer cluster** as a greater than expected number of cancer cases that occurs within a group of people in a geographic area over a defined period of time. As a group, cancers are very common. One of every four deaths in the United States is attributable to some form of cancer. Multiple factors affect the likelihood of developing cancer, including age, genetic factors, and such lifestyle behaviors as diet and smoking.

To determine whether a statistically significant excess of cancer existed in the geographic areas of concern, the number of observed cases was compared to what would be “expected” based on the state cancer rates. Calculating the expected number(s) of cancer cases takes into consideration the sex, and ages of people who are diagnosed with cancer. This is important because sex, and age impact cancer rates. If we are trying to determine if there is more or less cancer in a community compared to the rest of the state, we must make sure that the difference in cancer rates is not simply due to one of these factors. For this cancer statistics review for the Waminster, Warrington, and Horsham area, seven cancer types (i.e., bladder, kidney, liver, non-Hodgkin’s lymphoma, multiple myeloma, prostate, and testicular) were selected for inclusion based on associations in the literature of these cancer types and the historical environmental contaminants of concern in this area (PFAS, PCE, and TCE).

In general, if further study is indicated after a preliminary cancer data review as conducted in this cancer incidence analysis, PADOH determines the feasibility of conducting an epidemiologic study. If the epidemiologic study is feasible, the final step is to recommend an etiologic investigation to see if the cancer(s) can be related to the exposure of concern. Very few cancer cluster investigations in the United States proceed to this stage.

Results

For zip codes 18974, 18976, and 19044 and the zip codes combined, kidney and liver cancers were all found to be within expected ranges in both males and females. Statistically significant increases (SIR) relative to statewide rates were found for the following cancers and zip codes:

- **Bladder**

- » Males, 2005–2013, increased by approximately 1.3 times statewide rate, zip code 18974
- » Males, 2005–2013, increased by approximately 1.2 times statewide rate, combined zip codes

- **Myeloma**

- » Males, 1985–1994, increased by approximately 1.9 times statewide rate, zip code 18974
- » Males, 1985–1994, increased by approximately 1.6 times statewide rate, combined zip codes

- **Non-Hodgkin's lymphoma (NHL)**

- » Females, 1985–1994, increased by approximately 1.5 times statewide rate, zip code 18974
- » Females, 1985–1994, increased by approximately 1.4 times statewide rate, combined zip codes
- » Males, 2005–2013, increased by approximately 1.3 times statewide rate, zip code 18974
- » Males, 2005–2013, increased by approximately 1.2 times statewide rate, combined zip codes

- **Testis**

- » Males, 1985–1994 and 1995–2004, increased by approximately 2.1 times statewide rate, zip code 19044

Statistically significant decreases relative to statewide rates were found in the following cancers and zip codes:

- **Bladder**

- » Males, 1985–1994, decreased by approximately 0.3 times statewide rate, zip code 18976

- **Prostate**

- » Males, 1995–2004, decreased by approximately 0.8 times statewide rate, zip code 19044

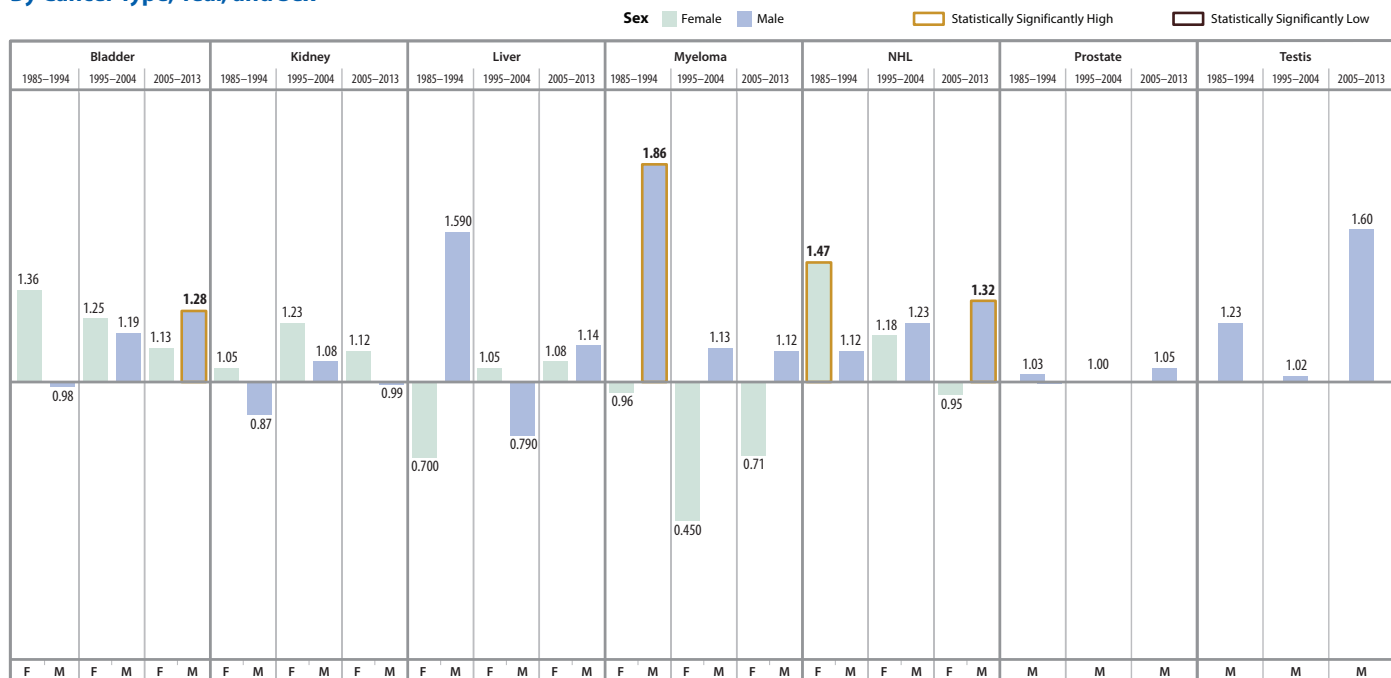
These results are summarized in Figure 2 (page 6) and in Table 1 (page 9).

Cancer Data Review (1985–2013)

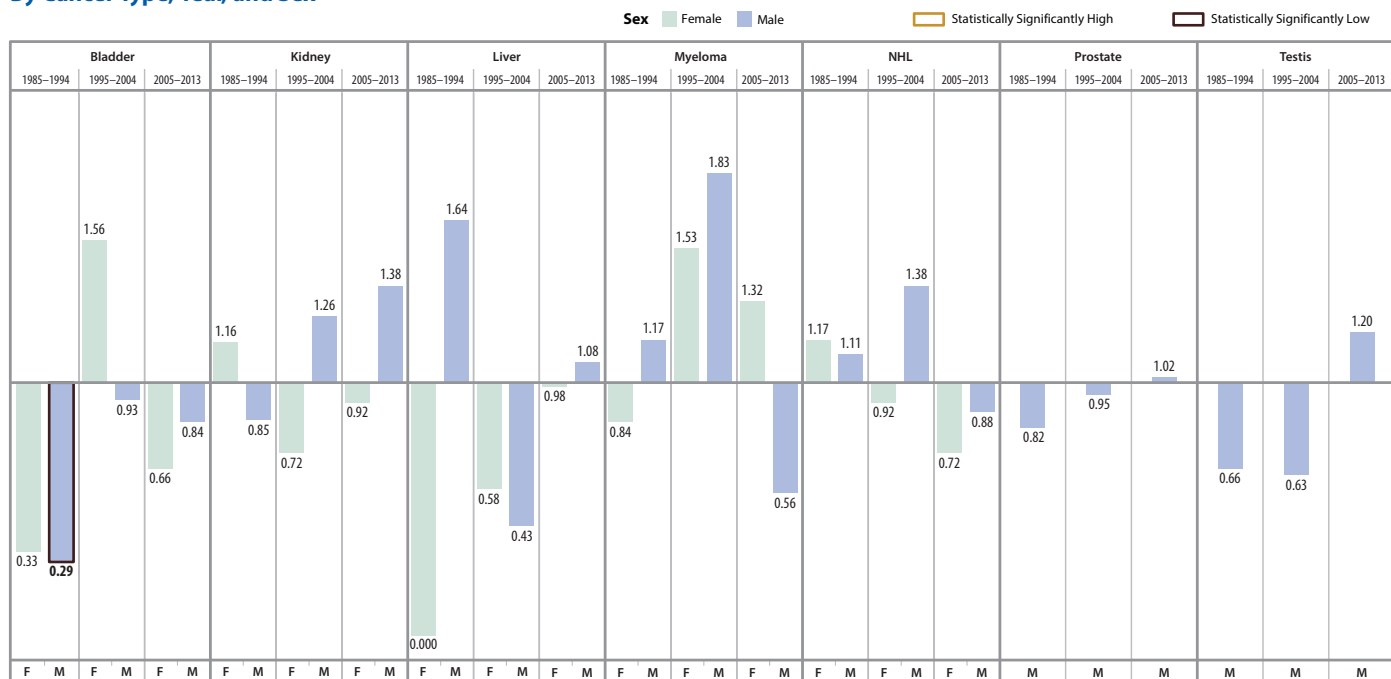
Selected Zip Codes of Warminster, Warrington, and Horsham, PA

Figure 2:

SIRs for Warminster (18974) By Cancer Type, Year, and Sex



SIRs for Warrington (18976) By Cancer Type, Year, and Sex

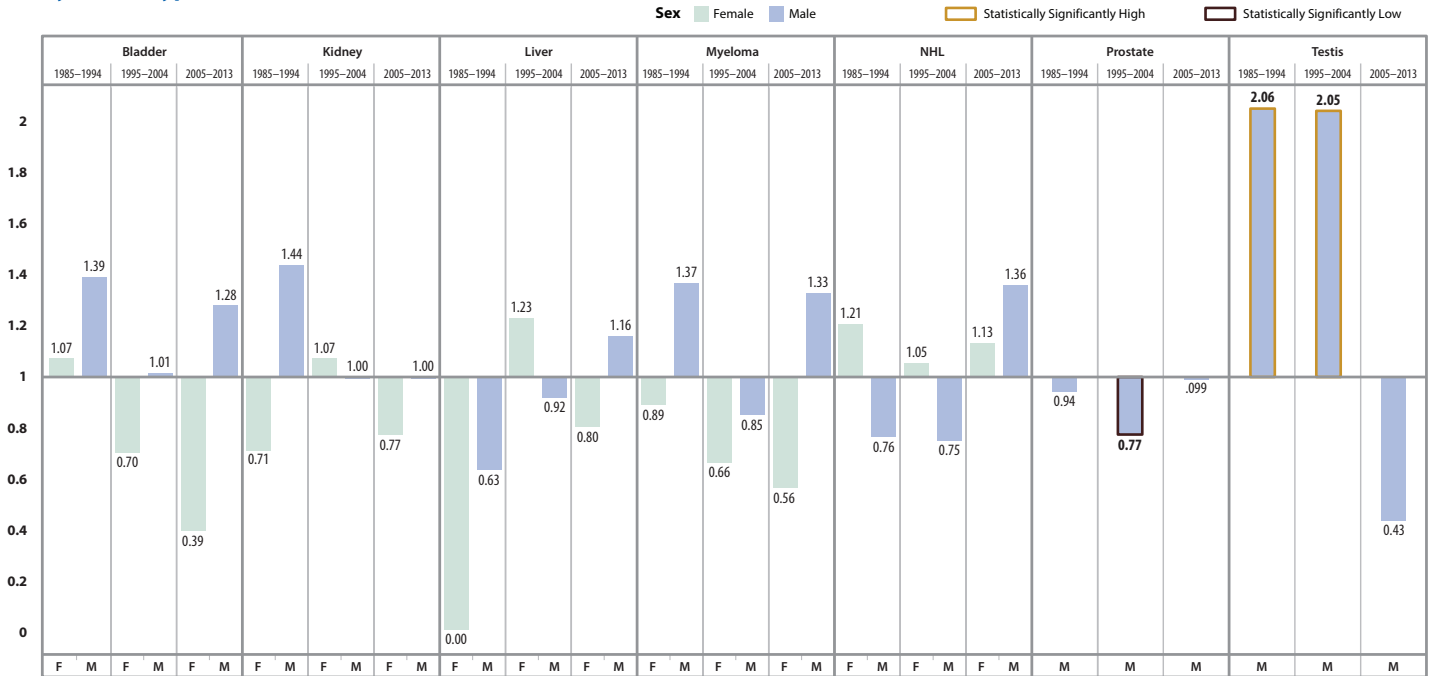


Cancer Data Review (1985–2013)

Selected Zip Codes of Warminster, Warrington, and Horsham, PA

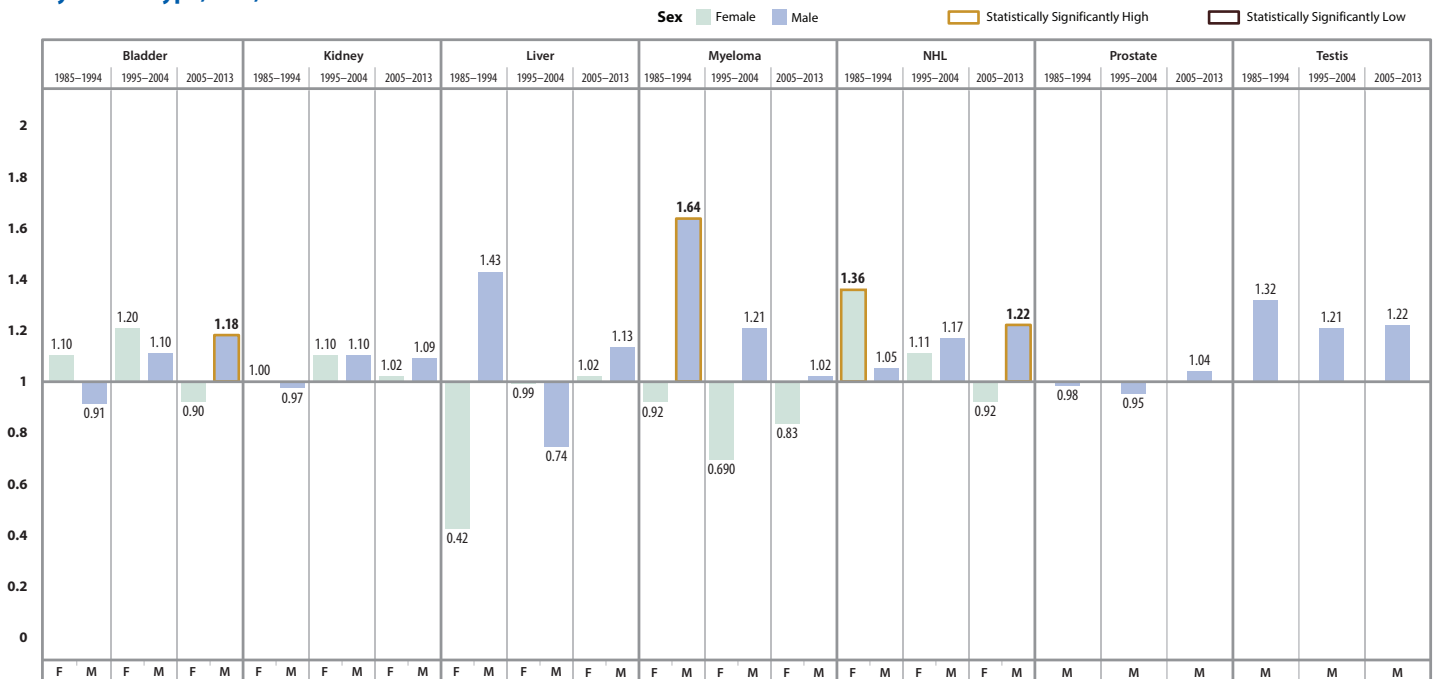
SIRs for Horsham (19044)

By Cancer Type, Year, and Sex



SIRs for Combined Zip Codes (18974, 18976, & 19044)

By Cancer Type, Year, and Sex



Cancer Data Review (1985–2013)

Selected Zip Codes of Warminster, Warrington, and Horsham, PA

Discussion

For PFAS, studies in humans have shown that certain PFAS may be associated with prostate, kidney, and testicular cancer. For TCE, there is strong evidence that TCE can cause kidney cancer in people, and some evidence for TCE-induced liver cancer and non-Hodgkin's lymphoma. For PCE, studies in humans suggest that exposure to PCE might lead to a higher risk of getting bladder cancer, multiple myeloma, or non-Hodgkin's lymphoma. Studies in humans have not been able to determine whether or not carbon tetrachloride or 1,2-DCE can cause cancer. This cancer registry information review provides a picture of both increases and decreases for the cancers of potential environmental interest in the Warminster and Willow Grove area, as compared to statewide rates.

Liver, prostate, and kidney cancer rates were within expected ranges or lower than expected in across all genders, zip codes and time periods.

Bladder cancer rates for males were 1.2–1.3 times higher in zip code 18974 (Warminster) and all three combined zip codes during 2005 to 2013, but were 0.3 times lower for males in zip code 18976 (Warrington) over the time period of 1985–1994, and were at expected rates for males in the 1995–2004 time period and for females in all the time periods.

Non-Hodgkin's lymphoma was increased in both males (1.3 times higher) and females (1.5 times higher) in the 18974 (Warminster) zip code, but these increases occurred in different time periods. These results drove the parallel increases observed in males (1.2 times higher) and females (1.4 times higher) in the three zip codes combined for those two same time intervals.

For testis cancer, two time periods showed higher statistical increases from 1985–1994 (2.1 times higher) and 1995–2004 (2.1 times higher) in zip code 19044 (Horsham) only, and then a large decrease in cases observed in the most recent time period from 2005–2013 in this zip code. Testis was at expected rates for the other two zip codes and all three zip codes combined. The number of testis cases involved is relatively small in (e.g., 11–12 in the first two time periods in zip code 19044, and 2 in the most recent time period), adding to the uncertainty of this information.

Limitations

- A review of cancer incidence data does not determine the cause of any observed increases or decreases in cancer types.
- Zip code level analyses can provide a helpful preliminary screen of cancer registry data, but

zip code boundaries may only approximate potential geographic areas of interest.

- Cancer registry incidence data are based on residence at the time of diagnosis. Cancers can take years, or even decades to develop following exposure to a cancer-causing agent. Cancers diagnosed in people right now may have been influenced by something that happened somewhere else a long time ago.
- Although cancer overall is a common diagnosis, there may only be a small number of a particular cancer type in a particular zip code. Researchers need larger numbers of persons in order to have a more accurate and representative picture of the reality of a community.
- Cancer registry data only includes very limited or no information on lifestyle, demographic, or occupational risk factors. Science does not know the causes of most types of cancer. For each person, cancer is thought to be caused by a combination of many factors, genetic and environmental.

Conclusion

This cancer incidence data review provides an inconclusive picture of cancer rates for the cancers of potential interest in the three main zip codes near the Warminster and Willow Grove sites. This pattern of increases in some cancer types and decreases in others is commonly seen in zip code level analyses. Even when statistical increases were observed in this preliminary review for the Warminster and Willow Grove area, these results were not consistent across time periods, genders, or zip codes. This inconsistent pattern makes it difficult to determine if these results are meaningful.

This preliminary summary did identify a few statistically increased results for the potential cancers of interest (e.g., testis and non-Hodgkin's lymphoma) that might warrant further discussion. It is important to note the estimates for these cancers were generally based upon small numbers of cases (particularly the testis cases). The reliability is reduced for statistical estimates based on small numbers.

Given these findings and the legacy of environmental contamination in this area, as new data or additional information become available, consideration will be given to updating and/or further study of this information.

Cancer Data Review (1985–2013)

Selected Zip Codes of Warminster, Warrington, and Horsham, PA

Table 1: Warminster, Warrington, and Horsham Area Zip Code Cancer Data Review (1985-2013)

PADOH obtained data from the Pennsylvania Cancer Registry, which is a comprehensive database of all cancers diagnosed in Pennsylvania residents. Since 1985, the Pennsylvania Cancer Registry has collected patient-specific cancer data that include geographic location, date of diagnosis, and cancer type. To determine if the rates are statistically elevated, the zip code is the standard unit of measurement because the denominator is well defined and the analysis can generate statistically significant results for a small geographic area. Multiple-year data are generally used in analyses because cases collected in a single year are subject to a large amount of chance variation compared to a longer interval.

The actual risk or rate for residents of a zip code was expressed as the ratio of the rate for the study population compared to the rate for the entire state, or the Standardized Incidence Ratio (SIR). This is equivalent to comparing the numbers of cancers diagnosed among residents to the number expected. Cases diagnosed were obtained from the Pennsylvania Cancer Registry, where Pennsylvania's statewide incidence rates were used to determine the number of cancers expected. The SIR is considered an estimate of the risk in the zip codes evaluated relative to Pennsylvania. Though the incidence ratio suggests a certain risk, it must be evaluated to determine if the ratio is statistically significant. This approach takes into account the likelihood that the result occurred by chance. The 95% confidence interval represents the range in which we would expect the SIR to fall 95% of the time. If the confidence interval contains a range that includes 1.0, no statistically significant excess of cancer is indicated. The confidence intervals are particularly important when trying to interpret small numbers of cases. If only one or two cases are expected for a particular cancer, then the report of three or four observed cases will result in a very large SIR. As long as the 95% confidence interval contains 1.0, this indicates that the SIR is still within the range one might expect and, therefore, not statistically significant.

The tabular information below presents the number of observed cases for males and females, the number of "expected" cases, the SIR, and the corresponding 95% confidence interval using information on diagnosed cases of bladder, kidney, liver, myeloma, NHL, prostate, and testis in the Pennsylvania Cancer Registry for zip codes 18974, 18976, and 19044 for the years 1985–2013.

		Time period											
		1985–1994				1995–2004				2005–2013			
	Sex	Observed	Expected	SIR	95% CI	Observed	Expected	SIR	95% CI	Observed	Expected	SIR	95% CI
Bladder		1985–1994				1995–2004				2005–2013			
18974 (Warminster)	Male	53	54	0.98	0.73–1.28	94	79	1.19	0.96–1.46	152	119	1.28*	1.08–1.5
	Female	25	18	1.36	0.88–2.01	33	26	1.25	0.86–1.76	44	39	1.13	0.82–1.51
18976 (Warrington)	Male	5	17	0.29**	0.09–0.68	22	24	0.93	0.58–1.41	34	41	0.84	0.58–1.17
	Female	2	6	0.33	0.04–1.19	12	8	1.56	0.81–2.73	9	14	0.66	0.3–1.25
19044 (Horsham)	Male	20	14	1.39	0.85–2.15	22	22	1.01	0.63–1.53	31	24	1.28	0.87–1.81
	Female	6	6	1.07	0.39–2.33	5	7	0.70	0.23–1.63	3	8	0.39	0.08–1.13
Combined (3 Zips)	Male	78	86	0.91	0.72–1.14	138	124	1.11	0.93–1.31	217	184	1.18*	1.03–1.35
	Female	33	30	1.10	0.76–1.54	50	41	1.21	0.9–1.6	56	61	0.92	0.7–1.2
Kidney		1985–1994				1995–2004				2005–2013			
18974 (Warminster)	Male	19	22	0.87	0.52–1.35	39	36	1.08	0.77–1.48	55	56	0.99	0.75–1.29
	Female	14	13	1.05	0.57–1.76	27	22	1.23	0.81–1.79	41	37	1.12	0.81–1.52
18976 (Warrington)	Male	6	7	0.85	0.31–1.85	15	12	1.26	0.7–2.07	31	22	1.38	0.94–1.97
	Female	5	4	1.16	0.38–2.71	5	7	0.72	0.23–1.69	13	14	0.92	0.49–1.57
19044 (Horsham)	Male	9	6	1.44	0.66–2.74	11	11	1.00	0.5–1.78	15	15	1.00	0.56–1.64
	Female	3	4	0.71	0.15–2.06	7	7	1.07	0.43–2.21	7	9	0.77	0.31–1.59
Combined (3 Zips)	Male	34	35	0.97	0.67–1.35	65	59	1.10	0.85–1.4	101	93	1.09	0.88–1.32
	Female	22	22	1.00	0.63–1.52	39	35	1.10	0.79–1.51	61	60	1.02	0.78–1.31
Liver		1985–1994				1995–2004				2005–2013			
18974 (Warminster)	Male	9	6	1.59	0.73–3.01	11	14	0.79	0.39–1.41	31	27	1.14	0.78–1.62
	Female	2	3	0.70	0.08–2.51	6	6	1.05	0.38–2.28	12	11	1.08	0.56–1.89
18976 (Warrington)	Male	3	2	1.64	0.34–4.78	2	5	0.43	0.05–1.55	12	11	1.08	0.56–1.89
	Female	0	1	0.00		1	2	0.58	0.01–3.23	4	4	0.98	0.27–2.5
19044 (Horsham)	Male	1	2	0.63	0.02–3.51	4	4	0.92	0.25–2.36	9	8	1.16	0.53–2.21
	Female	0	1	0.00		2	2	1.23	0.15–4.46	2	2	0.80	0.1–2.9
Combined (3 Zips)	Male	13	9	1.43	0.76–2.44	17	23	0.74	0.43–1.19	52	46	1.13	0.84–1.48
	Female	2	5	0.42	0.05–1.52	9	9	0.99	0.45–1.88	18	18	1.02	0.6–1.61

Cancer Data Review (1985–2013)

Selected Zip Codes of Warminster, Warrington, and Horsham, PA

	Sex	Time period											
		1985–1994				1995–2004				2005–2013			
		Observed	Expected	SIR	95% CI	Observed	Expected	SIR	95% CI	Observed	Expected	SIR	95% CI
Myeloma		1985–1994				1995–2004				2005–2013			
18974 (Warminster)	Male	15	8	1.86*	1.04–3.06	14	12	1.13	0.62–1.89	22	20	1.12	0.7–1.7
	Female	7	7	0.96	0.39–1.97	5	11	0.45	0.15–1.05	12	17	0.71	0.37–1.24
18976 (Warrington)	Male	3	3	1.17	0.24–3.41	7	4	1.83	0.74–3.77	4	7	0.56	0.15–1.43
	Female	2	2	0.84	0.1–3.03	5	3	1.53	0.5–3.58	8	6	1.32	0.57–2.6
19044 (Horsham)	Male	3	2	1.37	0.28–4.01	3	4	0.85	0.17–2.48	6	5	1.33	0.49–2.89
	Female	2	2	0.89	0.11–3.22	2	3	0.66	0.08–2.38	2	4	0.56	0.07–2.02
Combined (3 Zips)	Male	21	13	1.64*	1.01–2.5	24	20	1.21	0.78–1.81	32	31	1.02	0.7–1.44
	Female	11	12	0.92	0.46–1.65	12	17	0.69	0.36–1.2	22	27	0.83	0.52–.26
NHL		1985–1994				1995–2004				2005–2013			
18974 (Warminster)	Male	39	35	1.12	0.8–1.53	67	55	1.23	0.95–1.56	104	79	1.32*	1.08–1.6
	Female	42	29	1.47*	1.06–1.99	54	46	1.18	0.89–1.54	65	68	0.95	0.73–.21
18976 (Warrington)	Male	13	12	1.11	0.59–1.9	25	18	1.38	0.89–2.04	26	29	0.88	0.58–1.29
	Female	11	9	1.17	0.58–2.09	13	14	0.92	0.49–1.58	18	25	0.72	0.43–1.14
19044 (Horsham)	Male	8	11	0.76	0.33–1.5	13	17	0.75	0.4–1.29	26	19	1.36	0.89–1.99
	Female	11	9	1.21	0.6–2.17	14	13	1.05	0.57–1.76	17	15	1.13	0.66–1.8
Combined (3 Zips)	Male	60	57	1.05	0.8–1.36	105	90	1.17	0.95–1.41	156	127	1.22*	1.04–1.43
	Female	64	47	1.36*	1.05–1.74	81	73	1.11	0.88–1.38	100	109	0.92	0.75–1.12
Prostate		1985–1994				1995–2004				2005–2013			
18974 (Warminster)	Male	176	170	1.03	0.89–1.2	332	333	1.00	0.89–1.11	371	352	1.05	0.95–1.17
18976 (Warrington)	Male	44	53	0.82	0.6–1.1	94	99	0.95	0.77–1.17	143	140	1.02	0.86–1.2
19044 (Horsham)	Male	40	43	0.94	0.67–1.28	69	90	0.77**	0.6–0.97	89	90	0.99	0.8–1.22
Combined (3 Zips)	Male	260	266	0.98	0.86–1.1	495	522	0.95	0.87–1.04	603	582	1.04	0.95–1.12
Testis		1985–1994				1995–2004				2005–2013			
18974 (Warminster)	Male	13	11	1.23	0.66–2.1	11	11	1.02	0.51–1.82	16	10	1.60	0.91–2.6
18976 (Warrington)	Male	3	5	0.66	0.14–1.93	3	5	0.63	0.13–1.83	6	5	1.20	0.44–2.6
19044 (Horsham)	Male	11	5	2.06*	1.03–3.68	12	6	2.05*	1.06–3.59	2	5	0.43	0.05–1.56
Combined (3 Zips)	Male	27	21	1.32	0.87–1.92	26	22	1.21	0.79–1.78	24	20	1.22	0.78–1.82

* Statistically significant higher at 95% confidence level

** Statistically significant lower at 95% confidence level

Cancer Data Review (1985–2013)

Selected Zip Codes of Warminster, Warrington, and Horsham, PA

Data sources:

Pennsylvania Cancer Registry dataset from 1985 to 2013 for cancer incidence.

U.S. Census Bureau, 2010 Census. Summary File 1, Tables P12, P13, and PCT12 were used for population by age group, gender and zip code tabulation areas for 2010 population. These population were used for expected cases and age-adjusted rate calculation for time period 2005–2013.

U.S. Census Bureau, Census 2000 Summary File 1, Matrices P13 and PCT12 were used for population by age group, gender and zip code tabulation areas for 2000 population. These population were used for expected cases and age-adjusted rate calculation for time period 1995–2004.

U.S. Census Bureau's 1990 Census Summary File 3b was used for population by age group, gender and zip code tabulation areas for 1990 population. These population were used for expected cases and age-adjusted rate calculation for time period 1985–1994.

Expected cases were rounded to the nearest integer since cases cannot be fractions. SIRs were calculated using all decimal places in expected cases to provide better precisions in SIR estimation. Exact 95% confidence intervals were calculated using method described by Sahai and Khurshid assuming Poisson distribution.¹

Age-adjusted rates were calculated using 2000 U.S. standard population with 18 standard age groups. 95% confidence interval for age-adjusted rate were estimated using method described by Keyfitz.²

Three zip code combined areas comprises zip codes 18974, 18976 and 19044.

¹ Sahai H, Khurshid A (1993). Confidence Intervals for the Mean of a Poisson Distribution: A Review. *Biometrical J*, 35: 857–67.

² Keyfitz N (1996). Sampling Variance of Standardized Mortality Rates. *Human Biology*, 38:309–317.

