High Cancer Mortality Rates from Childhood Leukemia and Young Adult Hodgkin’s Disease and Lymphoma in the New Jersey-New York-Philadelphia Metropolitan Corridor, 1950 to 1969

Michael R. Greenberg, John Caruana, Briavel Holcomb, Gwendolyn Greenberg, Ronald Parker, Judith Louis, and Paul White


ABSTRACT

In comparison to the United States as a whole and to their total population age-adjusted rates, the New Jersey-New York-Philadelphia Metropolitan Region was found to have excessively high childhood leukemia and high young adult Hodgkin’s disease and lymphoma cancer mortality rates in the period from 1950 to 1969.

INTRODUCTION

Leukemia, Hodgkin’s disease, and lymphoma are systemic cancers. From 1950 to 1969, they accounted for about 9% of cancer mortalities in the United States. Their importance among children and young adults (age groups 0 to 34 yr) is far greater, since these 3 disease categories account for about one-half of the cancer deaths for persons less than 35 yr of age.

As part of a study of cancer mortality and risk factor patterns in the New Jersey-New York-Philadelphia Metropolitan Regions (3, 4), the authors sought to determine if the study area exhibited unusual childhood and young adult mortality patterns. The report that follows demonstrates that substantially elevated cancers. From 1950 to 1969, they accounted for about 9% of cancer mortality patterns exist.

MATERIALS AND METHODS

Data. The REG3 contains 25 million people and 49 counties, including all of the State of New Jersey, the New York Metropolitan area, the Philadelphia Metropolitan area, and adjacent counties that have been sources of commuters to the cities and have been resettlement areas for the urban industrial counties (Chart 1). The REG was constructed to control for intraregional migration as much as possible.

Mortality counts for 1950 to 1969 were provided by the National Cancer Institute, conforming to the National Cancer Institute’s recommendations for each of the above 17 age groups of 5 years each were prepared to obtain the most general perspective.

3 The abbreviations used are: REG, study region; ICD, International Classification Of Diseases, Sixth and Seventh Revisions; RON, rest of nation.

Methods. The methodological approach was to compute and compare parallel cancer mortality rates for the REG and RON. The following rates and their specific purposes are summarized below.

1. Age-specific rates for the white male and female populations for each of the above 17 age groups of 5 years each were computed in order to make the finest possible comparisons between the REG and the RON. Ten-yr age group aggregates were also computed to broaden the population at risk base.

2. Age-adjusted rates for the total white male and female populations were prepared to obtain the most general perspective.

3. Age-adjusted rates for the white male and female populations 0 to 34 yr old were calculated in order to help substantiate the 5- and 10-yr rates while at the same time eliminate the influence of the middle-aged and elderly populations. Persons 35 yr and older accounted for 81% of the REG white population cancer mortalities attributed to leukemia, Hodgkin’s disease, and lymphoma from 1950 to 1969. It should be noted that 0 to 34 yr was a compromise between those who suggested 20-yr age groups and those who suggested 0 to 44 or 0 to 54 yr.

Having computed separate but parallel rates for the REG and RON, 2 sets of statistics were computed. One was a simple age-specific rate index derived by dividing the REG rate by the RON rate and multiplying the result by 100. The RON and REG comparisons were made to eliminate the influence of the REG’s population (about 10% of the nation’s) on the national totals. A rate of 100 means that the rate of the area of interest is identical to the national rate. The age-specific rate indices also allowed us to calculate excess or deficits in mortality. For example, if the REG’s white male leukemia 15- to 19-yr age group index is 112, we can calculate the number of excess

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RESULTS

There is a clear and statistically significant excess of childhood leukemia, teenage and young adult Hodgkin’s disease, and lymphoma in the REG (Table 1). The REG leukemia age-specific rate index peaks at ages 5 to 14 yr, about 15% higher than that of the RON, and then it gradually declines (Table 1). By ages 65 to 74 yr, the REG leukemia rates are at or below the average of the RON. The Hodgkin’s and lymphoma rates suddenly rise to a peak at 15 to 24 yr between 20 and 88% higher than the RON rates and then again gradually drop off.

Since the peaks in Table 1 are clearly manifested for both the male and female populations, it is hard to believe that they are random. Indeed, nearly all of the REG rates of particular concern (age groups 0 to 34 yr) were significantly different from their RON counterparts at the 0.05 and 0.01 level.

Given the fact that more than 25 million people live in the REG mortalities in the REG.

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### Table 1
Comparison of REG and RON age-specific rates for leukemia, Hodgkin's disease, and lymphoma, 1950 to 1969

<table>
<thead>
<tr>
<th>Age group (yr)</th>
<th>WM REG rates/100,000</th>
<th>WM Hodgkin's REG rates/100,000</th>
<th>WM Lymphoma REG rates/100,000</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Index</td>
<td>p</td>
<td>Index</td>
</tr>
<tr>
<td>0-4</td>
<td>100</td>
<td>5.4</td>
<td>102</td>
</tr>
<tr>
<td>5-9</td>
<td>118</td>
<td>99</td>
<td>123</td>
</tr>
<tr>
<td>10-14</td>
<td>119</td>
<td>99</td>
<td>114</td>
</tr>
<tr>
<td>15-19</td>
<td>114</td>
<td>95</td>
<td>112</td>
</tr>
<tr>
<td>20-24</td>
<td>109</td>
<td>90</td>
<td>107</td>
</tr>
<tr>
<td>25-29</td>
<td>113</td>
<td>90</td>
<td>100</td>
</tr>
<tr>
<td>30-34</td>
<td>112</td>
<td>90</td>
<td>120</td>
</tr>
<tr>
<td>35-39</td>
<td>113</td>
<td>90</td>
<td>112</td>
</tr>
<tr>
<td>40-44</td>
<td>115</td>
<td>95</td>
<td>109</td>
</tr>
<tr>
<td>45-49</td>
<td>111</td>
<td>95</td>
<td>102</td>
</tr>
<tr>
<td>50-54</td>
<td>107</td>
<td>90</td>
<td>112</td>
</tr>
<tr>
<td>55-59</td>
<td>107</td>
<td>90</td>
<td>113</td>
</tr>
<tr>
<td>60-64</td>
<td>100</td>
<td>90</td>
<td>110</td>
</tr>
<tr>
<td>65-69</td>
<td>98</td>
<td>29.3</td>
<td>107</td>
</tr>
<tr>
<td>70-74</td>
<td>98</td>
<td>41.0</td>
<td>101</td>
</tr>
<tr>
<td>75-84</td>
<td>90</td>
<td>55.2</td>
<td>97</td>
</tr>
<tr>
<td>85+</td>
<td>87</td>
<td>63.8</td>
<td>90</td>
</tr>
</tbody>
</table>

* WM, white male; WF, white female.
* b Computed by the formula: (REG/RON) × 100.
* c Probability that REG rate is significantly higher than RON rate if probability exceeds 80%.
* d Rate less than 0.3/100,000.

### Table 2
Total and excess white population leukemia, Hodgkin’s disease, and lymphoma mortalities in the region, in comparison to the RON in 1950 to 1969

<table>
<thead>
<tr>
<th>Age group (yr)</th>
<th>A. Leukemia Male</th>
<th>A. Leukemia Female</th>
<th>B. Hodgkin’s disease Male</th>
<th>B. Hodgkin’s disease Female</th>
<th>C. Lymphoma Male</th>
<th>C. Lymphoma Female</th>
<th>Total A, B, and C Male</th>
<th>Total A, B, and C Female</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Excess</td>
<td>Relative risk</td>
<td>Total</td>
<td>Excess</td>
<td>Relative risk</td>
<td>Total</td>
<td>Excess</td>
</tr>
<tr>
<td>0-34</td>
<td>3,911</td>
<td>382</td>
<td>1.11</td>
<td>2,967</td>
<td>296</td>
<td>1.11</td>
<td>1,386</td>
<td>346</td>
</tr>
<tr>
<td>35 or greater</td>
<td>13,525</td>
<td>-80</td>
<td>0.99</td>
<td>10,701</td>
<td>437</td>
<td>1.04</td>
<td>3,945</td>
<td>263</td>
</tr>
<tr>
<td>Total</td>
<td>17,436</td>
<td>302</td>
<td>1.02</td>
<td>13,668</td>
<td>733</td>
<td>1.06</td>
<td>5,329</td>
<td>611</td>
</tr>
</tbody>
</table>
REG, the number of excess mortalities is substantial (Table 2). Almost 60,000 white people died as a result of the 3 diseases during the 2 decades. Relative risk rates were calculated by applying the 5-yr age-specific rates of the RON to the REG and subtracting the difference between the RON and REG rates. The result is excess or deficit mortalities. Whereas the 0 to 34 yr age population accounts for 19% of the mortalities (more than 11,000), it is responsible for 38% (more than 1,600) of the excess deaths (Table 2, Column 21). Briefly summarizing, the REG has significantly higher childhood and young adult leukemia, Hodgkin’s disease, and lymphoma mortalities than does the RON.

Have the relative differences between the REG and the RON increased during the recent past? In particular, we sought to determine if any of the 0 to 34-yr age group rates of the REG had increased substantially more rapidly than did their RON counterparts. When combined with the static analysis results, such a finding would imply a risk factor(s) worthy of special attention.

To provide an initial perspective, trends for the entire population were studied. Differences between the REG and the RON in leukemia and lymphoma have narrowed (Table 3). The REG and RON white male leukemia and white male and female lymphoma mortality rates increased from the 1950 to 1954 period to the 1965 to 1969 period; the RON rates increased more rapidly than did the REG rates. The REG white female leukemia rate decreased, while the RON rates increased. The result in all 4 cases is a narrowing of the gap between the REG and the RON.

There is no clear trend for Hodgkin’s disease. The REG rates have increased, the RON rates show less change.

With the total-population, age-adjusted rates as a perspective, analysis of the 0 to 34-yr age group rates isolated the 15 to 24-yr age group as worthy of special attention. With respect to lymphoma, the REG rate for white females ages 15 to 24 yr increased 15% (Table 4, Column 18) between the 1950 to 1959 period to the 1960 to 1969 period; the RON rates increased more rapidly than did the REG rates. The REG white female leukemia rate decreased, while the RON rates increased. The result in all 4 cases is a narrowing of the gap between the REG and the RON.

Table 3

<table>
<thead>
<tr>
<th>Time period</th>
<th>REG/RON × 100</th>
<th>Leukemia (ICD 204)</th>
<th>Hodgkin's (ICD 201)</th>
<th>Lymphoma (ICD 200, 202, 205)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>WM*</td>
<td>WF</td>
<td>WM*</td>
<td>WF</td>
</tr>
<tr>
<td>1950–1954</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1955–1959</td>
<td>105</td>
<td>112</td>
<td>123</td>
<td>116</td>
</tr>
<tr>
<td>1960–1964</td>
<td>112</td>
<td>101</td>
<td>134</td>
<td>112</td>
</tr>
<tr>
<td>1965–1969</td>
<td>102</td>
<td>112</td>
<td>122</td>
<td>112</td>
</tr>
<tr>
<td>REG 1955–1969 × 100</td>
<td>102</td>
<td>95</td>
<td>105</td>
<td>106</td>
</tr>
<tr>
<td>REG 1950–1954</td>
<td></td>
<td></td>
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</tbody>
</table>

*WM, white male; WF, white female.
With the exception of white females ages 5 to 14 yr, the REG leukemia rates did not increase. The decrease was sufficiently great to reduce the difference between the REG and RON white male rates. The differences between the REG and RON white female rates increased in 3 of the 4 cases (Table 4, Columns 3 and 4). However, when combined with the absolute decrease within the REG, white female leukemia seems less interesting than Hodgkin’s disease and lymphoma among the 15 to 24-yr age group for follow-up studies.

**DISCUSSION**

Why did the New Jersey-New York-Philadelphia axis have excessive rates? Could the recently identified Rutherford cluster of childhood and young adult leukemia, Hodgkin’s, and lymphoma rates be related to the more general regional pattern of relatively high childhood and young adult mortality rates described above? Likewise, could this general regional finding be directly related to Vianna’s findings of excess Hodgkin’s cases in Nassau and Suffolk Counties and other areas in New York State (9, 10)?

Several steps are planned in an effort to answer these questions: (a) county rates have been prepared and are being studied. (b) A finer breakdown of the 3 diseases will be obtained to determine if, as expected, only a few specific types are responsible for the excess; (c) more recent mortality data (1970 to 1975) have been obtained to determine if the relatively high rates of the REG have changed over time; (d) correlations between the age-specific rates and 71 risk factors gathered by our research team (3, 4) will be made at the county scale in order to try to derive risk factor clues. The risk factors include measures of social class, ethnicity, industrial location, air quality, traffic density, and other factors that the literature suggests may be associated with the presence of these diseases. These will be evaluated using weighted and unweighted regression and correlation analyses to seek risk factor clues and counties for case-control studies in the region; (e) similar analyses are planned on the 25 most populous metropolitan regions in the United States to determine if the New Jersey-New York-Philadelphia axis is unique in its excess of childhood leukemia and young adult Hodgkin’s disease and lymphoma cancer mortality. Overall, the findings of this first study clearly suggest the need for further analyses.

**REFERENCES**

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