RESEARCH COMMUNICATION

Childhood Cancer Frequency in the Center of Tunisia

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Abstract

Objective: In this paper, we analyzed the frequency of childhood cancer in the Center of Tunisia during 1993–2006. Design: The different types of cancer were grouped according to the International Classification for Cancer in Children. The general and specific frequencies by age and by sex were analyzed. Results: A total of 727 new cases of childhood cancer were registered, with a male to-female sex ratio of 1.7/1. Leukemias had the highest frequency (27%) and, of these, lymphoid leukemias were the most prevalent (73.5%). Thereafter, in descending order of frequency, were lymphomas (25.7%), tumors of the central nervous system (CNS, 9.2%), neuroblastomas (7.7%), sarcomas (6.9%), carcinomas (6.3%), bone tumors (5.8%), nephroblastomas (5.5%), and germinal cell tumors (2.6%). The highest frequency of cancer was found at age 10-14 years (34.9%). Leukemias were the most frequent in age groups 1-4 and 5-9 years, whereas, neuroblastomas and lymphomas were the most frequent at age under one year and 10-14 years, respectively. Of those cases of solid tumors, 55.8% were diagnosed as having advanced stages of the disease. Conclusion: Leukemias, lymphomas, and CNS tumors were the principal cancers in the Center of Tunisia. A childhood cancer registry with high-resolution data collection is advocated for in-depth analysis of pediatric malignancies.

Keywords: Cancer - childhood - epidemiology - frequency - Tunisia

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Introduction

Childhood cancers are rare compared with cancers that occur in adults (Jemal et al., 2003). Cancer is the second commonest cause of death in children in the developed countries (Parkin et al., 1998). Nevertheless, childhood cancer and its treatment have remained a challenge for patients, their families, and the oncologists caring for them, as well as from a public health viewpoint (Kaatsch, 2010). Childhood cancer comprises a variety of malignancies with frequency varying worldwide by age, sex, ethnicity and geography (Kramarova and Stiller, 1998; Parkin, 2002; Kaatsch, 2010). In developed countries, the three most common cancers are leukemias, tumors of the central nervous system (CNS), and lymphomas (Bernard et al., 1993; Miller et al., 1995; Parkin et al., 1998), whereas in Latin America, the order of frequencies is distinct: leukemias are still in first place, with lymphomas being more common than are CNS tumors (Drup et al., 1990; Martín et al., 1997; Parkin et al., 1998; Pérez-Perdomo and Rodríguez-Figueroa, 2000). In African countries such as Nigeria, Malawi, and Egypt, lymphomas are the principal neoplasias (Parkin et al., 1998). Publications on childhood cancer frequency are sparse from Tunisia (Cammoun et al., 1976).

In this report, we present for the first time the frequency of malignant neoplasias in the child population residing in the Center of Tunisia during the period 1993-2006, based on the Cancer Registry of the Center of Tunisia, and to compare our estimates with data from other countries.

Materials and Methods

The population-based Cancer Registry of the Center of Tunisia was established in 1987 under the auspices of the International Agency of Research on Cancer (IARC), Lyon, France and located in the Pathology Department of the Farhet Hached University Hospital, Sousse, Tunisia. The cancer registry has provided important information on cancer patterns over the previous years (Parkin et al., 2003; Curado et al., 2007; Missaoui et al., 2010).

The Cancer Registry of the Center of Tunisia covers an entirely population (all ages) estimated at 2 760 900 in 2004 in the ratio of 974 males to 1 000 females. The corresponding childhood population figures were 847 600 in the ratio of 984 boys to 1 000 girls. Cancer Registry of the Center of Tunisia includes six provinces: Sousse, Monastir, Mahdia, Kasserine, Sidi Bouzid and Kairouan

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Table 1. Frequency of Cancer in Children in the Center of Tunisia (1993-2006)

Diagnostic group	Total Frequency		Frequency by Group	
	n	%	n	%
I. Leukemias, myeloproliferative diseases, and myelodysplastic diseases ('Leukemias')	196	27.0❶	196	100.0
a. Lymphoid leukemias	144	19.8	144	73.5
b. Acute myeloid leukemias	47	6.5	47	24.0
c. Chronic myeloproliferative diseases	2	0.3	2	1.0
d. Other myeloproliferative diseases	1	0.1	1	0.5
e. Other and unspecified leukemias	2	0.3	2	1.0
II. . Lymphomas and reticuloendothelial neoplasms ('Lymphomas')	187	25.7❷	187	100.0
a. Hodgkin's lymphomas	63	8.7	63	33.7
b. Non-Hodgkin's lymphomas (excluding Burkitt lymphomas)	82	11.3	82	43.8
c. Burkitt lymphomas	42	5.8	42	22.5
III. CNS and miscellaneous intracranial and intraspinal neoplasms ('CNS')	67	9.2❸	67	100.0
a. Ependyomas and choroid plexus tumors	9	1.2	9	13.4
b. Astrocytomas	15	2.1	15	22.4
c. Intracranial and intraspinal embryonal tumors	21	2.9	21	31.3
d. Other gliomas	5	0.7	5	7.5
e. Other specified intracranial and intraspinal neoplasms	11	1.5	11	16.4
f. Unspecified intracranial and intraspinal neoplasms	6	0.8	6	9.0
IV. Neuroblastoma and other peripheral nervous cell tumors (Neuroblastomas)	56	7.7❹	56	100.0
a. Neuroblastomas and ganglioneuroblastomas	55	7.6	55	98.2
b. Other peripheral nervous cell tumors	1	0.1	1	1.8
V. Retinoblastomas	14	1.9	14	100.0
VI. Renal Tumors	40	5.5	40	100.0
a. Nephroblastomas and other nonepithelial renal tumors	38	5.2	38	95.0
b. Renal carcinomas	2	0.3	2	5.0
VII. Hepatic Tumors	8	1.1	8	100.0
a. Hepatoblastomas	5	0.7	5	62.5
b. Hepatic carcinomas	3	0.4	3	37.5
VIII. Malignant bone tumors	42	5.8	42	100.0
a. Osteosarcomas	28	3.8	28	66.7
b. Chondrosarcomas	2	0.3	2	4.7
c. Ewing sarcoma and related bone sarcomas	12	1.6	12	28.6
IX. Soft tissue and other extraosseous sarcomas ('Soft tissue')	50	6.9❺	50	100.0
a. Rhabdomyosarcomas	28	3.8	28	56.0
b. Fibrosarcomas and other fibrous neoplasms	4	0.5	4	8.0
c. Kaposi sarcomas	1	0.1	1	2.0
d. Other specific soft tissue sarcomas	15	2.1	15	30.0
e. Unspecified soft tissue sarcomas	2	0.3	2	4.0
X. Germ cell tumors, trophoblastic tumors, and neoplasms of gonads ('Germ cell')	19	2.6	19	100.0
a. Intracranial and intraspinal germ cell tumors	5	0.7	5	26.3
b. Extracranial and extragonodal germ cell tumors	3	0.4	3	15.8
c. Gonadal germ cell tumors	8	1.1	8	42.1
d. Gonadal carcinomas	2	0.3	2	10.5
e. Other and unspecified gonodal tumors	1	0.1	1	5.3
XI. Other malignant epithelial neoplasms and malignant melanomas	46	6.3	46	100.0
b. Thyroid carcinomas	1	0.1	1	2.2
c. Nasopharyngeal carcinomas	25	3.4	25	54.3
d. Melanomas	1	0.1	1	2.2
e. Skin carcinomas	16	2.2	16	34.8
f. Other and unspecified carcinomas	3	0.4	3	6.5
XII. Other and unspecified malignant neoplasms	2	0.3	2	100
a. Other specified malignant tumors	1	0.1	1	50.0
b. Other unspecified malignant tumors	1	0.1	1	50.0
All cancers	727	100.0	727	100.0

Numbers in circles indicate the five highest frequencies, in descending order; CNS: central nervous system.

covering a total surface of 28 426 km^2.

In this report, we carried out an observational and descriptive study of 727 childhood cancer cases retrieved from the Cancer Registry of the Center of Tunisia. Newly diagnosed cases of malignant neoplasias in children less than 15 years of age, attended from 1 January 1993 to 31 December 2006, were included in this study. In 100% of these cases, the diagnosis was confirmed by histological tests and/or by aspiration of the bone marrow. For this article, the variables analyzed were the following: type of neoplasia, sex of the patient, age at the time of diagnosis, and the stage of the cancer for those children with solid tumors.

To encode the different cases of cancer, topographical and morphological coding was used. The second edition of the "International Classification of Diseases for Oncology"

(ICD-O-2) was used for the cases collected from 1993 through 1999; the third edition (ICD-O-3), for the cases collected from 2000 through 2006 (Percy et al., 1990; Fritz et al., 2000). For determining the stage of cases of lymphomas and carcinomas, the recommendations of the American Joint Committee on Cancer (AJCC) and the International Union Against Cancer (IUAC) were used (Fleming et al., 1997). The stages for CNS tumors, neuroblastomas, retinoblastomas, renal tumors, and those of the liver, bones, soft tissues, and germinal cells (GCT) were determined following the recommendations of the Children's Oncology Group (Children's Oncology Group Pediatric Staging Guide).

Cases were grouped according to the International Classification for Cancer in Children (ICCC) that has established 12 different groups of cancer in children (Steliarova-Foucher et al., 2005). From these were calculated the absolute and relative frequencies, both in general and according to sex and to age, the latter category being divided into four subgroups: under one year, one to four year-olds; five to nine year-olds; and ten to fourteen year-olds. The determination of the stage of the disease was made in 432 of the case of solid tumors. Therefore, for the present paper the frequencies of the diagnostic states were based on this number of cases of children with solid tumors.

Results

A total of 727 cases of malignant neoplasias were analyzed. Of these, in the order of the most frequently found, were the following types of tumors: leukemias with 196 cases (27%); lymphomas with 187 cases (25.7%); CNS tumors with 67 cases (9.2%), neuroblastomas with 56 cases (7.7%); sarcomas with 50 cases (6.9%); carcinomas with 46 cases (6.3%); bone tumors with 42 cases (5.8%), renal tumors with 40 cases (5.5%); GCT with 19 cases (2.6%); and the remainder of the neoplasias were found in low percentages (Table 1).

Table 1 shows that, in examining the subtypes of the different groups of neoplasias, it was found that, of the leukemias, the most frequent were the lymphoid leukemia (n = 144; 73.5%); of the lymphomas, the non-Hodgkin's lymphomas (n = 82; 43.8%); of the CNS tumors, the medulloblastomas (n = 21; 31.3%); of the tumors of the sympathetic nervous system (SNS), neuroblastomas (n = 55; 98.2%); of the renal tumors, nephroblastomas (n = 38; 95%); of hepatic tumors, hepatoblastomas (n = 5; 62.5%); of bone tumors, osteosarcomas (n = 28; 66.7%); of the sarcomas of the soft tissues, rabdomyosarcomas (n = 28; 56%); of the GCT, gonadal tumors (n = 8; 42.1%); and of the carcinomas, nasopharyngeal (n = 25; 54.3%).

The percentages of the different neoplasias showed variations according to sex and age group. In males, over 64% of the cases consisted of the following types of tumors: lymphomas (n = 134; 29.1%); leukemias (n = 118; 25.7%); and CNS tumors (n = 46; 10.0%). In females, 67% of the cases consisted of leukemias (n = 78; 29.2%); lymphomas (n = 53; 19.8%); nephroblastomas (n = 24; 9.0%); and SNS tumors (n = 24; 9.0%). Overall, the ratio of males to females was 1.7; however, this ratio varied for the different groups of neoplasias, most notably a high of 3.3 for non-Hodgkin's lymphomas and a low of 0.6 for GCT (Table 2).

Table 2 shows that, under one year of age, neuroblastomas were the most frequent (52%). For 1-4 and 5-9 year-olds, leukemias had the highest frequency, ranging from 29% to 33.6%. While, for 10-14 year-olds, lymphomas had the highest frequency with 25.6%. In second and third place for the different age groups were the following types of tumors: under one year, sarcomas (n = 5; 20%) and retinoblastomas (n = 2; 8%), 1-4 year-olds, lymphomas (n = 55; 23.8%) and renal tumors (n = 33; 14.3%); 5-9 year-olds, lymphomas (n = 67; 30.9%) and CNS tumors (n = 29; 13.3%); and 10-14 year-olds, leukemias (n = 55; 21.6%) and carcinomas (n = 39; 15.4%).

With regard to the spread of the disease at the time

Table 2. Frequency of Cancer, According to Sex and to Age Group, in Children in the Center of Tunisia (1993-2006)

Diagnostic Group	Age Group (years)								Sex				Ratio
	< 1		1-4		5-9		10-14		Male		Female		M/F
	n	%	n	%	n	%	n	%	n	%	n	%	
I. Leukemias	1	4.0	67	29.0❶	73	33.6❶	55	21.6❷	118	25.7❷	78	29.2❶	1.5
II. Lymphomas	0	0.0	55	23.8❷	67	30.9❷	65	25.6❶	134	29.1❶	53	19.8❷	2.5
Hodgkin's diseases	0	0.0	4	1.7	28	12.9	31	12.2	40	8.7	23	8.6	1.7
Non-Hodgkin's lymphomas	0	0.0	30	13.0	26	12.0	26	10.2	63	13.7❸	19	7.1	3.3
III. CNS tumors	1	4.0	12	5.2	29	13.3❸	25	9.8	46	10.0	21	7.9	2.2
IV. Neuroblastomas	13	52.0❶	32	13.8	7	3.2	4	1.6	32	7.0	24	9.0❸	1.3
V. Retinoblastomas	2	8.0❸	11	4.8	1	0.5	0	0.0	9	1.9	5	1.9	1.8
VI. Renal tumors	1	4.0	33	14.3❸	5	2.3	1	0.4	16	3.5	24	9.0❸	0.7
VII. Hepatic tumors	1	4.0	3	1.3	1	0.5	3	1.2	8	1.7	0	0.0	-
VIII. Malignant bone tumors	0	0.0	1	0.4	7	3.2	34	13.4	22	4.8	20	7.5	1.1
IX. Soft tissue sarcomas	5	20.0❷	9	3.9	16	7.4	20	7.9	33	7.2	17	6.3	1.9
X. Germ sell tumors	1	4.0	8	3.5	3	1.4	7	2.7	7	1.5	12	4.5	0.6
XI. Malignant epithelial tumors and melanomas	0	0.0	0	0.0	7	3.2	39	15.4❸	34	7.4	12	4.5	2.8
XII. Other and unspecified malignant neoplasms	0	0.0	0	0.0	1	0.5	1	0.4	1	0.2	1	0.4	1.0
All Childhood Cancers	25	100.0	231	100.0	217	100.0	254	100.0	460	100.0	267	100.0	1.7

Numbers in circles indicate the three highest frequencies, in descending order; M: male; F: female; CNS: central nervous system; SNS: sympathetic nervous system.

of diagnosis for those children the stage of whose solid tumors had been determined, 78 (18%) were stage I; 112 (25.9%), stage II; 107 (24.7%), stage III; and 135 (31.2%), stage IV.

Discussion

This is the first report of childhood cancer frequency, covering the fourteen year period from 1993-2006, taken from the Cancer Registry of the Center of Tunisia. The distribution of childhood cancer was similar to that reported in other countries. The leukemias (including myeloproliferative and myelodysplastic diseases), lymphomas (including reticuloendothelial neoplasms), and CNS tumors represent the largest diagnostic groups. The range of diagnoses is clearly different from the diagnoses seen in adults (Missaoui et al., 2010).

Leukemia is currently the most common diagnosed cancer of childhood. It made up 27% of pediatric cancers in the Center of Tunisia, similar to that reported in the United States (Linabery and Ross, 2008) and in the Nordic countries (Olsen et al., 2009), and lesser to percentages reported in Ireland and France (30%) (Desandes et al., 2004; Stack et al., 2007), in Switzerland (31.7%) (Michel et al., 2007), in Germany (33%) (Spix et al., 2008), in Australia (34%) (Baade et al., 2010), and in Shanghai and Chennai, China (35%) (Swaminathan et al., 2008; Bao et al., 2009). In our study, leukemias occur predominantly as acute leukemias, with lymphoid leukemias representing the largest proportion similar to that reported from other cancer registries. In the United States, the lymphoid leukemia was the most frequent leukemia (72.5%) (Li et al., 2009). Furthermore, in Europe, according to the German Childhood Cancer Registry (GCCR) and the Automated Childhood Cancer Information System (ACCIS), the acute lymphoid leukemia was the most common type of leukemias (81%) (Steliarova-Foucher, 2004; Kaatsch and Mergenthaler, 2008; German Childhood Cancer Registry, 2009). In these countries, leukemia was the most frequent among children aged higher than one year. However, in the Center of Tunisia, during the observation study, leukemia was the most frequent malignancy only in the age groups of 1-4 and 5-9 years.

The second commonest childhood cancer was lymphoma during the observation period. In adults, lymphomas were ranked third on the scale of the most common cancers in the Center of Tunisia (Missaoui et al., 2010). Non-Hodgkin's lymphomas (including Burkitt lymphoma) and Hodgkin's lymphomas were the most frequent diagnoses among children. The data obtained in our study are similar to those reported in Chennai, India, where lymphomas were ranged second among pediatric malignancies with lesser relative frequency (20%) (Swaminathan et al., 2008). While, for most developed countries, lymphomas were ranked the third place among childhood cancers with values ranging between 10% in Australia and 14.6% in USA (Michel et al., 2007; Li et al., 2008; German Childhood Cancer Registry, 2009; Baade et al., 2010). Whereas, in African countries, lymphomas were the principal childhood cancer with frequencies exceeding 50% of all malignancies (Welbeck and Hesse, 1998; Mgaya and Kitinya, 2000; Banda et al., 2001).

In this study, the frequency of CNS tumors was found to be less than that in developed countries (Olsen et al., 2006; Baade et al., 2010; Kaatsch, 2010; Lacour et al., 2010). According to the GCCR, CNS tumors were ranked the second position with 22.6% of all pediatric malignancies in Germany (German Childhood Cancer Registry, 2009; Kaatsch, 2010). Data from the population-based Australian Pediatric Cancer Registry, the French National Registry of Childhood Solid Tumors (NRCST), and the Nordic cancer registries showed that CNS tumors were the second commonest cancer (23%) (Olsen et al., 2009; Baade et al., 2010; Lacour et al., 2010).

Data for children under one year of age showed that neuroblastoma was the principal tumor, similar to that reported in developed countries (Bernard et al., 1993; Miller et al., 1995). However, the frequency of neuroblastomas was higher than those in the USA (Li et al., 2008) and Germany (Kaatsch and Spix, 2006; Kaatsch, 2010). The screening programs and, more generally, improved access to medical care may explain these differences (Spix et al., 2010), as has also been suggested by the Childhood Cancer Registry of Piedmont, which observed a significant increase in the incidence of neuroblastoma in the first year of life during the 35-year period (1967-2001), when no active screening was conducted in Piedmont (Dalmasso et al., 2005). In Tunisia, there is still no screening program for the neuroblastoma which could explain the high frequency observed during the period study.

In the Center of Tunisia, the nasopharyngeal carcinoma accounted for 3.5% of all pediatric cancers. The frequency of nasopharyngeal carcinoma varies extensively with age, and ethnic and geographical origin (Ayan et al., 2003). Nasopharyngeal carcinoma is an endemic tumor that is common in southern parts of China, Southeast Asia, the Mediterranean basin, and Alaska, but it is rarer in Japan, Europe, and North America (Ayan et al., 2003). Children under 16 years of age account for 1-2% of all patients with NPC in China, 2.4% in the UK, 7.2% in Turkey, 10% in the USA, 13% in Kenya, and 18% in Uganda (Ayan et al., 2003). The variations of nasopharyngeal carcinoma frequency between different geographical and ethnic groups indicate that both genetic and environmental factors contribute to its development (Ayan et al., 2003).

In the present study, 55.9% of the childhood tumors were in advanced stages at the time of diagnosis suggesting a poor prognosis for the patient. These findings justify the need to develop effective programs aiming at the control and prevention of the spread of cancer amongst Tunisian children. Although the early diagnosis of cancer in children as a factor in a good prognosis is controversial (Massey-Stokes and Lanning, 2002), it is probable that such a program would have a great impact in Tunisia. For this reason, the influence of various factors such as the patient's family (educational level, socio-economic status, etc.), the type of cancer, the age of the child, the health system, and the physicians that care for the child on intake should be taken into account.

In conclusion, among children residing in the Center of Tunisia, the principal neoplasias were leukemias,

lymphomas, and CNS tumors. It was found that, of the children with solid tumors, more than half of the cases were diagnosed as having advanced stages of the disease. Although this report includes only 14 year-period of data, we believe that the figures presented in this study provide a reasonably accurate description of childhood cancers and can contribute to a better understanding of cancer patterns along the Center of Tunisia. Nevertheless, a childhood cancer registry with high-resolution data collection is advocated for in-depth analysis of pediatric malignancies.

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References

Ayan I, Kaytan E, Ayan N (2003). Childhood nasopharyngeal carcinoma: From biology to treatment. *Lancet Oncol*, **4**, 13-21.

Baade PD, Youlden DR, Valery PC, et al (2010). Trends in incidence of childhood cancer in Australia, 1983-2006. *Br J Cancer*, **102**, 620-6.

Banda LT, Parkin DM, Dzamalala CP, et al (2001). Cancer incidence in Blantyre, Malawi 1994-1998. *Trop Med Int Hlth*, **6**, 296-304.

Bao PP, Zheng Y, Wang CF, et al (2009). Time trends and characteristics of childhood cancer among children age 0-14 in Shanghai. *Pediatr Blood Cancer*, **53**, 13-6.

Bernard JL, Bernard-Couteret E, Coste D, et al (1993). Childhood cancer incidence in south-east of France. *Eur J Cancer*, **16**, 2284-91.

Cammoun M, Houissa T, Ellouz R, et al (1976). Cancer in children in Tunisia. Relative incidence of different histologic types. A propos of 582 cases. *Tunis Med*, **54**, 765-71.

Children's Oncology Group Pediatric Staging Guide. http://www.childrensoncology-group.org.

Curado MP, Edwards B, Shin HR, et al (2007). Cancer Incidence in Five Continents, Vol. IX. IARC Scientific Publications, Lyon.

Dalmasso P, Pastore G, Zuccolo L, et al (2005). Temporal trends in the incidence of childhood leukemia, lymphomas and solid tumors in north-west Italy, 1967-2001. A report of the childhood cancer registry of piedmont. *Haematologica*, **90**, 1197-204.

Desandes E, Clavel J, Berger C, et al (2004). Cancer incidence among children in France, 1990- 1999. *Pediatr Blood Cancer*, **43**, 749-57.

Drup R, Hernández A, Pollono D (1990). Incidence of childhood cancer in La Plata, Argentina, 1977-1987. *Int J Cancer*, **45**, 1045-7.

Fleming ID, Cooper JS, Henson DE (1997). AJCC Staging Manual, 5th edn. Lippincott Williams & Wilkins, Philadelphia.

Fritz A, Percy C, Jack A, et al (2000). International classification of diseases for oncology 3rd edn. World health organization, Geneva.

German Childhood Cancer Registry. Annual report 2008 (2009) http://www.kinderkrebsregister.de/english/content08.html.

Jemal A, Murray T, Samuels A, et al (2003). Cancer statistics, 2003. *CA Cancer J Clin*, **53**, 5-26.

Kaatsch P (2010). Epidemiology of childhood cancer. *Cancer Treat Rev*, **36**, 277-85.

Kaatsch P, Mergenthaler A (2008). Incidence, time trends and regional variation of childhood leukaemia in Germany and Europe. *Radiat Prot Dosimetry*, **132**, 107-13.

Kaatsch P, Spix C (2006). Annual report 2005 (1980-2004). German Childhood Cancer Registry. Institut für Medizinische Biometrie, Epidemiologie und Informatik, Mainz.

Kramarova E, Stiller CA (1998) International Classification of Childhood Cancer (ICCC). In: Parkin DM, Kramarova E, Draper GJ, et al (ed). International incidence of childhood cancer. Lyon: IARC Scientific Publication, pp. 15-9.

Lacour B, Guyot-Goubin A, Guissou S, et al (2010). Incidence of childhood cancer in France: National Children Cancer Registries, 2000-2004. *Eur J Cancer Prev*, **19**, 173-81.

Li J, Thompson TD, Miller JW, et al (2008). Cancer incidence among children and adolescents in the United States, 2001-2003. *Pediatrics*, **121**, 1470-7.

Linabery AM, Ross JA (2008). Trends in childhood cancer incidence in the US (1992-2004). *Cancer*, **112**, 416-32.

Martín AA, Alert JA, Renó JS, et al (1997). Incidence of childhood cancer in Cuba (1986-1990). *Int J Cancer*, **72**, 551-5.

Massey-Stokes M, Lanning B (2002). Childhood cancer and environmental toxins: the debate continues. *Fam Community Hlth*, **24**, 27-38.

Mgaya EM, Kitinya JN (2000). Histopathology of malignant tumours of childhood in Tanzania. *East Afr Med J*, **77**, 435-9.

Michel G, von der Weid NX, Zwahlen M, et al (2007). The Swiss Childhood Cancer Registry: rationale, organisation and results for the years 2001-2005. *Swiss Med Wkly*, **137**, 502-9.

Miller RW, Young JL, Novakovic B (1995). Childhood cancer. *Cancer*, **75**, 395-405.

Missaoui N, Trabelsi A, Parkin DM, et al (2010) Trends in the incidence of cancer in the Sousse region, Tunisia, 1993-2006. *Int J Cancer*, **127**, 2669-77.

Olsen JH, Möller T, Anderson H, et al (2009) Lifelong cancer incidence in 47,697 patients treated for childhood cancer in the Nordic countries. *J Natl Cancer Inst*, **101**, 806-13.

Parkin DM, Kramarova E, Draper G, et al (1998). International incidence of childhood cancer. Lyon: IARC Scientific Publications, pp. 391.

Parkin DM, Ferlay J, Hamdi-Chérif M, et al (2003). Cancer in Africa, Epidemiology and Prevention. Lyon: IARC Press.

Parkin DM, Whelan SL, Ferlay J, et al (2002). Cancer incidence in five continents. Lyon: IARC Scientific Publication.

Percy C, Van Holten V, Muir C (1990). International Classification of Diseases for Oncology, 2nd edn. Geneva: World Health Organization.

Pérez-Perdomo RV, Rodríguez-Figueroa L (2000). Characteristics of cancer patients under age 20 at a population-based registry, Puerto Rico, 1980-1991. *P R Hlth Sci J*, **19**, 123-9.

Stack M, Walsh PM, Comber H, et al (2007). Childhood cancer in Ireland: a population-based study. *Arch Dis Child*, **92**, 890-7.

Steliarova-Foucher E, Stiller C, Kaatsch P, et al (2004). Geographical patterns and time trends of cancer incidence and survival among children and adolescents in Europe since 1970s (the ACCIS project): an epidemiological study. *Lancet*, **364**, 2097-105.

Steliarova-Foucher E, Stiller C, Lacour B, et al (2005). International classification of childhood cancer, third edition. *Cancer*, **103**, 1457-67.

Spix C, Eletr D, Blettner M, et al (2008). Temporal trends in the incidence rate of childhood cancer in Germany 1987-2004. *Int J Cancer*, **122**, 1859-67.

Spix C, Pastore G, Sankila R, et al (2006). Neuroblastoma incidence and survival in European children (1978-1997): report from the automated childhood cancer information

system project. *Eur J Cancer*, **42**, 2081-91.
Swaminathan R, Rama R, Shanta V (2008) Childhood cancers in Chennai, India, 1990-2001: incidence and survival. *Int J Cancer*, **122**, 2607-11.
Welbeck JE, Hesse AA (1998). Pattern of childhood malignancy in Korle Bu teaching hospital, Ghana. *West Afr J Med*, **17**, 81-4.