THE EVOLUTION OF HODGKIN'S DISEASE INCIDENCE AFTER ACCIDENTAL IRRADIATION IN MUREŞ COUNTY[#]

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Abstract. A study of Hodgkin's disease incidence and the influence of accidental ionizing radiation occurred after the nuclear explosion in Chernobyl in 1986 on Mureş County population was performed. We studied the annual incidence of Hodgkin's disease in the Mureş County between 1983–2002, according to gender, age, and origin. This study is a cohort type, with ecological preponderance. In Mureş County, the incidence of Hodgkin's disease showed statistically significant increases only during the first post-accident period. The results of our study do not indicate a statistically significant association between risk factor (accidental ionizing radiation) and disease (Hodgkin's lymphoma), thus exposure to radiation could not be proved as an etiological factor for this malignancy so far.

Key words: ionizing radiation, Hodgkin's disease, statistical analysis.

INTRODUCTION

Hodgkin's disease (HD) is a malignant disorder of the lymphatic system, characterized by a malignant cell proliferation with an inflammatory reaction. Like other cancers, lymphomas occur when cells divide too often and too quickly. When this occurs, cancer cells may overcrowd, invade, and destroy lymphoid tissues and metastasize to other organs. There are two main types of lymphoma: Hodgkin's disease and non-Hodgkin lymphoma. Hodgkin's disease is named after Thomas Hodgkin, who recognized it in 1832 for the first time. The lymphatic tissue in Hodgkin's disease contains specific cells called Reed-Sternberg cells, that cannot be found in any other type of cancer. These cells distinguish Hodgkin's disease

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from non-Hodgkin's lymphoma. Certain factors can increase the risk for HD. Some of these factors, such as age and genetics, cannot be modified, while other factors such as environment or lifestyle choices can be changed. The rate of HD is high in two age groups: young people between the ages of 15–40, and elder people aged over 55. Generally, both Hodgkin's disease and non-Hodgkin lymphoma affect men more often than women. The risk of HD is increased in people who have been infected with viruses, such as Epstein-Barr virus (EBV). EBV infects B lymphocytic cells and causes a disease known as infectious mononucleosis. In people who suffer from it, the infected B-cells are detected and killed by the body's T-cells. But if the patient has a T-cell shortage, the EBV-infected B-cells build up within the bloodstream and increase the risk for genetic mutations that can cause lymphoma. It is important to note that there is no evidence of EBV infection in many HD patients, so its role in the development of the disease remains uncertain [3, 4, 5, 7, 8].

The nuclear accident at Chernobyl was the largest civil accident, which affected the population and the ecological system not only in the vicinity of the nuclear station, but also across Europe. Our country was included on the list of countries that were affected by the radioactive pollution. Romania was affected by the radioactive cloud that spread around from the nuclear station of Chernobyl on April 30, 1986. Radioactivity monitoring stations recorded maximum values especially on the 1st and 2nd of May, 1986. The explanation is that for a period of 4 days after the accident, during April 29 – May 1, 1986, the radioactive cloud changed its direction over Europe, moving towards south and southwest. Because of precipitations during those days and dry sedimentation, radionuclides from the atmosphere also got into the other components of the environment: soil, water, biosphere [1, 2, 9].

Although radiation is not considered to be an etiologic factor in the development of Hodgkin's lymphoma, we studied the incidence of this disease in Mureş County during a period of 20 years, before and after the accidental nuclear explosion at Chernobyl in 1986.

The study of Hodgkin's disease incidence on Mureş County population was performed. The studied patients were hospitalized in the following clinics: Hematology Department of Medical Clinic I, Department of Hematology and Stem Cell Transplant of Medical Clinic II, Department of Oncology of Pediatrics Clinic I, Târgu Mureş.

MATERIALS AND METHODS

The performed study is of a cohort type, based on ecological preponderance, where the analysed units are whole populations or groups rather than individual subjects.

Regarding the sample size of this study, we investigated all cases of this type of illness found in the archives of Mureş County Clinics during 1983–2002. We determined the annual and cumulative incidence (for periods of 3 years) reported to the County population, according to demographic data.

We collected data concerning patients' age and gender, the year of the diagnosis, the type of acute leukemia/lymphoma, living conditions and geographical area of origin. The study covered the period of 1983–2002.

Due to the existence of incomplete records in some clinics, we could not study the incidence of malignant hemopathies for more than 3 years in pre-Chernobyl period (1983–1985). Thus, we have grouped the post-Chernobyl interval in 5 periods of 3 years, to calculate and compare the cumulative incidence values. Although 2001, 2002 were initially taken into consideration, they could not be grouped in a comparative 3-year period, therefore we used special statistical techniques (e.g. resampling) in order to provide the missing values. While most textbooks of statistics [6] recommend caution when applying such methods, we preferred to skip this period, in order to avoid affecting the objectivity of the conclusions.

The stipulated statistical analysis consisted in calculating the expected relative risk (RR] and the related confidence interval (CI). RR and CI were calculated using the CHI^2 test, which was applied using the YATES correction, and not the Fisher test, because of the ecological character of this study, which resulted in greater values in the contingency tables.

RESULTS

According to the case records, in the last 20 years 189 patients were diagnosed with Hodgkin's disease. Out of these, 100 were male patients (52.91%) and 89 (47.09%) female patients.

We also determined the evolution rate of Hodgkin's disease developed in Mureş County during 1983–2002. Out of the 189 patients with Hodgkin's disease, 179 (94.70%) were adults and 10 (5.30%) children.

At the same time we determined the evolution of the Hodgkin's disease rate in Mureş County during 1983–2002, taking into account the ages of patients whose cases we followed in the framework of this study.

Out of the total number of patients with Hodgkin's disease, 105 (55.55%) originated from urban areas and 84 (44.45%) from rural areas.

We determined the evolution rate of Hodgkin's disease regarding origin too.

We calculated the incidence of Hodgkin's disease for each year during 1983–2002 by corroborating, analyzing and processing the descriptive data appropriate to the group of studied patients in Mureş County as shown in Figures 1 and 2.

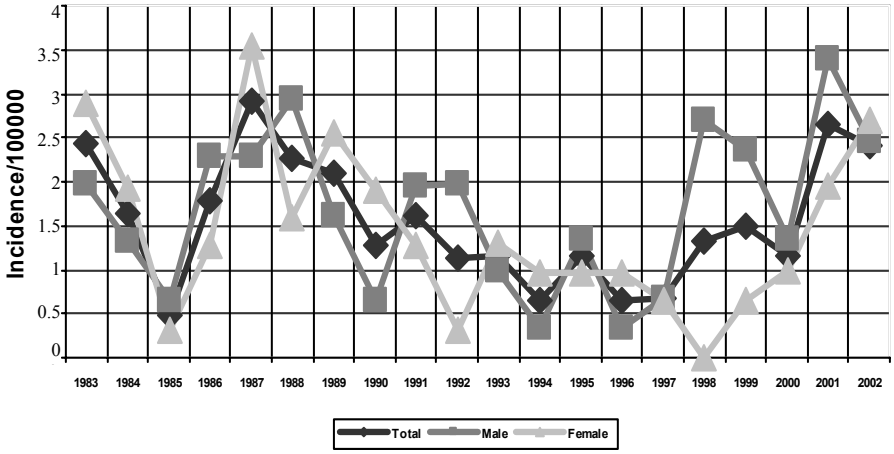

Fig. 1. Incidence of HD by gender in Mureş County over a time interval of 20 years (1983–2002).

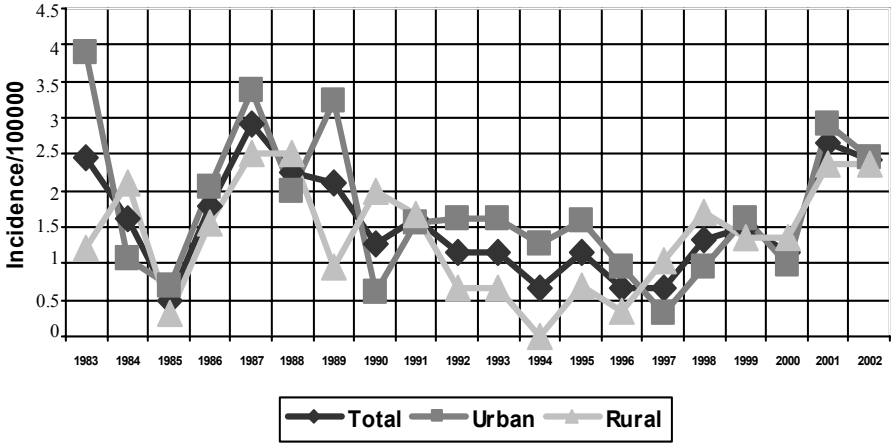

Fig. 2. Incidence by the origin of Hodgkin's disease in Mureş County during 1983–2002.

We can observe a positive association, although not statistically significant, between exposure to a risk factor (ionizing radiation due to the Chernobyl accident) and disease (Hodgkin's disease) over 2 out of the 5 studied periods (1986–1988, 1989–1991) as shown in Table 1 and Figure 3. There is a statistically significant negative association between exposure and disease during 1992–2000 with a relative risk decrease, even at negative values, during the last studied periods.

There is a statistically insignificant positive association between exposure to risk factors and disease during the first 3 years after accidental exposure in 1986 as seen in Table 2 and Figure 4.

Table 1

Statistical analysis of Hodgkin's disease in Mureş County

Period	No. of HD cases	Number of population exposed to risk	Relative risk (RR) (CI 95 %)	Chi^2 Test	P	CI (3 years)	Attributable risk
1983–1985 (no exposure)	**28**	**614296**				**4.558**	
1986–1988	43	614725	1.535 (0.953;2.470)	2.751	0.097	6.995	2.437
1989–1991	31	621246	1,095 (0.657;1.825)	0.047	0.828	4.990	0.432
1992–1994	18	612521	0.645 (0.357;1.166)	1.735	0.188	2.939	–1.619
1995–1997	15	606777	0.542 (0.289;1.016)	3.203	0.074	2.472	–2.086
1998–2000	24	602721	0.874 (0.506;1.507	0.12	0.728	3.982	–0.576

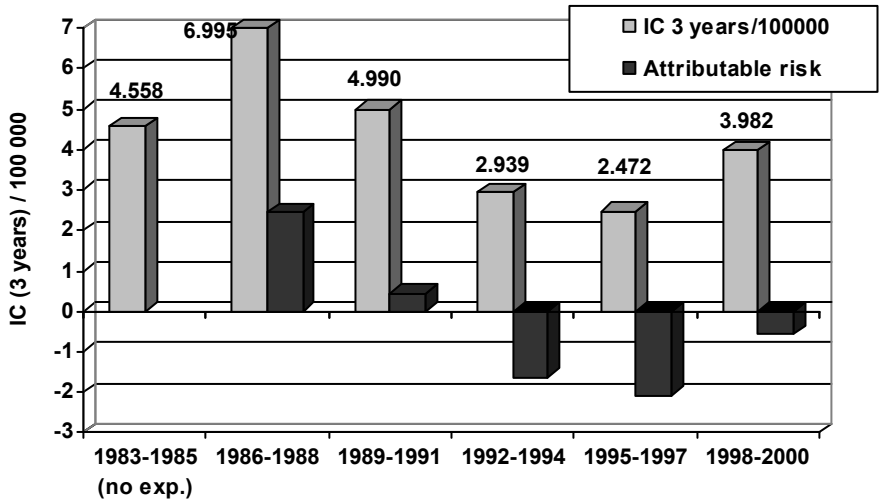

Fig. 3. Representation of the cumulative incidence risk and attributable risk assigned to Hodgkin's disease.

The other intervals (1989–1991, 1992–1994, 1995–1997 and 1998–2000) present a negative association, although not statistically significant, between exposure and disease, with a relative risk decrease, even at negative values, during the last four post-accident periods.

Table 2

Statistical parameters of Hodgkin's disease in urban areas

Period	No. of BH cases (urban)	Number of population exposed to risk	Relative risk (RR) (CI 95 %)	Chi^2 Test	P	CI (3 years)	Attributable risk
1983–1985 (no exposure)	**16**	**282898**				**5.656**	
1986–1988	22	291162	1.336 (0.702;2.544)	0.522	0.470	7.556	1.900
1989–1991	17	309481	0.971 (0.491;1.923)	0.007	0.933	5.493	–0.163
1992–1994	14	310680	0.797 (0.389;1.633)	0.193	0.660	4.506	–1.150
1995–1997	9	314305	0.503 (0.224;1.146)	2.145	0.143	2.863	–2.792
1998–2000	11	310920	0.626 (0.290;1.348)	1.033	0.310	3.538	–2.118

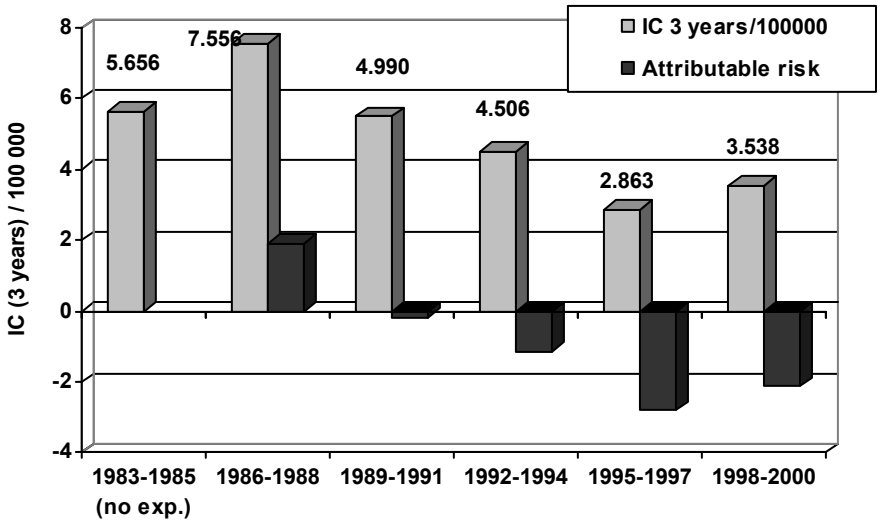

Fig. 4. Cumulative incidence and attributable risk for Hodgkin's disease in urban areas.

We can notice a slight positive association between greater exposure to the risk factor and disease over the first 2 out of the 5 studied periods (1986–1988, 1989–1991), although lacking statistical significance as shown in Table 3 and Figure 5.

The other intervals (1992–1994, 1995–1997 and 1998–2000) present a negative association (not statistically significant) between exposure and disease, with a relative risk decrease, even at negative values, during the last three post-accident periods.

Table 3

Statistical parameters of Hodgkin's disease in rural areas

Period	No. of HD cases (rural)	Number of population exposed to risk	Relative risk (RR) (CI 95 %)	Chi^2 Test	P	CI (3 years)	Attributable risk
1983–1985 (no exposure)	**12**	**331398**				**3.621**	
1986–1988	21	323563	1.792 (0.882;3.664)	2.136	0.144	6.490	2.869
1989–1991	14	311765	1.240 (0.574;2.682)	0.124	0.725	4.491	0.870
1992–1994	4	301841	0.366 (0.118;1.135)	2.449	0.118	1.325	–2.296
1995–1997	6	292472	0.557 (0.213;1.510)	0.838	0.360	2.051	–1.570
1998–2000	13	291801	1.230 (0.561;2.697)	0.101	0.750	4.455	0.834

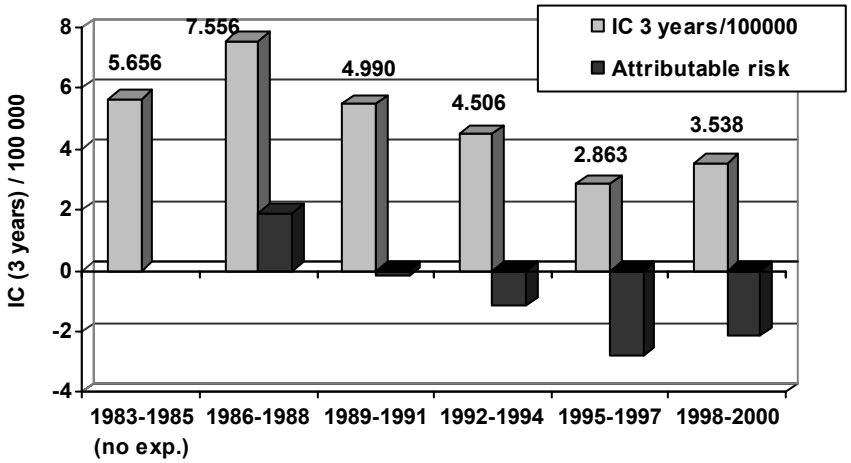

Fig. 5. Cumulative incidence and attributable risk for Hodgkin's disease in rural areas.

As shown in Table 4 and Figure 6, there is a slight positive association between exposure to risk factor and disease, lacking statistical significance, over the three out of the 5 studied periods. For all other intervals there is a statistically significant negative association, with a relative risk decrease to negative values, too, during two periods after the nuclear accident.

Table 4

Statistical evaluation of male patients suffering from Hodgkin's disease in Mureş County

Period	No. of HD cases (males)	Number of population exposed to risk	Relative risk (RR) (CI 95 %)	Chi^2 Test	P	CI (3 years)	Attributable risk
1983–1985 (no exposure)	**12**	**304170**				**3.945**	
1986–1988	23	304263	1.916 (0.953;3.851)	2.854	0.091	7.559	3.614
1989–1991	13	307328	1.072 (0.489;2.350)	0.03	0.862	4.230	0.285
1992–1994	10	302687	0.837 (0.367;1.939)	0.041	0.840	3.304	–0.641
1995–1997	7	298763	0.594 (0.234;1.509)	0.772	0.380	2.343	–1.602
1998–2000	19	295759	1.628 (0.790;3.355)	1.336	0.248	6.424	2.479

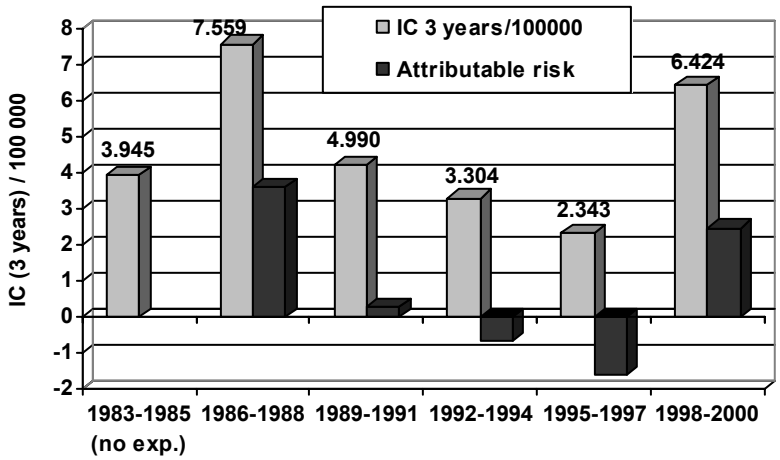

Fig. 6. Cumulative incidence and attributable risk in male patients suffering from Hodgkin's disease.

There is a statistically insignificant positive association between exposure to risk factors and disease in the first period after 1986 and there is a statistically significant negative association during the last studied period as seen in Table 5 and Figure 7.

The other intervals present a statistically significant negative association, with a relative risk decrease even on negative values for the last three investigated periods after the accident.

Table 5

Statistical evaluation of female patients suffering from Hodgkin's disease in Mureş County

Period	Number of HD cases (females)	Number of population exposed to risk	Relative risk (RR) (CI 95 %)	Chi^2 Test	P	CI (3 years)	Attributable risk
1983–1985 (no exposure)	**17**	**310126**				**5.482**	
1986–1988	20	310462	1.175 (0.616;2.244)	0.106	0.745	6.442	0.960
1989–1991	18	313918	1.046 (0.539;2.030)	0.018	0.894	5.734	0.252
1992–1994	8	309834	0.471 (0.203;1/092)	2.553	0.110	2.582	–2.900
1995–1997	8	308014	0.474 (0.204;1.908)	2.506	0.113	2.597	–2.884
1998–2000	5	306962	0.297 (0.110;0.806)	5.388	0.020	1.629	–3.853

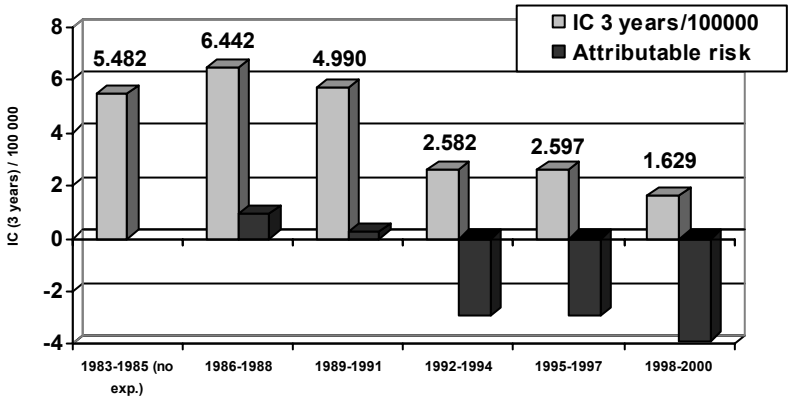

Fig. 7. Cumulative incidence and attributed risk in female patients suffering from Hodgkin's disease.

CONCLUSIONS

The study of the influence of physical factors upon the induction of hematological disorders adds new data regarding the influence of ionizing radiation in Hodgkin's disease. The impact of ionizing radiation on Hodgkin's disease incidence is open to discussions.

Concerning Hodgkin's disease, the results indicate an association between the above-mentioned risk factor and disease type, although lacking statistical significance. Thus, radiation has not proved to be an etiological factor for this malignancy so far.

Because of the fact that the etiological factors of cancer are multiple and they exert synergistic actions, we cannot establish with certainty the extent to which radiations play a role in the induction of Hodgkin's disease.

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