

Pattern of malignancies in children <15 years of age reported in Hadhramout Cancer Registry, Yemen between 2002 and 2014

Mazin A. Jawass, MD, MSc, Jalil I. Al-Ezzi, FICMS, DCH, Hanan S. Bin Gouth, MD, MSc, Saleh A. Bahwal, MD, MSc, Fawzia F. Bamatraf, MD, MBBS, Abubakir A. Ba'amer, CABCM.

ABSTRACT

الأهداف: لمعرفة نمط سرطان الأطفال في محور حضرموت- اليمن خلال الفترة ما بين يناير 2002م وديسمبر 2014م.

الطريقة: هذه الدراسة الوصفية الاسترجاعية مبنية على معلومات مستقاة للأطفال المسجلين في وحدة تسجيل السرطان في حضرموت - اليمن. وقد تم تحديد كل الأطفال اليمنيين من كلا الجنسين الذين هم أقل من 15 سنة والذين تم تشخيص حالتهم على أنهم مصابين بالسرطان.

النتائج: مجموع 406 أطفال يكونوا 8.5% من مجموع المرضى بالسرطان المسجلين، متوسط عمرهم (4.18 ± 7.34) سنة، نسبة الذكور 59.1% والإناث 40.9% بزيادة الذكور عن الإناث بمعدل (1.4:1)، كانت الفئة العمرية من 5-9 سنوات هي أكثر فئة شيوعاً بنسبة 35%، يليها الفئة العمرية من 10-14 سنة بنسبة 33.7%، وأخيراً الفئة العمرية من 0-4 سنوات بنسبة 31%، أكثر أنواع السرطان انتشاراً هي سرطانات الدم بنسبة 47% من الحالات يليها سرطانات الجهاز العصبي بنسبة 15%، الأورام الأكثر شيوعاً هي أورام الغدة اللمفاوية بنسبة 24%، بعد ذلك سرطان ابيضاض الدم بنسبة 23%، ثم سرطانات الانسجة 13.1%، ثم سرطان الجهاز العصبي المتوسط بنسبة 11.6%.

الخاتمة: هناك معدل انتشار أقل لسرطان الأطفال في محور حضرموت- اليمن مقارنة بالدول النامية، أكثر الأنواع انتشاراً في الأطفال هي أورام الغدة اللمفاوية، ويليها سرطان الدم وسرطانات الأنسجة والجهاز العصبي.

Objectives: To describe the patterns of childhood cancers in Hadhramout Sector, Yemen between January 2002 and December 2014.

Methods: This descriptive retrospective study was based on secondary data from Hadhramout Cancer Registry, Hadhramout, Yemen. All Yemeni children

under age of 15 years, who were diagnosed with cancer were included. The International Childhood Cancer Classification system was used to categorize cancer types.

Results: A total of 406 childhood cancers of both gender <15 years of age were reported. These represented 8.5% of all cases registered. The mean age was 7.34 ± 4.18 years. There were 240 males (59.1%) and 166 females (40.9%) with a male to female ratio of 1.4:1. Calculated incidence of cancer in children in this population is 1.9 per 100,000. The predominant age group was 5-9 years (35%) followed by 10-14 years (33.7%), and 0-4 years group (31%). The most common group of malignancies were hematological malignancies accounting for 47% of cases, followed by nervous system malignancies (15%). The most frequently reported cancer types were lymphoma (24%), leukemia (23%), carcinoma (13.1%), and central nervous system (CNS) tumors (11.6%).

Conclusions: There is a lower frequency of childhood cancer in Hadhramout Sector when compared with developed countries. The most common cancers among children were lymphoma, leukemia, carcinoma, and CNS tumors.

Saudi Med J 2016; Vol. 37 (5): 513-520
doi:10.15537/smj.2016.5.14954

From the Department of Pediatrics (Jawass, Al-Ezzi, Bin Gouth, Bahwal), and the Department of Community Medicine (Bamatraf, Ba'amer), College of Medicine, Hadhramout University, Al-Mukalla, Hadhramout, Yemen.

Received 31st January 2016. Accepted 26th February 2016.

Address correspondence and reprint request to: Dr. Mazin A. Jawass, Department of Pediatrics, College of Medicine, Hadhramout University, Al-Mukalla, Hadhramout, Yemen.
E-mail: dr.mazin.jawass@gmail.com

Pediatric malignancies affect more than 175,000 children younger than 15 years annually and account for 1.4% of all cancers worldwide.^{1,2} In Yemen, although there is no proper cancer registry, available data shows that approximately 753 cases of childhood malignancies were detected with an annual incidence of 34 cases. The calculated incidence of cancer in children in this population is 1.9 per 100,000. The most common types of cancers reported in Yemen are leukemia, lymphoma, and central nervous system (CNS) tumors.³⁻⁵ The cancer registry is considered the corner stone for the documentation of basic data of cancer patients and an entry into a computerized register, and this is considered as an initial step in the establishment of the epidemiology of cancer.^{6,7} Cancer registries are currently available in many Arab countries, including Yemen.⁸ Hadhramout Cancer Center (HCC) was established by the Ministry of Health in 2002 to serve people in the Hadhramout sector, which consists of 3 governorates (Hadhramout, Shabwa, and Almahra) with a population of approximately 1,820,163 inhabitants, and children <15-years-old represent 46% from Hadhramout setor population.⁹ This study was conducted to describe the problem of cancer, and to assess the prevalence and pattern of different types of cancer by age distribution and gender among Yemeni children in Hadhramout sector, Yemen during a 13 years period from January 2002 to December 2014

Methods. This descriptive retrospective study was based on secondary data from Hadhramout Cancer Registry (HCR). The collected details were entered into the computerized package CanReg5¹⁰ (Software for cancer registries) and revised for any duplication or incompleteness. Validation of data was carried out by the computer system on each data item to ensure that no invalid codes are fed into the database. Confidentiality of the received data is one of the important tasks of the working group.

Neoplasms are coded and classified according to the International Classification of Diseases for Oncology (ICD-O).¹¹ and the 10th revision¹² An updated childhood classification allows the new and expanded coding of cancer, which have been introduced.¹¹ It has to be noted that upon establishing HCR, data from Hadhramout Cancer Center were retrospectively

entered into the newly established electronic registry using the data from the paper charts. In this study, the basic epidemiologic data was retrieved from the records of children with cancer who were <15 years of age at diagnosis, who were diagnosed between January 2002 and December 2014. Analysis included identification of the patient demographic characteristics, gender, age, year of diagnosis, site, morphology, histology, and topography of cancer, and place of residence.

Different types of pediatric malignancies were grouped into 12 major diagnostic groups with further sub-classification according to the International Classification of Childhood Cancer (ICCC) into 3 age-groups: 0-4 years, 5-9 years, 10-14 years.^{13,14} Data was reviewed for incompleteness or missing entries; any registered case with incomplete or missing data was excluded from the study.

Sample size. A total of 406 children <15 years of age with cancer registered in HCR from January 2002 to December 2014. Inclusion criteria were cancer children aged <15 years with complete registered data. Exclusion criteria were cancer children ≥ 15 years old, and children <15 years old with incomplete registered data.

Ethical considerations. The research protocol was conducted according to the principles of the Helsinki Declaration, as well as reviewed and approved by the College Ethical Research Committee. There was no need for informed consent from patients because the data was secondary data with no linking to patient identity.

Statistical analysis. The data were processed and analyzed using the Statistical Package for Social Sciences for windows version 16 (SPSS Inc, Chicago, IL, USA). Statistical analysis included quantitative descriptive analysis and summary statistics for describing the frequency of diagnostic group and subgroups of childhood cancer. Quantitative analysis of the studied variables included Chi squares, Fischer exact test, and rates stratified by gender and age. We also used data from previous publications to compare the frequency of different cancer types registered from Aden,^{3,4} Sanaa,⁵ and the Surveillance, Epidemiology, and End Results (SEER) Program and SEER*Stat Database of the National cancer institute, USA that works to provide information on cancer statistics.¹⁵

Results. A total of 406 childhood cancers of both gender, comprising 8.5% of all malignancies (n=4796) that were registered in the HCR from January 2002 to December 2014. The mean age was 7.34 ± 4.18 years. There were 240 (59.1%) males and 166 (40.9%) females with a male to female ratio of 1.4:1. The highest frequency was reported in the 5-9 years group

Disclosure. Authors have no conflict of interests, and the work was not supported or funded by any drug company.

Table 1 - Distribution of different pediatric cancer types according to age-group and gender in the Hadhramout region of Yemen.

Diagnostic group	Age groups n (%)			Total	Gender n (%)		Total
	0-4	5-9	10-14		Male	Female	
<i>Hematological malignancies</i>							
Leukemias	25 (6.2)	38 (9.4)	30 (7.4)	93 (23.0)	49 (52.7)	44 (47.3)	93 (100)
Lymphomas	26 (6.4)	35 (8.6)	36 (8.9)	97 (24.0)	73 (75.3)	24 (24.7)	97 (100)
Total	51 (12.6)	73 (18.0)	66 (16.3)	190 (47.0)	122 (64.2)	68 (35.8)	190 (100)
<i>Nervous system malignancies</i>							
CNS tumors	13 (3.2)	18 (4.4)	16 (3.9)	47 (11.6)	26 (54.2)	21 (45.8)	47 (100)
SNS tumors	8 (2.0)	6 (1.4)	0 (0.0)	14 (3.4)	6 (42.9)	8 (57.1)	14 (100)
Total	21 (5.2)	24 (5.9)	16 (3.9)	61 (15.0)	32 (52.5)	29 (47.5)	61 (100)
<i>Solid tumors</i>							
Bone tumors	3 (0.7)	6 (1.4)	12 (3.0)	21 (5.2)	10 (47.6)	11 (52.3)	21 (100)
<i>Other different solid tumors</i>							
Soft-tissue sarcomas	6 (1.4)	9 (2.2)	9 (2.2)	24 (5.9)	11 (45.8)	13 (54.2)	24 (100)
Carcinoma	6 (1.4)	22 (5.4)	25 (6.2)	53 (13.1)	34 (54.0)	19 (46.0)	53 (100)
Renal tumors	16 (3.9)	4 (1.0)	2 (0.5)	22 (5.4)	8 (36.4)	14 (63.6)	22 (100)
Eye tumors	16 (3.9)	3 (0.7)	0 (0.0)	19 (4.7)	13 (68.4)	6 (31.6)	19 (100)
Hepatic tumors	3 (0.7)	0 (0.0)	3 (0.7)	6 (1.4)	4 (66.7)	2 (33.3)	6 (100)
Other malignant tumors	4 (1.0)	2 (0.5)	4 (1.0)	10 (2.5)	6 (60)	4 (40.0)	10 (100)
Total	54 (13.3)	46 (11.3)	55 (13.6)	155 (38.2)	86 (55.5)	69 (44.5)	155 (100)
Total	126 (31.0)	143 (35.2)	137 (33.7)	406 (100)	240 (59.1)	166 (40.9)	406 (100)

Table 2 - Frequencies of different hematologic malignancies according to age-group and gender among pediatric patients in the Hadhramout region of Yemen.

Diagnostic group	Age groups n (%)			Total	Gender n (%)		Total
	0-4	5-9	10-14		Male	Female	
<i>Leukemias</i>							
Acute lymphoblastic leukemia	20 (21.5)	26 (28.0)	19 (20.4)	65 (69.9)	36 (55.4)	29 (44.6)	65 (100)
Acute non-lymphoblastic leukemia	3 (3.2)	6 (6.5)	4 (4.3)	13 (14.0)	5 (38.5)	8 (61.5)	13 (100)
Chronic juvenile myeloid leukemia	0 (0.0)	0 (0.0)	1 (1.0)	1 (1.0)	0 (0.0)	1 (100)	1 (100)
Other specific leukemia	0 (0.0)	0 (0.0)	1 (1.0)	1 (1.0)	0 (0.0)	1 (100)	1 (100)
Other non specific leukemia	2 (2.2)	6 (6.5)	5 (5.4)	13 (14.0)	8 (61.5)	5 (38.5)	13 (100)
Total	25 (26.9)	38 (40.9)	30 (32.2)	93 (100)	49 (52.7)	44 (47.3)	93 (100)
<i>Lymphoma</i>							
Hodgkin lymphoma	7 (7.2)	17 (17.5)	24 (24.7)	48 (49.5)	41 (85.4)	7 (14.6)	48 (100)
Non-Hodgkin lymphoma	10 (10.3)	13 (13.4)	10 (10.3)	33 (34.0)	24 (72.7)	9 (27.3)	33 (100)
Burkit lymphoma	4 (4.1)	2 (2.1)	0 (0.0)	6 (6.2)	3 (50.0)	3 (50.0)	6 (100)
Other non-specific lymphomas	5 (5.2)	3 (3.1)	2 (2.1)	10 (10.3)	5 (50.0)	5 (50.0)	10 (100)
Total	26 (26.8)	35 (36.1)	36 (37.1)	97 (100)	73 (75.3)	24 (24.7)	97 (100)
Total	51 (26.8)	73 (38.4)	66 (34.7)	190 (100)	122 (64.2)	68 (35.8)	190 (100)

Table 3 -Frequencies of different nervous system malignancies by age-group and gender among pediatric patients in the Hadhramout region of Yemen.

Diagnostic group	Age groups n (%)			Total	Gender n (%)		Total
	0-4	5-9	10-14		Male	Female	
<i>CNS tumors</i>							
Medulloblastoma	1 (2.1)	1 (2.1)	5 (10.6)	7 (14.9)	6 (85.7)	1 (14.3)	7 (100)
Gliomas	1 (2.1)	2 (4.3)	4 (8.5)	7 (14.9)	2 (28.6)	5 (71.4)	7 (100)
Astrocytoma	0 (0.0)	3 (6.4)	2 (4.3)	5 (10.6)	3 (60.0)	2 (40.0)	5 (100)
Primitive neuroectodermal tumors	2 (4.3)	2 (4.3)	0 (0.0)	4 (8.5)	1 (25.0)	3 (75.0)	4 (100)
Ependymoma	2 (4.3)	0 (0.0)	0 (0.0)	2 (4.3)	2 (100)	0 (0.0)	2 (100)
Other specific CNS tumors	2 (4.3)	2 (4.3)	0 (0.0)	4 (8.5)	1 (25.0)	3 (75.0)	4 (100)
Other non specific CNS tumors	5 (10.6)	8 (17.0)	5 (10.6)	18 (38.3)	11 (61.1)	7 (38.9)	18 (100)
Total	13 (27.7)	18 (38.3)	16 (34.0)	47 (100)	26 (54.2)	21 (45.8)	47 (100)
<i>SNS tumors</i>							
Neuroblastoma	8 (57.1)	5 (35.7)	0 (0.0)	13 (92.9)	6 (46.1)	7 (53.8)	13 (100)
Other SNS tumors	0 (0.0)	1 (7.1)	0 (0.0)	1 (7.1)	0 (0.0)	1 (100)	1 (100)
Total	8 (57.1)	6 (42.9)	0 (0.0)	14 (100)	6 (42.9)	8 (57.1)	14 (100)
Total	21 (34.4)	24 (39.3)	16 (26.2)	61 (100)	32 (52.5)	29 (47.5)	61 (100)

CNS - central nervous system, SNS - sympathetic nervous system

(n=143, 35.2%) followed by 10-14 years group (n=137, 33.7%), and 0-4 years group (n=126, 31%) as shown in Tables 1 & 2. When different cancer groups were evaluated, the most common group was hematological malignancies, followed by nervous system malignancies. The most frequent cancers among children based on the ICCC were lymphoma (24%), leukemia (23%), carcinomas (13.1%), and CNS tumors (11.6%) (Table 1).

In the 0-4 years age-group (n=126), lymphoma ranked first (n=26), followed by leukemia (n=25), renal (n=16) and eye tumors (n=16), CNS tumors (n=13), and sympathetic nervous system (SNS) tumors (n=8) (Table 1). In the 5-9 years age-group (n=143), leukemia ranked first (n=38), followed by lymphoma (n=35). Carcinomas represents the third cancer in this group (n=22), followed by CNS tumors (n=18), soft tissue sarcomas (n=9), bone (n=6), and SNS tumors (n=6). In the 10-14 years age-group (n=137), lymphoma ranked first (n=36), followed by leukemia (n=30), carcinoma (n=25), and CNS tumors (n=16).

The common cancer types among boys (compared with girls) in order of frequency were lymphomas (75.3%), leukemia (52.7%), carcinoma (54%), CNS tumors (54.2%), eye tumors (68.4%), soft tissue sarcomas (45.8%), bone tumors (47.6%), renal tumors

(36.4%), SNS tumors (42.9%), and hepatic tumors (6.7%) (Table 1).

Leukemias and lymphomas were the most numerous histiotypes, comprised of 47% of the total number of cancers (Table 2).

All lymphomas were more or less frequent in males than females. Hodgkin's disease (HD) predominated over non-Hodgkin's lymphoma (NHL). Both of them are more common in males than females, with a stronger male to female ratio of 5.8:1 in case of HD, and 2.7:1 in case of NHL, Burkitt's lymphoma shows equal gender incidence (Table 2).

Table 3 summarizes the different nervous system malignancies by age-group and gender. Medulloblastoma and gliomas were the most common CNS tumor with equal incidence, followed by astrocytoma, primitive neuroectodermal tumors, and ependymoma.

Table 4 summarizes the different solid tumors by age-group and gender. Rhabdomyosarcoma was the most common soft-tissue sarcomas, other rare tumors in our study were fibrosarcoma, angiomyosarcoma, lymphangiosarcoma. Skin carcinoma was the most common carcinoma, it is more common in the age group of 5-9 years, followed by nasopharyngeal carcinoma. Carcinoma is more common in males than females (Table 4).

Table 4 - Frequencies of different solid tumors by age-group and gender among pediatric patients in the Hadhramout region of Yemen.

Diagnostic group	Age groups n (%)			Total	Gender n (%)		Total
	0-4	5-9	10-14		Male	Female	
<i>Bone tumors</i>							
Ewing sarcoma	1 (4.7)	2 (9.5)	7 (33.3)	10 (47.6)	7 (70.0)	3 (30.0)	10 (100)
Osteosarcoma	1 (4.7)	0 (0.0)	4 (19.0)	5 (23.8)	2 (40.0)	3 (60.0)	5 (100)
Other non specific bone tumors	1 (4.7)	4 (19.0)	1 (4.7)	6 (28.5)	1 (16.7)	5 (83.3)	6 (100)
Total	3 (14.3)	6 (28.5)	12 (57.1)	21 (100)	10 (47.6)	11 (2.3)	21 (100)
<i>Soft-tissue sarcomas</i>							
Rhabdomyosarcoma	4 (16.7)	3 (12.5)	4 (16.7)	11 (45.8)	5 (45.5)	6 (54.5)	11 (100)
Other soft tissue sarcoma	2 (8.3)	6 (25.0)	5 (20.8)	13 (54.2)	6 (46.2)	7 (53.8)	13 (100)
Total	6 (25.0)	9 (37.5)	9 (37.5)	24 (100)	11 (45.8)	13 (54.2)	24 (100)
<i>Carcinoma</i>							
Skin	2 (3.8)	16 (30.2)	9 (17.0)	27 (51.0)	18 (66.7)	9 (33.3)	27 (100)
Nasopharyngeal	0 (0.0)	2 (3.8)	4 (7.5)	6 (11.3)	4 (66.7)	2 (33.3)	6 (100)
Other rare and non specific carcinoma	4 (7.5)	4 (7.5)	13 (24.5)	20 (37.7)	10 (50.0)	10 (50.0)	20 (100)
Total	6 (11.3)	22 (41.5)	25 (47.2)	53 (100)	34 (54.0)	19 (46.0)	53 (100)
<i>Renal tumors</i>							
Nephroblastoma	11 (50.0)	3 (13.6)	1 (4.5)	15 (68.2)	6 (40.0)	9 (60.0)	15 (100)
Renal cell carcinoma and other rare tumors	5 (22.7)	1 (4.5)	1 (4.5)	7 (31.8)	2 (22.2)	7 (77.8)	9 (100)
Total	16 (75.0)	4 (20.0)	2 (5.0)	22 (100)	8 (36.4)	14 (63.6)	22 (100)
<i>Hepatic tumors</i>							
Hepatoblastoma	2 (37.5)	0 (0.0)	0 (0.0)	2 (33.3)	1 (50.0)	1 (50.0)	2 (100)
Hepatocellular carcinoma	1 (12.5)	0 (0.0)	3 (50.0)	4 (66.7)	3 (75.0)	1 (25.0)	4 (100)
Total	3 (50.0)	0 (0.0)	3 (50.0)	6 (100)	4 (66.7)	2 (33.3)	6 (100)
<i>Eye tumors</i>							
Retinoblastoma	14 (73.7)	1 (5.3)	0 (0.0)	15 (78.9)	10 (66.7)	5 (33.3)	15 (100)
Other non specific eye tumors	2 (10.5)	2 (10.5)	0 (0.0)	4 (21.1)	3 (75.0)	1 (25.0)	4 (100)
Total	16 (84.0)	3 (15.8)	0 (0.0)	19 (100)	13 (68.4)	6 (31.6)	19 (100)
Other malignant tumors	4 (33.3)	2 (0.0)	4 (66.7)	10 (100)	6 (0.0)	4 (100)	10 (100)
Total	45 (40.9)	31 (28.2)	34 (30.9)	155 (100)	65 (59.0)	45 (40.9)	110 (100)

Gonadal and germ cell neoplasms all occur in males, there was one case of langerhans cell histiocytosis in male, and other unspecified malignant tumors (6 cases). Further analysis of nervous system tumors, bone tumors, and other solid tumors according to age is presented in Tables 3 & 4.

Comparison of pediatric cancer in Yemen and the SEER database. The distribution of different pediatric cancer types in HCR was compared with those reported previously from Aden, Sanaa, and the SEER database (Figure 1). The most common cancer type in Hadhramout (24%) and Sanaa (35%) was lymphomas. There was a higher percentage of retinoblastoma in Hadhramout (4.7%) compared with other reports. The

percentage of carcinomas in HCR (13%) was much higher than that reported in Sanaa (1.7%), as well as the SEER report (3.4%).^{3-5,14}

Discussion. A total of 406 childhood cancers of both sexes comprising 8.5% of all malignancies (n=4796) were registered at the HCR from January 2002 through December 2014. This is also comparable with reports from developing countries, where the childhood cancer incidence varies between 4.1-12.6%.³ A study conducted in Saudi Arabia¹⁶ reported a childhood cancer accounted for approximately 8% of total cancer cases, which is comparable with our results. A previous study³ from the Yemen was conducted using the data

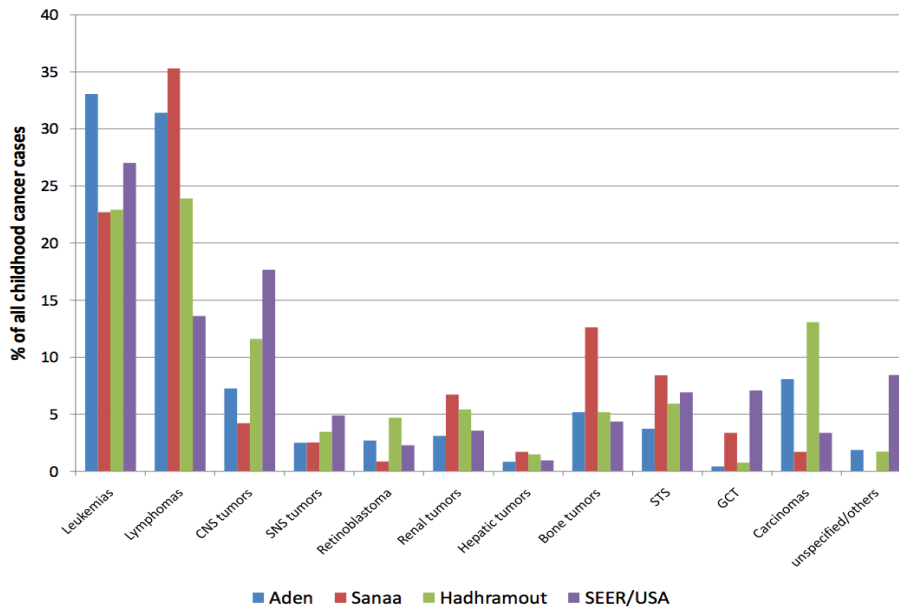


Figure 1 - Distribution of pediatric cancer types reported in Aden, Sanaa, Hadhramout, and the Surveillance, Epidemiology, and End Results (SEER) database.

from Aden Cancer Register for patients registered from 1997 until 2006, and showed that childhood cancers constitute 12.7% of all malignancies. In this study, the childhood cancer incidence was higher among Yemeni boys than girls, with a male to female ratio of 1.4:1. Similar to other reports from other Arab countries, male predominance was noticed with a male to female ratio of 1.4:1.¹⁷⁻²⁰

There was variable age-specific incidence pattern in our study with the predominant age group of 5-9 years (36% of all cases), a finding that is in accordance with other studies from Yemen.^{3,5} Also, our study showed that lymphomas are the most common childhood cancers (24%) followed by leukemias (23%), carcinomas (13.1%), and CNS tumors (11.6%). Our results are similar to developing countries especially African countries such as Sudan²⁰ and Nigeria,^{21,22} and also to a study conducted in Yemen,⁵ where lymphomas were the most common cancers.²³

We showed a relatively high proportion of hematological malignancies (47% of cases). Acute lymphoblastic leukemia has tendency to occur in young children with approximately 70% of cases occurring in children less than 9 years. It also has the preference to occur more in males than females.^{2-5,23,24} Acute myeloid leukemia occurs more frequently in females than males; this is an uncommon finding, but similar results were also found in another study conducted in Yemen.³ Only

one case of chronic juvenile myeloid leukemia was found in our study, which is a rare disease worldwide.^{2,24}

Most cases of lymphoma were reported in late childhood with 73.2% of cases reported in children 5-14 years. A male predominance was observed in all lymphoma subtypes, except for Burkitt's lymphoma. The higher than expected incidence of lymphoma in our population is similar to other reports from Africa. It is possible that genetic mixing or certain unknown environmental factors contribute to this similarity.²²

An important observation in our study was the large number of non specific CNS tumors (38.3%). This may be due to lack of advanced pathologic diagnostic facilities or to the fact that most patients with brain tumors travel abroad for diagnosis and treatment, even before their data is captured in our registry. Neuroblastoma is the most common SNS tumor. As expected, all cases were reported in children <9 years with the majority reported in children <4 years.^{1,25}

Ewing sarcoma was the most common bone tumor with more than half of cases reported in children 10-14 years. This is in contrast to other studies that reported osteosarcoma to be more common,^{1,3} but it agrees with the pattern of bone tumors in Africa² especially in Surinam and Nigeria.²¹ Rhabdomyosarcoma is the most common soft tissue sarcoma with most cases reported in children <9 years, this contrasts with the behavior

of rhabdomyosarcoma described in literatures and with similar results found in other studies.^{3,22}

Carcinoma represented 13.1% of cases with the majority of cases (88.7%) reported in children more than 5 years; most cases were reported in males (60%). An unusual finding is the large number of skin cancers representing more than half of all cases of carcinoma (51%) with the majority of these cases occurring in children more than 5 years. This may be explained by the finding of high consanguineous marriages in Shabowa and Hadhramout governorates with relative high incidence of cutaneous precancerous conditions such as xerodermapigmentosum.^{27,28} Nasopharyngeal carcinoma is the second most common type in children as it represented 11.3% of all carcinomas, a finding that is in line with other reports.^{29,30} Other rare carcinomas reported were adenocarcinoma, thyroid carcinoma, and adrenocortical carcinoma, with a low incidence similar to reports in the literature.³¹⁻³³

Nephroblastoma was the most common renal tumor in our study accounts for most cases reported in children <4 years, which is similar to the results found in other studies.³⁴ Primary neoplasms of the liver constitute 0.5-2% of cases in children <15 years.³⁵ In our study, hepatocellular carcinoma is the most common hepatic tumor accounting for two-thirds of hepatic tumors, followed by hepatoblastoma; this differs from other studies in Yemen,^{3,4} which found that hepatoblastoma was more common than hepatocellular carcinoma. Retinoblastoma is the most common eye tumor accounting for 78.9% of cases, most of them occur in children <4 years, this is similar to results found in other studies.^{3,36}

Study limitations. Absence of specialized diagnostic facilities, and incomplete cancer notification to the registry since many patients with malignancy travel abroad, and scanty available information on cancer in Yemen.

In conclusion, when the distribution of our cases was compared with other reports from Yemen and to the SEER database, interesting differences were identified. Higher numbers of patients with lymphoma and carcinomas were observed, especially in our study. Also, a lower frequency of CNS tumors was also observed. Further studies into the genetic and environmental causes of these differences are warranted.

References

1. Ward E, Desantis C, Robbins A, Kohler B, Jemal A. Childhood and adolescent cancer statistics. *CA Cancer J Clin* 2014; 64: 83-103.
2. Mans DR, Zijlmans CW. Childhood cancer in the Republic of Suriname (1980 through 2008). *The Open Epidemiology Journal* 2014; 7: 27-36.
3. Ba-Saddik IA. Childhood cancer in Aden, Yemen. *Cancer Epidemiol* 2013; 37: 803-806.
4. Badheeb A, Baamer A. The pattern and distribution of malignancies reported in Hadhramout Sector, Yemen-2002-2011. *Alandalus For Social and Applied Sciences Journal* 2012; 5: 7-16.
5. Al-Rabeei NA, Al-Thaifani AA, Al-Ariki AA. Assessment of childhood cancer at National Oncology Center in Sana'a city, Yemen. *El Mednifico Journal* 2014; 2: 345.
6. Ba Saleem HO, Bawazir AA, Moore M, Al-Sakkaf KA. Five Years Cancer Incidence in Aden Cancer Registry, Yemen (2002-2006). *Asian Pac J Cancer Prev* 2010; 11: 507-511.
7. Parkin DM. The evolution of the population-based cancer registry. *Nat Rev Cancer* 2006; 6: 603-612.
8. Salim EI, Moore MA, Al-Lawati JA, Al-Sayyad J, Bazawir A, Bener A, et al. Cancer epidemiology and control in the arab world - past, present and future. *Asian Pac J Cancer Prev* 2009; 10: 3-16.
9. Mopic Y. Preliminary report on the 2004 Population Census. Yemen: Sana'a, 2005. The General Census of Population 2004. [Updated 13 December 2013; Accessed 2016 April 14]. Available from URL: <http://www.mophp-ye.org/docs/Dat/2004%20Yemen%20Population%Estimates.pdf>
10. CanReg5 (Software for cancer registries) (Accessed 2016 April 14). Available from URL: http://www.iacr.com.fr/index.php?option=com_content&view=article&id=9:canreg5&catid=68&Itemid=445
11. Percy C, Van Holten V, Muir C, editors. International Classification of Diseases for Oncology. 2nd ed. Geneva (CZ): World Health Organization; 1992.
12. World Health Organization. International statistical classification of diseases and related health problems, 10th revision. Geneva (SZ): World Health Organization; 1992.
13. Kramarova E, Stiller CA. The international classification of childhood cancer. *Int J Cancer* 1996; 68: 759-765.
14. Steliarova-Foucher E, Stiller C, Lacour B, Kaatsch P. International Classification of Childhood Cancer, third edition. *Cancer* 2005; 103: 1457-1467.
15. Surveillance, Epidemiology, and End Results (SEER) Program. SEER*Stat Database: Incidence - SEER 13 Regs Limited-Use (1992-2004). Bethesda, Md: National Cancer Institute, Division of Cancer Control and Population Sciences, Surveillance Research Program, Cancer Statistics Branch, released April 2007, based on the November 2006 submission. Available at URL: www.seer.cancer.gov. Accessed on April 14, 2016.
16. Al-Mutlaq HM, Bawazir AA, Jradi H, Al-Dhalaan ZA, Al-Shehri A. Patterns of childhood cancer incidence in Saudi Arabia (1999-2008). *Asian Pac J Cancer Prev* 2015; 16: 431-435.
17. Inskip PD, Curtis RE. New malignancies following childhood cancer in the United States, 1973-2002. *Int J Cancer* 2007; 121: 2233-2240.
18. Al-Tarawneh M, Khatib S, Arqub K. Cancer incidence in Jordan, 1996-2005. *East Mediterr Health J* 2010; 16: 837-845.
19. Missaoui N, Khouzemi M, Landolsi H, Jaidene L, Abdelkrim SB, Abdelkader AB, et al. Childhood cancer frequency in the center of Tunisia. *Asian Pac J Cancer Prev* 2011; 12: 537-542.

20. Haroun HM, Mahfouz MS, Elhaj AM. Patterns of childhood cancer in children admitted to the Institute of Nuclear Medicine, Molecular Biology and Oncology (inmo), Wad Medani, Gezira State, Sudan. *Journal of Family & Community Medicine* 2006; 13: 71-74.
21. Samaila MO. Malignant tumors of childhood in Zaria. *African Journal of Paediatric Surgery* 2009; 6: 19-23.
22. Shehu UA, Adegoke SA, Abdulsalam U, Ibrahim M, Oyelami OA, Adeodu OO. Pattern of childhood malignant tumours in two tertiary teaching hospitals in Nigeria: comparative Study. *Niger J Paed* 2013; 40: 175-178.
23. Kulkarni KP, Marwaha RK. Significant male preponderance in childhood acute lymphoblastic leukemia in India and regional variation: tertiary care center experience, systematic review, and evaluation of population-based data. *Pediatr Hematol Oncol* 2013; 30: 557-567.
24. Hutter JJ. Childhood leukemia. *Pediatr Rev* 2010; 31: 234-241.
25. de Camargo B, de Oliveira Santos M, Rebelo MS, de Souza Reis R, Ferman S, Noronha CP, et al. Cancer incidence among children and adolescents in Brazil: first report of 14 population-based cancer registries. *Int J Cancer* 2010; 126: 715-720.
26. Brodeur GM, Hogarty MD, Mosse YP, Maris JM. Neuroblastoma. In: Pizzo PA, Poplack DG, editors. Principles and Practice of Pediatric Oncology. 6th ed. Philadelphia (PA): Wolters Kluwer Health/Lippincott Williams & Wilkins; 2010. p. 886-922.
27. Lopes-Cardoso C, Paes da Silva Ramos Fernandes LM, Ferreira-Rocha J, Teixeira-Soares C, Antônio-Barreto J, Humberto-Damante J. Xeroderma Pigmentosum - A case report with oral implications. *J Clin Exp Dent* 2012; 4: e248-e251.
28. Wong JR, Harris JK, Rodriguez-Galindo C, Johnson KJ. Incidence of childhood and adolescent melanoma in the United States: 1973-2009. *Pediatrics* 2013; 131: 846-854.
29. Liu W, Tang Y, Gao L, Huang X, Luo J, Zhang S, et al. Nasopharyngeal carcinoma in children and adolescents-a single institution experience of 158 patients. *Radiat Oncol* 2014; 9: 274.
30. Sultan I, Casanova M, Ferrari A, Rihani R, Rodriguez-Galindo C. Differential features of nasopharyngeal carcinoma in children and adults: a SEER study. *Pediatr Blood Cancer* 2010; 55: 279-284.
31. Al-Hussaini A, AlGhamdi S, Alsaaran R, Al-Kasim F, Habib Z, Nouri Ourfali N. Gastric adenocarcinoma presenting with gastric outlet obstruction in a child. Cairo: Hindawi Publishing Corporation; 2014.
32. Tuttle RM, Vaisman F, Tronko MD. Clinical presentation and clinical outcomes in Chernobyl-related paediatric thyroid cancers: what do we know now? What can we expect in the future? *Clin Oncol (R Coll Radiol)* 2011; 23: 268-275.
33. Ribeiro RC, Figueiredo B. Childhood adrenocortical tumours. *Eur J Cancer* 2004; 40: 1117-1126.
34. Bao PP, Zheng Y, Wang CF, Gu K, Jin F, Lu W. Time trends and characteristics of childhood cancer among children age 0-14 in Shanghai. *Pediatr Blood Cancer* 2009; 53: 13-16.
35. Tsai HL, Liu CS, Chin TW, Wei CF. Hepatoblastoma and hepatocellular carcinoma in children. *J Chin Med Assoc J* 2004; 67: 83-88.
36. Broadus E, Topham A, Sigh AD. Incidence of retinoblastoma in the USA: 1975-2004. *Br J Ophthalmol* 2009; 93: 21-23.

Student Corner

We invite students from a variety of medical disciplines to submit original contributions based on their supervised research.

The Student Corner of Saudi Med J aims to help students explore research opportunities and network with other peers and mentors in the same field.

Submission Guidelines

Submitted Abstracts should include the following:

- Title should be descriptive
- Author's names and affiliation (specify college level/year, academic degree of Senior Author)
 - Abstract must be structured and not more than 300 words
 - The following are the typical headings:

Objectives (background, why the study was done, specific aims)

Methods (setting, date of study, design, subjects, intervention and analysis)

Results (findings, data and statistical tests) and

Conclusion (general interpretation of results)

General Information on Abstract Submission

Submitted Abstracts should be co-authored by a Senior Supervisor

Abstracts will be reviewed by Student's Corner Section Editor

There is no fee to submit an Abstract

Ethical Approval should be provided

Non-indexed materials