Chapter 10
Cancers of the Bone and Joint

Denise R. Lewis and Lynn A. Gloeckler Ries

INTRODUCTION

Cancer of the bone and joint is a rare form of cancer. The most recent annual incidence rate among the SEER sites in the United States is 0.9 cases per 100,000 between 2000 and 2003 (1). In the U.S., incidence trends have mostly fluctuated, however there has been a slight decrease in incidence since 1994 (1). Bone and joint cancer mortality in the U.S. has decreased since 1969, with a large decrease reported in the late 1970's. U.S. mortality was reported at 0.4 deaths per 100,000 in 2006 (1). Survival statistics indicate better survival and quality of life, as surgery for these malignancies can incorporate limb sparing options. The 5-year survival rate for bone and joint cancer was 54% for patients diagnosed between 1975 and 1977 and 68% for patients diagnosed between 1996 and 2002.

MATERIALS AND METHODS

Between 1988 and 2001, there were 4,062 cases of bone and joint cancer diagnosed and reported to the SEER program (Table 10.1). Table 10.1 shows the exclusion of bone and joint cases from the initial number with the reason given for the exclusion. Cases from the Los Angeles registry were contributed for the years 1992 through 2001. Nearly 1,093 cases (27%) of the original cases were in children aged 0 to 19 years old, and were excluded from further analysis. More than half of the remaining cases were available for analysis (N=2,273), as they represent histologically confirmed, first primary adult cases of bone and joint cancer reported to the SEER program between 1988 and 2001.

Histologic Classification

Bone cancers have three major histologic types: osteosarcomas, chondrosarcomas, and Ewing sarcoma (2). These three types arise in the growing ends of long bones, cartilage, and the axial skeleton, respectively. In addition, there are numerous other histologic types that arise due to the precise location of the tumor and whether the tumor involves a combination of other tissue types including bone, joint and even muscle tissues (2). Of the major histologic types of bone and joint cancer, most in our analysis were chondrosarcomas (n=944), followed by osteosarcomas (n=625), and Ewing sarcoma (n=187; Table 10.2). Histologic classification for the current analysis was achieved using the ICD-O-2/ICD-O-3 morphology codes into the following categories of ICD-O M-9260, 9364, and 9473 for Ewing sarcoma; ICD-O M-9180-9185, 9192, 9193 for osteosarcoma; and ICD-O M-9220, 9221, 9231, 9240, 9242, and 9243 for chondrosarcoma. Twenty-

Table 10.1: Cancer of the Bone and Joint: Number of Cases and Exclusions by Reason, 12 SEER Areas, 1988-2001

Number Selected/Remaining	Number Excluded	Reason for Exclusion/selection
4,062	0	Select 1988-2001 diagnosis (Los Angeles for 1992-2001 only)
3,665	397	Select first primary only
3,633	32	Exclude death certificate only or at autopsy
3,600	33	Exclude unknown race
3,590	10	Exclude alive with no survival time
2,497	1,093	Exclude children (Ages 0-19)
2,497	0	Exclude in situ cancers for all except breast & bladder cancer
2,427	70	Exclude no or unknown microscopic confirmation
2,273	154	Exclude selected histologies*

* The following histologies were excluded from the present analysis due to small case numbers (n<30): Neoplasm, malignant (8000/3), Tumor cells, malignant (8801/3); Malignant tumor, small cell type (8002/3); Malignant tumor, giant cell type (8003/3); Squamous cell carcinoma (8070/3); Squamous cell carcinoma, keratinizing, not otherwise specified (8071/3); Paraganglioma, malignant (8680/3); Sarcoma, not otherwise specified (8800/3); Spindle cell sarcoma (8801/3); Giant cell sarcoma (8802/3); Small cell sarcoma (8803/3); Liposarcoma, not otherwise specified (8850/3); Leiomyosarcoma, not otherwise specified (8890/3); Rhabdoid sarcoma (8963/3); Mesenchymoma, malignant (8990/3); Synovial sarcoma, not otherwise specified (9040/3); Synovial sarcoma, spindle cell (9041/3); Ependymoma, not otherwise specified (9391/3); Meningioma, not otherwise specified (9530/3); Neurofibrosarcoma (9540/3); Neurilemmoma, malignant (9560/3).

two additional categories were included in the 'other' histology category.

Stage

Bone and joint cancers are staged according to SEER historical stage as localized, regional, distant, or unstaged. The staging categories are derived from the 10-digit Extent of Disease (EOD) codes. Codes are assigned based on the clinical, operative, and pathologic diagnosis of cancer. Bone and joint cancer stages are designated according to localized defined as confined to the primary site, regional defined as spreading directly beyond the primary site or involving regional lymph nodes, distant defined as metastatic. Unstaged tumors are also included.

Other Tumor Characteristics

Bone and joint cancers are also categorized according to grade (well, moderate or poorly differentiated, undifferentiated, and unknown), primary site (limbs or other site), and tumor size (0 to 8 centimeters, greater than 8 centimeters, or unknown size).

Age and Race

To investigate median and relative survival among bone and joint cancer cases, age was categorized as 20-39, 40-59, and 60 or more years of age. Two age categories, 40-59 and 60+ were combined for the analysis of Ewing sarcoma. Race-specific survival was calculated for whites, blacks, and other race, except for Ewing sarcoma where a separate analysis of race was not performed.

RESULTS

Table 10.2 shows the histology frequency distributions for adult bone and joint cancer. Of the 2,273 cases included in the analysis, 187 (8.2%) were classified as Ewing sarcoma, 625 (27.5%) were osteosarcoma, and 944 (41.5%) were chondrosarcoma. The remainder were classified in 'other' histologies, where chordoma was the most frequent type (219 cases; 9.6%), followed by malignant fibrous histiocytoma (72 cases; 3.2%). Within Ewing sarcoma, the majority (92.5%) was Ewing sarcoma, not otherwise specified (NOS). Within osteosarcoma, the majority were osteosarcoma, NOS (59.8%) followed by chondroblastic osteosarcoma (13.9%) and parosteal osteosarcoma (10.1%). Chondrosarcoma, NOS contributed to the majority of chondrosarcoma (89.8%) followed by myxoid chondrosarcoma (7.3%).

Demographic and Tumor Characteristics

Table 10.3 shows the demographic and tumor characteristics for bone and joint cancer at the time of diagnosis. For each of the histologic categories, a majority were diagnosed in males (69% for Ewing sarcoma, 54.1% for osteosarcoma, and 53.6% for chondrosarcoma). Bone and joint cancer of 'other' histologic types were also more frequent in males (57.6%). Bone and joint cancers were mostly diagnosed among whites, which is a reflection of the racial distribution within the SEER population.

Interestingly, the distribution of bone cancer histologies varied by race. Among whites, the most common histologies were chondrosarcoma (42.9% of cases), followed by osteosarcoma (25.1%), 'other' histologies (21.9%), and Ewing sarcoma (9.2%). In contrast, osteosarcoma represented 40.0% of black cases, followed by chondrosarcoma at 31.5%. Ewing sarcoma was rare, representing less than 5.0% of black cases.

Ewing sarcoma and osteosarcoma were mostly diagnosed in the 20-39 year age group (82.9% and 51.8% respectively), while chondrosarcoma was mostly diagnosed in the 40-59 year age group (38.6%). Bone and joint cancer in the 'other' histologic group was mostly diagnosed in the 60+ year age group (36.2%).

Historic stage frequencies indicate that cases were diagnosed in the regional stage most often for Ewing sarcoma (39.0%), osteosarcoma (41.3%), and in 'other' histologic types (39.8%). Chondrosarcoma was most often diagnosed in the localized stage (50.7%).

Chondrosarcomas were more often moderately differentiated at the time of diagnosis (39.8%), while osteosarcoma was mostly undifferentiated at diagnosis (35.7%). Ewing sarcoma and 'other' histologic types had a majority of unknown grade. Osteosarcoma and chondrosarcoma tended to be diagnosed in the limbs (63.5% and 54.3% respectively), while Ewing sarcoma was more frequently diagnosed in locations other than the limbs. When information about tumor size at diagnosis was available, most were in the 0 to 8 centimeter range (23.5% for Ewing sarcoma, 37.1% for osteosarcoma, 41.9% for chondrosarcoma, and 32.3% for 'other' histologic type).

Overall Survival

Table 10.4 shows the median survival time and the 1-, 2-, 3-, 5-, 8-, and 10-year relative survival rates by histologic type for 12 SEER registries from 1988 through 2001. For the 2,273 cases in the analysis, the median survival (in months) indicates that chondrosarcoma had

the longest median survival at more than 120 months, followed by bone and joint cancer of 'other' histology with a median survival of over 106 months, osteosarcoma with a median survival of 84.5 months and Ewing sarcoma with a median survival of 59 months. Relative survival indicated that those with bone and joint cancer had relative survival percentages of 88 percent at 1 year. Ewing sarcoma and osteosarcoma tended to have relative survival rates that were below the relative survival for chondrosarcoma (Table 10.4 and Figure 10.1). Bone and joint cancer with 'other' histologies had relative survival rates that were lower than chondrosarcoma.

Sex

Median survival for Ewing sarcoma was greater in females at more than 120 months compared with males at 53.8 months (Table 10.5). Relative survival among females with Ewing sarcoma was also greater than among males at the 3-, 5-, 8- and 10- year intervals. Females also had a higher median survival for osteosarcoma (93.7 months) compared to males (83.3 months; Table 10.6). Relative survival for 1- and 2- year interval was higher among males, and similar at 3-, 5-, and 8-years after diagnosis. Relative survival rates at 10-years were higher among females. Median survival was the same for males and females for chondrosarcoma at more than 120 months. The relative survival percentages for chondrosarcoma for females started slightly higher than for males at one year post-diagnosis. Females continued to have more favorable relative survival percentages through 10-years after diagnosis. Median survival for 'other' types of bone sarcoma was higher among females at greater than 120 months and 96.9 months for males (Table 10.8). For 'other' types, relative survival rates were higher for females after 5-years.

Table 10.2: Cancer of the Bone and Joint: Histology Distribution, Age 20+, 12 SEER Areas, 1988-2001

Histology Group	Histology/ICD-O Code	Cases	Percent of Category	Percent of Total
Total		2,273		100.0
Ewing Sarcoma		187	100.0	8.2
	Ewing sarcoma, NOS* (9260)	173	92.5	7.6
	Other (9364, 9473)	14	7.5	0.6
Osteosarcoma		625	100.0	27.5
	Osteosarcoma, NOS* (9180)	374	59.8	16.5
	Chondroblastic osteosarcoma (9181)	87	13.9	3.8
	Fibroblastic osteosarcoma (9182)	56	9.0	2.5
	Telangiectatic osteosarcoma (9183)	15	2.4	0.7
	Osteosarcoma in Paget's disease of bone (9184)	21	3.4	0.9
	Parosteal osteosarcoma (9192)	63	10.1	2.8
	Other (9185, 9193)	9	1.4	0.4
Chondrosarcoma		944	100.0	41.5
	Chondrosarcoma, NOS* (9220)	848	89.8	37.3
	Juxtacortical chondrosarcoma (9221)	7	0.7	0.3
	Myxoid chondrosarcoma (9231)	69	7.3	3.0
	Mesenchymal chondrosarcoma (9240)	14	1.5	0.6
	Other (9242, 9243)	6	0.6	0.3
Other Histologies		517	100.0	22.7
	Fibrosarcoma, NOS* (8810)	21	4.1	0.9
	Fibrous histiocytoma, malignant (8830)	72	13.9	3.2
	Hemangiosarcoma (9120)	26	5.0	1.1
	Hemangioendothelioma, malignant (9130)	13	2.5	0.6
	Epithelioid hemangioendothelioma, malignant (9133)	8	1.5	0.4
	Chondroblastoma, malignant (9230)	8	1.5	0.4
	Giant cell tumor of bone, malignant (9250)	52	10.1	2.3
	Adamantinoma of long bones (9261)	18	3.5	0.8
	Odontogenic tumor, malignant (9270)	29	5.6	1.3
	Ameloblastoma, malignant (9310)	36	7.0	1.6
	Chordoma (9370)	219	42.4	9.6
	Other (8072, 8805, 8811, 8823, 8851, 8910, 9043, 9150, 9321, 9330, 9371)	15	2.9	0.7

* NOS: Not Otherwise Specified

Age

The different types of cancer have very different survival time depending on the age of the patient. As seen in Table 10.5, younger Ewing sarcoma patients between 20 and 39 years old had better short term survival but not long-term survival. Relative survival rate tended to be lower in the 60+ age group for osteosarcoma, chondrosarcoma and 'other' bone sarcomas (Tables 10.6, 10.7, 10.8).

Race

Race information is not shown for Ewing sarcoma since there were few cases among non-white patients. Median survival for osteosarcoma varied by race, with whites having a higher median survival (82.6 months) than blacks (65.7 months, Table 10.6). For chondrosarcoma, blacks and whites shared a median survival greater than 120 months. Only slight survival differences were seen at the 10-year mark between whites (78%) and blacks (83%; Table 10.7). Median survival for 'other' bone cancer histologies was slightly higher in blacks (>120 months) than in whites (104.6 months; Table 10.8).

Historic Stage

Median survival was highest for each of the bone and joint cancers that had localized historic stage (Tables 10.6, 10.7, 10.8; median survival greater than 120 months). Tumors that were identified as regional historic stage also had long median survival times of greater than 120 months for Ewing sarcoma and chondrosarcoma. Osteosarcoma and 'other' bone sarcoma both had median survival of more than 90 months for regional historic stage, 93.6 months and 91.7 months, respectively. Tumors classified as distant historic stage had lower median survival times of 21.9 months for Ewing sarcoma, 9.9 months for osteosarcoma, 17 months

Table 10.3: Cancer of the Bone and Joint: Distributions by Sex, Race, Age (20+), Historic Stage, Grade, Primary Site, Tumor Size, and Histology, Ages 20+,12 SEER Areas, 1988-2001

	Histology							
	Ewing Sarcoma		Osteosarcoma		Chondrosarcoma		Other	
Characteristics	Cases	Percent	Cases	Percent	Cases	Percent	Cases	Percent
All Cases	187	100.0	625	100.0	944	100.0	517	100.0
Sex								
Male	129	69.0	338	54.1	506	53.6	298	57.6
Female	58	31.0	287	45.9	438	46.4	219	42.4
Race								
White	178	95.2	504	80.6	832	88.1	425	82.2
Black	<6	<5.0	76	12.2	60	6.4	51	9.9
Other	<6	<5.0	45	7.2	52	5.5	41	7.9
Age at Diagnosis (years)								
20-39	155	82.9	324	51.8	293	31.0	167	32.3
40-59	26	13.9	153	24.5	364	38.6	163	31.5
60+	6	3.2	148	23.7	287	30.4	187	36.2
Historic Stage								
Localized	34	18.2	200	32.0	479	50.7	176	34.0
Regional	73	39.0	258	41.3	343	36.3	206	39.8
Distant	58	31.0	108	17.3	61	6.5	79	15.3
Unstaged	22	11.8	59	9.4	61	6.5	56	10.8
Grade								
Well	0	0.0	46	7.4	354	37.5	21	4.1
Moderate	0	0.0	61	9.8	376	39.8	36	7.0
Poor	18	9.6	105	16.8	57	6.0	36	7.0
Undifferentiated	41	21.9	223	35.7	55	5.8	43	8.3
Unknown	128	68.4	190	30.4	102	10.8	381	73.7
Primary Site								
Limbs	71	38.0	397	63.5	513	54.3	163	31.5
Other	116	62.0	228	36.5	431	45.7	354	68.5
Tumor Size								
<= 8 cm	44	23.5	232	37.1	396	41.9	167	32.3
> 8 cm	42	22.5	126	20.2	192	20.3	68	13.2
Unknown	101	54.0	267	42.7	356	37.7	282	54.5

for chondrosarcoma, and 16.5 months for 'other' bone sarcoma.

Grade

Grade classification was not shown for Ewing sarcoma cases. In general, median survival was highest in the well and moderately differentiated cases for osteosarcoma and chondrosarcoma (median survival was greater than 120 months in these groups). A majority of cases of osteosarcoma had poor, undifferentiated, or unknown grade, and had median survival of 78.2 months, 46.6 months, and 43.4 months, respectively (Table 10.6). In contrast, approximately 23% of all chondrosarcoma cases had poor, undifferentiated, and unknown grade (Table 10.7). These cases had median survival times of 60.9 months, 15.4 months, and more than 120 months, respectively. Most of the 'other' bone sarcoma cases had unknown grade (74%; Table 10.8). Relative survival rates for osteosarcoma exceeded 85% at each of the 1-year, 2-year, 3-year, 5-year, 8-, and 10-year intervals for cases with well and moderate grades. Poor, undifferentiated, and unknown grade osteosarcoma relative survival ranged from 82% for 1-year relative survival for cases with poor or undifferentiated grade to 38% for undifferentiated cases at 10-years after diagnosis.

Relative survival rates for well or moderately differentiated chondrosarcoma exceeded 75% for the 1-year, 2-year, 3-year, 5-year, 8-, and 10-year relative survival intervals. Chondrosarcomas with unknown differentiation had relative survival percentages that remained above 71%. Poor and undifferentiated chondrosarcoma had lower relative survival percentages that ranged from 77 percent (1-year relative survival for poor grade) to 30 percent (8- and 10-year relative survival for undifferentiated). Most of the 'other' bone sarcomas had unknown differentiation and the 10 year relative survival rate was 62%.

Table 10.4: Cancer of the Bone and Joint: Number and Distribution of Cases, Median Survival Time (Months) and 1-, 2-, 3-, 5-, 8-, & 10-Year Relative Survival Rates (%) by Histology, Ages 20+, 12 SEER Areas, 1988-2001

Histology	Cases	Percent	Median Survival (Months)	Relative Survival Rate (%)					
				1-Year	2-Year	3-Year	5-Year	8-Year	10-Year
Total	2,273	100.0	>120	88.0	79.9	75.7	70.2	65.5	63.6
Ewing Sarcoma	187	8.2	59.0	83.2	68.9	60.3	48.4	44.6	44.6
Osteosarcoma	625	27.5	84.5	82.2	67.9	65.0	59.2	54.5	51.8
Chondrosarcoma	944	41.5	>120	93.0	88.9	85.4	81.6	79.1	78.5
Other Histologies	517	22.7	106.6	87.6	82.0	76.9	70.7	61.6	58.3

Table 10.5: Ewing Sarcoma: Number and Distribution of Cases, Median Survival Time (Months) and 1-, 2-, 3-, 5-, 8-, & 10-Year Relative Survival Rates (%) by Sex, Age (20+), Historic Stage, Primary Site and Tumor Size, 12 SEER Areas, 1988-2001

Characteristics	Cases	Percent	Median Survival (Months)	Relative Survival Rate (%)					
				1-Year	2-Year	3-Year	5-Year	8-Year	10-Year
All Cases	187	100.0	59.0	83.2	68.9	60.3	48.4	44.6	44.6
Sex									
Male	129	69.0	53.8	83.3	69.3	59.2	45.7	41.5	41.5
Female	58	31.0	>120	82.8	68.1	62.4	53.6	50.9	50.9
Age (years)									
20-39	155	82.9	59.5	84.5	69.4	60.4	48.9	44.5	44.5
40+	32	17.1	39.8	76.7	66.4	59.7	46.7	46.7	46.7
Historic Stage									
Localized	34	18.2	>120	98.4	79.0	72.4	60.4	60.4	60.4
Regional	73	39.0	>120	90.6	81.8	73.5	66.6	61.3	61.3
Distant	58	31.0	21.9	63.9	47.8	41.9	24.7	24.7	24.7
Unstaged	22	11.8	~	~	~	~	~	~	~
Primary Site									
Limbs	71	38.0	53.6	88.1	72.0	62.0	45.7	39.5	39.5
Other	116	62.0	59.4	80.1	67.1	59.2	49.9	47.1	47.1
Tumor Size									
<= 8 cm	44	23.5	>120	91.0	88.4	82.7	68.7	63.5	63.5
> 8 cm	42	22.5	34.7	69.1	52.0	49.3	36.2	32.6	32.6
Unknown	101	54.0	47.0	85.7	68.1	55.9	45.5	42.2	42.2

~ Statistic not displayed due to less than 25 cases.

Primary Site

Primary site classification was available for each of the subtypes of bone and joint cancer. Bone and joint cancer with the primary site reported in the limbs had median survival that exceeded 120 months for osteosarcoma, chondrosarcoma, and 'other' bone sarcoma. Median survival for Ewing sarcoma in the limbs was 53.6 months. Median survival for 'other' primary site varied at 59.4 months, 24.0 months, greater than 120 months, and 89.4 months for Ewing sarcoma, osteosarcoma, chondrosarcoma, and 'other' bone sarcoma, respectively. At 10 years after diagnosis, relative survival was highest for chondrosarcoma of the limbs (83%) and lowest for osteosarcoma of sites other than limbs (35%). Relative survival rates for Ewing sarcoma exceeded 80% for limbs primary site and 'other' primary site at the 1-year mark, then declined for both primary sites to 40% and 47% for limbs and 'other' primary site respectively at the 10-year mark. Relative survival for osteosarcoma ranged from 89% at 1 year to 61% at 10 years for limbs as the primary site, and 71% at 1-year for 35% at 10 years for 'other' primary site.

Tumor Size

Each of the bone and joint cancer subtypes of tumor size 0 to 8 centimeters had a median survival that exceeded 120 months, with the exception of 'other' bone sarcoma which had a median survival of 116.3 months. Median survival for bone and joint cancers that were greater than 8 centimeters varied with subtype, as Ewing sarcoma had a median survival of 34.7 months, osteosarcoma had a median survival of 31.3 months, chondrosarcoma had a median survival of more than 120 months, and 'other' bone sarcoma had a median survival of 56.8 months.

Table 10.6: Osteosarcoma: Number and Distribution of Cases, Median Survival Time (Months) and 1-, 2-, 3-, 5-, 8-, & 10-Year Relative Survival Rates (%) by Sex, Race, Age (20+), Historic Stage, Grade, Primary Site and Tumor Size, Ages 20+, 12 SEER Areas, 1988-2001

Characteristics	Cases	Percent	Median Survival (Months)	Relative Survival Rate (%)					
				1-Year	2-Year	3-Year	5-Year	8-Year	10-Year
All Cases	625	100.0	84.5	82.2	67.9	65.0	59.2	54.5	51.8
Sex									
Male	338	54.1	83.3	83.4	68.4	64.6	59.9	54.3	50.6
Female	287	45.9	93.7	81.0	67.4	65.4	58.3	54.5	53.1
Race									
White	504	80.6	82.6	81.2	67.0	63.8	58.4	54.0	52.0
Black	76	12.2	65.7	85.0	68.7	67.7	61.1	47.4	47.4
Other	45	7.2	>120	89.1	77.7	72.5	63.9	63.9	52.3
Age (years)									
20-39	324	51.8	>120	92.4	80.8	77.4	70.3	63.4	58.8
40-59	153	24.5	103.3	84.7	67.7	64.1	60.2	53.4	47.8
60+	148	23.7	14.2	56.4	37.8	35.1	27.9	25.6	25.6
Historic Stage									
Localized	200	32.0	>120	96.3	88.0	84.7	81.2	79.6	76.4
Regional	258	41.3	93.6	86.5	70.9	67.6	60.2	54.4	50.8
Distant	108	17.3	9.9	48.8	24.8	22.4	14.9	3.7	!
Unstaged	59	9.4	38.9	76.4	63.8	61.1	51.8	46.1	42.9
Grade									
Well	46	7.4	>120	100.0	100.0	100.0	96.2	96.2	86.7
Moderate	61	9.8	>120	97.1	90.7	90.7	87.3	85.3	85.3
Poor	105	16.8	78.2	81.7	67.9	65.1	56.6	51.7	51.7
Undifferentiated	223	35.7	46.6	81.1	61.9	56.6	50.5	39.3	37.7
Unknown	190	30.4	43.4	74.6	59.2	56.7	51.1	47.9	44.4
Primary Site									
Limbs	397	63.5	>120	88.9	77.1	74.6	67.6	62.5	60.7
Other	228	36.5	24.0	70.5	51.8	48.0	43.8	39.7	34.5
Tumor Size									
<= 8 cm	232	37.1	> 120	92.1	81.8	79.5	73.1	65.6	62.7
> 8 cm	126	20.2	31.3	73.3	54.6	51.4	45.9	43.8	41.4
Unknown	267	42.7	56.5	77.9	62.0	58.5	52.8	48.8	46.2

! Not enough intervals to produce rate.

Tumors of unknown size had median survival times of 47 months and 56.5 months for Ewing sarcoma and osteosarcoma respectively, while median survival for both chondrosarcoma and 'other' bone sarcoma of unknown tumor size was greater than 120 months. Relative survival rates were highest for tumor sizes of 0 to 8 centimeters (all were greater than 59% at 10-years after diagnosis).

DISCUSSION

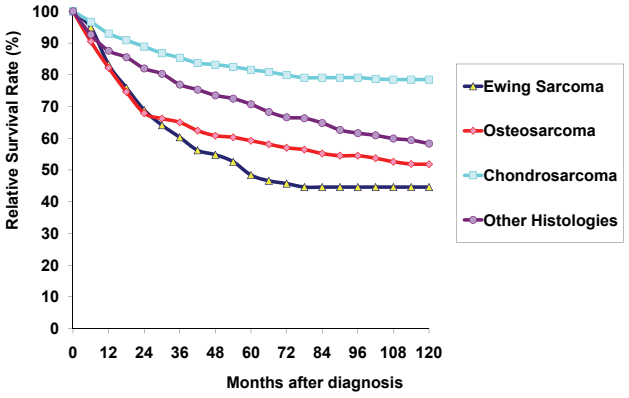
A review by Miller et al. (2) discussed various environmental factors, including exposure to ionizing radiation, chemicals, viruses, trauma, and metal implants as potential risk factors for bone and joint cancer. Host factors of importance for bone and joint cancer include pre-existing bone defects and familial aggregation of these cancers along with reports of multiple neoplasms. This review noted that in various populations, there has been no improvement in survival among patients of all ages in the U.S. or among children in Europe over the past 15 years. [Note: cell types differ for Ewing sarcoma and osteosarcoma, perhaps indicating different origins. Chondrosarcoma is epidemiologically dissimilar to osteosarcoma.]

A case-control study of 88 bone cancer cases aged 8 to 25 years and 3 matched control groups from Austria evaluated a variety of exposures to previous illness, bone injury or disease, nutrition, social and emotional factors and risk of bone cancer (3). Previous viral illnesses including chickenpox and mumps significantly increased the risk for bone cancer. Exposure to repeated polio vaccinations also were associated with elevated risk. Difficulties at school were associated with in an increased risk for bone cancer in both univariate and multivariate analyses. In a separate analy-

Table 10.7: Chondrosarcoma: Number and Distribution of Cases, Median Survival Time (Months) and 1-, 2-, 3-, 5-, 8-, & 10-Year Relative Survival Rates (%) by Sex, Race, Age (20+), Historic Stage, Grade, Primary Site and Tumor Size, Ages 20+, 12 SEER Areas, 1988-2001

Characteristics	Cases	Percent	Median Survival (Months)	Relative Survival Rate (%)					
				1-Year	2-Year	3-Year	5-Year	8-Year	10-Year
All Cases	944	100.0	>120	93.0	88.9	85.4	81.6	79.1	78.5
Sex									
Male	506	53.6	>120	92.5	87.6	83.5	77.8	74.3	73.7
Female	438	46.4	>120	93.6	90.5	87.6	86.0	84.1	84.0
Race									
White	832	88.1	>120	92.8	89.0	85.8	81.9	78.7	77.7
Black	60	6.4	>120	96.0	89.8	86.5	83.0	83.0	83.0
Other	52	5.5	>120	92.7	86.7	74.8	72.8	72.8	72.8
Age (years)									
20-39	293	31.0	>120	95.7	91.9	89.3	87.8	83.5	83.0
40-59	364	38.6	>120	96.6	91.2	88.7	86.4	83.5	81.6
60+	287	30.4	80.8	85.5	82.6	76.7	68.5	67.2	67.2
Historic Stage									
Localized	479	50.7	>120	98.9	98.3	94.9	93.8	92.0	91.8
Regional	343	36.3	>120	90.4	83.5	79.3	71.8	67.2	64.7
Distant	61	6.5	17.0	62.8	44.5	40.9	34.3	34.3	34.3
Unstaged	61	6.5	>120	91.3	89.2	85.6	82.6	77.0	77.0
Grade									
Well	354	37.5	>120	98.6	98.2	97.0	95.1	92.3	92.2
Moderate	376	39.8	>120	95.9	91.3	87.5	80.2	75.9	75.9
Poor	57	6.0	60.9	77.1	69.3	63.8	58.6	52.7	50.7
Undifferentiated	55	5.8	15.4	65.0	40.7	30.1	30.1	29.9	29.9
Unknown	102	10.8	>120	86.4	82.4	76.7	74.3	71.8	71.2
Primary Site									
Limbs	513	54.3	>120	94.8	92.1	88.3	86.2	84.2	83.0
Other	431	45.7	>120	90.9	85.1	81.7	76.2	72.5	72.4
Tumor Size									
<= 8 cm	396	41.9	> 120	97.2	95.2	92.1	87.6	84.3	82.4
> 8 cm	192	20.3	> 120	91.8	83.7	79.0	74.7	74.1	74.1
Unknown	356	37.7	> 120	89.0	84.7	81.2	78.6	74.5	74.5

Figure 10.1: Cancer of the Bone & Joint: Relative Survival Rates (%) by Histology, Ages 20+,12 SEER Areas, 1988-2001



sis of osteosarcoma cases, having more than one lifetime residence was associated with increased risk, along with difficulties at school (3).

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Table 10.8: Other Bone Sarcoma: Number and Distribution of Cases, Median Survival Time (Months) and 1-, 2-, 3-, 5-, 8-, & 10-Year Relative Survival Rates (%) by Sex, Age (20+), Historic Stage, Grade, Primary Site and Tumor Size, 12 SEER areas 1988-2001

Characteristics	Cases	Percent	Median Survival (Months)	Relative Survival Rate (%)					
				1-Year	2-Year	3-Year	5-Year	8-Year	10-Year
All Cases	517	100.0	106.6	87.6	82.0	76.9	70.7	61.6	58.3
Sex									
Male	298	57.6	96.9	86.7	83.4	77.0	69.3	59.5	55.7
Female	219	42.4	>120	88.5	79.8	76.7	71.9	64.5	61.6
Race									
White	425	82.2	104.6	86.3	81.9	77.3	71.4	61.1	57.3
Black	51	9.9	>120	94.8	83.6	79.8	76.1	74.3	74.3
Other	41	7.9	68.1	90.6	80.6	69.5	56.5	44.9	37.0
Age (years)									
20-39	167	32.3	>120	95.9	91.6	86.2	81.7	81.0	77.0
40-59	163	31.5	>120	90.0	86.0	82.1	76.6	62.2	58.8
60+	187	36.2	44.7	77.6	69.1	63.0	52.7	35.0	28.1
Historic Stage									
Localized	176	34.0	>120	94.1	88.7	85.3	79.5	75.4	75.4
Regional	206	39.8	91.7	94.2	87.8	81.6	71.9	57.7	52.3
Distant	79	15.3	16.5	54.3	46.3	41.1	41.1	26.6	24.3
Unstaged	56	10.8	>120	88.8	88.7	83.1	78.3	73.7	66.4
Grade									
Well	21	4.1	~	~	~	~	~	~	~
Moderate	36	7.0	>120	95.6	88.6	86.2	78.1	78.1	74.5
Poor	36	7.0	33.6	78.7	59.0	51.5	43.8	30.3	!
Undifferentiated	43	8.3	12.5	52.4	45.5	41.4	30.9	23.1	23.1
Unknown	381	73.7	>120	91.2	87.2	82.2	76.6	66.1	62.2
Primary Site									
Limbs	163	31.5	>120	84.9	76.9	73.6	72.6	69.4	69.4
Other	354	68.5	89.4	88.7	84.2	78.2	69.3	56.0	51.1
Tumor Size									
<= 8 cm	167	32.3	116.3	89.6	85.4	77.5	75.5	65.6	59.6
> 8 cm	68	13.2	56.8	87.9	74.1	71.1	51.6	38.8	33.6
Unknown	282	54.5	> 120	86.1	81.7	77.5	71.9	63.8	61.1

~ Statistic not displayed due to less than 25 cases.
! Not enough intervals to produce rate.