RESEARCH COMMUNICATION

Age-standardized Incidence Rates for Childhood Cancers at a Cancer Hospital in a Developing Country

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Abstract

Background: Cancer registration is a neglected area in several developing countries of the world including Pakistan due to funding problems and apathy of most health professionals towards reporting of cancer data. Methods: The epidemiologic review is the first of its type reporting cancers recorded at a cancer hospital in Lahore, Pakistan, in children less than 15-years of age, belonging to Lahore District, in a one-year time period from January 1, 2008-December 31, 2008. The results have been stratified by gender, 5-year age-groups (0-4, 5-9, and 10-14), and the International Classification of Childhood Cancers diagnostic groups. Crude- and age-specific-rates by age-groups were estimated and standardized by applying the direct method of age-standardization using the world standard of Segi (1960) to determine the incidence of childhood cancers per 100,000 population in one year. Results: In order of ranking, the age-standardized incidence rates (ASR) per 100,000 were as follows: amongst boys - leukemias 1.3, lymphomas and reticuloendothelial neoplasms 1.3, CNS and miscellaneous intracranial/intraspinal tumors 0.7, malignant bone tumors 0.4, and soft tissue sarcomas 0.4; amongst girls, leukemias 0.7, lymphomas and reticuloendothelial neoplasms 0.5, malignant bone tumors 0.3, CNS and miscellaneous intracranial/intraspinal tumors 0.3, and renal tumors 0.3. Conclusion: The results represent one institution. However, as pediatric cancer care units are rare and specialized, hospital cancer registries in developing countries are likely to record a significant proportion of pediatric cases diagnosed in the area. Hence, it may be worthwhile to generate yearly incidence reports in an attempt to evaluate the trends in childhood cancers in Lahore.

Key Words: Childhood cancers - Pakistan - incidence rates

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Introduction

Reporting of cancer and registration are neglected areas in several developing countries of the world including Pakistan. This is mainly due to funding problems and apathy of most health professionals towards initiating and supervising reporting of cancer data both at hospital- and population-levels. In developing regions of the world, population-level statistics are even more difficult to obtain than institutional statistics in adults and children. Moreover, low-resource countries are marred by challenges as infectious and parasitic diseases and also maternal and child health issues led by pregnancy and delivery complications (UICC, 2006). Therefore, most of the resources are concentrated on these problems instead of non-communicable diseases including cancer.

In some developing countries of the world, children constitute well over one-thirds of the population and childhood cancers represent 3-10% of the total as opposed to nearly 1% in developed regions of the world (IARC, 2008). Not only this, cancer accounts for nearly 4-5% of childhood deaths in developed areas of the world as opposed to less than 1% in developing countries, which are marred by problems as infectious diseases related mortality (IARC, 2008). Worldwide, in children less than 15 years of age, some 160,000 new cases and 90,000 deaths of cancer are estimated to occur each year (IARC, 2008).

This study was conducted at the Shaukat Khanum Memorial Cancer Hospital and Research Center (SKMCH & RC), a major dedicated cancer center in Lahore, Pakistan. The Hospital is a modern facility and offers comprehensive cancer care to patients on one site. It is a privately run charitable organization that provides free-of-cost cancer treatment including hospital care, medical supplies, and investigations to the vast majority of its cancer patients. Patients from all areas of Pakistan are referred to this centre for treatment of various malignancies. The Hospital has modern laboratory and radiology facilities and a fully integrated, computerized Hospital Information System. The Hospital has 90 inpatient beds in addition to a 7-bed intensive care unit (combined adult and pediatric) and a 15-bed separate pediatric daycare unit where outpatient chemotherapy is

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delivered. Demand for services remains higher than capacity at all times. Around 350 new pediatric cancer patients (≤ 18 years) are registered every year; this forms 11% of the total (adult and pediatric) new patients registered every year. The Hospital prioritizes intake into the system by triaging to match available capacity with the demand. This triage preferentially selects the patients that have a greater clinical likelihood of benefiting from treatment as well as those who are not currently under treatment elsewhere. For the purpose of this study, we included all patients, less than 15 years of age, presenting to the Hospital with a diagnosed malignancy, whether or not they were accepted for formal hospital registration. This was done to overcome the triage bias.

Materials and Methods

The epidemiologic review presented here is the first of its type reporting cancers recorded at a cancer hospital in children less than 15 years of age belonging to Lahore District during a one-year time period between January 1, 2008 and December 31, 2008. Both electronic and paper-based records/reports were reviewed retrospectively to obtain the information needed for the study. and all the cases (100%) were abstracted and coded by the Hospital Registry personnel. The patients were stratified by gender, 5-year age-groups (less than 5 years (0-4), 5 to less than 10 years (5-9), and 10 to less than 15 years (10-14)), and the International Classification of Childhood Cancers (ICCC) diagnostic groups (IARC, 1996).

Information was collected on the residents of Lahore on the following parameters: name, date of birth, age, age-group, gender, date of diagnosis, morphology code, ICCC diagnostic groups, town, and the most valid basis of diagnosis. Results were computed as crude, age-specific, and age-standardized rates. World population standard of Segi (1960) was used to standardize the results using the direct method of age-standardization (Segi, 1960). Incidence was calculated separately for males and females as number of new cases per 100,000 person-years. Since one year's data were being analyzed, this was equivalent to *n* cases per 100,000 population for that year and expressed as such. Further, the data available were anonymized and -aggregated to a level at which there was no risk of compromising the privacy of any individual. The study was submitted to the local Institutional Review Board and the Chair of the Board requested to grant a waiver from the requirement of a full ethical review. A waiver was given to the authors for this study.

Population of Lahore District

The population of Lahore District was estimated through figures provided by the Census Bureau of Pakistan based on the last census held in the country in 1998 (Census-Publication, 2000). The administrative or geographical unit of Lahore District includes both Lahore City and Lahore Cantonment. Lahore District is referred to as Lahore/city in this paper. In Lahore, the average growth rate per annum was projected to be 3.5% (Census-Publication, 2000). Therefore, in 2008, the total population of the city was estimated to be 8,913,214 (males: 4,695,181; females: 4,218,033). The number of children less than 15 years of age was estimated to be 3,496,866 as of January 1, 2008, accounting for 39.2% of the total population of Lahore. Population was categorized by gender and three age-groups as mentioned above (Table 1).

Table 1. Population Estimates by 5-year Age-groups and Gender

Age-group (years)	Male	Female
Lahore District in 2008		
0-4	571,079	549,445
5-9	620,087	582,727
10-14	607,810	565,718
Subtotal	1,798,976	1,697,890
Karachi South (1995-1997)		
0-4	125,591	123,090
5-9	125,411	118,633
10-14	112,541	100,273
Subtotal	893,798	765,052

Most Valid Basis of Diagnosis

The most valid basis of diagnosis was determined by selecting the most appropriate basis from the following list of categories: clinical only, clinical investigation (including X-ray, ultrasound), specific biochemical and/or immunological tests, cytology or hematology, histology of metastasis, histology of primary, death certificate only, exploratory surgery/autopsy, autopsy (macroscopic only) with concurrent or previous histology, and unknown (IARC, 1991).

Incidence Dates

Registration of incidence date was the date of histological confirmation and the date of the first consultation confirming clinical diagnosis at the outpatient evaluation clinic (IARC, 1995). The vast majority comprised those pediatric patients who after their confirmation of cancer diagnosis at the Hospital were registered at the Hospital for further evaluation and management. A few patients did not register at SKMCH & RC after their first assessment and clinical diagnosis. The latter group is presumed to have received treatment elsewhere. Both these groups were included in the study.

Check for Multiple Primaries and Duplicate Records, and Computation of Rates

Multiple primaries were considered by applying the rules developed by the Surveillance Epidemiology and End Results Program (SEER, 2007). Also, manual checks for duplicate records were performed by comparing names, age, gender, date of diagnosis, and diagnosis. Moreover, crude rates were calculated simply as the total cases divided by the total population over the age range 0-14 years. Age-specific rates were based on five-year age intervals and calculated by dividing the numbers of cases by the population of the same sex and age-group, over the relevant period. Five-year age-groups were expressed as 0-4, 5-9, and 10-14 years. Age-standardized incidence rates (ASR) were calculated by the direct method of standardization and represent a summation of

Table 2. Childhood Cancer among Males <15 years by Age-groups, in 2008

Diagnostic Groups	Number of cases				ASR (SKM)			ASR (KCR)			SKM Crude	SKM %	SKM ASR
	0-	5-	10-	0-14	0-	5-	10-	0-	5-	10-			
I) Leukemias:	3	10	12	25	0.5	1.6	2.0	2.1	2.4	1.8	1.4	26.0	1.3
Lymphoid Leukemia	1	6	6	13	0.2	1.0	1.0				0.7	13.5	0.7
Acute non-Lymphocytic Leukemia	0	2	3	5	0.0	0.3	0.5				0.3	5.2	0.2
Chronic Myeloid Leukemia	0	0	0	0	0.0	0.0	0.0				0.0	0.0	0.0
Other Specified Leukemias	0	1	0	1	0.0	0.2	0.0				0.1	1.0	0.1
Leukemia Unspecified	2	1	3	6	0.4	0.2	0.5				0.3	6.3	0.3
II) Lymphomas & Reticuloendothelial:	5	8	12	25	0.9	1.3	2.0				1.4	26.0	1.3
Hodgkin's disease	1	3	4	8	0.2	0.5	0.7	0.3	4.5	2.7	0.4	8.3	0.4
Non-Hodgkins	4	5	8	17	0.7	0.8	1.3	1.1	1.9	1.2	0.9	17.7	0.9
III) CNS & Intracranial & Intraspinal:	2	6	6	14	0.4	1.0	1.0	0.5	2.7	1.8	0.8	14.6	0.7
Ependymoma	1	0	0	1	0.2	0.0	0.0				0.1	1.0	0.1
Astrocytoma	1	1	3	5	0.2	0.2	0.5				0.3	5.2	0.3
Primitive Neuroectodermal Tumours	0	4	0	4	0.0	0.6	0.0				0.2	4.2	0.2
Other Gliomas	0	0	0	0	0.0	0.0	0.0				0.0	0.0	0.0
Other Specified	0	1	3	4	0.0	0.2	0.5				0.2	4.2	0.2
IV) Sympathetic Nervous System:	0	1	1	2	0.0	0.2	0.2				0.1	2.1	0.1
(Ganglio)Neuroblastoma	0	1	1	2	0.0	0.2	0.2				0.1	2.1	0.1
V) Retinoblastomas:	4	1	0	5	0.7	0.2	0.0	0.3	0.3	0.0	0.3	5.2	0.3
VI) Renal Tumours:	4	1	0	5	0.7	0.2	0.0	0.8	0.0	0.3	0.3	5.2	0.3
Wilm's Tumour, Rhabdoid sarcoma	3	1	0	4	0.5	0.2	0.0				0.2	4.2	0.3
Unspecified Malignant	1	0	0	1	0.2	0.0	0.0				0.1	1.0	0.1
VII) Hepatic Tumours:	0	0	0	0	0.0	0.0	0.0	0.5	0.3	0.0	0.0	0.0	0.0
VIII) Malignant Bone Tumors:	1	3	3	7	0.2	0.5	0.5	0.3	0.5	3.3	0.4	7.3	0.4
Osteosarcoma	0	1	2	3	0.0	0.2	0.3				0.2	3.1	0.1
Chondrosarcoma	0	0	0	0	0.0	0.0	0.0				0.0	0.0	0.0
Ewing's Sarcoma	0	2	0	2	0.0	0.3	0.0				0.1	2.1	0.1
Other Specified	0	0	0	0	0.0	0.0	0.0				0.0	0.0	0.0
Unspecified	1	0	1	2	0.2	0.0	0.2				0.1	2.1	0.1
IX) Soft Tissue Sarcomas:	2	3	2	7	0.4	0.5	0.3	0.8	0.5	0.9	0.4	7.3	0.4
Rhabdomyosarcoma /Embryonal	1	1	2	4	0.2	0.2	0.3				0.2	4.2	0.2
Other Specified	0	1	0	1	0.0	0.2	0.0				0.1	1.0	0.1
Unspecified	1	1	0	2	0.2	0.2	0.0				0.1	2.1	0.1
X) Germ cell,Trophoblastic & Other Gonadal:													
	3	0	0	3	0.5	0.0	0.0	0.0	0.0	0.0	0.2	3.1	0.2
Intracranial/spinal	0	0	0	0	0.0	0.0	0.0				0.0	0.0	0.0
Other and Unspecified Non-gonadal	2	0	0	2	0.4	0.0	0.0				0.1	2.1	0.1
Gonadal	1	0	0	1	0.2	0.0	0.0				0.1	1.0	0.1
Gonadal Carcinomas	0	0	0	0	0.0	0.0	0.0				0.0	0.0	0.0
XI) Carcinomas	1	0	0	1	0.2	0.0	0.0				0.1	1.0	0.1
Thyroid Carcinoma	0	0	0	0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0
Nasopharyngeal Carcinoma	0	0	0	0	0.0	0.0	0.0	0.5	0.3	0.9	0.0	0.0	0.0
Skin Carcinoma	1	0	0	1	0.2	0.0	0.0				0.1	1.0	0.1
XII) Other & Unspecified Malignancies:	1	0	1	2	0.2	0.0	0.2	0.3	0.0	0.3	0.1	2.1	0.1
Overall Total:	26	33	37	96	4.6	5.3	6.1	8.2	14.1	13.9	5.3	100	5.2

weighted age-specific rates, weighting being determined by the relative proportion of the population in each age-group compared with the proportion of persons in the corresponding age-groups of the Segi world standard population, The age composition of the reference population of Segi was 12000, 10000, and 9000 for age-groups 0-4, 5-9, and 10-14, respectively.

Further, comparisons of Lahore data with the Karachi Cancer Registry (KCR) data and those announced by the American Cancer Society were made. The KCR data included cases between 1995 and 1997 and results were presented as annual age-standardized incidence per 100,000 population under study. The Karachi South results were also generated using the ICCC diagnostic groups. Based on the 1995-1997 population figures for Karachi, the average annual population of children (under 15 years of age) in Karachi South was computed to be 705,539 (male 363,543 and female 341,996) (Bhurgri, 2001). Table 1 depicts the composition of the population by age-bands.

Results

The results generated were confirmed through the following distributions for the most valid basis of diagnosis (IARC, 1991): histology of primary, 96/145 (66.2%); cytology or hematology, 21/145 (14.5%); clinical only, 13/145 (9%); clinical investigation, 12/145 (8.3%); and histology of metastasis, 2/145 (1.4%). The diagnostic basis was unknown in one case (1/145 (0.7%)). Moreover, none of the children were diagnosed with more than one cancer.

Tables 2 and 3 depict the ensuing information: the

Table 3. Childhood Cancer among Females <15 years by Age-groups, in 2008

Diagnostic Groups	Number of cases				ASR (SKM)			ASR (KCR)			SKM Crude	SKM %	SKM ASR
	0-	5-	10-	0-14	0-	5-	10-	0-	5-	10-			
I) Leukemia:	4	3	4	11	0.7	0.5	0.7	0.3	0.3	0.7	0.6	22.4	0.7
Lymphoid Leukemia	3	2	3	8	0.5	0.3	0.5				0.5	16.3	0.5
Acute non-Lymphocytic Leukemia	0	0	0	0	0.0	0.0	0.0				0.0	0.0	0.0
Chronic Myeloid Leukemia	0	0	1	1	0.0	0.0	0.2				0.1	2.0	0.1
Other Specified Leukemias	0	0	0	0	0.0	0.0	0.0				0.0	0.0	0.0
Leukemia Unspecified	1	1	0	2	0.2	0.2	0.0				0.1	4.1	0.1
II) Lymphomas & Reticuloendothelial:	1	3	5	9	0.2	0.5	0.9				0.5	18.4	0.5
Hodgkin's disease	0	2	2	4	0.0	0.3	0.4	0.0	0.0	0.3	0.2	8.2	0.2
Non-Hodgkin Lymphoma	1	1	3	5	0.2	0.2	0.5	0.3	0.3	0.7	0.3	10.2	0.3
III) CNS:Misc. Intracranial & Intraspinal:	3	0	2	5	0.5	0.0	0.4	0.8	0.3	0.0	0.3	10.2	0.3
Ependymoma	0	0	0	0	0.0	0.0	0.0				0.0	0.0	0.0
Astrocytoma	2	0	0	2	0.4	0.0	0.0				0.1	4.1	0.1
Primitive Neuroectodermal Tumors	0	0	1	1	0.0	0.0	0.2				0.1	2.0	0.1
Other Gliomas	1	0	1	2	0.2	0.0	0.2				0.1	4.1	0.1
IV) Sympathetic Nervous System:	2	0	0	2	0.4	0.0	0.0				0.1	4.1	0.1
(Ganglio)Neuroblastoma	2	0	0	2	0.4	0.0	0.0				0.1	4.1	0.1
V) Retinoblastomas:	3	0	0	3	0.5	0.0	0.0	0.0	0.0	0.0	0.2	6.1	0.2
VI) Renal Tumors:	4	0	0	4	0.7	0.0	0.0	0.0	0.3	0.0	0.2	8.2	0.3
Wilm's Tumor, Rhabdoid sarcoma	4	0	0	4	0.7	0.0	0.0				0.2	8.2	0.3
VII) Hepatic Tumors:	1	0	0	1	0.2	0.0	0.0	0.0	0.0	0.0	0.1	2.0	0.1
Hepatoblastoma	1	0	0	1	0.2	0.0	0.0				0.1	2.0	0.1
VIII) Malignant Bone Tumors:	0	1	5	6	0.0	0.2	0.9	0.0	0.0	2.7	0.4	12.2	0.3
Osteosarcoma	0	1	4	5	0.0	0.2	0.7				0.3	10.2	0.3
Chondrosarcoma	0	0	0	0	0.0	0.0	0.0				0.0	0.0	0.0
Ewing's Sarcoma	0	0	1	1	0.0	0.0	0.2				0.1	2.0	0.1
IX) Soft Tissue Sarcomas:	2	0	1	3	0.4	0.0	0.2	0.0	0.6	0.7	0.2	6.1	0.2
Rhabdomyosarcoma/Embryonal Sarcoma	2	0	0	2	0.4	0.0	0.0				0.1	4.1	0.1
Other Specified Soft Tissue Sarcomas	0	0	1	1	0.0	0.0	0.2				0.1	2.0	0.1
X) Germ cell, Trophoblastic/Other Gonadal:	0	0	2	2	0.0	0.0	0.4	0.3	0.0	1.0	0.1	4.1	0.1
Gonadal Germ Cell Tumors	0	0	2	2	0.0	0.0	0.4				0.1	4.1	0.1
XI) Carcinomas:	1	0	2	3	0.2	0.0	0.4				0.2	6.1	0.2
Thyroid Carcinoma	0	0	1	1	0.0	0.0	0.2	0.3	1.7	1.0	0.1	2.0	0.1
Skin Carcinoma	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0
Other and Unspecified Carcinomas	0	0	1	1	0.0	0.0	0.2				0.1	2.0	0.1
XII) Other & Unspecified Malignancies:	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0
Overall Total:	21	7	21	49	3.8	1.2	3.7	1.6	2.8	2.3	2.9	100	2.9

number of cancer cases recorded at SKMCH & RC for the year 2008; the crude rates; the age-standardized incidence rates; and the proportional distribution of each cancer diagnosis by age-groups; also the overall age-standardized rate for the 0-14 year age-group. The tables also show comparison with the Karachi South annual incidence rate per 100,000 population being displayed under the title "KCR," which are the Karachi Cancer Registry results.

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At SKMCH & RC, a total of 145 children were identified by review of medical records and reports both in the paper-based and electronic format. There were more boys (96) than girls (49) representing approximately 66% and 34% respectively, of the total patient group under study (Tables 2 and 3). Overall, in the 0-14 year group, the age-adjusted incidence rates were computed to be 5.2 per 100,000 male population and 2.9 per 100,000 female population.

Amongst boys in whom 96 cases were recorded, the 10-14 year age-group had the highest incidence of cancer with the age-specific crude rate per 100,000 population being recorded as 6.1 followed by 5.3 in the 5-9 year age-category and 4.6 in the 0-4 year age-bracket as depicted in Table 2. Leukemias and also the group that included lymphomas and reticuloendothelial neoplasms accounted for the commonest cancer types with 25 cases being recorded in each diagnostic group in the year 2008, i.e. 26% of the total cases in males. The ASR for leukemias was 1.3/100,000 male population, similar to that for lymphomas and reticuloendothelial neoplasms. Central Nervous System (CNS) and miscellaneous intracranial and intraspinal neoplasms were next in the rank with 14 cases being recorded in 2008 representing nearly 14.6% of all cancers in male children with the ASR being 0.7 per 100,000. A summary of the age-standardized incidence rates is as follows: leukemias 1.3, lymphomas and reticuloendothelial neoplasms 1.3, CNS and miscellaneous intracranial and intraspinal tumors 0.7, malignant bone tumors 0.4, soft tissue sarcomas 0.4, retinoblastoma 0.3, renal tumors 0.3, germ cell, trophoblastic, and other gonadal neoplasms all together 0.2, sympathetic nervous system tumors 0.1, carcinomas and other malignant epithelial neoplasms 0.1, and other unspecific neoplasms

0.1 per 100,000 males.

In girls under 15 years of age, 49 cases belonging to Lahore were recorded for the year 2008 (Table 3). The age-specific rates for the 0-4 and 10-14 age-groups were 3.8 and 3.7 per 100,000 (21 patients each), whereas it was 1.2 for the 5-9 year age-group in whom 7 cases were registered. Lymphomas accounted for nearly 22.4% of all cancers amongst females, lymphomas and reticuloendothelial neoplasms 18.4%, and malignant bone tumors 10.2%. In order of the ranking of the age-standardized incidence rates by diagnostic groups, the list is as follows: leukemias 0.7, lymphomas and reticuloendothelial neoplasms 0.5, malignant bone tumors 0.3, CNS and miscellaneous intracranial and intraspinal tumors 0.3, renal tumors 0.3, retinoblastoma 0.2, soft tissue sarcomas 0.2, carcinomas and other malignant epithelial neoplasms 0.2, sympathetic nervous system tumors 0.1, germ cell, trophoblastic, and other gonadal neoplasms all together 0.1, and hepatic tumors 0.1 per 100,000 female population.

Results from Karachi and Lahore

In the Karachi Cancer Registry, amongst males less than 15 years of age, Hodgkin's lymphoma was the most commonly diagnosed malignancy. The ASR per 100,000 population for the 5-9 year age-group was 4.5 and for the 10-14 year age-group, it was 2.7 as opposed to 0.5 and 0.7 at SKMCH & RC for the same diagnosis (Hodgkin's disease) in the corresponding age-groups.

Leukemias were the second common malignancy in KCR with the ASR in the 5-9 group being 2.4, in the 0-4 group being 2.1, and in the 10-14 year age category being 1.8 whereas at SKMCH & RC it was 1.6, 0.5, and 2.0 in comparable age-categories. Further, in Karachi, for the CNS tumors along with miscellaneous intracranial and intraspinal neoplasms (ranking third in terms of incidence), the ASR was 2.7 for the 5-9 year group and 1.8 for the 10-14 year category versus 1.0 each for similar age-groups at SKMCH & RC. Again in Karachi, the ASR for non-Hodgkin's lymphoma (fourth commonest malignancy) was 1.9 in the 5-9 age-group, 1.2 in the 10-14 year age-category, and 1.1 in the 0-4 year age-group; however, at SKMCH & RC, it was 0.8, 1.3, and 0.7 for the same age-groups. Number 5 and 6 in the ranking in Karachi were the bone- and connective tissue-tumors, respectively. In each diagnostic group, the ASR was highest in the 10-14 year age-group (3.3 and 0.9 respectively); on the other hand, at SKMCH & RC, the ASRs were 0.5 and 0.3 in identical age-groups.

In KCR, amongst girls under 15 years of age, thyroid cancer was the most commonly diagnosed malignancy with the ASR being 1.7 in the 5.9 year age-category followed by 1.0 in the 10-14 year age-group; however, at SKMCH & RC, the ASR corresponding to these age-groups was 0 and 0.2. Bone tumors were the next common diagnosis with the ASR in the 10-14 year age-group being 2.7 as opposed to 0.9 at Hospital. Leukemias, non-Hodgkin's lymphomas, ovarian cancer, and connective tissue tumors each had an ASR of 1.3. Other tumors had ASRs lower than the results presented so far by other authors.

Discussion

At SKMCH & RC, childhood cancers have been classified using the International Classification of Childhood Cancers. The age-standardized results presented for the Karachi Cancer Registry have also used the ICCC diagnostic groups, though not as extensively as at SKMCH & RC. KCR is the only population-based registry in the country. Although comparisons have been made between the results from SKMCH & RC and Karachi, the KCR results are truly representative of the population of Karachi South, whereas, for Lahore, it has been difficult to assess as to how many childhood cancers are being recorded and managed by facilities other than SKMCH & RC.

The differences in the proportional distributions and the age-standardized rates in the comparisons that have been made between the patients of two Pakistani cities can be attributed to the fact that the results presented for Lahore represent a single institution, whereas, those for Karachi represent a sub-group of the population in a defined geographic location/district called Karachi South. Also, although all children who presented at SKMCH & RC, regardless of whether they were managed at the Hospital, have been included in the study, due to a nonexistent functioning population-based cancer registry in the city, it has been difficult to gauge whether any more children belonging to Lahore are being registered/managed at other facilities, and if so, what the actual numbers are. It is therefore, difficult to determine the completeness of registration despite attempts by the Registry Staff on an ongoing basis to do so. However, within the city of Lahore, there are very few specialized cancer care units and the pediatric unit at SKMCH & RC is a well structured unit within a complete cancer care facility. Thus, the likelihood that the Hospital is attracting a large proportion of the pediatric cases belonging to Lahore appears to be extremely high and could represent all the childhood cancer cases of Lahore. Although, this is a debatable topic, it is based on the premise that in developing countries of the world, such specialized units tend to attract all patients who are diagnosed with cancer or referred to the Hospital from other centers in the area (Valsecchi and Steliarova-Foucher, 2008).

A report by the American Cancer Society (ACS) has shown that according to the International Classification of Childhood Cancers, leukemias accounted for 32.6% of all childhood cancers in 2008 (American Cancer Society, 2008). At SKMCH & RC, leukemias accounted for nearly 24.8% of all childhood cancers. Results on proportional distributions of top ten cancers by diagnostic group as reported by ACS as opposed to SKMCH & RC, respectively, are as follows: leukemias 32.6% and 24.8%; brain and other nervous system tumors: 21.1% and 13.1%; neuroblastoma 6.7% and 2.8%; Wilm's tumor: 4.9% and 5.5%; non-Hodgkin's lymphoma 4.2% and 11%; Hodgkin's disease 3.7% and 8.3%; Rhabdomyosarcoma 3.5% and 4.1%; Retinoblastoma 2.8% and 5.5%; osteosarcoma 2.7% and 5.5%; and Ewing's sarcoma 1.4% and 2.1%. A comparison of the rankings shows that leukemias and brain along with other nervous system

tumors are ranked as number one and two for both ACS and SKMCH & RC, whereas the rankings for the rest are somewhat different for each. However, it is important to note that the frequencies of leukemias, brain tumors, and neuroblastoma are significantly lower in our study population compared to the ACS results. This can be explained by selective intake into the system due to triaging. This triage is exercised in all SKMCH & RC outreach centers so that acceptance into the system can be decided nearer people's homes. On the other hand, incidence of Wilm's tumor, Hodgkin's disease, and retinoblastoma is substantially higher. This could partially be explained by selective intake, as above. A true high incidence cannot, however, be ruled out particularly for retinoblastoma, as there are several studies that have suggested a higher incidence of this tumor in developing countries (IARC, 1998 and Epelman et al., 2004). The high incidence of bone and soft tissue sarcomas at our center may be a reflection of the fact that treatment of these malignancies requires a setup with good orthopedic, radiotherapy, and rehabilitation facilities that are present at SKMCH & RC and so patients are preferentially referred to this Hospital.

Despite drawbacks in this study, it may be meaningful to generate annual incidence reports in an attempt to evaluate the trends and patterns in childhood cancers in Lahore and use the data to plan programs for cancer control. Additionally, it would be of paramount importance to follow-up these patients to collect mortality- and survival- related information and thereby to ensure that cancer prevention and management are moving in the right direction. Meanwhile, efforts to set-up a fully functioning city-wide population-based cancer registry must continue along with education of the health professionals belonging to different walks of life so as to disseminate the significance of establishing cancer registries in our part of the world.

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