



**Radiographic Patterns of Hip Osteoarthritis and associated factors in SPHMMC,
ST. PAUL'S HOSPITAL MILLENNIUM MEDICAL COLLEGE DEPARTMENT OF
RADIOLOGY**

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- **Addis Ababa, Ethiopia**
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1 Acronyms/abbreviations

ACR: American College of Rheumatology

AP: Anteroposterior

BMI: Body Mass Index

JSN: Joint Space Narrowing

OA: Osteoarthritis

PI: Principal Investigator

SPHMMC: ST. PAUL'S HOSPITAL MILLENNIUM MEDICAL COLLEGE

WHO: World Health Organization

2 ABSTRACT

2.1 Background

Osteoarthritis (OA) is the most common chronic rheumatic disorder in the world. It results in joint pain, tenderness and significant disability. OA of hip is very important in terms of its public health significance. Significant morbidity and disability usually results from OA of these sites common indication of hip replacement surgery. Although OA is common, the radiologic and socio demographic patterns vary among different studies. Information obtained from studies of the radiologic and socio demographic pattern of the disease in different regions can help in interventional programs aimed at prevention and control. It will also help as source of reference for radiologists, orthopedists, rheumatologists, resident and medical students.

2.2 OBJECTIVE:

The objective of this study is to determine the radiographic pattern of hip OA among patients being with hip OA who are visiting SPHMMC.

2.3 Materials and Methods:

Hospital based descriptive cross sectional study was conducted on 132 pelvic and hip x-ray of patients with HIP Osteoarthritis in SPHMMC were reviewed to determine the pattern of hip and knee OA. Kobo collect toolbox software was used in data collection. Data was cleaned for completeness and then transferred into SPSS version 25 and analyzed with it.

2.4 Results:

A total of 132 pelvic and hip AP x-ray of patients with radiographic osteoarthritis reviewed. 62.2% of the participants were female and 38.8 were male. Out Of 132, 35 cases had bilateral disease while the rest had unilateral hip OA. The mean age was 59.27years. 37(28%) were overweight, 22(16.7) were obese.

2.5

2.6 Conclusion:

The study showed that hip OA is more common in Females, middle aged and elderly population. Superolateral and the superomedial compartments are the

most commonly affected by OA. And significant number of these patients are either overweight or obese.

3 INTRODUCTION

3.1 BACKGROUDN

- Osteoarthritis (OA) is most prevalent type of arthritis which increased by 113.25% from 247.51 million in 1990 to 527.81 million in 2019 globally and major cause functional impairment in older adults, the joints most frequently affected are the knees, hands and the hips accounting for ~60.6%, 23.7%, and 5.5%, respectively⁽¹⁾. Pathology affecting the entire joint, such as cartilage degeneration, bone remodeling, osteophyte production, and synovial inflammation, are characteristics of OA and cause pain, stiffness, edema, and a loss of normal joint function ⁽²⁾.
- Hip osteoarthritis (OA), which affects 8.55%^(3, 4) of the global population overall and is a leading cause of hip pain, functional impairment, and poor quality of life, was once thought to be idiopathic in origin but Growing data, however, suggests that mechanical causes are nearly always at play in the development of hip OA over the past 20 years⁽⁵⁾. Particularly, higher intra-articular stresses pushing across the joint appear to cause hip OA, either as a result of aberrant hip morphology, excessive joint loading, or a combination of these factors, Hip dysplasia, which is an under coverage of the acetabulum in relation to the femoral head, and hip morphology linked with femoroacetabular impingement syndrome (FAIS), or cam and pincer morphology, have both been identified as possible risk factors for hip OA.

3.2 Statement of the problem

- Despite the fact that OA is a global problem, different communities have different disease prevalence and patterns due mainly socio-demographic differences. There aren't many studies that discuss the clinical course of OA in individuals from Ethiopia. Contrary to industrialized nations, Ethiopia is a developing nation where agriculture and physically demanding works provides the majority of the population's means of subsistence which is significant factor for OA development mainly in the lower limbs.⁽⁶⁾ Urban and rural areas of the country, however, have different occupations, Compared to rural regions where most people do agriculture, there are more sales and service-oriented persons in urban areas. Another issue in our culture is that individuals often put off decisions about seeking treatment until their ailment's symptoms get worse. Most of the time, people do not pay attention to minor issues till they become incapacitating, which might make their medical condition worse. These considerations make it likely that the severity and pattern of OA will differ from that of the Western world⁽⁷⁾.
- Due to the underdeveloped rheumatology service in the nation, this field is not thoroughly investigated. There is currently little information on the kind and prevalence of osteoarthritis in Ethiopia. When creating healthcare strategies, data examining the prevalence and risk factors of OA are crucial.

3.3 Significance of the study

- SPMMH is a tertiary hospital where patients come from all across the nation, allowing us to see the differences in OA patterns between patients from urban and rural areas.

Planning for management and prevention and deepening our understanding of the illness's pathophysiology may benefit from knowledge gained from studies of the pattern of the disease across other continents.

For the Minister of Health and other governmental and non-governmental organizations, this study may mark a turning point in their efforts to develop osteoarthritis intervention programs that specifically **target the key risk categories**.

For the education purposes, this research will also be useful as source of reference for residents and students.

Therefore in order to evaluate the pattern of osteoarthritis based on the hip joint and related risk factors, this study will be carried out.

4 Literature Review

- **Osteoarthritis** affected 595 million individuals worldwide in 2020, accounting for 7.6% of the world's population and representing a 132.2% rise in incidence since 1990. By 2050, it is anticipated that there would be a rise in osteoarthritis cases of 74.9% for knee, 48.6% for hand, **78.6% for hip**, and 95.1% for other kinds.⁽⁸⁾ Similarly the studies made in MENA countries (middle east and north Africa) show results comparable to global prevalence and risk factors for OA.⁽⁹⁾ Ethiopia Some of the studies show that OA as the second most common MSK problem in northwest Ethiopia accounting 10% preceded by lower back pain and while other

Radiographic patterns of Hip OA Superior pole migration (superolateral, intermediate, supero-medial) which is the most common, medial/axial migration and indeterminate, The most common is the supero-lateral joint pattern which is

relatively more common in black accounting (Kellgren grade). Superior pole migration occurred in 82% (46% superolateral, 25% intermediate, 11% superomedial), medial/axial migration occurred in only 8%, and in 10% the pattern was indeterminate. ⁽¹¹⁾

The radiographic pattern by race, a study in the USA shows that The hips of African American men and women demonstrated an increased frequency and severity of superior JSN, less mild axial JSN and overall more severe disease defined by the severe axial JSN than white men and women, despite the comparable frequency of radiographic hip OA among African Americans and whites (African American woman had 40% increased odds for more frequent and severe medial osteophytes compared with white on average of sex). ⁽¹²⁾

The **main associated factors** for the developments and the prediction of the progression of hip OA are **age, female sex, obesity**, prior joint trauma, and variables related to occupational strain on the joint and Cam⁽¹²⁾ or pincer type shape abnormalities. ^{(13, 14) (15, 16,17)}

Some studies suggest that Hip OA more prevalent in female population after the 50 years while it's slightly higher in male under the age of 50 years by Dagenais, S. ET al(22).

The radiographic hip OA pattern is influenced by developmental hip morphology mainly 1) cam impingement caused by non-spherical head and 2) pincer impingement caused by excessive acetabular cover, in which cases there is antero-posterior joint damages in cam impingement and circumferential joint damage in pincer impingement(18).

Study done in Douala general hospital (Cameroon, Africa) shown that the most frequent radiological grade was K-L4(39.3%), The condition was unilateral in 73.1% of cases; it was unipolar in 65.4% (superior pole most affected); bicompartamental in 14.1%, tricompartamental in 20.5% of cases and female sex increased BMI age over 50yrs most important associated factors(19).

OBSEITY is chronic metabolic diseased which is risk factor for the development of many systemic illness and the association arthritis is known and increasing as the obese or over weight proportion of the populations is increasing and tends to cause more bilateral disease as suggested by many studies including this Kenyan which concluded Bilateral disease was more prevalent in obese (52.4%) and overweight (44.6%) participants than participants with normal weight (26.5%) $P=0.007(20)$.

Ethiopian hospital based study done in Tikuranbessa specialized hospital shown that hip OA occurred more in Female population (68%) and in the middle age and elderly population and supero0lateral JSN while 19 of them that is 44% had either Supero-medial (Axial) or medial JSN by Bemnet (21).

5 OBJECTIVES

5.1 GENERAL OBJECTIVE

- To describe the pattern of OA of Hip in SPHMMC

5.2 Specific Objectives

- To determine the pattern of Hip OA based on site and compartment involvement
- To determine the radiographic pattern of hip OA based associated clinical presentations
- To determine radiographic pattern of hip OA based on age and sex
- To determine radiographic pattern of hip OA based on BMI

6 STUDT AREA, POPULATION AND METHOD OF STUDY

6.1 STUDY AREA

- The study will be conducted at Radiology Department, SPHMMC, Addis Ababa, Ethiopia. SPHMMC is a large referral teaching hospital, under the FMOH OF ETHIOPIA, located in Addis Ababa. It has departments such as internal medicine, surgery, gynecology and obstetrics, pediatrics, radiotherapy, adult oncology, pediatric oncology /hematology, nuclear medicine, psychiatry, laboratory, orthopedics, rheumatology, pharmacy etc. The hospital has multi-specialty wards and give diagnostic and treatment service for about tens of thousands patients per year. The Radiology department is one of the many departments in the institution which gives radiologic medical service, therapeutic and academic activities.

6.2 STUDY DESIGN AND DURATION OF STUDY.

- Hospital based descriptive cross sectional prospective study using a questionnaire.

6.3 POPULATION

6.3.1 SOURCE POPULATION

- All patients who undergo pelvic or hip x-ray examination for hip OA at SPHMMC.

6.3.2 STUDY POPULATION

- The study populations will be all patients who have follow up or come for new diagnosis of hip OA in and have pelvic or hip x-ray examinations at St. Paul's Millennium Medical College between June and November 2023

7 Inclusion and exclusion Criteria

7.1 Inclusion criteria

- All patients who have follow up at orthopedics or rheumatologic clinics with diagnosis of Hip radiographic Osteoarthritis of Hip and who have appropriate radiographs done at department of radiology.

7.2 Exclusion Criteria

Any erosions or peri-articular osteoporosis suggestive of other type of arthritis

8 SAMPLE SIZE DETERMINATION AND SAMPLING TECHNIQUE

8.1 Sample Size and Sampling Procedure

- The sample size is estimated using sample size determination formula for single population proportion of 8.55%(from global prevalence of x-ray based hip OA diagnosis including similar low income both African and Asian and also from western countries) ^(3, 4) worldwide with 95 % certainty, 0.05 type I error and a maximum discrepancy of 5% between the sample and the underlying population and adding 10 % to the sample size for a possible non response a total sample size of 132 is calculated using the formula indicated below:

$$\text{Cochran formula } n = (Z_{\alpha/2})^2 \frac{P(1-P)}{d^2} + 10\% \text{ of nonresponse rate}$$

Where

n = the desired sample size

P = Proportion of patients with hipOA

$Z_{\alpha/2}$ = Critical value at 95% confidence level of certainty (1.96) and

d = 0.05

$$n = (1.96)^2 \frac{0.0855(1-0.0855)}{0.05^2} + 12 \text{ (OF NONRESPONSE RATE)} = 132$$

The 132 patients will be selected by simple random sampling technique from a consecutive list of outpatients in consecutive days of examination during the study period.

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9 Data collection tools and procedures

- Data was collected using kobo collect toolbox after the form designed and inserted which included background information, clinical details, and imaging details. Data was gathered from logbook, medical records and database of patient registry over the specified period, and the charts of the selected ones was traced, retrieved and reviewed. Two professional healthcare workers (fellow residents in the MSK radiology unit) were recruited, and brief trained on the data collection process mainly about the **kobo collect toolbox** by the principal investigator.

- All the pelvic and Hip x-rays of the enrolled subjects was reviewed by the principle investigator, the height, weight and MBI was taken by the principle investigator and the trained stuffs of the specific units.

10 STUDY VARIABLES

10.1 DEPENDENT VARIABLES

- Radiographic Pattern of Hip Osteoarthritis

10.2 INDEPENDENT VARIABLE

- Age
- Sex
- Occupation
- BMI
- Compartments affected

10.3 TERMS AND OPERATIONAL DEFINITIONS

- **Radiographic Definition of OA:** Radiographs with definite Osteophytes with or without Joint space narrowing, sclerosis, subchondral cyst and bony deformity which is scored by KellegrenLawrence method.(Annex II)
- **Bone Sclerosis:** Abnormal increase in density detected by radiograph.

- **BMI:** BMI was calculated as weight in kilograms divided by height in meters squared, and BMI categories were defined as: underweight/normal (BMI <25), overweight ($25 \leq \text{BMI} < 30$) and obese ($30 \leq \text{BMI}$).
- **Radiography:** is an imaging technique using X-rays to view the internal form of an object.
- **Standard Views:** For Hip Radiograph: Appropriate AP radiograph of Hip/Pelvis, Frog leg lateral view.

10.4 Data Analysis Procedure

- The data was transferred and analyzed by SPSS 25. Both descriptive to calculate the mean, median and graphics were used to display frequency analysis and analytic statistics including correlation (bivariate analysis) was used to assess the association of variables.

11 Ethical clearance

- Ethical clearance was obtained from the department research and SPHMMC's research review board, after the proposed defense and consent waived. Privacy of individual respondents and confidentiality of information was respected. There was no risk or benefit in taking part in the survey by individual patients.

11.1 Dissemination of Results

- The findings of this study will be shared with all relevant bodies in SPHMMC and other health facilities. The key findings will be shared with FMOH, and

other stakeholders. Poster/Oral presentations will be made to Ethiopian Society of radiologists /Ethiopian Public Health Association. Publications will be made in the Ethiopian Journal of Health Sciences

12 RESULTS

1. SOCIODEMOGRAPHIC CHARECTEISTICS:-

12.1

- This study includes 132 AP pelvic and hip X-RAYS of patients with the diagnosis of HIP OA (at least Kellgren and Lawrence **grade 2 (minimal): definite osteophytes and possible joint space narrowing**) of whom 82(62.1%) and 50(37.9%) out of the 132 x-ray cases were for female and male respective with mean age of 59.27 and minimum and maximum of 29years and 85years respectively. Female mean age is 59.10 while it is 59.56 in male.

Table 1: sex distribution

		Frequency	Percent	Valid Percent
Valid	FEMALE	82	62.1	62.1
	MALE	50	37.9	37.9
	Total	132	100.0	100.0

Table 2: AGE RANGE OF THE RESPONDENTS

		Frequen cy	Percent	Valid Percent
Valid	29 to 50	34	25.8	25.8
	51 to 70	70	53.0	53.0
	71 to 85	28	21.2	21.2
	Total	132	100.0	100.0

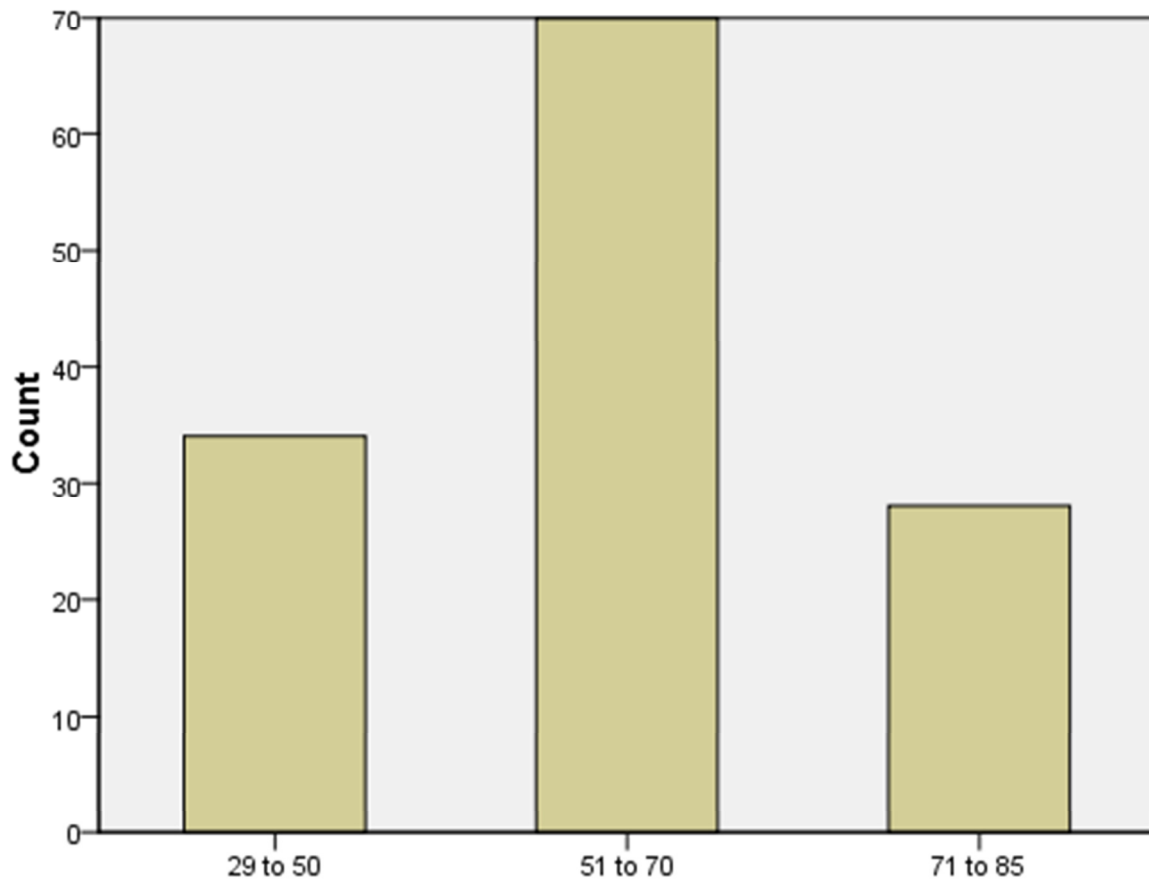


Figure 1: Age category distribution of patients with diagnosis of Hip

- The majority (73 individuals) of these respondents are elderly people and reported unemployed at the time of the evaluation for the imaging.

2. Distribution Radiologic based on location and radiologic x-ray findings

- In 35(26.5%) cases out of 132 x-rays had bilateral hip joint disease while in more than 2/3rds of the cases there were only unilateral disease affecting either left or right hips joints 59(44.7%) and 38(28.8%) respectively.

- Joint space narrowing, subchondral sclerosis and osteophytes were the most frequent imaging findings mostly present in combinations seen in 96(72.7%), 72(54.55%) and 45(34.41%) cases respectively while sub chondral cysts(seen in 3cases) and loose bodies(seen in 1 case) were uncommon and rare findings.

Table 3 : The frequency of bilateral or unilateral joint involvement

		Frequency	Percent	Valid Percent
Valid	BOTH	35	26.5	26.5
	LEFT	59	44.7	44.7
	RIGHT	38	28.8	28.8
	Total	132	100.0	100.0

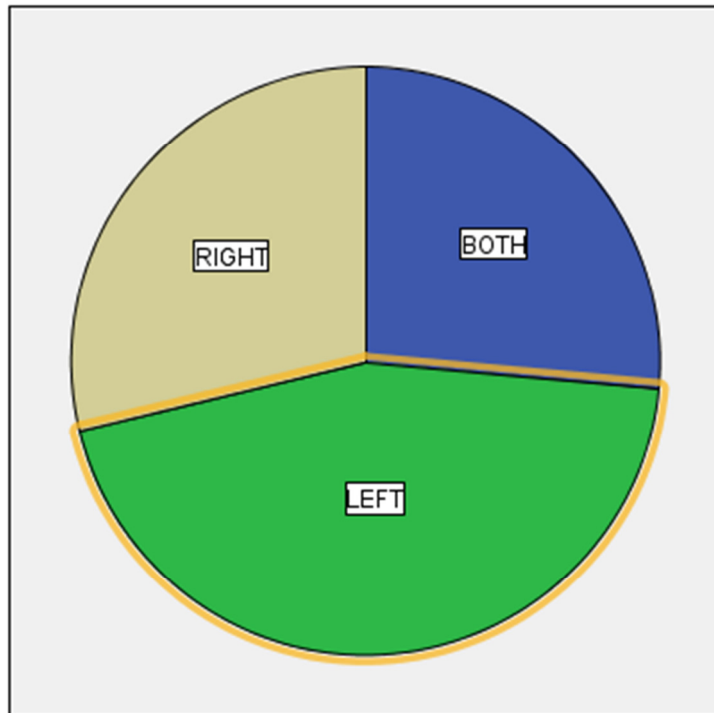


Figure 2: pie chart showing the distribution frequency of the bilateral and unilateral involvement

3. Distribution according to joint compartment involvement patterns

1. The supero-lateral compartment of the hip joints was the most commonly affected in both as the only affected compartment and in combination with other compartments affected in 52(39.4%) isolated. The superomedial/axial and the inferomedial/medial are the 2nd and the 3rd most commonly affected in this study both in isolation and in combination with other compartments accounting 10(7.6%) and 8(6.1%) respectively in single compartments involvement cases. The superolateral-axial involvement was the most common bicompartimental pattern accounting 29(22%) of cases, followed by superolateral –medial(inferomedial) compartments involvement which is affected in 16(12.1%) of the cases.

Table 4: patterns of hip joint OA compartmental involvements

		Frequency	Percent	Valid Percent
Valid	Circumferential_indefinite	5	3.8	3.8
	Inferomedial	8	6.1	6.1
	Inferomedial-superomedial	2	1.5	1.5
	Superolateral	52	39.4	39.4
	Superolateral-inferomedial	16	12.1	12.1
	superolateral superomedial	29	22.0	22.0
	Superomedial	10	7.6	7.6
	superomedial inferom	6	4.5	4.5
	superomedial superol	4	3.0	3.0
	Total	132	100.0	100.0

4. Clinical presentation

- All the 132 patients presented with hip pain while 18 of them had limbing due to the pain in addition.

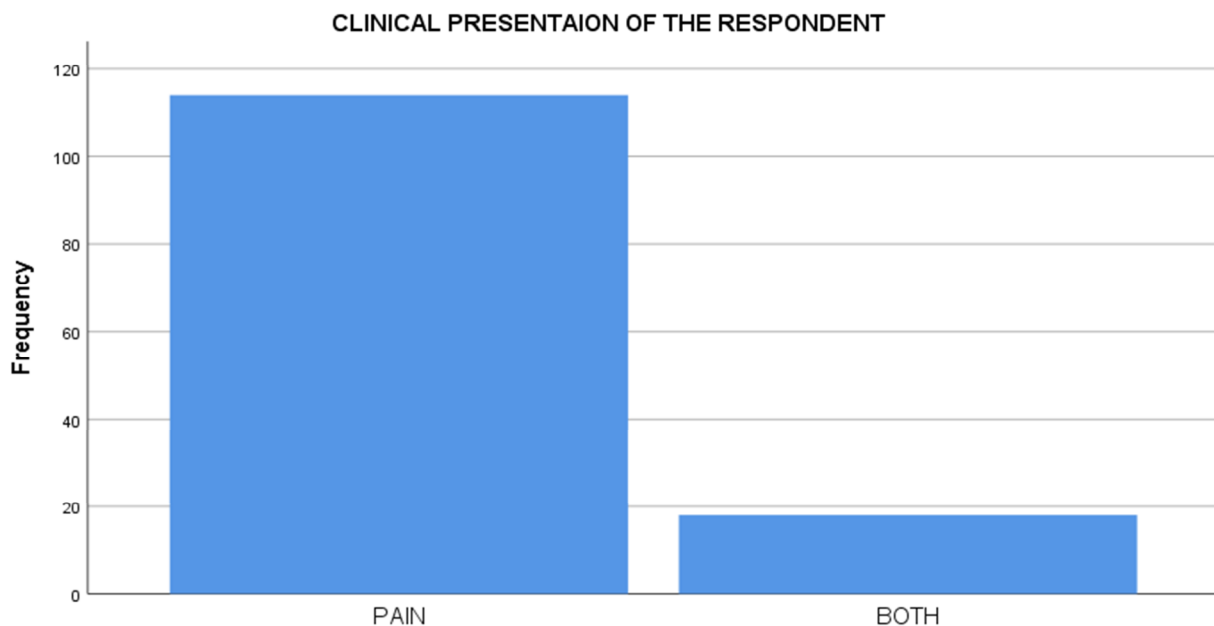


Figure 3:Showing the distribution of the clinical presentation

12.2

5. SEVERETY DISTRIBUTION

THE MAJORITY OF THE SUBJECTS HAD MODERATE TO SEVERE (82.6%) JOINT DISEASE ACCOUNTING 69(52.3%) MODERATE GRADE 3 AND 40(30.3%) GRADE 4 DISEASE. THE MILD DISEASE WAS FOUND IN 23(17.4%) SUBJECTS OF THE STUDY GROUP.

Table 5 :kellgren and lawrence grade Severity distribution

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	GRADE 2	23	17.4	17.4	17.4
	GRADE 3	69	52.3	52.3	69.7
	GRADE4	40	30.3	30.3	100.0
	Total	132	100.0	100.0	

6. ASSOCIATIONS:

The most common associated factors were female sex accounting 82(62.2%), age above 50years which is 98 cases(73.2%) and higher BMI Patients with BMI >25 were considered overweight and BMI>30 as obese. Among these patients with hip OA, 65(49.2%) were in normal weight range, 37(28%) were overweight, 22(16.7) were obese, 8(6.1%) either weight or height was not documented so it was not possible to determine their BMI. There were no underweight cases in this study.

7. Chronic medical illness

9(6.8%)out of the 132 cases had chronic medical illness in which 5 had only hypertension,2of them both DM and HTN while 2 cases had only diabetes mellitus.

13 DISCUSION

The study reviewed 132 mostly AP pelvic and view (8cases) AP properly taken x-rays for patient with pelvic-hip pain to determine the pattern of hip OA and the associated factors in SPHMMC in the study and found that the majority of the cases were female population (62.2%) older adults and elderly (72.1%), Which is comparable to previous Ethiopian hospital based study which showed Female

population predominance (68%) by bemnet.2019 (20). The mean age was 59.27 which is similar to similar study done in the united states which had The mean age of 59years by Joanna Ledingham et al.1996(11).

The unilateral disease (73.5%) was more common than bilateral ((26.5%) which is in accordance with study done in Kenya which shown bilateral (44.3%) knee or hip disease and unilateral disease (55.7%) involvement by H.A. Nour ET al.2013 (21).

Regarding the pattern of hip joint compartments involvement, the superolateral compartment was the single compartment involved and superomedial/axial was the second most common single compartment involvement while superolateral-axial and superomedial-medial bicompartments involvements were the most common patterns in cases of multiple compartment involvements. These are in line with previous different studies including one done in TASH Ethiopia which reported as Superolateral compartment most commonly affected followed by axial and medial compartments by bemnet.2019 (20). And study in the US 46% superolateral, 25% intermediate, 11% superomedial), medial/axial migration occurred in only 8% by Ledingham, J (11).

The main associated factors included obesity in which 44.7% of the study group were either obese or over with no significant difference seen compared to the normal weighted individuals in the study in terms of radiographic pattern or severity in contrast to some studies which associated by laterality and severity of the disease with increased BMI like Stürmer et al(23).

14 Conclusion:

Hip OA was more common in female and after 50years of age which is similar to other African worldwide studies. The most commonly affected compartments were superolateral and superomedial of the hip joints which is consistent with

existing previous hip OA understanding. Nearly half of the subjects with hip OA are arthritis were either overweight or obese.

15 Limitations of the Study

1. The research was done in tertiary hospital with relatively small sample size which may not reflect the true distribution of the disease
2. The majority of the study group was unemployed elderly patients.
3. There was no control group to study associations especially obesity with development of knee and Hip OA

16 Recommendation

We recommend population based study done on large sample size regarding prevalence and pattern of OA in Ethiopia. We recommend studies to evaluate the impact of obesity in the development of OA. We also recommend prevention programs aimed at reducing obesity both at national and individual level

4. The study was done on Hip joint which is not the most common site for OA to reflect burden of the disease particularly in the working class people

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17.1 Annexes

17.1.1 ANNEX – part I

17.1.2QUESTIONNAIRE:

1RADIOGRAPHIC PATTERNS OF HIP OSTEO ARTHRITIS AND ASSOCIATED FACTORS

RADIOGRAPHIC PATTERNS OF HIP OA QUESTIONNAIRE

1. ID

2. SEX

MALE ☐ FEMALE



3. AGE IN YEARS

4. CLINICAL PRESENTATION

☒ PAIN ☐ LIMBING ☐ BOTH

5. OCCUPATION

☒ UNEMPLOYED ☐ FARMER ☐ PRIVATE BUSINES ☐ OTHER(SPECIFY)

6. ANY KNOWN CHRONIC ILLNESS

☒ YES ☐ NO

7. DIAGNOSIS(if yes is selected in the above question)

☒ DIABETES MELLITUS ☐ HYPERTENSION ☐ BOTH DM AND HYPERTENSION ☐
OTHER(SPECIFY)

8. THE X-RAY VIEW TAKEN

☒ AP PELVIC ☐ AP HIP

9. DEVELOPMENTAL ANATOMIC ABNORMALITY OF THE OF THE HIP JOINTS

☒ YES ☐ NO

10. WHAT IS THE ANOMALY TYPE(if yes is selected in the above question)

☒ Pincer type FAI ☐ CAM type FAI ☐ HIP DYSPLACIA

11. WHICH JOINT IS /ARE AFFECTED

☒ RIGHT ☐ LEFT ☐ BOTH

12. THE RADIOLOGIC FINDINGS

☐ SCLEROSIS ☐ JSN(JOINT SPACE NARROWING) ☐ OSTEOPHYTES ☐
SUBCHONDRAL CYSTS ☐ LOOSE BODIES

13. WHICH HIP JOINT COMPARTEMENT IS AFFECTED

☐ SUPEROLATERAL ☐ SUPEROMEDIAL ☐ INFEROMEDIAL ☐
CIRCUMFERENTIAL(INDETERMINATE)

14. Kellgren and Lawrence grade

☐ 2 ☐ 3 ☐ 4

15. WEIGHT

16. HEIGHTBMI

17. (BODY MASS INDEX)

17.2 ANNEX II: Kellgren-Lawrence(KL)grading system of OA

- **KL-Grade 0**-indicates that no radiographs feature of OA.
- **KL-Grade 1**-is doubt full JNS and osteophytes lipping.
- **KL-Grade 2**- the presence of definite radiograph osteophytes and possible JSN
- **KL-Grade 3**- multiple osteophytes, definite JSN, sclerosis, possible bony deformity
- **KL-Grade 4**- large osteophytes, marked JSN, severe sclerosis and definite bone deformity.

18 RADIOGRAPHIC PATTERNS OF HIP OSTEOARTHRITIS

ID of the participant

AGE of the participant *in years*

CLINICAL PRESENTATION

☐ Option 1 PAIN ☐ Option 2 LIMBING ☐ Option 3 BOTH

SEX

☒ MALE ☐ FEMALE

Any known chronic illness

☐ yes ☒ No

X-RAY VIEW TAKEN

☒ AP PELVIC ☐ AP HIP ☒ OTHER SPECIFY

WHICH JOINT IS AFFECTED

☒ RIGHT ☐ LEFT ☐ BOTH

RADIOGRAPHIC FINDINGS *ALL THE FINDS PRESENT SHOULD BE SELECTED*

☐ SCLEROSIS ☐ JOINT SPACE NARROWING ☐ SUBCHONDRAL CYSTS ☐ LOOSE BODIES ☐ OTHERS SPECIFY

WHICH COMPARTEMENT IS AFFECTED *ALL THE AFFECTED COMPARTEMENTS SHOULD E SELECTED*

☐ SUPEROLATERAL ☐ SUPEROMEDIAL/AXIAL ☐ MEDIAL ☐ INDETERMINATE
Kellgren and Lawrence grade

☒ Option 1 2 ☐ Option 2 3 ☒ Option 3 4

WEIGHT

HEIGHT

BODY MASS INDEX