

Leukemia, Lymphoma & Multiple Myeloma In Ohio, 1998-2002

August 2005



This Report on Leukemia, Lymphoma and Multiple Myeloma Contains:

- Incidence and Mortality by Cancer Type
- Cancer Trends by Age Group and Gender
- Incidence Rates by Race and Gender
- Survival Probabilities
- Risk Factors
- Sources of Data and Additional Information

Blood-related Cancers: Incidence and Mortality in Ohio

Blood-related cancers originate in the bone marrow (Leukemia and Multiple Myeloma) or lymphatic tissue (non-Hodgkin's and Hodgkin's Lymphomas). These cancers involve the uncontrolled growth of cells with similar functions and origins and result from an acquired genetic injury to DNA of a single cell, which becomes malignant (cancerous) and multiplies continuously. The accumulation of malignant cells interferes with the body's production of healthy blood cells and ability to protect itself against infections.

Leukemia, Lymphoma and Multiple Myeloma made up about 8 percent (4,453 average annual cases) of the invasive cancer cases diagnosed among Ohio residents from 1998 to 2002 that were reported to the Ohio Cancer Incidence Surveillance System (OCISS) (Table 1). Similarly, blood-related cancers were responsible for 10 percent of total cancer deaths in 1998-2002, with an average of 2,509 deaths per year (920 Leukemia; 57 Hodgkin's Lymphoma; 1,062 non-Hodgkin's Lymphoma; and 469 Multiple Myeloma).

Table 1.
**Blood-related Cancers: Average Annual Number and
Percent of Invasive Cancer Cases in Ohio, 1998-2002**

| | Avg Annual Number | Percent |
|------------------------|-------------------|---------------|
| All Sites/Types | 55,679 | 100.0% |
| Non-Hodgkin's Lymphoma | 2,247 | 4.0% |
| Leukemias | 1,264 | 2.3% |
| Multiple Myeloma | 613 | 1.1% |
| Hodgkin's Lymphoma | 329 | 0.6% |

Source: Ohio Cancer Incidence Surveillance System, Ohio Department of Health, 2005.

The estimated completeness of reporting for Hodgkin's Lymphoma was 100 percent for the five-year time period. However, completeness estimates for Leukemia (86 percent), non-Hodgkin's Lymphoma (89 percent) and Multiple Myeloma (90 percent) were less than the national standard of 95 percent for complete case ascertainment. Case counts and rates for these cancer types should, therefore, be interpreted with caution.

Leukemia

Leukemia is a type of cancer that originates in the bone marrow and causes the production of abnormal blood cells, particularly white blood cells that help the body fight infections and other diseases. Leukemia can be either acute or chronic. In acute leukemia, abnormal blood cells are unable to properly mature and cannot carry out normal functions. These abnormal cells accumulate more rapidly and the disease worsens more quickly. In chronic leukemia, the cells can mature, but are not completely normal and do not fight infection as well. Leukemia can arise in either of two main types of white blood cells – lymphoid cells or myeloid cells. The four primary types of leukemia are the following:

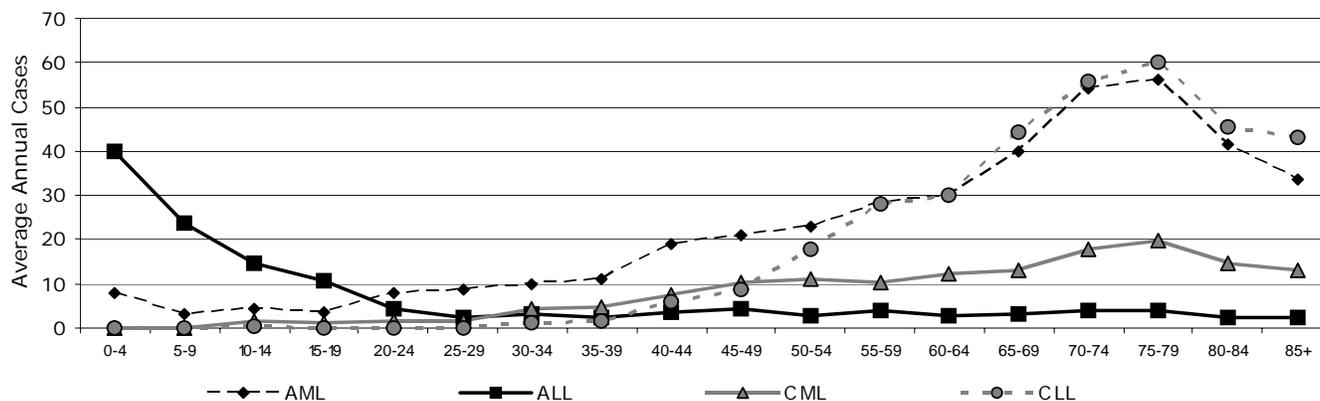
Acute Lymphocytic (ALL): Results from an acquired genetic injury to DNA of a single cell in the bone marrow. Most common type in young children, but also affects adults, mainly those age 65 and older.

Acute Myeloid (AML): Results from genetic damage to DNA of developing cells in the bone marrow. Occurs in both adults and children.

Chronic Lymphocytic (CLL): Results from a malignant disorder involving a progressive accumulation of small, mature-appearing lymphocytes in blood lymph nodes, the spleen and bone marrow. Most often affects adults age 55 and older and is rare in children.

Chronic Myeloid (CML): Results from injury to the DNA of a stem cell in the bone marrow leading to uncontrolled growth of white cells. Occurs mainly in adults.

Figure 1:
Average Annual Number of Leukemia Cases by Age Group and Type, Ohio, 1998-2002



Source: Ohio Cancer Incidence Surveillance System, Ohio Department of Health, 2005.

As seen in Figure 1, the incidence of leukemia in Ohio varied according to age group and type of leukemia. For ALL, the average age at diagnosis was 22.6 years; however, half the number of cases occurred among children 10 years of age and younger. The average ages at diagnosis for AML, CLL and CML were 62.0, 71.1, and 63.3 years, respectively. The incidence of AML, CLL and CML increased with advancing age, reaching a peak among adults between 70 and 79 years of age. However, the increase in incidence of CML among older age groups was less than that of AML and CLL. Leukemia incidence in the United States follows patterns similar to those shown for Ohio in Figure 1.

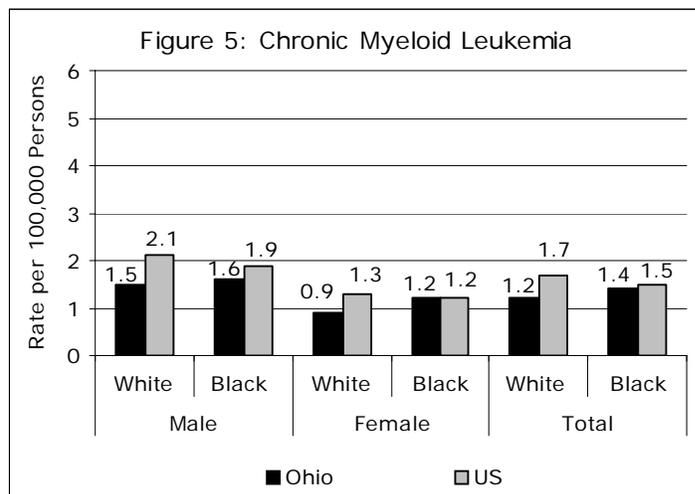
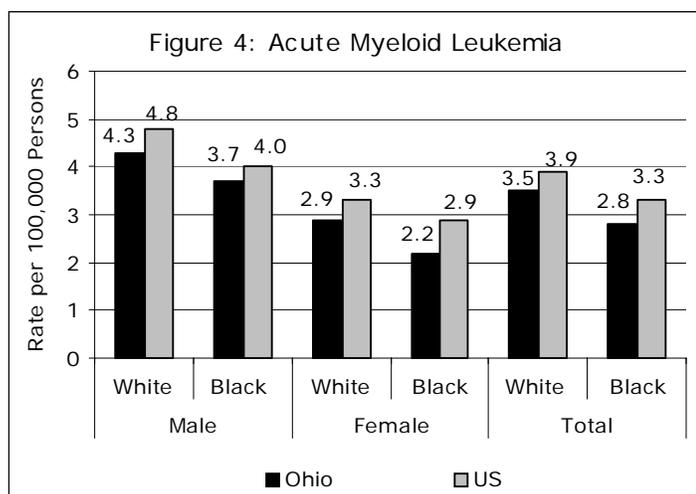
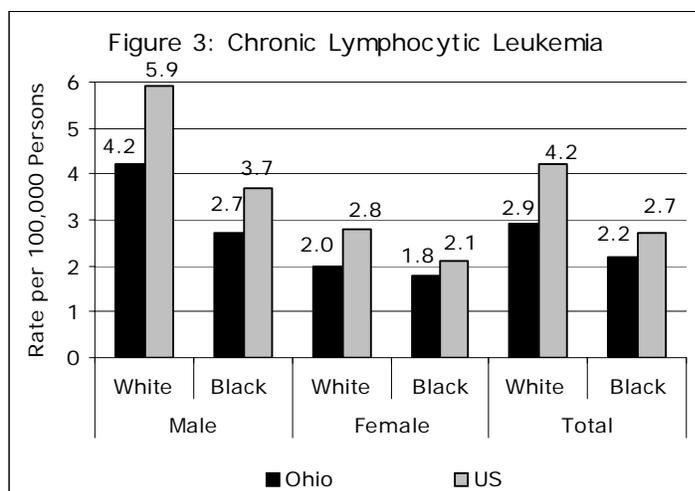
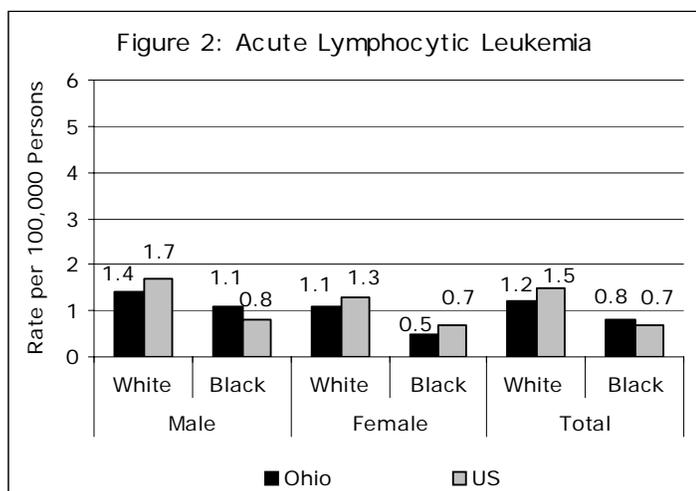
Technical Note: Leukemias were defined by the International Classification of Diseases for Oncology, Third Edition (ICD-O-3). **ALL:** types 9826, 9835-9837; **CLL:** type 9823 (sites C420, C421, C424); **AML:** types 9840, 9861, 9866, 9867, 9871-9874, 9895-9897, 9910, 9920; **CML:** types 9863, 9875, 9876, 9945, 9946; **Other types:** 9733, 9742, 9800, 9801, 9805, 9820, 9827 (sites C420, C421, C424), 9831, 9832-9834, 9860, 9870, 9891, 9930, 9931, 9940, 9948, 9963, 9964.

Types of Leukemia by Gender and Race

As shown in Figures 2-5, the incidence of leukemia varies according to gender, race and the type of leukemia. For all leukemias combined, the 1998-2002 average annual age-adjusted incidence rate in Ohio (10.8 per 100,000 persons) was 13 percent less than the U.S. (SEER) rate (12.4 per 100,000 persons). Incidence rates of CLL (2.9 per 100,000) and AML (3.4 per 100,000) were greater than those of ALL (1.2 per 100,000) and CML (1.2 per 100,000) in Ohio, as well as in the United States. For each type of leukemia, in both Ohio and the United States, incidence rates for whites and blacks were greater for males compared to females. Incidence rates of ALL, CLL and AML were greater for whites (both genders combined) compared to blacks in both Ohio and the United States, but the incidence rates of CML were similar for these selected race categories. For each race- and gender-specific comparison, with the exception of ALL among black males, incidence rates for each type of leukemia were lower in Ohio compared to the United States; however, it should be noted that the 1998-2002 estimated completeness of reporting for leukemia was 86 percent, which may be responsible for the lower incidence rates in Ohio.

Figures 2-5:

Average Annual Age-adjusted Leukemia Incidence Rates, per 100,000 Persons, by Type of Leukemia, Race and Gender in Ohio with Comparison to the US, 1998-2002



Source: Ohio Cancer Incidence Surveillance System, Ohio Department of Health, 2005, and the Surveillance, Epidemiology and End Results Program, National Cancer Institute, 2005.

Leukemia Survival

Based on the follow-up of individuals diagnosed with leukemia (all leukemias combined) in the United States (SEER) during the years 1995-2001, survival five years after diagnosis was 47.6 percent. Survival probability varies by leukemia type; among individuals diagnosed with leukemia between 1995 and 2001, survival five years after diagnosis was lowest for AML (19.8 percent), followed by CML (39.0 percent), ALL (64.6 percent) and CLL (74.2 percent).

The five-year survival probability for all leukemias combined was lower among blacks (38.1 percent) compared to whites (49.1 percent). Analyses by leukemia type reveal that the survival was lower for blacks compared to whites for ALL, CLL and CML, whereas, the survival was greater for blacks diagnosed with AML as compared to whites.

Five-year survival probability for all leukemias combined was lower among individuals 65 years of age and older (34.7 percent) compared to persons less than 65 years of age (58.2 percent). This finding holds true for all four types of leukemia.

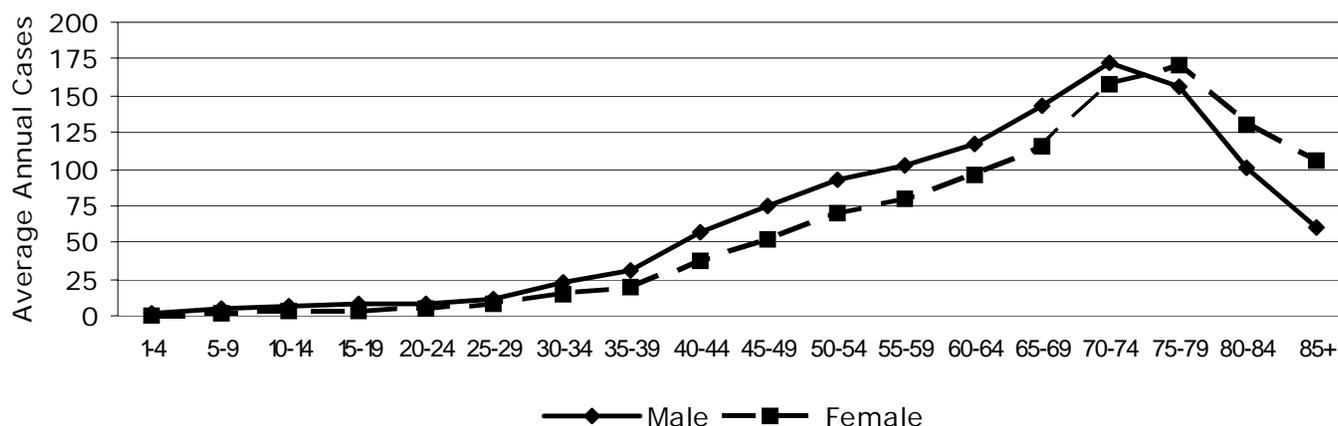
Risk Factors for Leukemia

- Leukemia occurs more often in males as compared to females and whites as compared to blacks. Differences by race, however, may be a proxy for other factors, such as socioeconomic status and access to care.
 - Exposure to large amounts of high-energy radiation, such as from an atomic bomb explosion or nuclear reactor accident, increases risk of AML, ALL and CML.
 - Long-term herbicide/pesticide exposure increases risk of CLL.
 - Long-term exposure to high levels of benzene increases risk of AML.
 - Certain chemotherapy drugs used to treat other cancers increase risk of AML.
 - Carcinogens in cigarette smoke, particularly benzene, account for one in five cases of AML.
 - Certain inherited genetic conditions, such as Down's syndrome, Fanconi's anemia, Wiskott-Aldrich syndrome, Bloom's syndrome, Li-Fraumeni syndrome or ataxia telangiectasia, increase risk.
 - 1st degree relatives of CLL patients have 2-4 times increased risk of CLL.
 - Infection with the human T-cell leukemia/lymphoma virus (HTLV-1) increases risk of a rare type of ALL.
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Non-Hodgkin's Lymphoma

Lymphomas are cancers that result from the abnormal growth and accumulation of cells in the lymphoid tissue of the lymphatic system, which is responsible for filtering germs, cancer cells and fluids from the extremities and internal organs. Hodgkin's Lymphoma is one specialized type of lymphoma; all other lymphomas are called non-Hodgkin's Lymphomas (NHL). Since lymphatic tissue is present in many parts of the body, NHL can arise almost anywhere in the body.

Figure 6:
Average Annual Number of Non-Hodgkin's Lymphoma Cases, by Age Group and Gender, Ohio, 1998-2002



Source: Ohio Cancer Incidence Surveillance System, Ohio Department of Health, 2005.

As seen in Figure 6, the incidence of non-Hodgkin's Lymphoma in Ohio varied according to age at diagnosis. The average age at diagnosis for males was 63.2 years and for females was 67.3 years. For both males and females, the average annual number of cases increased with advancing age, with the greatest average annual number of cases occurring among adults ages 70 to 79. The average annual number of non-Hodgkin's Lymphoma cases was greater among males compared to females between the ages of 35 and 74, but was greater among females ages 75 and older. Non-Hodgkin's Lymphoma incidence in the United States follows patterns similar to those for Ohio.

Non-Hodgkin's Lymphoma Survival

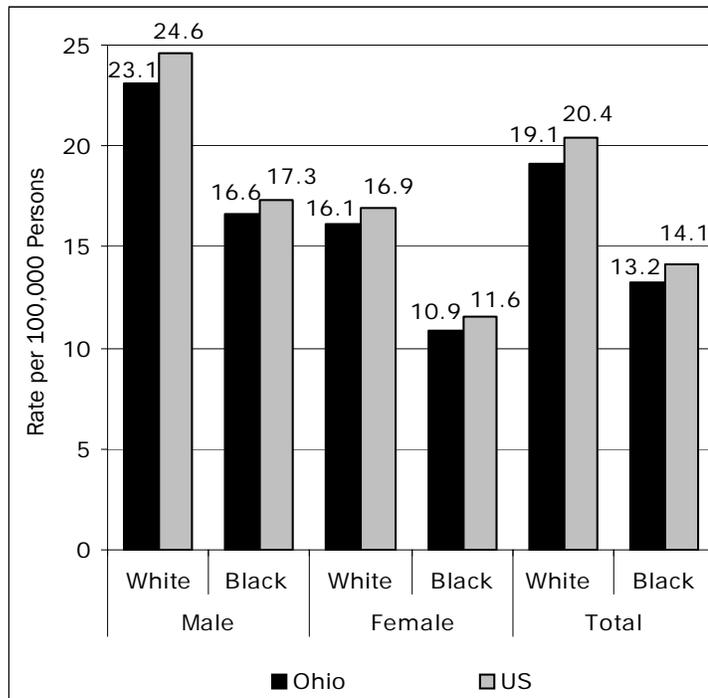
Based on the follow-up of individuals diagnosed with non-Hodgkin's Lymphoma in the United States (SEER) during the years 1995-2001, survival five years after diagnosis was approximately 60.2 percent. The five-year survival probability was lower among blacks (52.3 percent) compared to whites (61.2 percent), and was slightly lower among males (58.2 percent) compared to females (62.6 percent). The five-year survival probability also varied according to age at diagnosis. Among individuals 65 years of age and older, the five-year survival probability was lower compared to individuals under age 65 (52.0 percent and 66.7 percent, respectively).

Technical Note: Non-Hodgkin's Lymphoma was defined by the International Classification of Diseases for Oncology, Third Edition (ICD-O-3), histology types 9590-9596, 9670-9671, 9673, 9675, 9678-9680, 9684, 9687, 9689-9691, 9695, 9698-9702, 9705, 9708-9709, 9714-9719, 9727-9729, 9823 (sites <C420, C422-C423, and >C424), and 9827 (sites <C420, C422-C423, and >C424).

Non-Hodgkin's Lymphoma by Gender and Race

Figure 7:

Average Annual Age-adjusted Non-Hodgkin's Lymphoma Incidence Rates, per 100,000 Persons, by Race and Gender in Ohio with Comparison to the US, 1998-2002



As shown in Figure 7, the incidence of non-Hodgkin's Lymphoma varies according to race and gender. The 1998-2002 average annual incidence rate of non-Hodgkin's Lymphoma in Ohio (19.1 per 100,000 persons) was slightly less than that for the United States (SEER) (19.4 per 100,000 persons). In both Ohio and the United States, the incidence rates of non-Hodgkin's Lymphoma in both whites and blacks were greater for males compared to females. Incidence rates of non-Hodgkin's Lymphoma were greater for whites (both genders combined) compared to blacks in both Ohio and the United States. For each race- and gender-specific comparison, incidence rates of non-Hodgkin's Lymphoma in Ohio were lower than those in the United States; however, completeness of reporting for this cancer site in 1998-2002 was estimated to be 89 percent, which may be responsible for the lower rates in Ohio.

Source: Ohio Cancer Incidence Surveillance System, Ohio Department of Health, 2005, and the Surveillance, Epidemiology and End Results Program, National Cancer Institute, 2005.

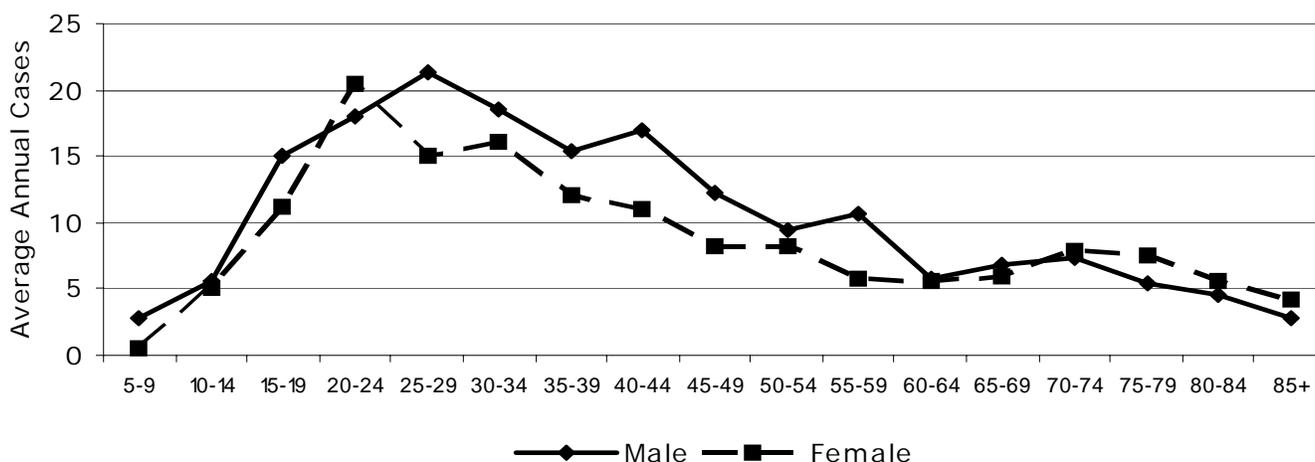
Risk Factors for Non-Hodgkin's Lymphoma

- NHL is more common in males as compared to females, and the risk increases with advancing age.
- Inherited immune deficiencies, autoimmune diseases, HIV/AIDS and immunosuppressant drugs following organ transplants increase risk.
- Persons infected with the Human T-cell leukemia/lymphoma virus (HTLV-1), Epstein-Barr virus, Human Herpes Virus-8 or Hepatitis C virus have an increased risk of NHL.
- Exposure to certain chemicals, such as benzene, pesticides, solvents or fertilizers, increases risk.
- Radiation and chemotherapy used in the treatment of other cancers increases risk.
- Exposure to large amounts of high-energy radiation, such as from an atomic bomb explosion or nuclear reactor accident, increases risk.
- The bacteria *Helicobacter pylori*, known to cause stomach ulcers, has been found to cause some lymphomas of the stomach.

Hodgkin's Lymphoma

Hodgkin's Lymphoma, also known as Hodgkin's Disease, is a specialized type of lymphoma that can arise almost anywhere in the body, most commonly in the lymph nodes of the chest, neck, and under the arms. Hodgkin's Lymphoma causes enlargement of the lymphatic tissue, which then can put pressure on important structures.

Figure 8:
Average Annual Number of Hodgkin's Lymphoma Cases, by Age Group and Gender, Ohio, 1998-2002



Source: Ohio Cancer Incidence Surveillance System, Ohio Department of Health, 2005.

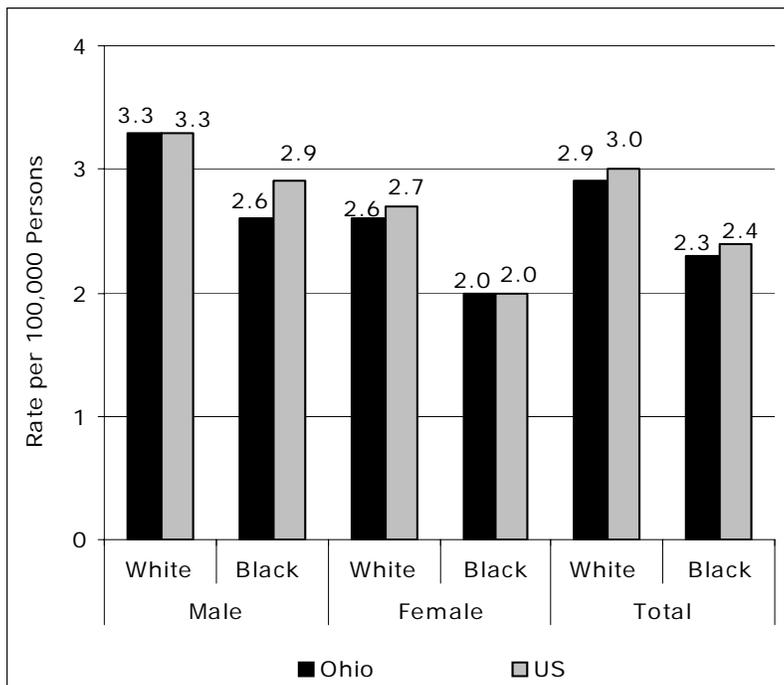
As seen in Figure 8, the incidence of Hodgkin's Lymphoma in Ohio varied according to age at diagnosis. The average age at diagnosis for males (40.5 years) was similar to that for females (42.6 years). The average annual number of cases increased with advancing age until ages 25-29 for males and 20-24 for females, followed by a decline thereafter for both genders. The average annual number of Hodgkin's Lymphoma cases was greater among males under 60 years of age, with the exception of the 20-24 age group, but was greater among females ages 75 and older.

Hodgkin's Lymphoma Survival

Based on the follow-up of individuals diagnosed with Hodgkin's Lymphoma in the United States (SEER) during the years 1995-2001, survival five years after diagnosis was 85.3 percent. The five-year survival probability was lower among blacks (80.4 percent) compared to whites (86.0 percent), and was lower among males (83.8 percent) compared to females (87.0 percent). The five-year survival probability also varied according to age at diagnosis; among individuals 65 years of age and older, the five-year survival probability was 53.5 percent, compared to 88.6 percent for individuals under age 65.

Hodgkin's Lymphoma by Gender and Race

Figure 9:
Average Annual Age-adjusted Hodgkin's Lymphoma Incidence Rates, per 100,000 Persons, by Race and Gender in Ohio with Comparison to the US, 1998-2002



As shown in Figure 9, the incidence of Hodgkin's Lymphoma varies according to race and gender. The 1998-2002 average annual age-adjusted incidence rate of Hodgkin's Lymphoma in Ohio was nearly equal to that for the United States (SEER). In both Ohio and the United States, the incidence rates of Hodgkin's Lymphoma were greater for males compared to females for persons of both white and black race. Whites (both genders combined) had higher incidence rates of Hodgkin's Lymphoma compared to blacks in both Ohio and the United States.

Source: Ohio Cancer Incidence Surveillance System, Ohio Department of Health, 2005, and the Surveillance, Epidemiology and End Results Program, National Cancer Institute, 2005.

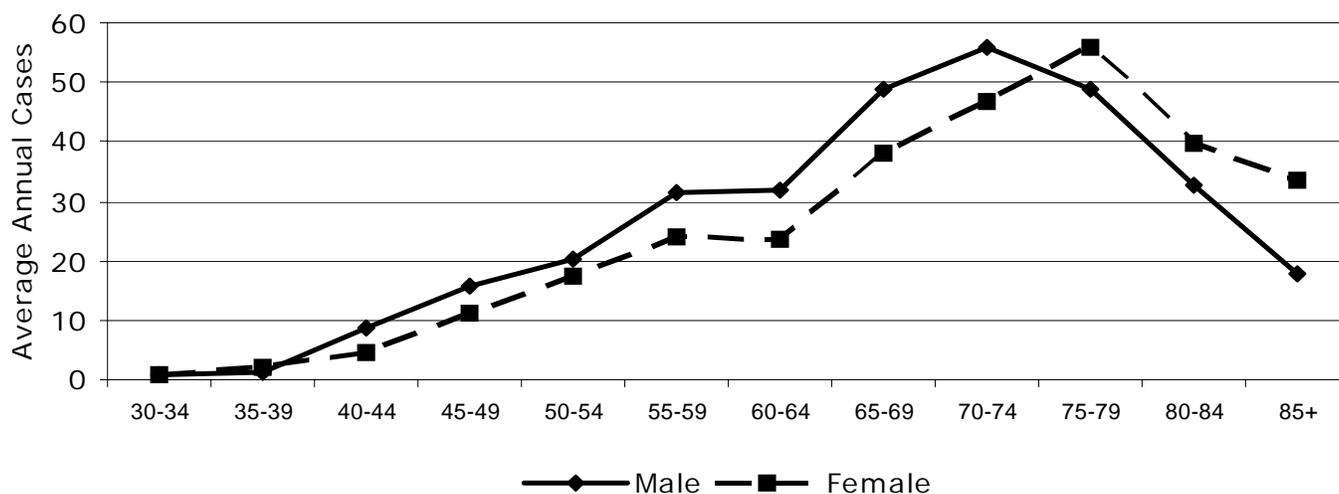
Risk Factors for Hodgkin's Lymphoma

- Hodgkin's Lymphoma is more common in males as compared to females and among persons ages 15-34 and 55 years and older.
- Siblings of persons with Hodgkin's Lymphoma are more likely to develop the disease, especially siblings of the same gender.
- Infection with the Epstein-Barr virus, which causes infectious mononucleosis, increases risk.
- Reduced immunity (such as in person's with AIDS), immunosuppressant drugs following organ transplants and congenital immunodeficiency syndromes, such as ataxia-telangiectasia, are associated with an increased risk of developing Hodgkin's Lymphoma.

Multiple Myeloma

Multiple Myeloma is a cancer that affects certain white cells, called plasma cells, which arise in the bone marrow. When the plasma cells grow out of control they may produce tumors in multiple sites, known as multiple myeloma. The disease can lead to a shortage of red blood cells (anemia) causing fatigue, a shortage of blood platelets leading to excessive bleeding, or a shortage of “good” white blood cells (leukopenia) leading to decreased resistance to infection.

Figure 10:
Average Annual Number of Multiple Myeloma Cases, by Age Group and Gender, Ohio, 1998-2002



Source: *Ohio Cancer Incidence Surveillance System, Ohio Department of Health, 2005.*

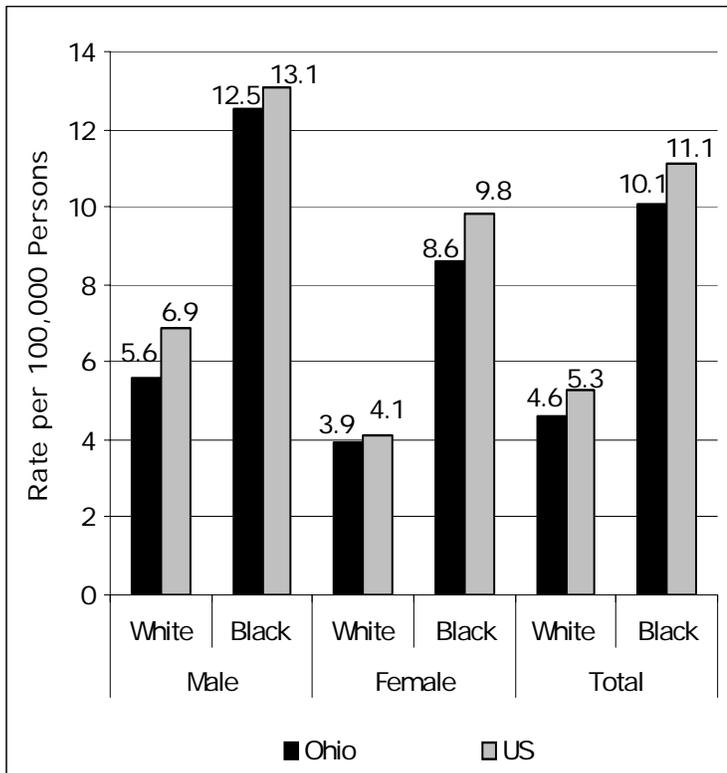
As seen in Figure 10, the incidence of Multiple Myeloma in Ohio varied by the age at which the cancer was diagnosed. The average age at diagnosis for males was 67.9 years and for females was 70.6 years. For males, the average annual number of cases increased with advancing age until ages 70-74, after which the incidence declined. For females, the number of cases increased until ages 75-79 and declined thereafter. The average annual number of Multiple Myeloma cases was greater among males compared to females for all age groups between 40 and 74 years, but was greater for females ages 75 and older.

Multiple Myeloma Survival

Based on the follow-up of individuals diagnosed with Multiple Myeloma in the United States (SEER) during the years 1995-2001, survival five years after diagnosis was 32.4 percent. The five-year survival probability was slightly lower among whites (32.2 percent) compared to blacks (33.3 percent), and was lower among females (28.4 percent) compared to males (36.1 percent). The five-year survival probability also varied according to age at diagnosis; among individuals 65 years of age and older, the five-year survival probability was 25.2 percent, compared to 42.9 percent for individuals under age 65.

Multiple Myeloma by Gender and Race

Figure 11: Average Annual Age-adjusted Multiple Myeloma Incidence Rates, per 100,000 Persons, by Race and Gender in Ohio with Comparison to the US, 1998-2002



As shown in Figure 11, the incidence of Multiple Myeloma varies according to race and gender. The 1998-2002 average annual incidence rate of multiple myeloma in Ohio (5.2 per 100,000 persons) was less than the U.S. (SEER) rate (5.6 per 100,000 persons). In both Ohio and the United States, incidence rates of Multiple Myeloma in both whites and blacks were greater for males compared to females. Blacks of both genders combined had higher incidence rates of Multiple Myeloma compared to whites in both Ohio and the United States. For each race- and gender-specific comparison, incidence rates of Multiple Myeloma in Ohio were lower than those in the United States; however, this may be due to low completeness of reporting in Ohio for this cancer type, which was estimated to be 90 percent for the years 1998-2002.

Source: Ohio Cancer Incidence Surveillance System, Ohio Department of Health, 2005, and the Surveillance, Epidemiology and End Results Program, National Cancer Institute, 2005.

Risk Factors for Multiple Myeloma

- Multiple Myeloma is more common in males as compared to females, twice as common in blacks as compared to whites, and most common among persons in older age groups. Differences by race, however, may be a proxy for other factors, such as socioeconomic status and access to care.
- Exposure to radiation increases risk.
- Children and siblings of persons with Multiple Myeloma have a slight increased risk.
- Exposure to petroleum products, benzene, agricultural chemicals and certain metals, particularly nickel, increases the risk of Multiple Myeloma.
- About 20 percent of persons with monoclonal gammopathy of undetermined significance (MGUS) or extramedullary plasmacytoma will develop Multiple Myeloma.

The Ohio Cancer
Incidence Surveillance
System (OCISS)

Ohio Department of
Health

and

The Arthur G. James
Cancer Hospital and
Richard J. Solove
Research Institute at
The Ohio State
University

To address comments
and information
requests:

Ohio Cancer Incidence
Surveillance System
Ohio Department of Health
246 North High Street
Columbus, OH 43215

Phone: (614) 752-2689
Fax: (614) 644-1909
E-mail:
ociss@odh.ohio.gov

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Sources of Data

- Ohio Incidence: Ohio Cancer Incidence Surveillance System, Ohio Department of Health, 2005 (http://www2.odh.ohio.gov/ODHPrograms/CI_SURV/ci_surv1.htm).
- Ohio Mortality: Vital Statistics Program, Ohio Department of Health, 2005 (<http://www2.odh.ohio.gov/VitStats/vsmain1.htm>).
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- U.S. Five-year Survival: Ries LAG, Eisner MP, Kosary CL, Hankey BF, Miller BA, Clegg L, Mariotto A, Feuer EJ, Edwards BK (eds). SEER Cancer Statistics Review, 1975-2002, National Cancer Institute. Bethesda, MD, http://seer.cancer.gov/csr/1975_2002/, based on November 2004 SEER data submission, posted to the SEER web site 2005.

Sources of Additional Information

- National Cancer Institute (<http://www.cancer.gov>)
<http://www.cancer.gov/cancertopics/types/leukemia/>
<http://www.cancer.gov/cancertopics/types/non-Hodgkins-lymphoma>
<http://www.cancer.gov/cancertopics/types/hodgkinslymphoma>
<http://www.cancer.gov/cancertopics/types/myeloma>
- American Cancer Society (<http://www.cancer.org>)
- The Leukemia & Lymphoma Society (http://www.leukemia.org/hm_1ls)