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Incidence of childhood cancers in rural areas of the Lublin Region in 1988–2000

The growth of a neoplasm results from interactions of various carcinogenic factors – genetic, chemical, physical and biological ones. The dynamic industrial-economic development observed in the recent decades is indisputably associated with an increase in the number of carcinogenic factors in all constituents of our environment (air, soil, water, food). The highest accumulation of those factors occurs in big cities and industrial regions (2). Although the rural environment is also likely to be the source of specific carcinogens (chemical fertilizers, pesticides, etc.), the relation between the exposure to those factors and increased number of malignant tumours is much weaker than that observed in the industrial regions and cities (6). The incidence of malignant tumours in the regions characterized by low pollution seems to be worth analyzing. One of such areas is the Lublin Region, which is mostly agricultural with few industrial centers located in bigger towns (9). The study analysed the incidence of malignant tumours diagnosed in children and adolescents living in the Lublin rural regions.

MATERIAL AND METHODS

The study included the population of children and adolescents, aged 0–17, living in the Lublin rural regions in the years 1988–2000 (the area of the present Lublin province and areas of former Biała Podlaska, Chełm, Lublin and Zamość provinces).

The tumours were divided according to the International Classification of Childhood Cancers (ICCC) which is a morphological classification dividing the tumours into 12 main diagnostic groups. The analysis determined the incidence of all tumours and individual types in the successive years as well as the rates of percentage structure and incidence expressed as Incidence Rates (IR) and Age Standardized Rates (ASR), which were calculated according to the following formulas: IR = Ncs/NP x 1,000,000 (where Ncs – number of cases reported for the first time in a particular year, NP – size of the population in a particular year) and ASR = $[x_1*y_1+x_2*y_2+.....+x_n*y_n]/[y_1+y_2+....+y_n]$ (where x_{1-n} - IR for individual 5-year age groups, y_{1-n} – size of the standard population in the same age groups).

The standardized rates were calculated for children aged 0–14 years. The data concerning the standard world population were taken from *International Incidence of Childhood Cancer*, Vol. II IARC Lyon, France, 1998, p. 12. The analysis did not include the secondary registrations (the aim of the study was to examine the incidence and not prevalence of malignant tumours). Moreover, the children hospitalized or consulted in the Lublin Region but living outside the region were excluded. The above parameters were calculated for the whole rural population aged 0–17 according to sex and age on diagnosis. Four age groups were distinguished: 0–4, 5–9, 10–14, 15–17 years.

RESULTS

Number of cancer cases. Between 1988 and 2000 a total of 430 cases of childhood cancers were noted in rural areas of the Lublin Region occurring among 0–17 years old children. In this group were 231 boys (53.7%) and 199 girls (46.3%). Age and sex distribution of cancers was presented in Table 1. Table 2 describes the number and percentage of cancers by the main diagnostic groups based on the International Childhood Cancer Classification.

Table 1. Age and sex distribution of the childhood cancer cases among children 0–17 years living in rural areas in the Lublin Region of Poland in 1988–2000

0–4 years		5–9 years		10–14 years		15–17 years		All	
n	%	n	%	n	%	n	%	n	%
147	35	92	21	109	25	82	19	430	100
75	33	53	23	61	26	42	18	231	100
72	36	39	20	48	24	40	20	199	100
1		1.4		1.3		1		1.2	

M/F - sex ratio – the ratio of number of cases in males to that in females

Table 2. Number, percentage and Incidence Rates per million of childhood cancer cases by the main diagnostic groups for children living in rural areas in the Lublin Region of Poland in 1988–2000

Diagnostic subgroups	Number of cases among 0–17--year-old-children	%	Incidence rate per million (IR)
Leukaemias	105	24.4	24.6
Lymphomas	69	16.0	16.2
Central Nervous System	84	19.5	19.7
Sympathetic Nervous System	19	4.4	4.5
Retinoblastoma	14	3.3	3.3
Renal Tumours	30	7.0	7.0
Hepatic Tumours	5	1.2	1.2
Bone Tumours	25	5.8	5.9
Soft Tissue Sarcomas	34	7.9	8.0
Germ Cell	18	4.2	4.2
Carcinomas	15	3.5	3.5

Incidence Rates. The main Incidence Rate in the whole group was 100.8 per million (from 65.1 to 137.6). Among 0–14-year-old children Age-standardized Incidence Rates (ASR) were also calculated. The main ASR was 106.6 per million. The number of cases in the succeeding years of

observation, Incidence Rates among all children as well as among boys and girls and ASR among 0–14-year-old children were presented in Table 3. The comparison of incidence measured by IR among boys and girls revealed higher incidence among boys (Table 3). Moreover, in the group aged 0–14, higher incidence was found among boys (ASR–111.3/1 mln, number of cases – 189) than among girls (ASR – 100.4/1 mln, number of cases – 159).

Table 3. Number of cancer cases and Cancers Incidence Rates per million children living in rural areas in the Lublin Region of Poland

Number of cases among 0–17-year-olds	Incidence rate per million 0–17 yrs (IR)	Number of cases among 0–14-year-olds	Age-standard incidence rate per million 0–14 yrs (ASR)	Number of cases among 0–17-year-old boys	Incidence rate per million – boys 0–17 yrs	Number of cases among 0–17-year-old girls	Incidence rate per million – girls 0–17 yrs
35	102.1	32	119.0	21	119.7	14	83.8
34	100.9	25	89.2	18	104.4	16	97.3
39	116.6	33	122.3	19	110.9	20	122.6
30	90.4	27	104.7	16	94.1	14	86.5
46	137.6	38	145.6	20	116.6	26	159.6
36	109.1	29	114.7	23	135.9	13	81.0
39	119.5	34	134.4	25	149.2	14	88.1
40	124.2	29	120.8	18	108.8	22	140.4
33	103.9	27	112.5	15	91.9	18	116.6
27	86.4	19	79.9	16	99.6	11	72.4
31	101.0	22	86.4	15	95.2	16	107.1
22	65.1	18	73.7	15	86.3	7	42.6
18	54.4	15	60.3	10	58.9	8	49.7
430	100.8	348	106.0	231	105.6	199	95.8

The incidence according to the types of cancers in the whole population examined is presented in Table 2. The leukemia incidence in the 13-year-period of examination remained at the constant level, with a slight decrease observed at the end of that period. The lymphoma incidence constantly and slowly increased throughout the whole period. The CNS tumour incidence showed marked fluctuations of its rates in the individual years. In 1997 a decrease in incidence was observed.

DISCUSSION

The yearly number of malignant tumour cases remained at the similar level in the whole group, only slight fluctuations were observed in the individual observation years. The comparison of the incidence structure in the rural region of Lublin and in Poland showed significant differences in relation to several neoplasms (5). Compared to Poland, the percentage of leukaemias was lower in the Lublin Region (24.4 *vs* 28%). In the remaining neoplasms the differences were slight.

In the examined group, higher incidence of neoplasms was observed in boys, which was also confirmed by other authors (8). In the whole group, the M/F ratio was 1.2 on average. Similar values

were demonstrated in the majority of European countries (M/F=1.2–1.3). Compared to the other age groups, higher incidence was found in the 0–4 group, both in boys and girls. This correlation is widely confirmed by others (3, 8, 12). The youngest children show the highest sensitivity to various carcinogenic factors affecting them already in the fetal life (2). Moreover, the harmful effects on the gametes of future parents should be stressed, which may lead to the development of neoplastic diseases in their offspring, especially in the early period of life (10, 11).

Despite the reports confirming an increase in the incidence of neoplastic diseases (3), the epidemiological analysis carried out in the rural region of Lublin did not reveal such a tendency. The incidence rates in the individual years were stable, both in the whole population and in the sex groups; with one alarming exception – a constant increase in the incidence of lymphomas.

The average incidence in the children aged 0–17 was lower than that in Poland (5). In most reports, including world-wide studies, the authors present the results concerning the 0–14 -year age groups. The comparison of incidence in this age group in the rural region of Lublin and selected European countries of various degrees of industrialization, urbanization, life standards and environmental protection showed that the risk of malignant tumours among children in the Lublin regions was lower (12).

Lower neoplasm incidence in the rural environment is definitely related to lower exposure of its population to carcinogenic factors, both of children and future parents. However, many authors indicate increasingly higher risk of neoplasms in children living in the country, suggesting that the reasons are mainly connected with increased chemicalization of agriculture (6) and development of animal breeding, which is likely to be the reservoir of carcinogenic, infectious factors also for people (15).

Furthermore, the role of infectious factors is stressed, particularly in leukaemias (4) and lymphomas (13). Increased accumulation of infectious factors in city population is associated with higher population density and constant influx of new inhabitants. M u i r h e a d (7) reports almost a 40% increase in the risk of neoplasms, especially leucaemias, in the regions of high population density compared to low population density areas.

Many authors suggest that leukaemias are related not only to infectious factors of confirmed carcinogenic effects, e.g. HTLV-1 and EBV, viruses causing leucaemia in animals, but also to so--called "normal" infections whose etiology is often difficult to define (4). W i e m e l s (14) suggests that childhood leucaemias are often initiated by chromosome translocation in the fetal life and in the later period even normal infections may promote further reactions leading to the development of this disease, especially when the immune responses are impaired. The rural environment is obviously less exposed to such factors, which may also be connected with lower number of neoplasms.

Comparing the incidence in towns and in the country, one should not neglect the effects of different living conditions. Analysing the relation between the neoplasm incidence and socio-economic conditions of families, the authors indicate higher incidence in the families of higher income (10).

The above mentioned increasingly higher incidence of lymphomas requires further observation. The causes may include the biological-chemical factors discussed as well as genetic ones, mainly the carrier state of the mutated gene responsible for Nijmegen breakage syndrome (NBS). The patients with NBS are exposed to over 1,000 times higher risk of neoplasms originating from the lymphatic system. A vast majority of patients comes from Central Europe, mainly Poland (1). The systematic genetic studies will allow to define whether the Lublin Region incidence of heterozygotous carriers of the mutated gene is higher than that in the other regions of Poland.

CONCLUSIONS

1. The patient's place of residence is one of the factors affecting the structure of childhood cancers.

2. Higher percentage of lymphomas and CNS tumours and lower percentage of leucaemias and tumours of the sympathetic nervous system and bones was observed in the Lublin Region compared to the values determined for the whole country.

3. The population examined showed lower malignant tumour incidence than that in the whole country.

4. In the population analysed, increased lymphoma incidence was found; the differences in the groups of other neoplasms were insignificant.

REFERENCES

1. Chrzanowska K.: Zespół Nijmegen – pierwotne małogłowie z wysokim ryzykiem rozwoju nowotworu. Ped. Pol., 5, 327, 2001.
2. Doll R. S., Wakeford R.: Risk of childhood cancer from fetal irradiation. Br. J. Radiol., 70, 130, 1997.
3. Gurney J. G. et al.: Trends in cancer incidence among children in the U.S. Cancer, 3, 532, 1996.
4. Kinlen L. J.: Epidemiological evidence for an infective basis in childhood leukaemia. Br. J. Cancer, 71, 1, 1995.
5. Kowalczyk J. R., Dudkiewicz E.: Częstość występowania nowotworów złośliwych u dzieci w Polsce i możliwości wczesnego rozpoznania. Przegl. Ped., 3, 199, 1999.
6. Meinert R. et al.: Leukaemia and non-Hodgkin lymphoma in childhood and exposure to pesticides: Results of a register-based case-control study in Germany. Am. J. Epidemiol., 7, 639, 2000.
7. Muirhead C. R.: Childhood leukaemia in metropolitan regions in the United States: a possible relation to population density. Cancer Cause Control, 6, 383, 1995.
8. Parkin D. M. et. al.: International Incidence of Childhood Cancer, Vol. II. IARC Scientific Publications No. 144, Lyon 1998.
9. Raport o stanie środowiska województwa lubelskiego. Biblioteka Monitoringu Środowiska, Lublin 2000.
10. Schuz J. et. al.: Association of childhood cancer with factors related to pregnancy and birth. Int. J. Epidemiol., 28, 631, 1999.
11. Schuz J. et al.: Risk of childhood leukaemia and parental self-reported occupational exposure to chemicals, dusts, and fumes: Results from pooled analyses of German population-based case--control studies. Cancer Epidemiol. Biomarkers Prev., 8, 835, 2000.
12. Stiller C. A., Parkin D. M.: Geographic and ethnic variations in the incidence of childhood cancer. Br. Med. Bull., 2, 682, 1996.
13. Westergaard T. et al.: Birth order, sibship size and risk of Hodgkin's disease in children and young adults: a population-based study of 31 million person-years. Int. J. Cancer, 6, 977, 1997.
14. Wiemels J. L. et al.: Prenatal origin of acute lymphoblastic leukaemia in children. Lancet, 354, 1499, 1999.
15. Yeni-Komshian H., Holly E. A.: Childhood brain tumors and exposure to animals and farm life: A review. Paediatr. Perinatal. Epidemiol., 3, 248, 2000.

SUMMARY

The purpose of the work was the analysis of the number and structure of new neoplasm and morbidity in children living in rural areas of the Lublin Region of Poland. Methods: the study included

the population of children aged 0–17 in the years 1988–2000. The tumours were divided according to the International Classification of Childhood Cancers. The analysis determined the incidence of all tumours and individual types and the rates of percentage structure and incidence. These parameters were calculated for the whole population according to sex and age. Results: 430 cases of childhood cancers were reported. Boys were 53.7%. The most frequent was leukemia (24.4%), neoplasm of CNS (19.5%) and lymphomas (16%). The mean morbidity rate was 100,8 per million (among boys – 105.6, girls – 95.8). Conclusions: 1. The patient's place of residence is one of the factors affecting the structure of cancers. 2. Higher percentage of lymphomas and CNS tumours and lower percentage of leucaemias and tumours of the sympathetic nervous system and bones was observed in the Lublin Region compared to the values determined for the whole country. 3. The population examined showed lower malignant tumour incidence than that in the whole country as well as increased lymphoma incidence.

Występowanie nowotworów złośliwych wśród dzieci i młodzieży z obszarów wiejskich Lubelszczyzny w latach 1988-2000

Celem pracy była analiza liczby nowych zachorowań, struktury zachorowań oraz zachorowalności na nowotwory złośliwe wśród dzieci zamieszkujących tereny wiejskie Lubelszczyzny. Badaniem objęto populację dzieci i młodzieży w wieku 0–17 lat w latach 1988–2000. Nowotwory podzielono zgodnie z Międzynarodową Klasyfikacją Nowotworów Dziecięcych (ICCC). Określono liczbę zachorowań na wszystkie nowotwory oraz na poszczególne typy w kolejnych latach, obliczono wskaźniki struktury procentowej oraz zachorowalność. Parametry te obliczono dla całej populacji oraz w zależności od płci i wieku. Odnotowano 430 przypadków nowotworów. Chłopcy stanowili 53,7%. Najczęstszymi nowotworami były białaczka (24,4%), nowotwory OUN (19,5%) i chłoniaki (16%). Średnia zachorowalność wynosiła 100,8/1mln (chłopcy – 105,6, dziewczęta – 95,8/1mln). Wnioski: 1. Pochodzenie pacjentów jest jednym z czynników wpływających na strukturę zachorowań na nowotwory. 2. Stwierdzono wyższy odsetek chłoniaków i nowotworów OUN oraz niższy białaczek, nowotworów układu współczulnego i kości w porównaniu z wartościami odnotowanymi na terenie całej Polski. 3. W badanej populacji stwierdzono niższą zachorowalność na nowotwory złośliwe niż na terenie całej Polski jak również wzrost zachorowalności na chłoniaki.