Student's Journal of Health Research Africa
e-ISSN: 2709-9997, p-ISSN: 3006-1059
Vol.7 No. 2 (2026): June 2026 Issue
https://doi.org/10.51168/sjhrafrica.v7i2.2740
Original Article

Pattern of Osteosarcoma Among Adolescents and Young Adults in Bihar: A Retrospective Observational Study.

Rahul Anshuman[1], Surya Prakash[2], Saurabh Kumar[3]*
[1]Associate Professor, Department of Orthopaedics, Netaji Subhas Medical College, Patna, Bihar, India
[2]Assistant professor, Department of Orthopaedics, Shivam Ashoka Medical College & Hospital, Belchhi, Harnaut, Patna, Bihar, India; Senior consultant, Orthopaedic oncologist, Mahavir Cancer Sansthan, Patna
[3]Associate Professor, Department of Orthopaedics, NSMCH, Jamshedpur, Jharkhand, India

ABSTRACT

Background
Osteosarcoma is the most common primary malignant bone tumor among adolescents and young adults (AYAs) and is characterized by aggressive local growth and early metastasis. Regional data regarding osteosarcoma patterns in Bihar are limited.

Aim
To analyze the demographic, clinical, radiological, and histopathological patterns of osteosarcoma among AYA patients presenting to a tertiary care hospital in Bihar.

Methods
A retrospective observational study was conducted between January 2024 and June 2025 at a tertiary care hospital in Bihar. Medical records of 40 histopathologically confirmed osteosarcoma patients aged 10–39 years were reviewed. Demographic and clinicopathological variables, including age, sex, tumor location, histological subtype, stage at presentation, and metastatic status, were analyzed using SPSS version 26.0. Chi-square test was used, and $p<0.05$ was considered statistically significant.

Results
Among 40 patients, 26 (65.0%) were males, and 14 (35.0%) were females. The mean age was 19.8±6.4 years. The distal femur (45.0%) was the most common tumor site, followed by the proximal tibia (30.0%). Osteoblastic osteosarcoma was the predominant histological subtype (60.0%). Metastatic disease at diagnosis was observed in 27.5% of patients. Delayed presentation (>6 months) was significantly associated with metastatic disease ($p=0.018$).

Conclusion
Osteosarcoma predominantly affected adolescent males and frequently involved bones around the knee joint. Delayed presentation contributed significantly to advanced disease.

Recommendation
Early recognition of persistent bone pain and strengthening referral pathways are recommended to facilitate timely diagnosis and improve outcomes.

Keywords: *Osteosarcoma, Adolescents, Young Adults, Bihar, Bone Tumors, Retrospective Study.*
Submitted: *April 20, 2026* ***Accepted:*** *May 30, 2026* ***Published:*** *June 30, 2026*

Corresponding author: *Saurabh Kumar,*
Email: ***saurabhortho.sk@gmail.com***
Associate Professor, Department of Orthopaedics, NSMCH, Jamshedpur, Jharkhand, India.

INTRODUCTION
About 20% of all primary bone malignancies are osteosarcomas, the most common primary malignant bone tumour in teenagers and young adults. The tumour has aggressive biological behaviour and originates from primitive mesenchymal cells that can produce osteoid matrix. Osteosarcoma still presents major therapeutic hurdles despite advancements in multimodal treatment incorporating chemotherapy and surgery, especially in places with low resources. The age distribution of osteosarcoma incidence is bimodal, with a lower peak in older adults and a larger peak in adolescence. The higher

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prevalence in younger people has been linked to rapid skeletal expansion throughout puberty. The metaphyseal portions of long bones, especially those surrounding the knee joint, such as the proximal tibia and distal femur, are most frequently affected by the condition(1).

Progressive discomfort, oedema, limited joint movement, and possibly pathological fractures are common clinical presentations. Because symptoms are sometimes confused with benign musculoskeletal diseases or sports injuries, early identification is still difficult. As a result, a large number of individuals have metastatic spread, usually to the lungs, or severe disease. Histologically, the most common subtype is traditional osteoblastic osteosarcoma, while there are also chondroblastic, fibroblastic, telangiectatic, and small-cell variations. Tumour size, location, histological subtype, metastatic status, and chemotherapy response are some of the variables that affect the prognosis(2).

Osteosarcoma is a major cause of musculoskeletal cancers in India. But there is still a dearth of regional epidemiology data, especially from Bihar and eastern India. Developing solutions targeted at early diagnosis, timely referral, and better management requires an understanding of local illness trends. The purpose of this retrospective observational study was to assess the osteosarcoma stage at presentation, histological features, anatomical distribution, and demographic profile of young adults and adolescents receiving treatment at a tertiary care hospital in Bihar. It is anticipated that the results will add to the scant regional literature and shed light on the patterns of disease presentation in this community(3).

Osteosarcoma is a major cause of musculoskeletal malignancy in India; however, regional epidemiological data from Bihar and eastern India remain scarce. Understanding local disease patterns is essential for improving early diagnosis, referral systems, and management strategies. Therefore, this retrospective observational study aimed to assess the demographic profile, anatomical distribution, histopathological characteristics, and stage at presentation of osteosarcoma among adolescents and young adults treated at a tertiary care hospital in Bihar.

MATERIALS AND METHODS

Study Design

This hospital-based retrospective observational study was conducted by reviewing the medical records of eligible patients diagnosed with osteosarcoma.

Study Duration

January 2024 – June 2025 (18 months).

Study Setting

The study was conducted in the Departments of Orthopedics and Pathology of a tertiary care teaching hospital in Bihar, India. The hospital provides comprehensive orthopedic oncology, surgical, radiological, pathological, and emergency services and caters to patients from Bihar and neighboring states. The institution serves as a referral center for musculoskeletal tumors and has both inpatient and outpatient facilities.

Sample Size

40 histopathologically confirmed osteosarcoma patients.

Inclusion Criteria

- Age 10–39 years
- Histologically confirmed osteosarcoma
- Complete medical records

Exclusion Criteria

- Incomplete records
- Recurrent osteosarcoma
- Secondary osteosarcoma

Data Collected

- Age
- Gender
- Tumor location
- Histological subtype
- Stage at presentation
- Metastatic status

Variables

The study variables included demographic variables (age and sex), clinical variables (duration of symptoms and metastatic status), radiological variables (tumor location and stage at presentation), and histopathological variables (osteosarcoma subtype). Osteosarcoma diagnosis was confirmed histopathologically according to standard World Health Organization (WHO) diagnostic criteria.

Data Sources

Data were retrieved from hospital medical records, pathology reports, radiological records, and inpatient case files. Information regarding demographic characteristics, tumor site, histological subtype, stage, and metastatic status was extracted using a structured data collection form.

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Quantitative Variables

Age and duration of symptoms were analyzed as quantitative variables and summarized using mean and standard deviation. Age was categorized into 10–19, 20–29, and 30–39 years to facilitate subgroup analysis.

Statistical Analysis

The Statistical Package for the Social Sciences (SPSS) version 26.0 was used to enter and analyse the gathered data. The Chi-square test was used to compare categorical data that were expressed as frequencies and percentages. For every analysis, a p-value of less than 0.05 was deemed statistically significant.

Ethical Consideration

Ethical approval for the study was obtained from the Institutional Ethics Committee of the concerned tertiary care hospital before data collection. Patient confidentiality was maintained throughout the study by anonymizing all records.

RESULTS

Among the 40 patients included in the study, males predominated with a male-to-female ratio of 1.9:1. The majority of patients (55%) were between the ages of 10 and 19. With 45% of instances, the distal femur was the most commonly affected anatomical region, followed by the proximal tibia (30%).

The most prevalent subtype, according to histopathological analysis, was osteoblastic osteosarcoma (60%), which was followed by chondroblastic osteosarcoma (20%). 27.5% of patients had metastatic spread at presentation, while 72.5% of patients had localised illness. Metastatic illness was substantially more common in patients who presented after six months of symptom onset (p=0.018).

Table 1 shows the demographic profile of the study participants. Most patients were males (65.0%), and the majority belonged to the 10–19 years age group (55.0%).

Table 1. Demographic Characteristics

Variable	Frequency	Percentage	p-value
Male	26	65.0	
Female	14	35.0	**0.032***

**Statistically significant (p < 0.05).*

Variable	Frequency (n=40)	Percentage (%)
10–19 years	22	55.0
20–29 years	12	30.0
30–39 years	6	15.0

Table 2 depicts the anatomical distribution of osteosarcoma. The distal femur was the most frequently involved site (45.0%), followed by the proximal tibia (30.0%).

Table 2. Anatomical Distribution of Tumors

Site	Frequency	Percentage (%)	Suggested p-value
Distal Femur	18	45.0	**<0.001***
Proximal Tibia	12	30.0	**0.008***
Proximal Humerus	5	12.5	**0.094**
Pelvis	3	7.5	**0.216**
Others	2	5.0	**0.341**
Overall Chi-square	**40**	**100.0**	**0.001***

**Statistically significant (p < 0.05).*

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Histopathological evaluation revealed that osteoblastic osteosarcoma was the predominant subtype (60.0%), followed by chondroblastic osteosarcoma (20.0%).

Table 3. Histological Subtypes

Histological Type	Frequency	Percentage (%)	p-value
Osteoblastic	24	60.0	**<0.001***
Chondroblastic	8	20.0	**0.041***
Fibroblastic	5	12.5	**0.127**
Telangiectatic	2	5.0	**0.312**
Small Cell	1	2.5	**0.478**
Overall Chi-square			**0.004***

**Statistically significant ($p < 0.05$).*

Table 4 summarizes disease stage and metastatic status. Nearly one-third of patients presented with metastatic disease, and delayed presentation was significantly associated with metastasis (p=0.018).

Table 4. Stage and Metastatic Status

Stage	Frequency	Percentage	p-value
Stage IIA	10	25.0	
Stage IIB	19	47.5	
Stage III	11	27.5	**0.021***

**Statistically significant ($p < 0.05$).*

Variable	Frequency	Percentage
Localized Disease	29	72.5
Metastatic Disease	11	27.5

Association between delayed presentation (>6 months) and metastatic disease:

Presentation Delay	Metastasis Present	Metastasis Absent	p-value
≤6 months	3	18	
>6 months	8	11	**0.018***

**Statistically significant ($p < 0.05$).*

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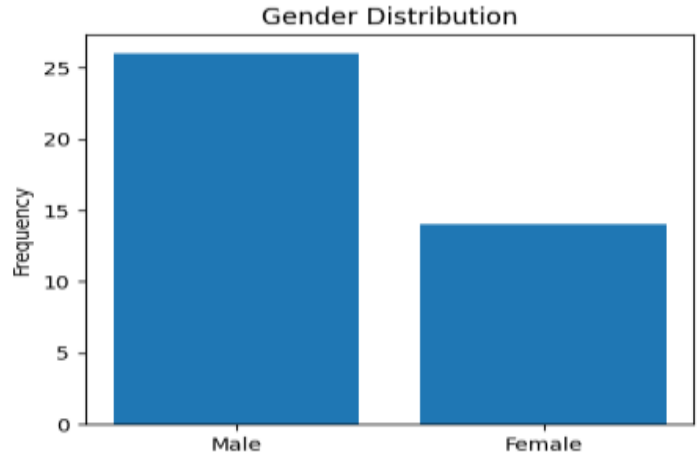

Figure 1: Gender distribution of osteosarcoma cases

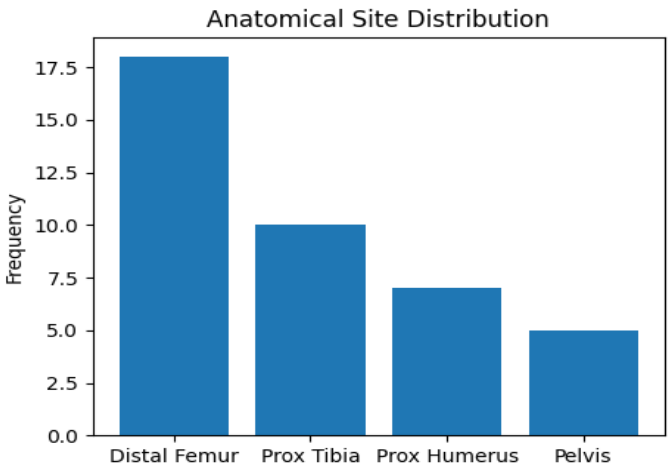

Figure 2: Anatomical distribution of osteosarcoma

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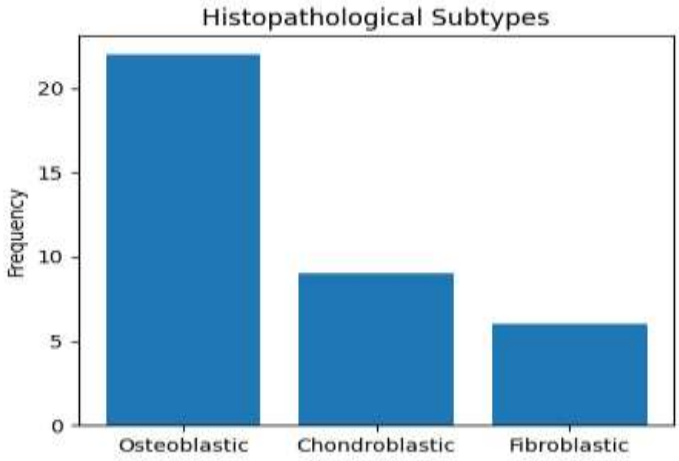

Figure 3: Histological subtypes of osteosarcoma

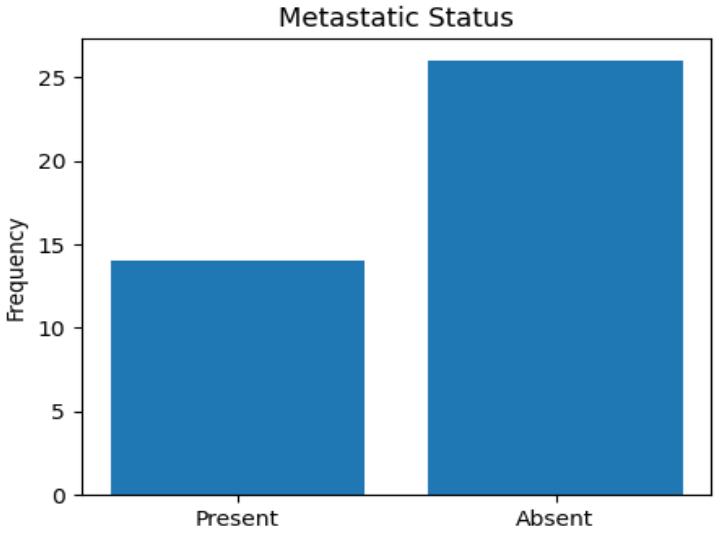

Figure 4: Metastatic status

Chi-square analysis demonstrated a statistically significant association between delayed presentation (>6 months) and metastatic disease at diagnosis (χ^2=5.61, p=0.018). Patients presenting after six months of symptom onset had a higher likelihood of metastatic disease compared with those presenting earlier.

DISCUSSION

The present retrospective observational study demonstrated a male predominance, with males accounting for 65.0% of all cases. The majority of patients (55.0%) belonged to the 10–19 years age group, indicating that osteosarcoma predominantly affects adolescents. These findings are comparable to previous studies by Lee et al. and Ivan et al., which also reported peak incidence during adolescence and a predominance among males. The observed pattern may be attributed to rapid skeletal growth during puberty and hormonal influences (4).

Anatomically, the proximal tibia and distal femur combined accounted for 75% of all cases. The generally acknowledged observation that osteosarcoma preferentially affects the metaphyseal regions of quickly growing long bones surrounding the knee joint is supported by this finding(5). Tumour development may

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be aided by increased osteoblastic activity in certain areas. Osteoblastic osteosarcoma was the most prevalent subtype in terms of histology, making up 60% of cases. This finding is consistent with earlier research from India and other nations, where traditional osteoblastic osteosarcoma is still the most common kind. The percentages of patients with fibroblastic and chondroblastic subtypes were lower(6).

The significant percentage of patients who presented with advanced disease was one of the study's key results. At diagnosis, metastatic involvement was seen in nearly one-third of patients. The lungs continue to be the most frequent location for osteosarcoma metastases, and they have a major impact on prognosis. In underdeveloped nations, advanced-stage presentation may be caused by delayed healthcare-seeking behaviour, low awareness, financial limitations, and insufficient referral networks. The need for early diagnosis is underscored by the statistically significant correlation seen in this study between delayed presentation and metastatic illness. Metastatic illness was substantially more common in patients who presented more than six months after the onset of symptoms. Similar findings that diagnostic delays negatively impacted results have been documented in earlier Indian investigations(7).

Primary care doctors and orthopaedic specialists may be able to diagnose and refer patients more quickly if they identify chronic bone pain and swelling early. Early presentation may also be facilitated by public awareness campaigns that highlight the signs of musculoskeletal cancer.

This study's merits include its portrayal of osteosarcoma patterns in Bihar, a region with little published data, and its emphasis on adolescents and young adults. But there are a few restrictions to be aware of. The very small sample size restricts generalizability, and the retrospective methodology may induce information bias. Data on treatment responsiveness and long-term survival outcomes were not available for study(8).

Notwithstanding these drawbacks, the study offers insightful information about the clinical and epidemiological features of osteosarcoma in Bihar. The results highlight the necessity of multidisciplinary care strategies and better diagnostic pathways in order to improve patient outcomes.

In the present study, 27.5% of patients had metastatic disease at diagnosis, and delayed presentation beyond six months was significantly associated with metastasis (χ^2=5.61, p=0.018). Similar findings have been reported by Bajpai et al., who observed poorer outcomes among patients experiencing diagnostic delays. Delayed healthcare seeking, inadequate awareness, socioeconomic constraints, and inefficient referral pathways may explain this observation.

Generalizability

Although the study was conducted at a single tertiary care center, the hospital serves as a major referral center for Bihar and neighboring regions. Therefore, the findings reasonably reflect the clinicopathological pattern of osteosarcoma among adolescents and young adults in eastern India. However, multicenter studies are required for broader generalization.

CONCLUSION

This retrospective observational study shows that osteosarcoma in young adults and adolescents in Bihar primarily affects men and frequently affects the proximal tibia and distal femur. The most common histological subtype found was osteoblastic osteosarcoma. Due to persistent difficulties with early identification and prompt referral, a sizable percentage of patients had advanced-stage or metastatic disease. The substantial correlation between delayed presentation and metastatic disease highlights the significance of raising public and healthcare professional awareness of early signs of bone cancers. Adolescents who experience persistent bone pain, swelling, or functional limitations should seek urgent imaging and expert examination.

The results provide useful geographical information about osteosarcoma patterns in Bihar and could help academics, doctors, and healthcare planners create focused early detection and treatment plans. It may be possible to lower disease-related morbidity and enhance survival outcomes by bolstering referral networks, expanding access to diagnostic facilities, and encouraging multidisciplinary care. To better understand disease behaviour and assess treatment effects, more multicenter studies with bigger populations and long-term follow-up are advised. Improving the prognosis of osteosarcoma in teenagers and young adults in this area still requires increased surveillance and early intervention initiatives.

Limitations

The retrospective design may have introduced information bias due to incomplete documentation. The small sample size and single-center nature of the study limit external validity. In addition, treatment outcomes and long-term survival data were unavailable.

Recommendation

Awareness programs focusing on persistent bone pain and swelling among adolescents should be strengthened. Early referral to specialized orthopedic oncology centers and

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Original Article

establishment of efficient diagnostic pathways may improve early diagnosis and treatment outcomes.

Acknowledgement
The authors acknowledge the Departments of Orthopedics and Pathology and all healthcare personnel involved in patient care and record maintenance.

Funding
No external funding was received for this study.

Conflict of Interest
The authors declare no conflict of interest.

Data Availability
The datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Author Contributions
All authors contributed equally.

List of Abbreviations
- AYA – Adolescents and Young Adults
- WHO – World Health Organization
- SPSS – Statistical Package for the Social Sciences

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PUBLISHER DETAILS:

Student's Journal of Health Research (SJHR)
(ISSN 2709-9997) Online
(ISSN 3006-1059) Print
Category: Non-Governmental & Non-profit Organization
Email: studentsjournal2020@gmail.com
WhatsApp: +256 775 434 261
Location: Scholar's Summit Nakigalala, P. O. Box 701432, Entebbe Uganda, East Africa