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Incidence of Cancer in Children in the Province of Torino (Italy) 1967–1978*

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Abstract—*A population-based registry of cancer in children (aged 0–14 yr) has been in operation in the Province of Torino since 1965. During 1967–1978 a total of 870 cases were recorded. Overall incidence rates were 160 per million per year in boys and 128 in girls. Relative frequencies of the most common cancer types were comparable to those recorded in other western populations. No major differences were noticed between 1967–1970, 1971–1974 and 1975–1978. Rates were higher in boys than in girls for leukaemias, neuroblastomas, Hodgkin's- and non-Hodgkin's lymphomas. Residents in the city of Torino and residents in the rest of the province were compared: incidence rates of tumours of the central nervous system and neuroblastomas, but not other rates, were higher in the city of Torino.*

INTRODUCTION

THE PROVINCE of Torino (6830 km^2) is located in the NW part of Italy: it is highly industrialized (in 1971, 62% of the active population was engaged in industrial activities). Its population increased from 1.43 million in 1951 to 2.29 million in 1971 (of which 0.50 million were aged 0–14 yr) and remained stable thereafter.

Registration of cancer in ages 0–14 yr has received particular attention since the creation of the Cancer Registry of Piedmont in 1964. Data up to 1974 have been previously reported [1]. The present report describes incidence rates of cancer in children resident in the Province between 1967 and 1978. Rates were also reported separately for the City of Torino and for the rest of the Province. Observations were compared to those from population-based children cancer registries or surveys in other countries.

MATERIALS AND METHODS

At 1–2 year intervals clinical records of cancer cases have been searched for in all paediatric units, as well as haematologic, neurologic, orthopaedic and radiotherapeutic units operating in the hospitals of the Province. The search has been extended in the records of all services of histopathology and morbid anatomy in the Province. Eight outstanding hospitals located outside the Province, including two in France, have also been contacted in order to identify children with cancer who were residents in the Province of Torino.

Children dying of cancer were identified through the lists of deceased people regularly sent from the 315 towns of the Province to the Piedmont Cancer Registry.

A total of 1027 residents in the Province with cancer diagnosed after 1965 and before reaching the 15th birthday were so identified. The 870 newly diagnosed cases registered since 1967 were used for estimating rates. Seven hundred and forty-four cases (85.6%) were confirmed histologically (or on bone marrow aspiration in the case of leukaemias). For 35 cases (4.0%) the only information collected related to the diagnosis on the death certificate. These proportions did not change substantially during the three quadriennial periods 1967–1970, 1971–1974 and 1975–1978.

Tumour sites were coded according to the 8th Revision of the International Classification of Diseases and cell types were coded as suggested by Miller [2]. Histiocytosis X was not included. In estimating rates, brain blood vessel tumours were considered with the other tumours of the central nervous system and hepatoblastomas and hepatomas were con-

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sidered as a single entity, as were thyroid adenomas and carcinomas. Cytological types of leukaemias were coded only since 1975.

No data on the age composition of the population of the Italian provinces were available for years between general censuses; therefore, all rates were calculated on the 1971 population. No age-standardization was introduced in the estimate of rates for the 0–14 yr age group. In 1971 the population of the Province in age groups 0–4, 5–9 and 10–14 yr were, respectively 179, 173 and 148 thousand. Boys and girls were, respectively, 256 and 244 thousand. The absolute number of births among residents in the Province increased sharply from 21,000 to 34,000 between 1959 and 1964; it then remained stable up to 1975 and rapidly decreased to 25,000 in 1978. All rates are annual $\times 10^6$. Ninety-five percent confidence limits of rates have been estimated according to Haenszel *et al.* [3]. Differences between two rates were considered to be significant when there was no overlap between the two 95% confidence limit intervals [4]. This leads to a loss in sensitivity, but a conservative attitude in descriptive epidemiology seems logical as a first approach.

RESULTS

Table 1 reports sex-specific incidence rates for the main types of cancer throughout 1967–1978. Among the 88 lukaemias recorded since 1975, there were 68 acute lymphocytic, 13 specified non-lymphocytic and 7 unspecified leukaemias. Among the 179 tumours of the central nervous system, the histological type was known for 110, viz., 36 medulloblastomas, 41 astrocytomas, 10 craniopharyngiomas, 10 angiomas or angiosarcomas, 8 ependymomas, 5 other tumours. All but one of the thyroid tumours were histologically diagnosed as carcinomas.

A relative high male/female rate ratio was observed for leukaemias, neuroblastomas, Hodgkin's lymphomas and non-Hodgkin's lymphomas. Only for the latter, however, did the 95% confidence limits of the rate in the two sexes not overlap (8–15 in boys and 2–7 in girls).

Age-specific incidence rates for leukaemias are given in Table 2. The highest rate was recorded at age 3; this was followed by a progressive decline until age 8, after which only minor fluctuations were observed. These rates are calculated on the 1971 population and are unlikely affected by the decrease in birth rate after 1976. Six leukaemias occurred in children with Down's syndrome.

For most tumour types frequencies were fairly constant throughout the three quadriennial periods 1967–1970, 1971–1974 and 1975–1978. One exception to this were rhabdomyosarcomas, with 1, 5 and 10 cases registered respectively in the 3 periods: this probably reflects improvements in diagnostic procedures. Relative frequencies of leukaemia in the three periods were, respectively, 95/287 (33%), 108/298 (37%) and 88/285 (31%). The responding figures for tumours of the central nervous system were 51/287 (18%), 63/298 (21%) and 65/285 (23%).

Table 1. Cancer incidence rats (annual $\times 10^6$) during 1967–1978 among residents in the Province of Torino, aged 0–14 yr

	Males		Females		%Histologically confirmed
	n	rate	*n*	rate	
Leukaemias	169	54.9	122	41.7	96
Tumours of the CNS*	100	32.5	79	27.0	63
Neuroblastomas	37	12.0	24	8.2	98
Nephroblastomas	20	6.5	19	6.5	88
Hodgkin's lymphomas	29	9.4	16	5.5	100
Non-Hodgkin's lymphomas	34	11.0	13	4.4	91
Rhabdomyosarcomas	7	2.3	9	3.1	100
Other soft tissue sarcomas	23	7.4	14	4.8	86
Osteosarcomas	10	3.2	15	5.1	92
Ewing's sarcomas	8	2.6	4	1.4	92
Retinoblastomas	12	3.9	12	4.1	75
Liver primary cancers	6	1.9	5	1.7	91
Gonadal cancers	4	1.3	10	3.4	100
Thyroid tumours	6	1.9	6	2.1	100
Extragenital teratomas	5	1.6	10	3.4	100
Other cancers	24	7.8	18	6.2	47
Total	494	160.4	376	128.5	86

*Central nervous system.

Table 2. Age-specific incidence rates of leukaemia in children aged 0–14 yr in the Province of Torino during 1967–1978

Age at diagnosis (yr)	No. of cases	Annual rate $\times 10^6$
0	19	44.0
1	15	35.7
2	33	76.4
3	46	106.5
4	30	71.4
5	24	55.5
6	23	53.2
7	19	44.0
8	14	35.3
9	11	29.6
10	11	29.6
11	13	33.9
12	6	17.2
13	11	32.7
14	16	47.6

Rates in the City of Torino and in the rest of the Province were similar, with the exception of tumours of the central nervous system and neuroblastomas, both of which showed an approximately 50% excess in the city (Table 3). The 95% confidence intervals of the rate of tumours of the central nervous system were 28.6–42.7 and 19.8–31.3 respectively in the City of Torino and in the rest of the Province. The corresponding figures for neuroblastomas were 9.0–17.4 and 5.0–11.6.

Throughout the whole 1965–1978 period two pairs of sibs with cancer were identified, i.e., two brothers with acute lymphocytic leukaemia diagnosed at ages 5 and 2 yr, and two brothers respectively diagnosed with acute lymphocytic leukaemia at age 4 yr and non-Hodgkin's lymphoma at age 12 yr.

Only one case of a second tumour before age 15 yr was recorded: this was a girl with a Hodgkin's lymphoma and an ovarian dysgerminoma, both diagnosed at age 14 yr. Another girl diagnosed with acute lymphocytic leukaemia at age 10 yr developed a breast cancer 7 years later and died shortly thereafter.

Table 3. Cancer incidence rates (annual × 10^6) in children aged 0–14 yr among residents in the City of Torino and among residents in the rest of the Province during 1967–1978

	City of Torino		Rest of the Province	
	n	Rate	*n*	Rate
Leukaemias	145	49.7	146	47.1
Tumours of the CNS*	102	35.0	77	24.9
Neuroblastomas	37	12.7	24	7.8
Nephroblastomas	16	5.5	23	7.4
Hodgkin's lymphomas	25	8.6	20	6.5
Non-Hodgkin's lymphomas	22	7.6	25	8.1
Soft tissue sarcomas (all)	28	9.6	25	8.1
Osteosarcomas	15	5.1	10	3.2
Ewing's sarcomas	4	1.4	8	2.6
Retinoblastomas	12	4.1	12	3.9
Other and unspecified cancers	48	16.4	46	14.9
Total	454	155.9	416	134.5

*Central nervous system.

DISCUSSION

Other children's cancer registries operating in the world are those of Manchester [5], of Queensland [6] and of the Aichi Prefecture in Japan [7], as well as the special Childhood Cancer Registry connected with the Finnish Cancer Registry [8]. Rates in the U.S. have been reported from the Third U.S. National Cancer Survey, 1969–1971 [9], and from the Surveillance, Epidemiology and End Results Program (SEER) in 1973–1976 [10]. Table 4 compares children resident in the Province of Torino in 1967–1978, U.S. white children in 1973–1976 and children resident in the Northwestern Regional Health Authority in the U.K. (i.e., the population served by the Manchester Children's Tumour Registry) in 1954–1977. Most rates are about 1.2–1.4 times higher in the Province of Torino than in Manchester. This might reflect stricter resistering criteria in Manchester than in Torino. Rates were remarkably similar in the Province of Torino and in U.S. white children, except for leukaemias and tumours of the central nervous system, which were about 1.2–1.3 times higher in Torino. These differences in incidence rates of

Table 4. Cancer incidence rates (annual × 10^6) in ages 0–14 yr in the Province of Torino 1967–1978, in U.S. white children 1973–1976 and in Manchester 1954–1977

	Province of Torino	U.S.	Manchester
Leukaemias	48.5	37.5	33.1
Tumours of the CNS*	29.8	22.2	23.3
Neuroblastomas	10.1	8.3	6.5
Nephroblastomas†	6.5	7.1	5.5
Hodgkin's lymphomas	7.5	7.5	3.6
Non-Hodgkin's lymphomas	7.8	9.3	4.5
Soft tissue sarcomas (all)	8.8	7.5	6.0
Sarcomas of the bone (all)	6.2	5.7	4.6
Retinoblastomas	4.0	3.0	3.0
Liver primary cancers	1.8	1.6	0.5
Thyroid tumours	2.0	1.9	6.6
Other and unspecified cancers	11.9	9.8	
Total	144.9	121.2	97.2

*Central nervous system.
†Including other renal cancers.

infantile cancers among Western countries, however, are by far much smaller than well known differences regarding adult cancers, such as those of the respiratory tract.

The incidence peak of leukaemias at age 3 yr in the Province of Torino, followed by a decrease until age 8 yr, corresponds to previous observations in white children in the U.S. [11] and in Norway [12]. On the contrary, in Shanghai during 1972–1978, the rate peaked at age 5 yr and decreased slowly until age 11 yr [11]. A peak of leukaemia mortality at age 3–4 yr was noticed about 20 years ago in Great Britain [13] and in U.S. white, but not black, children [14]. In the U.S. such a mortality peak tends to disappear [15], and this might be a consequence of lower exposures to diagnostic X-rays during pregnancy.

In Manchester the incidence of acute lymphocytic (but no other) leukaemias increased after 1970 [16]. In Torino, leukaemias have been registered by cell type only since 1975, so that the two series cannot be compared. However, rates of all leukaemias did not show a consistent trend in Torino.

Male/female rate ratios between 1.3 and 1.7 were observed for leukaemias, neuroblastomas and Hodgkin's lymphomas, none being statistically significant. On the contrary, the 2.5-fold excess of non-Hodgkin's lymphomas in boys was statistically significant. Relatively high male/female ratios, and particularly a 2-fold excess of lymphomas in boys, were also reported in Finland [8], in both white and black children in the U.S. [9] and in Manchester [5]. In addition, an approximately 1.5–fold excess of neuroblastomas in males was found in Torino as well as in Manchester, but not in other places studied.

Incidence rates of most tumours were similar in the city of Torino, which is fully urban, and in the rest of the Province, which includes both urban and rural areas. The only exceptions were tumours of the central nervous system and neuroblastomas. The quality of registration of the former, however, was the least acceptable of the whole series (37% without histological confirmation vs 9% for all other tumours considered together), whereas the absolute number of neuroblastomas was small. No urban/rural difference in neurogenic tumours in childhood has been noticed in the Norway National Cancer Registry, which reports rates separately for rural and urban areas [17]. Therefore, the observation in the Province of Torino of a metropolitan/non-metropolitan gradient requires confirmation; however, it may indicate an interesting lead for analytical epidemiological studies on neurogenic tumours in childhood.

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REFERENCES

1. PASTORE G, ANGLESIO E, CAPPA PM, IULIANO F, TERRACINI B. Epidemiologia dei tumori infantili nella Provincia di Torino. *Riv Ital Ped* 1979, **5**, 337–345.
2. MILLER RW. Fifty-two forms of childhood cancer: United States mortality experience (1960–66). *J Pediatr* 1969, **75**, 685–689.
3. HAENSZEL W, LOVELAND D, SIRKEN MG. Lung cancer mortality as related to residence and smoking histories. *J Natl Cancer Inst* 1962, **28**, 947–1001.
4. HOOVER R, FRAUMENI JF, JR. Cancer mortality in U.S. countries with chemical industries. *Environ Res* 1975, **42**, 196–207.
5. BIRCH JM, MARSDEN HB, SWINDELL R. Incidence of malignant diseases in childhood: a 24-year review of the Manchester children's tumour registry data. *Br J Cancer* 1980, **42**, 215–223.
6. Queensland Cancer Fund. *Queensland Childhood Malignancy Registry.* First annual report, 1979.
7. HANAWA Y. Children's cancer in Japan by registration. In: *All Japan Children's Cancer Registration* 1969–1973. Nagoya, Children's Cancer Association of Japan, 1975, p. 37.
8. TEPPO L, SALONEN T, HAKULINEN T. Incidence of childhood cancer in Finland. *J Natl Cancer Inst* 1975, **55**, 1065–1067.
9. YOUNG JL, MILLER RW. Incidence of malignant tumors in U.S. children. *J Pediatr* 1975, **86**, 254–258.
10. YOUNG JL, HEISE HW, SILVERBERG E, MYERS MH. *Cancer Incidence, Survival and Mortality for Children under* 15 *Yrs of Age.* New York, American Cancer Society, Professional Education Publication, 1978.
11. LI FP, JIN F, TU C, GAO Y. Incidence of childhood leukemia in Shanghai. *Int J Cancer* 1980 **25**, 701–703.

12. BJELKE E. Leukemia in children and young adults in Norway: type distribution, incidence and survival. *Cancer* 1964, **17**, 248–255.
13. COURT BROWN WM, DOLL R. Leukaemia in childhood and young adult life. Trends in mortality in relation to aetiology. *Br Med J* 1961, **1**, 981–988.
14. MILLER RW, DALAGER NW, U.S. childhood cancer deaths by cell type, 1960–68. *J Pediatr* 1974, **85**, 664–668.
15. HANSON MR, MCKAY FW, MILLER RW. Three-dimensional perspective of U.S. cancer mortality. *Lancet* 1980, **ii**, 246–247.
16. BIRCH JM, MARSDEN HB, SWINDELL R. Acute lymphoid leukaemia of childhood in North-west England. *Lancet* 1979, **ii**, 154–155.
17. WATERHOUSE H, MUIR C, CORREA P, POWELL J. (eds.) *Cancer Incidence in Five Continents, Vol. III.* Lyon, International Agency for Research on Cancer and International Association of Cancer Registries, IARC Scientific Publication No. 15, 1976.