Incidence and frequency rates of childhood cancer in Namibia

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Objective. To estimate the extent of paediatric malignancy in an African country and to compare these findings with paediatric cancer rates in other countries.

Design. A retrospective descriptive study which calculated incidence and frequency rates from the data obtained from a 6-year survey of childhood cancer in Namibia.

Setting. Children from the general community who were referred by primary care physicians or clinics and diagnosed in peripheral district hospitals or a tertiary care institution.

Patients. A total of 163 children less than 15 years of age diagnosed with any malignant neoplasm, intracranial tumour or histiocytosis between 1983 and 1988.

Intervention. None.

Main outcome measures. The minimum overall incidence of childhood cancer recorded in Namibia was lower than the rates usually reported by economically privileged countries. The rates of certain malignancies corresponded to the rates recorded in other African countries.

Results. The overall incidence of childhood cancer was 55.5 per million. Tumours of the central nervous system occurred most commonly (18%), followed by renal tumours (14%), leukaemia (12%) and lymphoma (11.5%). The 5.8 per million incidence rate of retinoblastoma was similar to the rates recorded in other African countries but higher than in the UK or the USA. The incidence rates per million children for renal tumours, malignant bone tumours and soft-tissue sarcomas were 7.4, 4.8 and 5.2, respectively, which correspond with the rates in Western Europe and the USA. The incidence rate of CNS tumours was only 9.3 per million. Both leukaemia (6.5 per million) and lymphoma (6.3 per million) had rates far lower than those recorded in central Africa or developed Western countries.

Conclusion. The incidence pattern of childhood cancer in Namibia demonstrates features of both the patterns described as typical for Africa and those described for industrialised countries.

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In the report by Parkin[1] on the worldwide occurrence of paediatric cancer, the data of ten registries from Africa were included. The majority of these registries made use of relative frequency rates to estimate cancer frequency, and incidence rates could be calculated only for the registries of Bulawayo (Zimbabwe),[2] Ibadan (Nigeria)[3] and Kampala (Uganda).[4] The registries demonstrated a wide variation in the occurrence of childhood cancer in Africa. The incidence of paediatric malignancies in the majority of African countries, however, remains unknown. The purpose of this paper is to report the incidence of childhood cancer in Namibia for the period January 1983 to December 1988.

Methods

During the 6-year period from January 1983 to December 1988 a survey of paediatric cancer in Namibian children was undertaken to provide the basis for a population-based childhood tumour registry. The study population consisted of all children resident in Namibia during the survey. Any child less than 15 years of age with a diagnosis of any malignant neoplasm, intracranial tumour or histiocytosis was eligible for registration. Tumours were coded according to the *International Classification of Diseases for Oncology* (*ICD-O*)[5] and classified as proposed by Birch and Marsden.[6] Name, age, sex, date of birth, ethnic group, address, diagnosis and diagnosis date were considered essential information to be recorded for each patient whenever possible. Date of diagnosis was the date that the patient first presented with clinical symptoms related to the malignancy or, when this was unknown, the date that the diagnosis was recorded. Many of the children with cancer were referred to Tygerberg Hospital for treatment during the survey period. The data on these children were available in the Tygerberg children's tumour registry and were included in a previous report.[7] In a further attempt to maximise ascertainment, regular contact with all other paediatric cancer units in South Africa was maintained to ensure awareness of any cases referred to these units from Namibia. The investigators also personally scrutinised the clinical records of all district, central and referral hospitals in Namibia for previously unrecorded patients with proven or clinically suspected malignancies. The former were included and every effort was made by means of personal home visits or visits by other medical and/or nursing staff or social workers to establish the clinical course and health status of patients in the latter group. The only pathology laboratory in Namibia during the survey was the state pathology laboratory in Windhoek, the capital city, which served as a referral centre for all of Namibia. The records of this laboratory were made available to the investigators so that they could search for unrecorded cases. Contact was also made with medical practitioners in rural areas as well as health personnel in peripheral clinics, and messages were broadcast on the radio in an attempt to verify and contact all children with cancer.

The calculated average childhood population during the 6 years of the survey was 495 689. This figure was obtained by using the data of the 1981 national census and assuming a 3% annual increase in the population to allow for births and deaths.[8] This growth rate was recommended by the Directorate: Development Co-ordination SWA for statistical purposes, and was derived from the average growth rate which had been recorded since the previous population census in 1970. The mean childhood populations for the age groups 0, 1 - 4, 5 - 9 and 10 - 14 years were 32 220, 141 767, 169 526 and 152 176, respectively.

Incidence and relative frequency rates were calculated for all the malignancies as well as for the age groups 0, 1 - 4, 5 - 9 and 10 - 14 years. The mean and median ages of patients were calculated for the individual tumour groups. Incidence rates were standardised according to the direct method using the world standard population as the reference population.[9,10] The age-standardised cancer ratio to adjust relative frequency was calculated by use of the standard population as used by Parkin *et al*.[1] When incidence rates were statistically compared, indirect standardisation and calculation of the standardised incidence ratio (SIR) were undertaken.[9] The total age-specific incidence rates were used as the reference population for calculating the SIRs to evaluate differences in the individual age groups. Two-sided statistical tests were used to determine the significance of the SIRs.

Results

The 163 tumours that were recorded represent an overall annual incidence of 55.5 per million population. The total number, relative frequency and incidence rates of the recorded tumours are listed in Table I. Because of the small number of tumours recorded, results for boys and girls and age-specific rates for individual diagnostic groups are not presented separately. Ninety-one per cent of the 163 tumours were histologically verified, which included bone marrow examinations on all but 2 of the leukaemia patients who were diagnosed on the basis of the presence of numerous blast cells on a peripheral smear. Ten brain tumours and 2 sympathetic nervous system tumours were diagnosed by clinical, laboratory and radiological investigation.

Brain and spinal cord tumours occurred most commonly, followed by renal tumours, lymphomas and leukaemias. Despite the high relative frequency rates of these tumours, only the renal tumours had an incidence comparable to the rates recorded in developed Western countries (Table II). Sixteen of the 19 leukaemia patients had acute lymphocytic leukaemia (ALL) with a ratio of ALL/acute non-lymphocytic leukaemia of 0.2. Neuroblastoma (NB) comprised 9.3% of all tumours, only slightly less than the frequencies of 10.5% and 9.5% recorded for retinoblastomas (RBs) and soft-tissue sarcomas (STSs), respectively. NB and RB had high incidence rates relative to those in Uganda and developed Western countries, respectively.[4,11,12] The recorded incidence rates of the main diagnostic groups are compared with the rates of three African countries, the USA and the UK in Table II.

Tumours occurred with equal frequency in both sexes. Of 163 registered patients, 88 were boys and 75 girls, a ratio of 1.2. The mean age of all the patients was 7.2 years (median 7 years), 6.9 years (median 7 years) for boys and 7.5 years (median 7.25 years) for girls. The overall age-specific incidence rates of the tumours in the age groups 0 years, 1 - 4 years, 5 - 9 years and 10 - 14 years were 57 per million, 59 per million, 42 per million and 63 per million, respectively. The lowest incidence rate in the 5 - 9-year age group did not differ statistically from the rates recorded in

Table I. Total number, relative frequency and incidence rates of tumours recorded in Namibia, 1983 - 1988

Diagnostic group	No. of cases	Relative frequency (%)		Rates per million	
		Crude	Adjusted	Crude	Adjusted
Leukaemias	19	11.7	11.6	6.4	6.5
Lymphomas	19	11.7	11.5	6.4	6.3
CNS	28	17.2	17.8	9.4	9.3
Sympathetic NS	14	8.6	9.3	4.7	5.2
Retinoblastoma	16	9.8	10.5	5.4	5.8
Renal tumours	21	12.9	13.8	7.1	7.4
Liver tumours	1	0.6	0.6	0.3	0.4
Bone tumours	15	9.2	8.1	5.0	4.8
Soft-tissue sarcomas	16	9.8	9.5	5.4	5.2
Gonadal and germ cell	3	1.8	1.7	1.0	1.0
Epithelial neoplasms	4	2.5	2.2	1.3	1.3
Other	7	4.3	3.5	2.4	2.3
Total	163	100	100	55	55.5

Table II. Incidence rates (per million) in Namibia and other countries

Diagnostic groups	Countries					
	Namibia	Zimbabwe[2]	Uganda[4]	Nigeria[3]	USA[11]	UK[12]
Leukaemias	6.5	16.0	14.4	11.5	24.1	38.3
Lymphomas	6.3	14.5	27.9	96.5	9.8	12.3
Brain and CNS	9.3	14.7	4.2	5.0	21.3	25.8
Sympathetic NS	5.2	8.0	1.7	6.0	8.8	7.7
Retinoblastoma	5.8	5.9	7.1	7.6	4.3	2.2
Renal tumours	7.4	8.2	8.0	10.8	11.0	7.0
Hepatic tumours	0.4	—	0.6	2.2	1.0	1.0
Malignant bone tumours	4.8	2.0	7.5	2.8	4.8	4.4
Soft-tissue sarcomas	5.2	8.7	8.0	8.7	7.7	5.0
Gonadal and germ cell	1.0	2.3	2.1	0.6	3.9	4.4
Epithelial tumours	1.3	4.4	7.7	1.9	4.5	2.4
Other	2.3	—	1.7	1.7	2.9	0.6
Total	55.5	84.7	90.9	155.5	104.1	111.1

the other age groups. Comparison of tumour occurrence in boys, girls and all patients in the standard age groups is shown in Table III.

Table III. Evaluation of tumour occurrence in four age groups in boys and girls by SIRs

Age group	Exp 1	Obs 2	SIR	*P*-value
Tumour distribution by age group in all children				
0	10.6	11	103.8	NS
1 - 4	46.8	50	106.8	NS
5 - 9	55.9	43	76.9	NS
10 - 14	50.2	59	117.5	NS
Tumour distribution by age group in boys				
0	6.0	7	116.7	NS
1 - 4	24.8	26	104.8	NS
5 - 9	30.3	25	82.5	NS
10 - 14	26.9	30	111.5	NS
Tumour distribution by age group in girls				
0	4.9	4	81.6	NS
1 - 4	21.5	24	111.6	NS
5 - 9	25.2	18	71.4	NS
10 - 14	22.9	29	126.6	NS

Exp 1 = expected number of cases; Obs 2 = observed number of cases; NS = not significant ($P > 0.05$).

The median ages of patients with sympathetic nervous system tumours, retinoblastoma and renal tumours were 2.4, 3 and 3.5 years, respectively. This was significantly lower than the median ages of children diagnosed with leukaemias (9.5 years), lymphomas (8 years), central nervous system (CNS) tumours (7.8 years), bone tumours (12 years) and STSs (13 years).

Discussion

Relative frequency rates and cancer ratios are unsuitable for the comparison of cancer occurrence between different registries or countries as the increased incidence of one cancer will influence the relative frequency rate of another cancer. Incidence rates that use population-based data, obtained from population-based tumour registries or surveys that have been recorded in an unbiased way, are a better indication of the real frequency of tumour occurrence.[13] In this survey we attempted to record in an unbiased fashion all tumours that occurred in Namibian children under 15 years of age over a 6-year period.

The overall recorded tumour incidence of 55 per million is about half the minimum incidence recorded worldwide.[14] This low overall rate is probably due to a failure to diagnose all the malignancies that occurred during the survey.

Incomplete ascertainment of tumours may have been due to the failure of health workers to diagnose a malignancy because of inexperience in recognising a childhood malignancy, or because of the difficulty in distinguishing between the overlapping symptomatology of cancer and commonly occurring infectious conditions such as malaria or tuberculosis. Alternatively, the low incidence rates may be due to pre-emptive deaths caused by infectious or nutritional disease. It is also possible that the undiagnosed child may never have attended a regular medical service, either because of parental reluctance to take the child to such a service or because of the physical inaccessibility of health care. The child may also have been referred to a health service not committed to register cancer patients. Ninety-one per cent of the tumours in this survey were histologically verified. This is a very high proportion for a developing country and may indicate a failure to register some clinically diagnosed cases. A search through the clinical records of all district hospitals and systematic questioning of medical personnel at peripheral clinics as well as medical practitioners in rural areas, however, did not confirm this suspicion. All practising paediatricians in Namibia were members of staff of the Windhoek state referral hospital during the study. It is therefore unlikely that any oncology patients were privately treated or referred elsewhere, without the knowledge of the investigators. Regular contact with paediatric cancer units in South Africa failed to identify any cases not recorded in this registry.

The Namibian children's tumour registry can attempt to improve ascertainment by the regular scrutiny of all diagnostic sources that were identified during the survey. These are mainly the records of the government pathology service in Windhoek, and the records of the adult oncology clinic at Central Windhoek Hospital, which sometimes treats patients younger than 15 years of age. Education of primary health care workers to suspect childhood cancer should improve ascertainment.

There was no difference in the mean or median ages of male and female patients. The male/female ratio of 1.2 was largely the result of an excess number of boys with lymphoma (ratio 2.8). This male predominance is in keeping with international trends.[14] More boys than girls were diagnosed with malignant bone tumours. The male/female ratio was 2.0 in contrast to reports in the literature that show higher rates in girls,[14] especially in the 10 - 14-year age group where the incidence rates of osteosarcomas vary from approximately 5 to 10 per million and 4 to 7.5 per million for girls and boys, respectively.

Tumours occurred with equal frequency in all the age groups in boys, in girls and in the combined group. It should be noted that although the SIR in the four age groups did not differ statistically, the value of 117.5 for all children aged 10 - 14 years and 126.6 for all girls aged 10 - 14 years did indicate a possible increased frequency of tumours in older children and especially in older girls. Children in Europe, the UK and the USA usually have the highest rate recorded in children less than 4 years of age,[12,15,16] while tumours occur more frequently in older children (10 - 14 years) in African countries.[3,4] The characteristic occurrence of NB, RB and renal tumours in young children in other countries[14] was also found in Namibia. The mean age of all leukaemia patients in Namibia, however, was 8 years. The peak in incidence of ALL in the 2 - 4-year age group, which is usually reported in developed countries, was absent. The mean age and age distribution for leukaemia, lymphoma, tumours of the CNS and STS did not differ from the recorded pattern of occurrence in developing countries.

The pattern, incidence and frequency rates of cancer in Namibian children demonstrate both interesting similarities to and differences from other African countries, the UK and the USA.[2-4,11,12] The relative frequency rates of RB, STS, renal tumours and bone tumours correspond to the pattern of increased frequency that is found in other countries in Africa and in black Americans, relative to white populations.

The 5.8 per million incidence rate of RB in Namibian children is lower than the rates of 7.1 per million and 7.6 per million recorded in Uganda and Nigeria, respectively,[3,4] but higher than the 4.3 per million recorded in the USA and the 2.2 per million in the UK.[11,12] Laterality was recorded in all the patients and bilateral tumours occurred in 25% of cases. The mean age at diagnosis was 3 years and no family history of RB could be obtained in any of the patients. The relatively high incidence of RB and the presentation at an older age in Namibian and other children in Africa may suggest an environmental influence for this type of tumour. Further studies are needed to elucidate this hypothesis. The recorded incidence rate of 4.8 per million for bone tumours corresponds to rates recorded in developed countries and is higher than the recorded rates of African countries with the exception of Uganda, which has an incidence of 7.5 per million. The majority of tumours were osteosarcomas and the ratio of Ewing's sarcoma to osteosarcoma was 0.17. These relatively high incidence rates of RB and malignant bone tumours become more significant when the low total incidence of childhood cancers recorded in Namibia is taken into account.

Tumours of the central and sympathetic nervous systems occurred more frequently than in most African countries.[14,17,18] This high relative frequency and incidence rate of brain tumours in Namibia are of special interest when the low rates that were previously accepted as typical of children from African countries are considered. Although tumours of the CNS occurred more frequently in Namibia than either leukaemia or lymphoma, the incidence rate of 9.3 per million is still less than half the rate recorded in developed countries (Table II). Although the low incidence of brain tumours in other sub-Saharan countries may reflect a true low incidence, our data suggest that many CNS tumours have previously not been recorded in Africa. This may have been due to the scarcity of modern diagnostic imaging facilities or to the non-recording of CNS tumours because of the inability to treat these patients. A low frequency of NB appears to be confined to East African countries.[17,18] The incidence of this tumour in Namibia corresponds to the rates recorded in Zimbabwe and Nigeria.

Despite the low overall incidence rate, some tumour groups were diagnosed with a frequency similar to those in developed countries, which have sophisticated and long-standing registries. If the incidence rates for American children are accepted as a reasonable norm for Namibia,[11] a variation in the completeness of ascertainment for different diagnostic categories is apparent. This indicates either selective complete ascertainment of some tumour groups or, if underdiagnosis applies to all tumour categories, that certain

tumours in Namibia have an incidence in excess of the rates usually reported in the literature. RB and malignant bone tumours appear to be the tumour groups with the highest incidence rates in relation to other countries while leukaemias and lymphomas constitute the main underdiagnosed cancers and also to a lesser extent, brain tumours. No reason was found for this possible selective underdiagnosis. Pre-emptive deaths in the leukaemic age group and similarity of symptoms in leukaemias, lymphomas and infectious diseases possibly contribute to underascertainment in these tumour groups. No reason could be found for the high incidence of RB and malignant bone tumours. These tumours were diagnosed mainly in children from the rural areas so that proximity to medical facilities did not account for the increased ascertainment of RB or bone tumours relative to other tumour groups. This high frequency of RB and bone tumours needs to be confirmed by ongoing tumour registration. The incidence of renal tumours in Namibia and other African countries does not vary significantly from the rates recorded in the majority of Western countries.

The pattern of childhood cancer in Namibia corresponds to that of industrialised countries for some disease categories, but demonstrates both similarities to and marked differences from previous reports on childhood cancer from countries in Africa.

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