

HIGHER RATES OF OSTEOSARCOMA IN  
SOUTHWEST WASHINGTON

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## Thesis Statement

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Statistically there are higher rates of Osteosarcoma diagnosed and deaths in children in Southwest Washington than what is expected in a population of this size. A child living in Southwest Washington is 1.7 – 2.7 as likely to be diagnosed with Osteosarcoma than in other areas of the United States and the statistics are raising.

## Introduction

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Osteosarcoma is an extremely rare form of bone cancer that affects both children and adults. According to the American Cancer Society (2007) there are about 900 new diagnosed cases of Osteosarcoma in the United States each year, 400 being children under 20 years of age. Recent research more specifically narrowed the age range for children being diagnosed with Osteosarcoma ranging from 13 to 19 years of age (Stiller 2007). According to Stiller (2007) “only Osteosarcoma, ovarian germ cell tumors and, in some populations, nasopharyngeal carcinoma have their highest incidence at age 15-19 years.”

A review of the demographic data, both nationally and at a State/local level and comparing the data with national cancer statistics, confirms there are higher rates of Osteosarcoma in Southwest Washington than what would be expected in a community of this size, and the rates are on the raise. The study from Doernbecher Children’s Hospital (Acosta, 2008) supports the hypothesis and goes further in showing that death rates from Osteosarcoma are higher in Southwest Washington when compared against the expected death rates nationally.

Lastly, the research shows the linkage between higher rates of Osteosarcoma and three environmental factors (Radon, Fluoride, and Dioxin). This review of the data shows that all three environmental toxins are present in Southwest Washington and could be the possible causes for the elevated levels of Osteosarcoma.

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## Section I – Statistical and demographic data

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According to the US Census (2006), there are 299,398,485 people in the United States +/-0.1%. There are 147,434,940 Males and 151,963,545 Females. For this study a focus will be placed on children under the age of 20, which represents 27.5% of the total population or 82,334,583 children in the United States. The US Census data (2000) State of Washington has a total population of 5,894,121. Children ages 0-19 make up 28.6% of the total State's population or 1,685,719 children, which is 0.9% higher than the national average. Finally, Clark County has a population of 115, 843 children under 20 years of age. On a percentage basis Clark County is 4.9% higher than Washington State and 6% higher than the US for children 0-19 of age.

	<u>Total population &lt;20:</u>	<u>Percentage of population</u>
United States	82,334,583	27.5%
Washington	1,685,719	28.6%
Clark County, WA	115,843	33.5%

## Section II – Expected Rates of Osteosarcoma compared with demographic data

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### Breakdown of Osteosarcoma diagnosed by age

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Since there are so few cases of Osteosarcoma in the United State each year there was little supporting data that broke out occurrences by age. All studies said Osteosarcoma impacted children and adolescents less than 20 years of age but the majority of the cases impacted children between 15 and 19. For a statistical comparison this study will use ages 0-20 but will provide demographic data on ages 15-19. Statistically, anyone under the age of 20 has a 1 in 205,837 chance of being diagnosed with Osteosarcoma in the United States. In the

State of Washington the odds are 1 in 210,714 and in Clark County 1 in 251,833 for children under the ages of 20 being diagnosed with Osteosarcoma.

According to the US Census data (2000) the State of Washington has a total population of 5,894,121. This calculates < 2% of the total population of the United States. Statistically, with  $\leq 2\%$  of the population of the United States in theory there should be  $\leq 2\%$  of the diagnosed cases in total and in children. Using that logic there should be 18 total diagnoses of Osteosarcoma in Washington annually; 10 in adults and 8 cases in children  $\leq 20$  years of age. For simplicity I rounded the numbers to the next whole number.

Clark County Washington has a total population of 345,238, which represents 5.8% of the total State population and .0012% of the United States population. If Clark County has .0012% of the US population in theory Clark County should have .0012% of the Osteosarcoma cases in the US. If the US expects 900 cases annually and the State of Washington expects 18 cases annually then Clark County should expect 1.04 cases annually. Adults would be expected to have .058 cases annually and children under the age of 20 would have 0.46 cases diagnosed annually.

### Actual reported rates of Osteosarcoma diagnosed in Clark County

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The next sequence in research was to obtain localized cancer data for Clark County. Dr. Cheteri at the Washington State Cancer Registry and Dr. Lillian Bensley at the Washington State Department of Health were contacted and did several analyses. The State looked at the number of people age 0-24 living in Clark County who were diagnosed with Bone Cancer during 1995-2004. Additionally, the State calculated the number of cancer cases that would have been expected in that area if the rate of newly diagnosed cancer had been the same as the rate in the state as a whole during the same time period.

What the State found is that there were 6 people age 0-24 diagnosed with Osteosarcoma between 1995 and 2004 in Clark County. A rate of 4.7 was expected incident over the 10 year period. With 6 cases observed the ratio of expected/observed was 1.3 (6/4.7). Thus, there were slightly more people diagnosed with Osteosarcoma than expected if the rates of newly diagnosed cancer in Clark County were the same as in the whole state. This number was not significantly elevated.

Upon further analysis the State of Washington realized there was one case that was not reported in 2000. Based on the updated report diagnosed cases went from 6 to 7, which took the expected/observed ratio from 1.3 to 1.5 over a 10 year period.

If the data is examined, from 1995 – 1999, the expected cases of Osteosarcoma 2.35 and observed 3, for an expected /observed ratio of 1.3 (3/2.35). But if the data is examined between 2000-2004 expected cases would remain 2.35 but observed 4 for an expected/observed ratio of 1.7. What this means is that a child 0-20 years old is 1.7 times more likely to be diagnosed with Osteosarcoma in Clark County than in other places in the State or Country. If examine the data in 5 year blocks the data also suggests the diagnosis rate is on the rise, which is also supported by research presented at the Pediatric Solid Tumor Conference (Acosta 2007).

In the research presented at the Solid Tumor Conference (Acosta 2007) in 2007 R. Acosta showed the expected incidence rate for Oregon and Southwest Washington was 4.8 per year. In 2007 Doernbecher Children's Hospital alone had 13 reported cases of Osteosarcoma for an expected/observed ratio of 2.7. This means in a child between the ages of 0-20 is almost three times as likely to get diagnosed with Osteosarcoma in Oregon and Southwest Washington than in other cities of similar size and population density. This data is critical because the State of Washington's data is from 1995-2004. Acosta's data (2007) reports from 2005 – 2007.

## Reliability of data and reporting

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In 1990, Washington State passed a law (RCW 70.54.230) that made cancer a reportable condition in Washington and mandated the Department of Health to establish a statewide cancer registry program. Under this mandate, the Department established the Washington State Cancer Registry and hospitals began reporting diagnosed cancer cases in 1992.

The cancer reporting rules (246-102 WAC) currently define reportable cancers as "any malignant neoplasm. The law (*Public Law 102-515, RCW 70.54.230, 246-102 WAC*), required data for cancer reporting includes patient demographics (such as age and sex) and medical information (such as type of cancer and date and stage at diagnosis) for all newly diagnosed cancers. Even with the law there is 3 to 4 year lag in the data reported to the State and the State's analysis.

Dr. Bensley and Dr. Cheteri, with the State of Washington were surveyed. Dr. Cheteri was questioned about the reliability of the reporting process and their confidence in the data. Dr. Cheteri said “it is in the best interest of the hospitals to report their cases as it helps us all. It is a State law that Hospitals must report every case so I am confident every case is reported” (Cheteri, M, personal communication, January 12, 2008). Because much of this data is protected by Federal HIPPA laws Dr. Cheteri could not provide me the list of names in his data base. However a survey of a local high school produced a list of six students in the area had been diagnosed with Osteosarcoma in between 2000 and 2004. That list was given to Dr. Cheteri a, who analyzed the names of children diagnosed with Bone Cancer in Clark County and the year of diagnosed. Dr. Cheteri found one of the children was missing from his data base and that a hospital failed to report one a case in 2000. The name was added and the statistics were recalculated.

### **Section III – Expected cure rates from Osteosarcoma**

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The American Cancer Society (2007) states the 5-year survival rate for patients with non-metastatic Osteosarcoma is over 70%. The American Cancer Society goes on to say “for those patients whose cancers respond well to chemotherapy and surgery the survival rates is even better, increasing to between 80% and 90%.” However, the study presented at the Solid Tumor Conference (Acosta 2007) in 2007 shows death rates doubling between 2005 and 2007 from Osteosarcoma just at Doernbecher Children’s Hospital alone.

A recent, informal survey of a local high school confirmed six children with Osteosarcoma in the Oregon and Southwest Washington. Of the six three have died from the disease and the remaining three have had reoccurrences of Osteosarcoma in the lungs and other bones. Survival rates after a reoccurrence is less that 10%.

### **Section IV – Environmental carcinogens linked to Osteosarcoma**

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Over the last 30 years there has been a lot of research linking environmental factors to cancer. While Researchers know little about exactly causes Osteosarcoma, what triggers the disease or the exact sequence of events that brings on an onset of the disease there have been several studies that link Osteosarcoma three

environmental factors, all of which exist at elevated level in the water supply of Clark County Washington.

Research has shown environmental exposure to Radon, Fluoride, or Dioxin directly link back to higher rates of Osteosarcoma. Radon naturally occurs in the water supply. Fluoride can also occur naturally but is often added to the water supply to strengthen the teeth in Children. The last is Dioxin or more specifically 2,3,7,8 – TCDD, which is the most toxic form on Dioxin and directly linked to cause Sarcomas. Dioxin is not produced or used commercially in the US. Dioxin is a contaminant formed in the production of some chlorinated organic compounds, including a few herbicides. Dioxin may also be formed during combustion of a variety of chlorinated organic compounds. When Dioxin is released into the environment the compound is considered very hazardous.

### Radon links to Osteosarcoma

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There have been a number of studies conducted by the states of Illinois, Iowa, Wisconsin and Canada that have linked Radon to higher rates of Osteosarcoma. In 2003, New Jersey's Department of Environmental Protection released a report of a case study demonstrated an association between elevated levels of radium (Radon) in the drinking water and a rare type of bone cancer. The health study reviewed cases of Osteosarcoma diagnosed from 1979-1998 and water tested from 1997-2000 to determine if higher risk existed in those areas of the state where ground water was found to exceed drinking water standards for radiological contamination. The New Jersey study examined 117 community water systems and subsystems serving 1.4 million people. The study showed a total of 75 cases Osteosarcoma cases over a 20 year period. On average in New Jersey, Osteosarcoma occurs in three people per million annually. The study showed in parts of New Jersey where radium concentrations exceeded federal standards "for males under the age of 25 years, the rate was approximately 70% higher" risk of developing Osteosarcoma (Burger et al, 2003).

Radon has been identified in the water in Southwest Washington. According to Clark County Public Utilities website (2006) "We tested our supply wells for radon in 2006, and found levels of this gas ranging from 155 to 610 picocuries per liter." The website does not say which well 34 ground water wells tested positive or how many. There was also no indication if the level have been raising, falling or staying the same. Further research and testing needs to be conducted to see if Radon in the water supply could be the cause for the elevated levels of

Osteosarcoma in Southwest Washington but the fact that Radon has been found in the water supply warrants further testing

## Fluoride links to Osteosarcoma

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There have been several prior studies by Harvard University where researchers were not able to detect an association between fluoride and Osteosarcoma. However, in 2001, Dr Bassin (2005) introduced an important addition to the scientific literature on fluoride exposure and Osteosarcoma. The commentary, produced by Connett, Neurath, and Connett, supports Bassin's findings and suggests if Bassin's methods and findings were applied to earlier studies, prior researchers would have come to the same conclusions. Dr. Connett goes on to say "if Bassin's methods were applied to all prior research there would be a clear pattern of the association between Osteosarcoma and fluoride exposure stretching back to 1956" (Connett et al, 2005). This research is an important study and makes the direct connection between fluoride and elevated rates of Osteosarcoma.

In an analysis of municipal water systems in the United States (Miller et al, 2003) 24 water systems were sampled for Fluoride content. Vancouver and Longview Washington were two of the 24 cities in the US examined. Vancouver and Longview were both in the top 8 of municipalities with highest levels out of the 24 surveyed. Vancouver Washington was specifically called out as having the "smallest variability was seen for Vancouver, WA where fluoride levels over the three phases averaged 0.8870.04 mg/ml (RSD of 4.6%). "

## Dioxin links to Osteosarcoma

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In a study published by the Center for Disease Control (National Center for Environmental Health, 2003), the CDC identified environmental exposures and the linkages to different cancer clusters. Specifically, the report (National Center for Environmental Health, 2003) calls out 2,3,7,8, TCDD (Dioxin) and the links to Sarcoma and Hematopoietic.

In 2007 there was a study of possible PCBs and Dioxins in the waters of Vancouver Lake (Washington State Department of Ecology, 2007). The study found that contaminate levels in fish from the lake exceeded the National Toxics Rule(NTR) human health criteria for total PCBs, 4,4'-DDE, 2,3,7,8-TCDD, Toxaphene, and Dieldrin. Total PCBs were elevated in all fish tissue samples. The report went on to say "Total PCBs and 2,3,7,8-TCDD in Vancouver Lake

fish tissue should be addressed through a statewide assessment” (Washington State Department of Ecology, 2007).

## **Conclusion**

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A review of the National, State and Local demographic data has shown, statistically, there are more cases of Osteosarcoma in Southwest Washington and the rates of new diagnoses are on the rise. The data also supports the fact that a child diagnosed with Osteosarcoma in Southwest Washington is almost three times as likely to die than in other parts of the United States. The research has shown there are at least three environmental factors that can contribute to higher rates of Osteosarcoma and the study has shown that all three exist in Southwest Washington, which may be the cause for the higher rates of Osteosarcoma. Based on these facts and the supporting data there is a greater chance of being diagnosed with Osteosarcoma in the Northwest and further epidemiological studies should be conducted.

## Appendix

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### Expected Rates of Osteosarcoma compared with demographic data

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#### Expected Osteosarcoma rates in the US using demographic data

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<b>Age Group</b>	<b>Location</b>	<b>Population</b>	<b>% of population</b>	<b>Annual Cases</b>	<b>Expected Cases</b>
All Ages	USA	299,398,485	100%	900 cases	1 in 332,665
Adults $\geq$ 20:	USA	217,063,902	72.5%	500 cases	1 in 434,128
Ages 0-19:	USA	82,334,583	27.5%	400 cases	1 in 205, 837
Ages 0-14:	USA	60,777,893	20.3%		
Ages 15-19:	USA	21,554,531	7.2%		

#### Expected Osteosarcoma rates in Washington State using demographic data

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<b>Age Group</b>	<b>Location</b>	<b>Population</b>	<b>% of population</b>	<b>Annual Cases</b>	<b>Expected Cases</b>
Total population:	Washington State	5,894,121	100%	18 cases	1 in 327,451
Adults $\geq$ 20:	Washington State	4,208,402	71.4%	10 cases	1 in 526,050
Ages 0-19:	Washington State	1,685,719	28.6%	8 cases	1 in 210,714
Ages 0-14:	Washington State	1,255,448	21.3%		
Ages 15-19:	Washington State	430,271	7.3%		

## Expected Osteosarcoma rates in Clark County Washington using demographic data

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<b>Age Group</b>	<b>Location</b>	<b>Population</b>	<b>Annual Cases</b>	<b>% of population</b>	<b>Expected Cases</b>
Total population:	Clark County, WA	345,238	1.04		1 in 331,960
Adults $\geq$ 20:	Clark County, WA	229,396	0.58 cases		1 in 395,510
Ages 0-19:	Clark County, WA	115,843	0.46 cases		1 in 251,833
Ages 0-14:	Clark County, WA	88,471			
Ages 15-19:	Clark County, WA	27,372			

## Demographic Data for the United States

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<u>Total population:</u>	<u>United States</u>			<u>299,398,485</u>
Adults $\geq$ 20:	Population is 72.6%	or		217,063,902
Ages 0-19:	Population is 27.5%	or		82,334,583
Ages 0-14:	Population is 20.3%	or		60,777,893
Ages 15-19:	Population is 7.2%	or		21,554,531

## Demographic Data for the State of Washington

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<u>Total population:</u>	<u>Washington State</u>			<u>5,894,121</u>
Adults $\geq$ 20:	Population is 71.4%	or		4,208,402
Ages 0-19:	Population is 28.6%	or		1,685,719
Ages 0-14:	Population is 21.3%	or		1,255,448
Ages 15-19:	Population is 7.3%	or		430,271

## Demographic Data for Clark County Washington

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Total population:	Clark County, WA		345,238
Adults $\geq$ 20:	Population is 66.5%	or	229,396
Ages 0-19:	Population is 33.5%	or	115,843
Ages 0-14:	Population is 25.6%	or	88,471
Ages 15-19:	Population is 7.9%	or	27,372

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