

Cancer Association of South Africa (CANSA)



Fact Sheet on Bone Cancer

Introduction

Bones are rigid organs that constitute part of the endoskeleton of vertebrates. Bone tissue is a type of dense connective tissue.

[Picture Credit: Skeleton]



Bone Cancer

Bone cancer is the uncontrolled growth of bone cells.

A *primary* bone tumour starts in the bone itself. It can develop anywhere in the body.



[Picture Credit: Bone Cancer]

There are several different types of bone tumours. Their names are based on the area of bone or surrounding tissue that is affected and the kind of cells forming the tumour.

He, F. & Matsumoto, Y. 2020.

“Bone is one of the most common distant organs in which tumor cells tend to metastasize depending on complicated immune system and bone microenvironments. Clinical symptoms such as severe pain and bone fractures associated with bone metastases severely affect patients' quality of life. According to the pathological types of bone destruction caused by the biological characteristics of different primary cancer cells, bone metastases are classified as osteolytic, osteoblastic and mixed types. Herein, we discuss the molecular mechanisms of bone metastasis and the therapeutic strategy with focus on bone metabolism.”

Pullan, J.E. & Budh, D.P. 2020.

“Primary bone cancer (PBC) is a rare malignant tumor of the bone, originating from primitive mesenchymal cells. It accounts for around 0.2% of all malignancies worldwide and is idiopathic in most cases. There are multiple subtypes, with osteosarcoma, chondrosarcoma, and Ewing sarcoma, the most common. Each varies in demographics, imaging appearance, and biological behavior. They are frequently aggressive and require early diagnosis, utilizing imaging and tissue biopsy. Surgical

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excision remains the mainstay of curative treatment, with chemotherapy and radiotherapy often used in conjunction.”

Types of Bone Tumours

Bone tumours comprise of:

- Osteosarcoma: osteosarcoma (also called *osteogenic sarcoma*) is the most common primary bone cancer. This cancer starts in the bone cells.
- Chondrosarcoma: chondrosarcoma is a cancer of cartilage cells.
- Ewing’s tumour: Ewing’s tumour is the third most common primary bone cancer, and the second most common in children, adolescents, and young adults. Malignant fibrous histiocytoma
- Fibrosarcoma This is another type of cancer that develops more often in ‘soft tissues’ than it does from bones. Fibrosarcoma usually occurs in elderly and middle-aged adults - leg, arm, and jaw bones are the ones most often affected.
- Giant cell tumour of bone
- Chordoma

Palmerini, E., Picci, P., Reichardt, P. & Downey, G. 2019.

BACKGROUND: Primary and recurrent giant cell tumor of bone is typically benign; however, rarely giant cell tumor of bone can undergo malignant transformation. Malignancy in giant cell tumor of bone may be primary (adjacent to benign giant cell tumor of bone at first diagnosis) or secondary (at the site of previously treated giant cell tumor of bone). Malignant giant cell tumor of bone has a poor prognosis; it is important to distinguish malignant from benign lesions to facilitate appropriate management. The true incidence of malignant giant cell tumor of bone is not known, probably owing to inaccurate diagnosis and inconsistent nomenclature. We have analyzed current data to provide a robust estimate of the incidence of malignancy in giant cell tumor of bone.

METHODS: A literature search was performed to source published reports of primary and secondary cases of malignant giant cell tumor of bone. Studies that reported a denominator were used to estimate the incidence of malignancy.

RESULTS: We identified 4 large series of patients with malignant giant cell tumor of bone that provided data on 2315 patients with giant cell tumor of bone. Across these studies, the cumulative incidence of malignancy was 4.0%; the cumulative incidence of primary malignancy was 1.6% compared with 2.4% for secondary malignancy. Our analyses confirmed that most malignant giant cell tumor of bone is secondary and occurs following radiation. In addition, data from 8 small series showed that 4.8% of patients with giant cell tumor of bone who received radiation therapy developed secondary malignancy.

CONCLUSIONS: Malignant giant cell tumor of bone is rare, and its identification is hindered by a lack of clear diagnostic criteria. For optimal care of patients with giant cell tumor of bone, we recommend: comprehensive histologic sampling to ensure accurate diagnoses; watchful follow-up, particularly for patients treated with radiation; and timely treatment of local recurrence.

Incidence of Bone Cancer in South Africa

According to the outdated National Cancer Registry (2017), known for under reporting, the following number of cases of bone cancer was histologically diagnosed in South Africa during 2017:

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Group - Males 2017	Actual No of Cases	Estimated Lifetime Risk	Percentage of All Cancers
All males	114	1:2 539	0,29%
Asian males	5	1:1 873	0,51%
Black males	61	1:4 017	0,46%
Coloured males	8	1:1 617	0,33%
White males	40	1:747	0,19%

Group - Females 2017	Actual No of Cases	Estimated Lifetime Risk	Percentage of All Cancers
All females	101	1:3 247	0,24%
Asian females	3	1:2 806	0,23%
Black females	58	1:5 525	0,30%
Coloured females	9	1:3 285	0,20%
White females	31	1:908	0,18%

N.B. 'Histologically diagnosed' means that a biopsy (removal of a specimen of tissue) was performed and that a diagnosis of Bone Cancer was confirmed by a qualified pathologist.

The frequency of histologically diagnosed cases of bone cancer in South Africa for 2017 was as follows (National Cancer Registry, 2017):

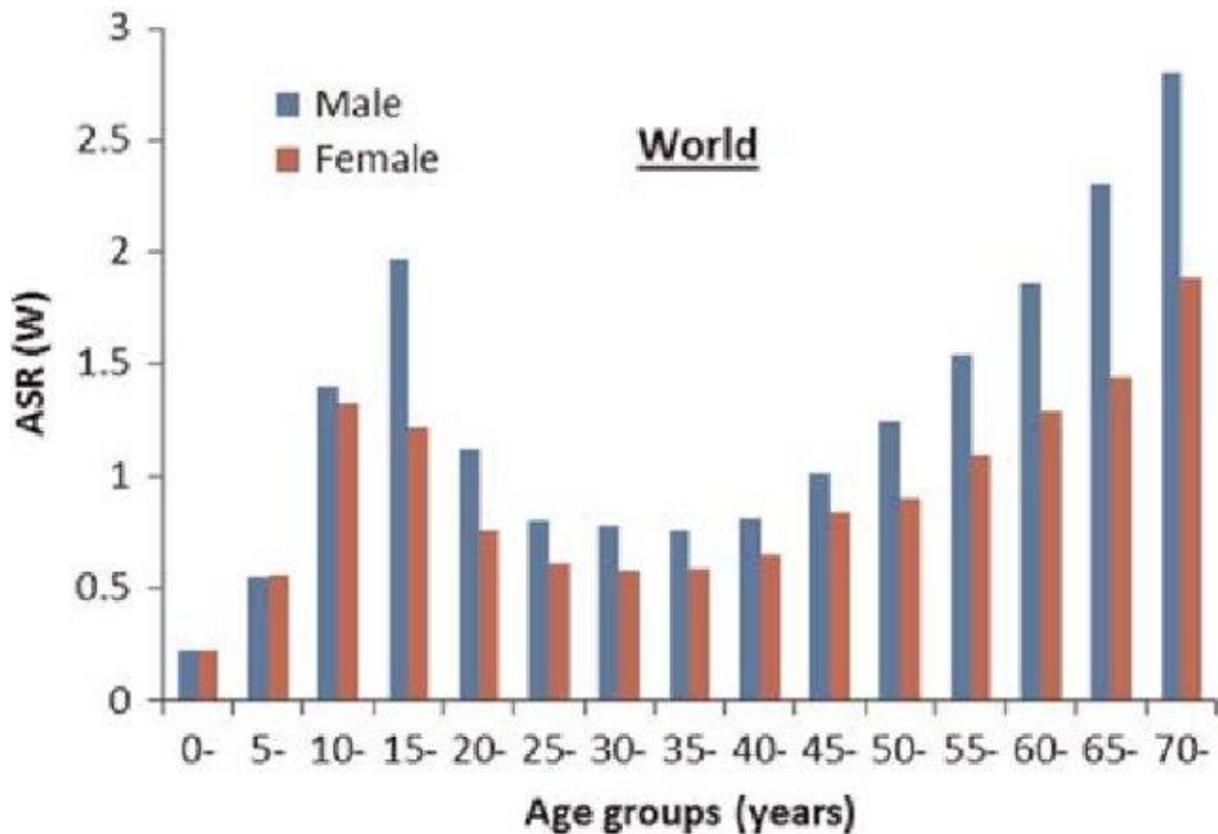
Group - Males 2017	0 – 19 Years	20 – 29 Years	30 – 39 Years	40 – 49 Years	50 – 59 Years	60 – 69 Years	70 – 79 Years	80+ Years
All males	38	20	10	19	13	6	6	3
Asian males	2	0	0	2	1	0	0	0
Black males	24	13	5	10	6	2	1	0
Coloured males	2	0	1	0	0	3	2	0
White males	10	0	1	3	2	5	3	0

Group - Females 2017	0 – 19 Years	20 – 29 Years	30 – 39 Years	40 – 49 Years	50 – 59 Years	60 – 69 Years	70 – 79 Years	80+ Years
All females	40	14	10	12	15	5	5	0
Asian females	1	0	0	1	0	1	0	0
Black females	30	9	8	5	3	2	1	0
Coloured females	2	1	1	1	3	1	0	0
White females	7	4	1	5	9	1	4	0

N.B. In the event that the totals in any of the above tables do not tally, this may be the result of uncertainties as to the age, race or sex of the individual. The totals for 'all males' and 'all females', however, always reflect the correct totals.

Global Incidence of Bone Cancer

The incidence of primary malignant bone tumours is relatively low, the mortality related to them is disproportionately high, especially among teenagers and young adults. The currently available incidence figures are based mainly on data collected from more developed countries. Global incidence figures and comparative figures between various regions and continents are not available (Kumar & Gupta, 2016).



Signs and Symptoms of Bone Cancer in Adults

Bone cancer is a rare cancer that occurs in the bone and destroys normal bone tissue. Although it may afflict any bone in the body, bone cancer typically affects long bones such as those found in the arms and legs.

Symptoms of bone cancer may include:

- Swelling in the affected area
- Bone fracture (especially as a result of a minimal injury)
- Bone pain
- Fatigue
- Weight loss

Signs and Symptoms of Bone Cancer in Children

Symptoms of bone cancer in children include:

- The presence of a mass or lump in the affected area
- Swelling in the affected area
- Fever
- Chills
- Night sweats
- Bone fracture (especially as a result of a minimal injury)

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- Bone pain
- Fatigue
- Weight loss without trying

Signs and Symptoms of Bone Cancer in Adults

The Signs and symptoms may include:

- Swelling and tenderness near the affected area
- Broken bone
- Fatigue
- Bone pain
- Unintended weight loss

Diagnosis of Bone Cancer

The following may be used to diagnose bone cancer:

- X-Rays
- Bone scan
- Magnetic Resonance Imaging
- Bone biopsy
 - Core needle biopsy:
 - Surgical biopsy:

Hosseini, A., Mirzaei, A., Salimi, V., Jamshidi, K., Babaheidarian, P., Fallah, S., Rampisheh, Z., Khademian, N., Abdolvahabi, Z., Bahrabadi, M., Ibrahimi, M., Hosami, F. & Tavakoli-Yaraki, M. 2020 .

Purpose: The status of the local and circulating SOX9, a master regulator of the tumor fate, and its relevance to tumor types, severity, invasion feature, response to therapy, and chemotherapy treatment were surveyed in bone cancer in the current study.

Methods: The *SOX9* expression level was evaluated in tissue and peripheral blood mononuclear cells from patients with different types of malignant and benign bone tumors also tumor margin tissues using Real-Time PCR. The protein level of SOX9 was assessed using immunohistochemistry and western blot analysis. Also, the correlations of the *SOX9* expression level with the patient's clinical and pathological features were considered.

Results: The remarkable overexpression of *SOX9* was detected in bone tumors compared to tumor margin tissues ($P < 0.0001$). Malignant bone tumors revealed a higher expression of *SOX9* compared to benign tumors ($P < 0.0001$) while osteosarcoma tumors showed higher expression levels compared to Ewing sarcoma, and chondrosarcoma. Overexpression of *SOX9* was observed in high grade, metastatic, recurrent tumors also tumors with poor response to therapy. Besides, the patients under the chemotherapy treatment demonstrated higher levels of *SOX9* compared to the rest of malignant tumors ($P = 0.02$). The simultaneous up-regulation of circulating *SOX9* in the patients with bone cancer was observed compared to healthy individuals ($P < 0.0001$) accompanying with overexpression of *SOX9* in malignant tumors compared to benign tumors ($P < 0.0001$). The circulating *SOX9* expression was up-regulated in the patients with malignant bone tumors who receive chemotherapy treatment also patients with high grade, metastatic, recurrent tumors. The protein level of SOX9 was in line with our data on the *SOX9* gene expression.

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Conclusion: The simultaneous overexpression of local and circulating SOX9 in bone cancer besides its positive correlation with tumor severity, malignancy, size, and chemotherapy may deserve receiving more attention in bone cancer diagnosis and therapy.

Han, S., Li, Y., Li, Y. & Zhao, M. 2019.

“Clinical value of PET/CT (positron emission tomography/computed tomography) in the diagnosis of malignant bone tumors (BT) was investigated. Fifty-four patients with BT were first diagnosed by ordinary CT and then by PET/CT. The diagnostic efficacy outcomes and diagnosis of malignant BT by clinical stage of the two methods for BT were observed and recorded, and the diagnostic value of PET/CT in the diagnosis of BT was evaluated. There were 14 cases of benign BT patients, 15 cases of stage I, 10 cases of stage II and 15 cases of stage III in malignant BT patients. The diagnostic coincidence rate of PET/CT was 92.59% and the diagnostic coincidence rate of CT was 72.22%, which showed that the diagnostic coincidence rate of PET/CT was significantly higher than that of CT ($P < 0.05$). The sensitivity, negative predictive value and positive predictive value of PET/CT were 95.00, 85.71 and 95.00%, respectively, which were higher than those of CT ($P < 0.05$). CT and PET/CT were used for the clinical staging and pathological diagnosis of malignant BT; the results showed that the diagnostic accuracy of PET/CT in the clinical stages of malignant BT was also significantly higher than that of CT ($P < 0.05$). The diagnostic efficacy of PET/CT in BT is better than that in CT. PET/CT can diagnose the pathological properties of BT more accurately, and can also effectively diagnose the clinical stage of malignant BT and provide clinical diagnostic basis for follow-up procedures.”

Staging of Bone Cancer

The stage of a cancer describes its size and whether it has spread.

There are two different staging systems used for bone cancer. This is the Enneking staging system, which is commonly used to stage bone cancers:

Stage 1

The cancer is low-grade and has not spread beyond the bone.

Stage 2

The cancer is high-grade and hasn't spread beyond the bone.

Stage 3

The bone cancer may be any grade and has spread to other parts of the body, such as the lungs.

Treatment of Bone Cancer

Treatment for different types of bone cancer may include:

- **Surgery**
The type of surgery a person has will depend on the size of the cancer, where it is in the body and whether it has grown into the tissues surrounding the bone. The surgeon may suggest:
 - Removing the bone affected by the cancer
 - Limb sparing surgery
 - Removal of an arm or leg (amputation)
 - Surgery to remove cancer that has spread
- **Chemotherapy**
- **Radiotherapy**

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Keil, L. 2020.

“The three most common primary bone cancers are osteosarcoma, Ewing sarcoma, and chondrosarcoma. Osteosarcoma occurs most often in children and young adults, with a peak incidence at ages 10 to 14 years. It also can occur later in life due to malignant transformation of benign bone lesions. Osteosarcoma occurs most commonly around the knee, but can occur in other bones. Management varies depending on tumor characteristics and involves chemotherapy and surgery. Ewing sarcoma is most common in teenagers. It occurs most commonly in long bones but can occur in the pelvis and other bones. Management involves surgical resection when possible, along with chemotherapy and occasionally radiation therapy. Chondrosarcoma typically occurs in patients 40 years and older. It can occur as a primary tumor or from malignant transformation of benign bone tumors. Chondrosarcomas are relatively resistant to chemoradiation, so surgery is the standard therapy. When any of these tumors is suspected, patients should be instructed to avoid weight-bearing on the affected extremity to help prevent pathologic fracture while evaluation is completed. Imaging with x-rays and occasionally magnetic resonance imaging study are the initial diagnostic steps. If imaging suggests a primary bone cancer, prompt referral to an orthopedic oncology subspecialist is indicated.”

Li, L., Liu, Y., Ren, X., Qu, K. & Liu, X. 2020.

Background: Advanced nursing care (ANC) has been reported to effectively relieve bone cancer pain, prevent psychological disorders and improve the quality of life (QoL) in patients with primary bone cancers (PBC) during the treatment. However, the exact effect of ANC remains controversial. This systematic review will aimed to assess the effectiveness of ANC on bone cancer pain, psychological disorders and QoL in patients with PBC.

Methods: Eligible randomized controlled trials (RCTs) and high-quality prospective cohort studies were searched from Excerpt Medica Database (Embase), PubMed, Google Scholar, Medline, Cochrane Library, Web of Science (WOS), China National Knowledge Infrastructure (CNKI), Chinese Bio Medical Database (CBM), China Scientific Journal Database (CSJD), and Wanfang Database. Papers in English or Chinese published from January 2000 to July 2020 will be included without any restrictions. The clinical outcomes including bone cancer pain, psychological disorders, QoL, and adverse events of ANC in patients with PBC were systematically evaluated. Two reviewers will separately carry out study selection and data extraction. Stata 14.0 and Review Manager 5.3 were used for data analysis. Methodological quality for each eligible clinical trial will be assessed by using Cochrane risk of bias tool. Subgroup and meta-regression analysis will be carried out depending on the availability of sufficient data.

Results: This study will comprehensively summarize all potential evidence to systematically investigate the effects and safety of ANC on bone cancer pain, psychological disorders and QoL in patients with PBC.

Conclusion: The findings of this study will help to determine whether ANC is effective or not on bone cancer pain, psychological disorders and QoL in patients with PBC.

Inplasy registration number: INPLASY202090037.

Zaiaczkowska, R., Kocot-Kepska, M., Leppert, W. & Wordliczek, J. 2019.

“The skeletal system is the third most common site for cancer metastases, surpassed only by the lungs and liver. Many tumors, especially those of the breast, prostate, lungs, and kidneys, have a strong predilection to metastasize to bone, which causes pain, hypercalcemia, pathological skeletal fractures, compression of the spinal cord or other nervous structures, decreased mobility, and increased mortality. Metastatic cancer-induced bone pain (CIBP) is a type of chronic pain with unique and complex pathophysiology characterized by nociceptive and neuropathic components. Its treatment should be multimodal (pharmacological and non-pharmacological), including causal

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anticancer and symptomatic analgesic treatment to improve quality of life (QoL). The aim of this paper is to discuss the mechanisms involved in the occurrence and persistence of cancer-associated bone pain and to review the treatment methods recommended by experts in clinical practice. The final part of the paper reviews experimental therapeutic methods that are currently being studied and that may improve the efficacy of bone pain treatment in cancer patients in the future.”

About Clinical Trials

Clinical trials are research studies that involve people. They are conducted under controlled conditions. Only about 10% of all drugs started in human clinical trials become an approved drug.

Clinical trials include:

- Trials to test effectiveness of new treatments
- Trials to test new ways of using current treatments
- Tests new interventions that may lower the risk of developing certain types of cancers
- Tests to find new ways of screening for cancer

The [South African National Clinical Trials Register](#) provides the public with updated information on clinical trials on human participants being conducted in South Africa. The Register provides information on the purpose of the clinical trial; who can participate, where the trial is located, and contact details.

For additional information, please visit: www.sanctr.gov.za/

Medical Disclaimer

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<http://www.cancer.org/cancer/bonecancer/detailedguide/bone-cancer-risk-factors>

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Bone Cancer

https://www.google.co.za/search?q=bone+cancer&source=lnms&tbm=isch&sa=X&ei=R1aLUvHNEMrDhAeF3YGgCw&sqi=2&ved=0CAcQ_AUoAQ&biw=1366&bih=642#facrc=_&imgdii=_&imgsrc=PTPd88tGdsLuM%3A%3BOA7zgXsHkdEgWM%3Bhttp%253A%252F%252Fwww.truthonpot.com%252Fwp-content%252Fuploads%252F2013%252F07%252Fbone-cancer-marijuana2-07-24.jpg%3Bhttp%253A%252F%252Fwww.truthonpot.com%252F2013%252F07%252F24%252Fmarijuana-could-treat-pain-from-bone-cancer-research-shows%252F%3B600%3B350

Bone Structure

https://www.google.co.za/search?q=structure+and+types+of+bones&source=lnms&tbm=isch&sa=X&ei=_Df2UeXuM867hAev7IGQCg&ved=0CAcQ_AUoAQ&biw=1366&bih=614#facrc=_&imgdii=_&imgsrc=HJz9uSbiWhmc3M%3A%3B7CvRedjOMoXWGM%3Bhttp%253A%252F%252Fwww.interactive-biology.com%252Fwp-content%252Fuploads%252F2012%252F06%252FBone-anatomy-1024x1024.jpg%3Bhttp%253A%252F%252Fwww.interactive-biology.com%252F3810%252Fbones-a-brief-review-on-its-functions-types-structure-and-development%252F%3B1024%3B1024

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Skeleton

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