


**COLLEGE OF HEALTH SCIENCE SCHOOL OF MEDICINE ,**
**DEPARTMENT OF PATHOLOGY**

# HISTOPATHOLOGICAL PATTERNS OF PRIMARY BONE TUMORS AT TIKUR ANBESSA SPECIALIZED HOSPITAL, ADDIS ABABA, ETHIOPIA: A RETROSPECTIVE CROSS- SECTIONAL ANALYSIS from 2020 to 2024.

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**Histopathological Patterns of Primary Bone Tumors at Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia: A Retrospective Cross-Sectional Analysis from 2020 to 2024**

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# LIST OF ACRONYMS

| | |
|---|---|
| AAU: | Addis Ababa University |
| Dr: | Doctor |
| ERN: | European Reference Network Pediatric Cancer |
| ESMO: | European Society for Medical Oncology |
| ETB: | Ethiopian Birr |
| EURACAN: | European Reference Network for Adult Cancers FOS: FBJ Murine Osteosarcoma Viral Oncogen Homolog |
| FOSB: subunit | FOSB Proto-Oncogene, AP – 1 Transcription factor |
| GLOBOCAN: | Global cancer Incidence and mortality Estimates IARC: International Agency for Research on Cancer |
| IHC: | Immunohistochemistry |
| MD: | Doctor of Medicine |
| PI : | Principal Investigator |
| RB1: | Retinoblastoma 1 |

| | |
|---|---|
| SEER: | Surveillance, Epidemiology, and End Results |
| SD: | Standard deviation |
| SPSS: | Statistical Package for Social Sciences |
| TP53: | Tumor Protein 53 |
| TASH: | Tikur Anbessa Specialized Hospital |
| WHO: | World Health Organization |

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# ABSTRACT

**Background:** Primary bone cancers are uncommon globally yet cause significant morbidity due to diagnostic challenges, surgical intervention, and the potential for metastasis. The WHO 2020 Classification gives us a way to make regular diagnoses that works well with other systems. Still, many low- and middle- income places, like Ethiopia, don't have hospital-wide summaries. The published data from Tikur Anbessa Specialized Hospital (TASH) in Addis Ababa only goes up to 2019, which is a big problem. Without a current, WHO-aligned institutional profile (2020–2024) detailing tumor spectrum, demographic characteristics (age, sex, and anatomic site), and the utilization of ancillary diagnostic tests, clinicians and health planners are deprived of the evidence necessary to enhance diagnostic pathways, allocate resources effectively, and formulate targeted strategies for sarcoma care.

**Objective:** The goal of this study was to describe the histopathological patterns of primary bone tumors diagnosed at Tikur Anbessa Specialized Hospital (TASH) in Addis Ababa, Ethiopia, from 2020 to 2024, based on the WHO 2020 classification.

**Methods:** A hospital-based cross-sectional study design with a 5-year retrospective period was used. We looked at 258 patient records that were kept in TASH from January 2020 to December 2024 at the pathology department of Tikur Anbessa Specialized Hospital. We used a checklist in Kobo toolbox to collect the data, and SPSS version 27 software to analyze it. We used frequency and percentage to talk about categorical data.

**Result**: We looked at a total of 258 cases. There were more males than females (55.8%) and the median age was 20 years. Benign tumors made up the largest group (50.0%), followed by malignant tumors (36.0%) and intermediate tumors (14.0%). Osteosarcoma was the most common specific diagnosis, with 26.0% of cases. Osteochondroma came in second with 16.3%, and ossifying fibroma came in third with 8.5%. The knee area (24.9%) and the jaw bones (16.9%) were the most common places in the body. All diagnoses (100%) relied solely on H&E morphology, with no recorded application of immunohistochemistry or molecular testing.

**Conclusion:**Primary bone tumors at TASH from 2020 to 2024 exhibit a shift back to a benign-predominant pattern compared to the 2015–2019 period. In children and adolescents Osteosarcoma was the most prevalent malignancy. The knee region and jaw bones were the most common anatomic sites



**Key words:** Primary bone tumors, Histopathology, Patterns, TASH, Ethiopia

# 1. INTRODUCTION

## 1.1. Background

Primary bone tumors are rare worldwide, but they lead to considerable morbidity due to diagnostic difficulties, surgical intervention, and the risk of metastasis. The World Health Organization (WHO) 5th edition classification (2020) categorizes bone cancers into benign, intermediate, and malignant groups using a detailed approach that encompasses histogenesis, morphology, immunophenotype, and, when applicable, molecular features (1). There are more benign bone tumors than malignant ones (such lymphomas and myelomas), but many benign lesions still go undetected and untreated (1, 2). A multidisciplinary approach is needed for an accurate diagnosis, and close clinico-radiologic correlation and histology are considered the best ways to do this (1).

Osteosarcoma is the most prevalent kind of malignant primary bone neoplasm. It typically impacts adolescents and young adults, originating in the metaphyseal regions of long bones, particularly the distal femur, proximal tibia, and proximal humerus. Chondrosarcoma and Ewing sarcoma represent major malignant bone tumor categories in adults and children, respectively (1, 3, and 4). Modern population-based registry studies are helping us learn more about how age, anatomy, and outcomes are distributed. This shows how important it is to have a consistent way to classify things and report them (5–7). GLOBOCAN 2020's worldwide cancer projections show that primary bone sarcomas are not very common.

but they happen more often in kids and teens. This shows that specialized methods are needed to find and treat these disorders (5).Data from the Surveillance, Epidemiology, and End Results (SEER) program and associated registry-based studies reveal a significant peak in osteosarcoma incidence among adolescents, along with ongoing discourse concerning a secondary, smaller peak in later adulthood, and a notable predilection for long bones—findings that inform service planning, survivorship models, and resource allocation (7,8). International standards, including those from the European Society for Medical Oncology (ESMO), stress the importance of a uniform diagnostic evaluation, staging, and multidisciplinary care in accordance with WHO 2020 criteria. This demonstrates the significance of high-quality institutional series

that include histopathological spectra alongside distributions of age, sex, and anatomic site (1,3).

There are still not many comprehensive population-based cancer registries in Africa, although hospital-based series reflect largely the same trends as those in other parts of the world. Osteochondroma and giant cell tumor are the most common benign tumors, whereas osteosarcoma is the most common primary malignant bone tumor. The most typical sites to develop it are long bones around the knee, and most of the people who get it are teens or young adults (5, 9, and 10). For instance, research in Nigeria consistently indicates that osteosarcoma is the predominant malignant bone neoplasm. They also say that coming in late and taking too long to get a diagnosis are two of the biggest reasons why things don't go well. This demonstrates the necessity for contemporary, center- specific audits throughout the continent (9, 10).

Information from the Addis Ababa/Tikur Anbessa Specialized Hospital (TASH) in Ethiopia gives us two crucial points of reference. A look back at 689 instances from 1967 to 1996 showed that there were more benign tumors than malignant ones. Osteochondroma and chondroma were the most common benign diagnosis, while osteosarcoma was the most prevalent sarcoma. The majority of occurrences occurred in individuals aged 10 to 29 (11). A more recent TASH study from 2015 to 2019 (n = 335) likewise indicated that osteochondroma was the most prevalent benign tumor and osteosarcoma was the most common malignant tumor, with long bones around the knee being the most afflicted. These trends are similar to those seen in other parts of the world and in other parts of the country (12). These investigations indicate that specific histologic types and age-site distributions persist; however, they also reveal a data deficiency post-2019 that necessitates a fresh institutional assessment to address.

Hereditary cancer predisposition syndromes (e.g., RB1 mutations and TP53/Li-Fraumeni syndrome), prior exposure to ionizing radiation, and pre-existing bone conditions such as multiple hereditary exostoses and Paget disease are established risk factors for primary bone sarcomas; however, the relative contribution of these factors varies by setting and remains incompletely characterized locally (1,3,8,13). TASH is the biggest tertiary referral and pathology center in Ethiopia. It processes a lot of musculoskeletal samples, which makes it an excellent place to update an institutional series that employs WHO 2020 criteria in modern clinico- radiologic workflows (1, 3, and 11).

Consequently, this retrospective cross-sectional study of primary bone tumors at TASH from 2020 to 2024 aims to (i) address the evidence gap post-2019, (ii) enable comparison with historical Ethiopian cohorts and contemporary international reports, and (iii) generate actionable baseline data to improve diagnostic accuracy, service planning, and multidisciplinary sarcoma care in Addis Ababa and similar resource-limited settings (2, 3, 12–14).

## 1.2 Statement of the problem

Primary bone tumors are rare, but they are very hard to diagnose, require complicated surgeries, and have a higher risk of spreading to other parts of the body. The WHO 2020 classification gives a complete way to diagnose bone tumors, but many low- and middle-income places, like Ethiopia, don't have up-to-date, hospital-level summaries that always use these criteria. Addis Ababa/Tikur Anbessa has the most up-to-date data from Ethiopia.

Specialized Hospital (TASH) shows patterns in the histology that happen over and over again and a preference for long bones around the knee. But there is only institutional evidence from 2019, and population-based registries still don't have all the information they need. Clinicians, multidisciplinary tumor boards, and healthcare planners don't have the important evidence they need to improve diagnostic pathways, set priorities for resources, and create targeted training and referral strategies without a current institutional profile (2020–2024) that meets WHO standards and shows the range of benign, intermediate, and malignant bone tumors, as well as the distribution of age, sex, and anatomical site, and records the current use of additional diagnostic methods like immunohistochemistry and molecular testing.

### 1.3 Rationale of the study

Primary bone tumors is a problem that affect adolescents and young adults all over the world. Identifying the histopathological patterns of primary bone tumors diagnosed may contribute for the foundation for strengthening national cancer registry inputs, enhancing trainee education and capacity building.

This study provides the first world health organization aligned, post 2019 institutional over view of primary bone tumors at Tikur Anbessa Specialized Hospital (TASH) for the period 2020 to 2024, thereby addressing a data and evidence gap. By identifying and characterizing the histopathology spectrum alongside demographic profiles and anatomic site distributions, the study brings interventional data to refine integrated clinico-radiologic pathologic workflows, standardize biopsy and staging pathways, and strengthen multidisciplinary decision making for limb sparing surgery and systemic therapy.

Furthermore, The findings from this study would serve as an input data for policymakers in planning and implementing mitigation activities of primary bone tumor. Moreover, the findings of this study could serve as baseline data for further research in this area .

## 2. Literature Review

A retrospective cross-sectional study conducted at Tikur Anbessa Specialized Hospital (TASH) from 2015 to 2019 by Weyessa, Kindie, and Yefter investigated the histological characteristics of primary bone cancers in Ethiopia, emphasizing the lack of local epidemiological data. The analysis of 335 surgical biopsy specimens indicated that malignant tumors constituted 53% of the cases, slightly exceeding benign tumors at 47%. Osteochondroma was the most prevalent benign tumor (32.3%), while osteosarcoma was the most prevalent malignant tumor (62%). The highest disease burden was noted in the 10–29-year age group, with malignant lesions primarily impacting the distal femur and proximal tibia.

In general, the results were in line with what is known about primary bone cancers around the world (12).

A retrospective descriptive study at the Department of Pathology, Faculty of Medicine, Addis Ababa University, from November 1967 to December 1996, analyzed 689 surgical biopsy specimens. Benign tumors represented 58% of cases, resulting in a benign-to-malignant ratio of 1.4:1. The most prevalent benign tumor was osteochondroma (36.5%), followed by chondroma (20.5%), giant cell tumor (13.8%), and osteoma (11.5%). Osteosarcoma was the most common type of malignant tumor (35.1%), followed by chondrosarcoma (27.1%) and Ewing's sarcoma (11.1%). It is important to note that whereas Western literature says that metastatic bone tumors are more common than initial malignant bone tumors, this Ethiopian study found 64 metastatic cases, which is only 79 cases of osteosarcoma. The majority of tumors were found in people between the ages of 10 and 29, with more men than women, and the tumors were located in the same places as they are around the world (11).

A descriptive study conducted in Port Harcourt, Nigeria, examining bone tumor presentations in teaching hospitals from 2010 to 2020, documented 143 admitted cases in West Africa. Osteosarcoma was the most prevalent type of tumor, making up 21.7% of all cases. Giant cell tumor and osteoma were next, each making up 17.5% of all cases. Bone cancers primarily impacted individuals aged 10 to 59 years, and in contrast to numerous studies, a female predominance was noted. The authors observed

that osteosarcoma predominated in surgical and inpatient cases, while osteochondroma was more commonly found in outpatient clinics (15).

A 40-year retrospective study (1977–2017) from Kinshasa, Democratic Republic of Congo, examined 104 cases of primary bone tumors, revealing that benign tumors were more prevalent (76%) than malignant tumors (24%). Osteochondroma was the most common non-cancerous tumor (24%), and osteosarcoma was the most common cancerous tumor (72%). The most affected group was children aged 1 to 17 years, and the femur was the bone that was most often injured (37.5%) (16).

A retrospective cross-sectional study in Western India (2023–2024) examined 63 histopathologically proven bone cancers outside of Africa. The average age of the patients was 25.8 years, and there were 1.17 men for every woman. Benign tumors made up 57.1% of the cases, and malignant tumors made up 42.9%.

The most prevalent benign tumors were giant cell tumors and osteochondromas. The most common malignant tumors were osteosarcomas and Ewing's sarcomas. The authors stressed that the age distribution and histopathological spectrum were quite similar to what is happening around the world (17).

Another Indian study conducted at a tertiary care institution in Srinagar (2006–2016) analyzed 123 primary bone tumor specimens, finding a prevalence of benign tumors (62.7%) compared to malignant tumors (38.2%), with a male predominance (60.9%). Osteochondroma was the most common benign tumor, and osteosarcoma was the most common malignant tumor, followed by Ewing's sarcoma and chondrosarcoma. The most prevalent places for tumors to grow were around the knee joint (18).

A cross-sectional study at Imam Khomeini Complex Hospital in Iran examined 617 primary bone tumor patients diagnosed from 2017 to 2022 in the Middle East.

There were more malignant tumors (384 instances) than benign lesions (233 cases), and most of them occurred in the second and third decades of life. In every benign and malignant category, men were more likely to be affected. Osteochondroma and enchondroma were the most common benign tumors, while osteosarcoma, chondrosarcoma, and Ewing's sarcoma were the most common malignant tumors. The study confirmed that osteosarcoma is the most common primary malignant bone neoplasm, and the demographic trends were in line with global statistics (6).
Choi and Ro's last point is that the WHO 2020 Classification of Tumors of Bone has changed a lot since molecular and genetic discoveries were combined. Reclassification is one of the most important changes.

aneurysmal bone cyst as a benign tumor and the addition of genetic markers like FOS/FOSB rearrangements in osteoid osteoma and osteoblastoma, as well as H3F3A mutations in giant cell tumor of bone. These improvements have made diagnosis, prognosis evaluation, and treatment categorization more accurate, which shows how important it is to use WHO-aligned standards in current institutional research (2).

# 3. Objective

## 3.1. General objective

❖ To discribe the histology of primary bone cancers found at Tikur Anbessa University Hospital in Addis Ababa, Ethiopia, between 2020 and 2024, following the WHO 2020 classification.

## 3.2 Specific objectives

❖ To discribe the histopathology spectrum (benign, intermediate, malignant) of primary bone tumors

❖ To analyze the age, sex, and anatomic site distributions of these tumors.

❖ To evaluate the diagnostic modalities employed, emphasizing clinico radiologic correlation and the application of available ancillary tests like immunohistochemistry.

# 4. Method and Materials

## 4.1. Study area and period

The study was conducted in Tikur Anbessa specialized hospital at the Department of Pathology from January 1, 2020, to December 31, 2024. Tikur Anbessa specialized hospital is the largest referral hospital in the country, and it was established in 1964 and with over 800 beds at different units. It was transferred to the school by the federal ministry of health, and it has since become a university teaching hospital. It offers diagnostic testing and treatment for approximately 370,000 to 400,000 patients per year. The various departments, facilities, and residents under specialty training in the school of medicine provide patient care in the hospital.

The Department of Pathology at Tikur Anbessa Specialized Hospital (TASH), is a premier diagnostic and academic hub in Ethiopia. Established in 1965 and housing the country's first residency program (1981), it provides comprehensive services, including surgical pathology, cytopathology, hematopathology, and neonatal autopsy. The department supports cancer diagnosis, research, and training, and features a newly renovated pathology museum for education.

## 4.2. Study design

- A 5-year hospital based retrospective cross-sectional study was carried out .

### 4.3. Population

#### 4.3.1. Source population

- All cases of primary bone tumors that receive a definitive histopathological diagnosis at the Department of Pathology, Tikur Anbasa Specialized Hospital.

### 4.3.2. Study population

- All cases of primary bone tumors that receive a definitive histopathological diagnosis at the Department of Pathology, Tikur Anbasa Specialized Hospital, January 1, 2020, to December 31, 2024.

## 4.4. Eligibility

### 4.4.1 Inclusion

- All cases with a histopathological diagnosis of a primary bone tumor, classified according to WHO criteria, documented in the pathology reports at TASH Specialized Hospital between January 1, 2020, and December 31, 2024.

- Cases with complete demographic information (age, sex) and sufficient pathological details (histological type, anatomic site).

### 4.4.2 Exclusion criteria

- Cases diagnosed as metastatic tumors to bone.

- Cases diagnosed as tumor-like lesions without true neoplastic characteristics

- Cases with incomplete or insufficient histopathological reports that preclude definitive classification, including suspicious for diagnosis and see descriptions.

- Cases with two or more critical missing variables for the objectives (e.g., age, sex, tumor type, site).

## 4.5. Sample size and sampling Technique

The medical record number (MRN) of all patients with a diagnosis of bone tumor was collected from the health management information system (HMIS) registration book of pathology department within the study period. HMIS record of the pathology was used as a sampling frame and then a census method was used that all individuals in the study population were included in the study

## 4.6 Data Collection Tool and Procedures

Data were collected retrospectively by the principal investigator using Structured Checklist and WHO classification criteria were used that encompasses Socio-demography, patological and radiologic features. Information was extracted from surgical pathology reports, biopsy requisition forms, and corresponding patient files (when available and linked through pathology numbers) obtained from registry books and the electronic database of the Pathology Department at Tikur Anbasa Specialized Hospital. Each identified case was reviewed according to the World Health Organization (WHO) classification criteria to ensure consistent diagnosis and categorization.

## 4.7 Data Quality control and management

To ensure the quality of data, Data collection was conducted by the principal investigator using a structured data collection protocol. the data principal investigator were trained for two days on basic data collection skills and data collection applications. The Structured checklists were tested on 5% of the sample. Problems highlighted during the pre-test were corrected before the start of the data collection. Regular consultations with the advisor were held to resolve any diagnostic or data interpretation challenges. The data collected were checked for completeness and consistency on each day of data collection.

## 4.8. Variables

### 4.8.1 Outcome variable

- Histopathological diagnosis of primary bone tumors (classified as benign, intermediate, or malignant according to WHO criteria and specific tumor types).

### 4.8.2 Explanatory variables

- Age (in years)
- Gender (male or female)
- The tumor's location in the body
- Diagnostic modalities employed (documented clinico-radiologic correlation, utilization of ancillary tests like immunohistochemistry).

## 4.9. Operational Definition

❖ **Primary Bone Tumor:** A neoplastic lesion originating from bone or cartilage tissue, confirmed by histopathological examination, excluding metastatic tumors.

❖ **WHO Criteria:** The diagnostic and classification guidelines for bone tumors outlined in the 5th edition of the World Health Organization Classification of Tumors of Bone.

❖ **Histopathological Spectrum:** The range and relative frequency of different types of primary bone tumors, which are classified as benign, intermediate, and malignant.

❖ **Anatomic Site:** The pathology report should say exactly which bone or part of a bone the tumor started in.

❖ **Clinico-radiologic correlation:** the documented process in the pathology report or clinical file that uses histological characteristics to help make a diagnosis by looking at clinical data and imaging results together.

## 4.10. Data processing and Analysis

After collecting the data, we checked to see if each study variable had a complete and correct response. If not, we cleaned the data and then imported the row data Excel sheet into SPSS version 27.

We looked at categorical variables, like our outcome variable histopathological diagnosis and explanatory variables, like tumor type, sex, anatomic site, and documented use of ancillary tests, by frequency and percentage. We used means with standard deviations and ranges to summarize continuous variables like age. Cross-tabulation was used to look at how primary bone tumor types were spread out by age group, sex, and anatomical site. Lastly, frequency tables, bar charts, and pie charts were used to show and visualize the data.

## 4.11. Ethical consideration

The Department of Pathology received the proposal, and the Research and Ethics Committee of the Department of Pathology of Addis Ababa University, College of Health Sciences, wrote a letter of approval. Then, the Head of the Pathology Department of Tikur Anbasa Specialized Hospital sent a letter of cooperation.

Because this was a retrospective study, all of the data came from existing logbooks and electronic databases. All information taken from patient records was kept private and not shared with anybody else. During data abstraction, patient identifiers were removed, and all electronic data was password-protected to keep it private.

## 4.12. Dissemination and utilization of results

The results of this research will be submitted to the Department of Pathology at Addis Ababa University Health Science and Medical College and will be presented during the final defense as part of the requirements for specialization. The study's findings will also be disseminated to relevant stakeholders. Next, we will try to show what we learned from several review meetings, seminars, and workshops. The manuscript will also be published in peer-reviewed journals.

# 5 Result

## 5.1 Sociodemographic characteristics of study population

A total of 258 patients with histologically confirmed primary bone tumors were included in this study. Of these, 144 (55.8%) were male and 114 (44.2%) were female, resulting in a male-to-female ratio of approximately 1.3:1.

The median age of the patients was 20 years with an interquartile range (IQR) of 15–30 years. Most cases occurred in young adults aged 18–35 years, who accounted for 116 patients (45.0%). Adolescents aged 13–17 years constituted 56 cases (21.7%), while children aged 1–12 years and adults aged 36–59 years each represented 41 cases (15.9%). Patients aged 60 years and above were least affected, comprising 4 cases (1.6%) of the study population (Table 1)

Table 1: Sociodemographic characteristics of study population at TASH pathology department 2020-2024

| | | Frequency | Percent |
|---|---|---|---|
| **Sex** | Female | 114 | 44.2 |
| | Male | 144 | 55.8 |
| | Total | 258 | 100.0 |
| **Age** | 1 - 12 Years | 41 | 15.9 |
| | 13-17 Years | 56 | 21.7 |
| | 18-35 Years | 116 | 45.0 |
| | 36-59 Year | 41 | 15.9 |

| | | | |
|---|---|---|---|
| | s | | |
| | ≥ 60 Years | 4 | 1.6 |
| | **Total** | **258** | **100.0** |

## 5.2 Histopathological Pattern of Primary Bone Tumors

Based on the WHO 2020 classification, benign tumors constituted the largest proportion of primary bone tumors, accounting for 129 cases (50.0%). Malignant tumors represented 93 cases (36.0%), while intermediate tumors—including locally aggressive and rarely metastasizing lesions comprised 36 cases (14.0%) of the total study population (Figure 1).

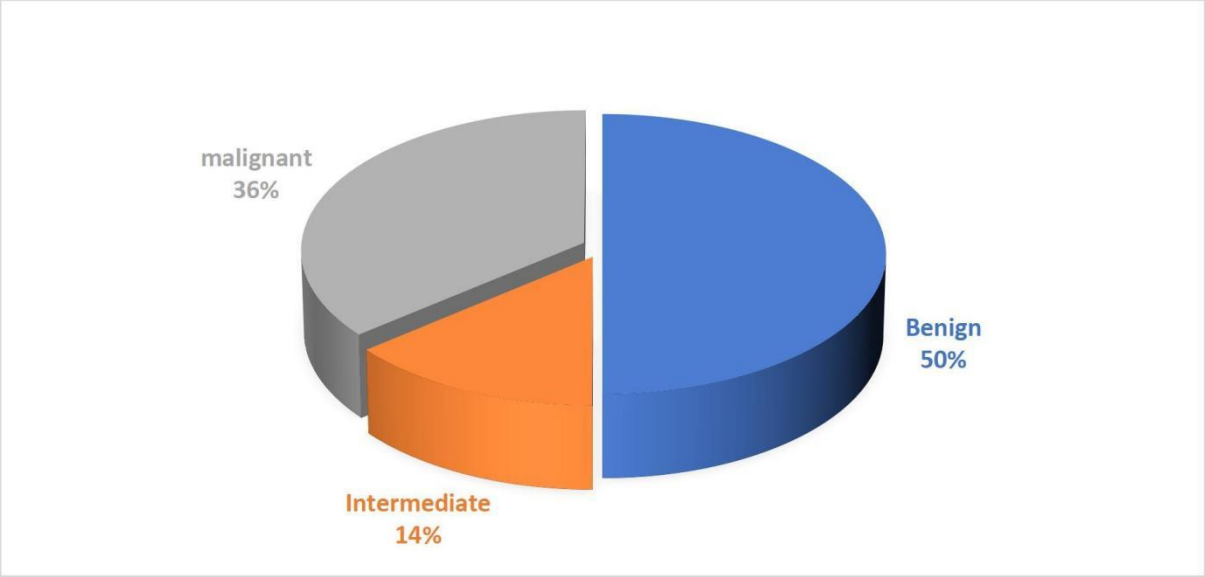



*Figure 1: Pattern of bone tumor at TASH pathology department from 2020 to2024*

Regarding the anatomic site of involvement, the most frequently affected location was the knee region including the distal femur, proximal tibia, and proximal fibula with 65 cases (24.9%). This was followed by tumors involving the jaw bones, accounting for 44 cases (16.9%).

Tumors of the lower leg long bones constituted 33 cases (12.6%), while lesions involving the trunk (vertebrae, ribs, and sternum) accounted for 28 cases (10.7%). Tumors of the pelvis and proximal femur comprised 25 cases (9.6%). The shoulder girdle, including the proximal humerus, clavicle, and scapula was involved in 18 cases (6.9%).

Tumors affecting the upper limb long bones and facial and skull bones each accounted for 13 cases (5.0%). Other less common sites, including the ankle joint and short tubular bones of the hands and feet, represented 19 cases (7.3%). The tumor site was unrecorded in 3 cases (1.1%) (Figure 2).

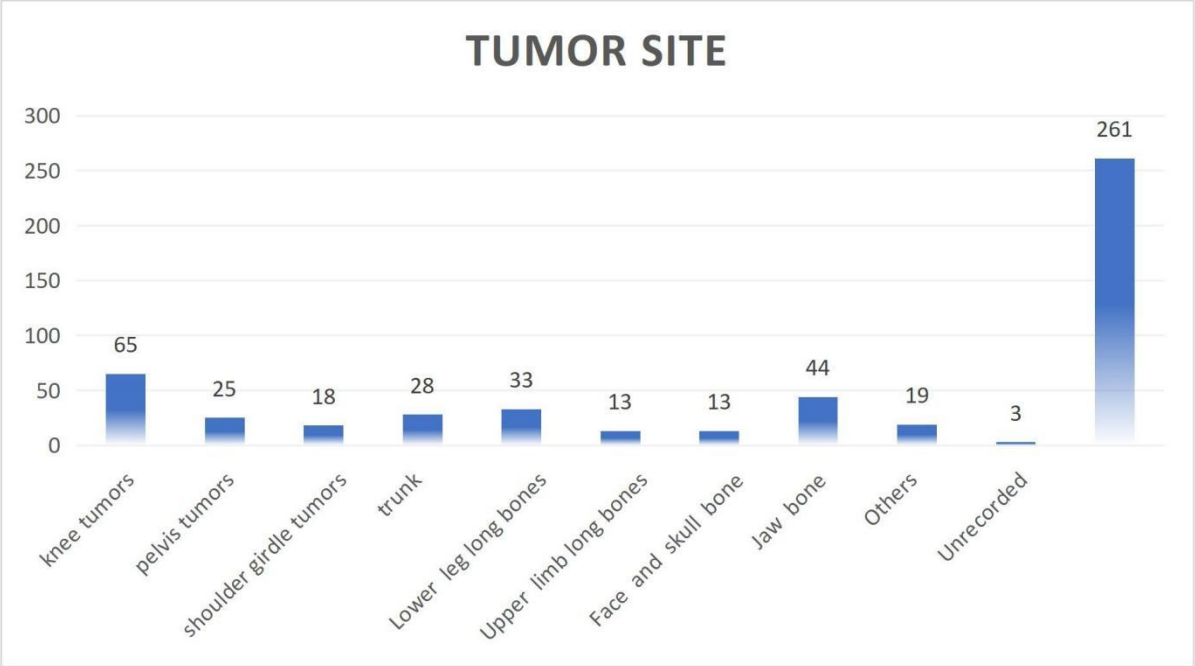



*Figure 2: Distribution of Tumors by Anatomic Site at TASH pathology department from2020 to 2024*

## 5.3. Spectrum of Specific Histopathological Diagnoses

Among the 258 bone tumor cases analyzed, Osteosarcoma was the most frequent, accounting for 67 cases (26.0%). This was followed by Osteochondroma with 42 cases (16.3%) and Ossifying fibroma with 22 cases (8.5%). Giant cell tumor of bone without ABC-like changes was observed in 20 cases (7.8%), while Giant cell tumor of bone with ABC-like changes was seen in 16 cases (6.2%).

Other tumors included Ewing sarcoma (15 cases, 5.8%), Fibrous dysplasia (14 cases, 5.4%), and Chondroblastoma (12 cases, 4.7%). Less common tumors were Chondrosarcoma (9 cases, 3.5%), Osteoma (8 cases, 3.1%), and Aneurismal bone cyst (8 cases, 3.1%).

Rare tumors with fewer than five cases each included Plasmacytoma (4 cases, 1.6%), Enchondroma (4 cases, 1.6%), Giant cell granuloma [central and peripheral] (4 cases, 1.6%), Chondroma (3 cases, 1.2%), Chondromyxoid fibroma (3 cases, 1.2%), Non-ossifying fibroma (2 cases, 0.8%), Atypical cartilaginous tumor (2 cases, 0.8%), Osteofibrous dysplasia (1 case, 0.4%), Osteoblastoma (1 case, 0.4%), and Cavernous hemangioma (1 case, 0.4%) (Table 2). Radiological findings were also reviewed across the study and 62% had attached reports.

Table 2: Histopathological Pattern of Primary Bone Tumors (N = 258) at TASH pathology department from 2020 to 2024

| Tumor | Number | Frequency (%) | Tumor classif |
|---|---|---|---|
| **Osteochondroma** | 42 | 16.3 | Benign |
| **Fibrous dysplasia** | 14 | 5.4 | Benign |
| **Osteofibrous dysplasia** | 1 | 0.4 | Benign |
| **Giant cell tumor of bone without ABC-like changes** | 20 | 7.8 | Intermediat |

| | | | |
|---|---|---|---|
| | | | e |
| **Giant cell tumor of bone with ABC-like changes** | 16 | 6.2 | Intermediate |
| **Aneurysmal bone cyst** | 8 | 3.1 | Benign |
| **Chondroblastoma** | 12 | 4.7 | Benign |
| **Osteoma** | 8 | 3.1 | Benign |
| **Enchondroma** | 4 | 1.6 | Benign |
| **Ewing sarcoma** | 15 | 5.8 | Malignant |
| **Osteosarcoma (all subtypes)** | 67 | 26.0 | Malignant |
| **Chondrosarcoma (all grades)** | 9 | 3.5 | Malignant |
| **Plasmacytoma** | 4 | 1.6 | Malignant |
| **Osteoblastoma** | 1 | 0.4 | Benign |

| | | | |
|---|---|---|---|
| **Chondroma** | 3 | 1.2 | Benign |
| **Non-ossifying fibroma** | 2 | 0.8 | Benign |
| **Ossifying fibroma** | 22 | 8.5 | Benign |
| **Giant cell granuloma [central & peripheral]** | 4 | 1.6 | Benign |
| **Chondromyxoid fibroma** | 3 | 1.2 | Benign |
| **Cavernous hemangioma** | 1 | 0.4 | Benign |
| **Atypical cartilaginous tumor** | 2 | 0.8 | Intermediate |
| **Total** | **258** | **100** | |

## 5.4 Association of Tumor Category with Demographic and Clinicopathologic Features

Malignant tumors showed a peak incidence in children and adolescents (1–17 years), while benign tumors were more frequent in young adults (18–35 years). This association between age group and tumor category was statistically significant ($\chi^2$ = 17.641, df = 8, p = 0.024).

The knee region was the most common site for both benign (n = 27) and malignant (n = 25) tumors. However, malignant tumors exhibited a wider anatomical distribution, with higher proportions in the pelvis (48%), shoulder girdle (50%), and trunk (57%) compared to benign tumors. The association between tumor site and tumor category was highly significant ($\chi^2 = 60.2$, df = 16, $p < 0.001$).

No significant association was found between sex and tumor category ($\chi^2 = 1.609$, df = 2, p = 0.447), with similar distributions of benign, intermediate, and malignant tumors in males and females. (See Table 3: Cross-tabulation of Tumor Category vs. Age Group, Sex, and Key Anatomic Sites with p-values (Table 3).

Table 3: Association of Tumor Category with Demographic and Clinicopathologic Features at TASH pathology department from 2020 to2024

| **Variable** | **Category** | **Benign (%)** | **Intermediate (%)** |
|---|---|---|---|
| **Sex** | Female | 62 (54.4) | 15 (13.2) |
| | Male | 67 (46.5 | 21 (14.6) |

| | | | |
|---|---|---|---|
| | | ) | |
| **Age (years)** | 12–12 | 18 (43.9) | 4 (9.8) |
| | 13–17 | 29 (51.8) | 1 (1.8) |
| | 18–35 | 61 (52.6) | 21 (18.1) |
| | 36–59 | 18 (43.9) | 10 (24.4) |
| | ≥60 | 3 (75.0) | 0 (0.0) |

| | | | |
|---|---|---|---|
| **Tumor Site** | Knee | 27 (41.5) | 13 (20.0) |
| | Pelvis | 9 (36.0) | 4 (16.0) |
| | Shoulder girdle | 8 (44.4) | 1 (5.6) |
| | Trunk | 11 (39.3) | 1 (3.6) |
| | Lower leg | 11 (33.3) | 7 (21.2) |
| | Upper limb | 4 (30.8) | 4 (30.8) |
| | Face/Skull | 11 (84.6) | 0 (0.0) |
| | Jaw | 36 (81.8) | 3 (6.8) |
| | Others | 14 (73.7) | 3 (15.8) |

## 6. Discussion

This retrospective study of 258 primary bone tumors at Tikur Anbessa Specialized Hospital (TASH) from 2020 to 2024 provides a substantial update to the histological classification of bone neoplasms in Ethiopia, employing the 5th Edition WHO classification [1].The findings indicate that benign lesions (50.0%) are more prevalent than malignant (36.0%) and intermediate (14.0%) cancers. Osteochondroma and osteosarcoma are the most prevalent benign and malignant tumors, respectively.The frequency of benign tumors identified in this study aligns with historical data from TASH (1967–1996), as reported by Gemechu [11], and with international studies from the Democratic Republic of Congo [16] and India [18], which consistently demonstrate a higher incidence of benign lesions.This data, however, contradicts the most recent institutional audit by Weyessa et al. (2015–2019), which showed that malignant tumors were slightly more common (53%) [12]. This change could be because the way patients were sent for surgery changed during the COVID-19 pandemic (2020–2022) or because the criteria used to exclude tumor-like lesions changed between the two research periods. Osteosarcoma constituted 26.0% of all cases and represented the majority of cancers in terms of specific histotypes.This is in line with global surveillance data [5] and regional studies from Nigeria [15], which show that osteosarcoma is always the most common primary bone cancer.The analysis corroborated the bimodal age distribution of bone cancers, exhibiting a significant bias towards the initial two decades.Malignant tumors exhibited a statistically significant correlation ($p=0.024$) with the pediatric and adolescent demographic (1–17 years), aligning with SEER database findings that categorize osteosarcoma as a disorder of skeletal development [7].In contrast to Western cohorts, which often report a secondary incidence peak among the elderly (associated with Paget's disease or radiation), this study found a minimal number of cases in individuals over 60, likely due to decreased life expectancy and under-diagnosis within the geriatric demographic in this context [7], [13]. The knee region (distal femur and proximal tibia) was the predominant site for both benign and malignant tumors (24.9%).This finding is consistent across all studies due to the high metabolic activity in

the metaphyses of long bones [6], [12]. This study notably recorded a substantial percentage of cancers in the jaw bones (16.9%). This is more than what is usually seen in general orthopedics oncology series.It shows how important TASH is as a place to send patients with maxillofacial pathology, which means that odontogenic and non-odontogenic jaw neoplasms need to be treated in different ways.A major part of this work is finding important diagnostic gaps.The histopathological spectrum generally aligns with WHO 2020 standards; however, the study solely employed Hematoxylin and Eosin (H&E) staining, with no documented use of Immunohistochemistry (IHC).Also, radiologic data was available in about 62% of the cases. In the era of molecularly characterized soft tissue and bone tumors [2], the absence of immunohistochemistry (IHC) poses a significant risk of misdiagnosis, particularly for "small round blue cell tumors" like Ewing sarcoma (5.8% in this study), which require molecular or immunohistochemical differentiation from lymphomas or rhabdomyosarcomas [3]. The elevated prevalence of osteosarcoma in Ethiopian children and adolescents necessitates prioritized early detection strategies to facilitate limb-salvage surgery and improve survival rates.The total absence of supplementary testing (IHC/molecular) at a tertiary referral level underscores a substantial infrastructural shortcoming. To correctly stage cancer and use precision medicine in places with few resources, it is important to improve pathology capacity.

## 7. Limitations of the study

- **Retrospective design:** This study used existing pathology records, which may not have all the information needed, such as radiological reports
- **Lack of immunohistochemistry (IHC):** All diagnoses were based only on standard histopathology, which may have made it harder to tell the difference between complex or small round cell tumors.
- This is a single-center study, so the results only apply to patients who were treated at Tikur Anbessa Specialized Hospital. They may not fully reflect bone tumor patterns in the rest of the Ethiopian population.

## 8. Conclusion

Primary bone tumors at TASH from 2020 to 2024 exhibit a shift back to a benign-predominant pattern compared to the 2015–2019 period. In children and adolescents Osteosarcoma was the most prevalent malignancy. The knee region and jaw bones were the most common anatomic sites

## 9. Recommendations

To make sure that local diagnostic practices follow the WHO 5th Edition classification standards, it is important to use extra diagnostic tools, especially immunohistochemistry (IHC), as part of the normal workflow.Morphology alone isn't enough to tell apart complicated things like small round cell tumors. To address the significant clinicopathologic gap identified in this study [1], [3], it is essential to establish a fundamental antibody panel and mandate the inclusion of radiological imaging with pathology requisitions.Using standardized synoptic reporting templates instead of narrative descriptions will also make sure that all of the important prognostic factors, like tumor size and margins, are fully reported. This will help teams from different fields make better choices and make the cancer registry stronger for future audits [5].

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## Annex I: Checklists

| Variable | Categories / Units |
|---|---|
| **Specimen Type** | MRM / Biopsy |
| **Sex** | Male / Female |
| **Age (years)** | 0–9 / 10–19 / 20–29 / 30–39 / 40–49 / 50–59 / 60–69 / ≥70 |
| **Tumor Site** | Knee (distal femur, proximal tibia, proximal fibula) Pelvis (pelvis, proximal femur) Shoulder girdle (proximal humerus, clavicle, scapula) Trunk (vertebrae, ribs, sternum) Lower leg long bones Upper limb long bones Face and skull bones Jaw bones Others (ankle, short tubular bones of hands/feet) |
| **Histopathological Diagnosis** | Specific tumor type (WHO classification) |
| **Tumor Category** | Benign / Intermediate / Malignant |
| **Radiological Diagnosis** | Yes / No |
| **Immunohistochemistry (IHC) Confirmation** | Yes / No |

## Annex II: Declaration form

I, the undersigned, declare that this thesis is my original work, has not been presented for a degree in this or any other university and that all sources of materials used for the thesis have been fully acknowledged.

Name: _____

Signature: _____

Name of the institution: _____

Date of submission: _____

This thesis has been submitted for examination with my approval as university advisors.

Name and Signature of the first advisor

_____

Name and Signature of the second advisor

_____

Name and Signature of the internalexaminer

_____