REPUBLIC OF YEMEN
UNIVERSITY OF SCIENCE AND TECHNOLOGY
FACTUALITY OF MEDICINE AND HEALTH SCIENCE
DIAGNOSTIC RADIOLOGY TECHNOLOGY DEPARTMENT

ASSESSMENT OF OSTEOPOROSIS PREVALENCE AMONG YEMENI POPULATION USING DUAL ENERGY X-RAY ABSORPTIOMETRY

دراسة معدل انتشار مرض هشاشة العظام بين السكان اليمنيين باستخدام جهاز قياس هشاشة العظام

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This Research Submitted in Fulfillment of The Requirement for The Degree of Bachelor in Diagnostic Radiology and Medical Imaging Technology

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ACKNOLEDGMENT

FIRST, WE THANK ALLAH FOR GIVING US STRENGTH AND PATIENCE TO FINISH THIS RESEARCH, THEN MANY THANKS TO DR. ABDULLAH TAHER ASSISTANT PROFESSOR OF MEDICAL PHYSICS AND RADIATION SCIENCES, THE SUPERVISOR OF OUR RESEARCH FOR HIS CONTINUOUS HELP IN SUPERVISION AND GUIDANCE, AND SPECIAL THANKS TO OUR DEPARTMENT OF RADIOLOGY AND MEDICAL IMAGING TECHNOLOGY AT THE UNIVERSITY OF SCIENCE AND TECHNOLOGY, ALSO TO ALL THE HOSPITALS AND CENTERS NEW SCAN CENTER, AL-RAZI, AL-MAMOUN CENTER, THE EUROPEAN HOSPITAL, AND UNIVERSITY OF SCIENCE AND TECHNOLOGY HOSPITAL" THAT SUPPORTED OUR RESEARCH, AND TO EVERYONE WHO GAVE US STRENGTH AND SUPPORT.

DEDICATION

THIS STUDY IS DEVOTED TO THE HEALTH COMMUNITY IN YEMEN IN THE HOPES THAT IT WILL AID IN RAISING AWARENESS OF THIS DISEASE. WE WOULD ALSO LIKE TO DEDICATE IT TO ALL STUDENTS WHO ARE INTERESTED IN LEARNING FROM IT AND GAINING KNOWLEDGE ABOUT IT, AS WELL AS TO THOSE WHO WISH TO CONTINUE SEARCHING ON THIS TOPIC.

LIST OF CONTENT

List of Abbreviations

WHO	World Health Organization
BMC	Bone mineral content
BMD	Bone mineral density
BMI	Body mass Index
O.P	osteoporosis
DEXA	Dual Energy X-Ray Absorptiometry
Sig	Significant
N	Number
Fig	Figure
SPSS	Statistical Package for the Social Sciences
PACS	Picture archiving and communicating system
SD	Standard deviation

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Abstract

Background : Osteoporosis is a condition that leads to loss of bone mass. Osteoporosis increases in patients with age 50 and above especially among menopausal women There is a risk factor of fracture especially in the spine for those patients with osteoporosis.

Aims : This descriptive cross sectional study aimed to study the prevalence of osteoporosis among Yemenis population using DEXA and in the sites of lumber spine and hip .

Methods : A total of 1551 patients who examined the hip and lumber using DEXA Hologic , Lunar and Primus have included in this study. This study calculated the risk associated with hip fractures for the patients who aged 50 and above.

Results: The results of this research showed that most of the cases that included in the study were females, 1458 (94%), and males were 93 (6%). The most affected age group was from (51 to 60 years) 30.8%. 311 patients were affected in the two sites, and 733 were affected in the lumber spine and 322 were affected in the hip only which indicates that lumber spine is the most affected site with osteoporosis. There was a liner regression of age with T-score, Z-score and BMC.

Conclusion: This study demonstrated that females who aged 50 and above have risk of developing osteoporosis more than males in the same age and increase their risk of developing fractures.

ملخص الدراسة

تمهيد : تعد هشاشة العظام مشكلة شائعة حيث تصبح العظام فيها ضعيفة، وسهلة الكسر، وتتطور ببطء على مدى عدة سنوات. وغالبًا ما يتم تشخيص المرض عند سقوط طفيف، أو تأثير مفاجئ يسبب كسر في العظام. يُشار إلى أن النساء أكثر عرضة لخطر الإصابة بهشاشة العظام بعد انقطاع الطمث.

منهجية البحث: تم تضمين ١٥٥١ مريض في البحث تم تصنيفهم ٣١١ مريض مصابين بهشاشة العظام في الحوض والعمود الفقري بينما ٧٣٣ مريض مصابين بهشاشة العظام في العمود الفقري فقط و٣٢٢ مريض مصابين بهشاشة العظام في الحوض فقط باستخدام جهاز قياس هشاشة العظام.

النتائج: أظهرت نتائج البحث أن معظم الحالات التي تم تضمينها في البحث كانت من فئة الإناث ١٤٥٨ (٩٤%) حيث كان الذكور ٩٣ بمعدل (٦%) من كافة المرضى في الدراسة. وكانت الفئة العمرية الأكثر اصابةً من ٥١ الى ٦٠ سنة بمعدل (٣٠,٨) و سجلت هشاشة العظام في الفقرات القطنية نسبة أعلى من عظم الحوض حيث أظهرت دراستنا أن للعمر علاقة مع كثافة العظام وفي هذه الدراسة تم حساب معدل خطر الإصابة بكسور عظم الحوض لكل المرضى التي تتجاوز أعمارهم ال ٥٠ لكل ٥ سنوات و ١٠ سنوات. توجد علاقة خطية بين العمر مع قيم ال T-score و Z-score وBMC ومعدل الاصابة بالكسور في الخمسة والعشرة سنين.

الاستنتاج: توضح هذه الدراسة ان حدوث هشاشة العظام يزداد مع تقدم العمر والغالب يكون عند الاناث التي تجاوزن عمر الخمسين مما يسبب زيادة في معدل الإصابة بالكسور لديهن.

Chapter 1

Introduction

Introduction

1.1 Overview

Osteoporosis is the most common metabolic bone disease and is considered a public health issue throughout the world; its most outstanding characteristic, is reduced bone density which makes the individual prone to fractures (Cauley 2013).

There are different methods of evaluating bone density; however, the current method is the non-invasive, simple, and harmless method of dual-energy X-ray absorptiometry (DEXA) According to the World Health Organization's criteria, it is normal when the T criterion is greater than -1; however, osteopenia occurs when it is between -1 and -2.5, and osteoporosis occurs when T is lower than -2.5 (In this state, bone density is 2.5 SD < mean for a 30-year-old male or female (Jermiah et al, 2015).

Lumber and hip is the recommended anatomy to be scanned by WHO and there is a few reasons for choosing these two sites Hip and Lumbar vertebrae has a large quantity of trabecular bone—the spongy, lattice-like bone on the inside- that tends to lose density as we age. Measurements taken at these locations can be easily replicated so that we can determine if there are changes in the quantity (density) of bone over time (American bone health 2018).

Osteoporosis is known as a multifactorial disease, such that certain diseases, such as hyperthyroidism, gonadal dysfunction, rheumatoid arthritis, Cushing's syndrome, and the long-term use of certain drugs, such as cortisone, can cause it. Other factors also contribute to the development of osteoporosis, such as physical inactivity or being underweight more than 10% compared to the weight in youths or a BMI lower than 19, hereditary factors, and alcohol addiction(Sforza et al, 2016).

Osteoporosis is an important cause of disease and disability in the elderly and occurs in approximately 55% of women aged over 50 years, and the treatment costs imposed as a result of bone fractures are very high. After the age of 50, the risk of hip and vertebral fractures is thrice as much, and the risk of wrist fracture is 6 times as much in women than in men. Considering the novel knowledge and findings on this disease, it is potentially preventable and can be detected and cured before a fracture occurs. Thus, its timely diagnosis and prevention of progress is the main goal of geriatric medicine. (Woolf ,Akessonk 2003) This silent disease has affected 200 million people around the world, such that in the US alone 5% of the population aged above 50 years have osteoporosis, and 1.5 million cases of osteoporotic fractures occur annually(Looker et al, 2005 2008).

Osteoporosis is a growing health care problem in developing countries, especially with increasing life expectancy, and it is considered as an important public health concern among aging populations; as the low trauma fractures are associated with premature mortality . It seems that bone mineral density is lower in most of the Middle Eastern countries compared to Western countries . However, in the absence of a fracture registry in most Middle Eastern countries, the data available from this region are limited According to the Technical Report of the World Health Organization, 2.9% of worldwide osteoporosis-related fractures occur in the Eastern Mediterranean countries (Kanis, WHO 2007). The prevalence and incidence of osteoporosis and osteoporotic fractures are unknown in Yemen .

1.2 Problem statement:

Based on the available literature there is no study about the prevalence of osteoporosis in Yemen, this study will introduce a new information related to prevalence and incidence of the osteoporosis among Yemeni population.

1.3 Objective:

1.3.1 General Objective:

This study aims to assess the Prevalence of osteoporosis among Yemeni population.

1.3.2 Specific Objective :

- To investigate the prevalence of osteoporosis among Yemeni population
- To investigate the correlation between the age and osteoporosis.
- To investigate the correlation between the BMI and osteoporosis .
- To investigate the association between the BMC & BMD and osteoporosis.

1.4 Strength of this study :

- Large sample size .
- The data collection was taken form several hospital and centers.
-The Probabilities of five and ten years hip fracture assessment were calculated .

1.5 Limitation of this study:

The limitations of this study can be summarized in the following points:

- This study data depends on the PACS only.
- This study sample size was taken just from Sana'a hospitals.
- The duration of the study was limited .

1.6 Outline of this study:

This study contains five chapters:

- Chapter one contains an introduction about this study, aims , problem statement , objective, strength and the limitation .
- Chapter two contains the literate review of this study.
- Chapter three state the methodology of this study.
- Chapter four contains the results and the dissection of this study.
- Chapter five contains the conclusion and the recommendations to this study.

Chapter 2

Literature Review

Literature Review

2.1 Theoretical background

Bones make up the skeletal system of the human body. Bone tissue (osseous tissue) differs greatly from other tissues in the body. Bone is hard and many of its functions depend on that characteristic hardness. The adult human has two hundred and six bones. There are several types of bones that are grouped together due to their general features, such as shape, placement and additional properties. They are usually classified into five types of bones that include the flat, long, short, irregular, and sesamoid bones (Poe 2013). The Gross Anatomy of the Bone The structure of a long bone allows for the best visualization of all of the parts of a bone. A long bone has two parts: the diaphysis and the epiphysis. The diaphysis is the tubular shaft that runs between the proximal and distal ends of the bone. The hollow region in the diaphysis is called the medullary cavity, which is filled with yellow marrow. The walls of the diaphysis are composed of dense and hard compact bone (Poe 2013).

2.1.1 Anatomy of a Long Bone：

A typical long bone shows the gross anatomical characteristics of bone.

The wider section at each end of the bone is called the epiphysis (plural = epiphyses), which is filled with spongy bone. Red marrow fills the spaces in the spongy bone. Each epiphysis meets the diaphysis at the metaphysis, the narrow area that contains the epiphyseal plate (growth plate), a layer of hyaline (transparent) cartilage in a growing bone. When the bone stops growing in early adulthood (approximately 18–21 years), the cartilage is replaced by osseous tissue and the epiphyseal plate becomes an epiphyseal line (Poe ,2013).

The medullary cavity has a delicate membranous lining called the endosteum (endo = “inside”; oste- = “bone”), where bone growth, repair, and remodeling occur. The outer surface of the bone is covered with a fibrous membrane called the periosteum (peri– = “around” or “surrounding”). The periosteum contains blood ligaments also attach to bones at the periosteum. The periosteum covers the entire outer surface except where the epiphyses meet other bones to form joints. In this region, the epiphyses are covered with articular cartilage, a thin layer of cartilage that reduces friction and acts as a shock absorber(Poe, 2013).

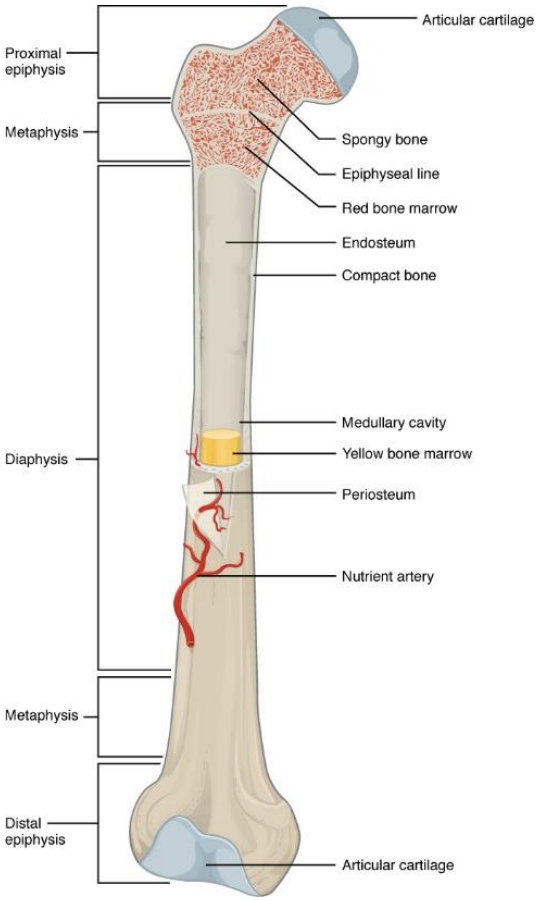


Fig. 2.1 : Anatomy of Long Bone
Source: Anatomy & Physiology (2023)

2.1.1.1 Periosteum and Endosteum :

The tough, thin outer membrane covering the bones is called the periosteum, and the endosteum lines the medullary cavity. Beneath the hard outer shell of the periosteum are tunnels and canals through which blood and lymphatic vessels run to carry nourishment for the bone. Muscles, ligaments, and tendons may attach to the periosteum(Poe, 2013).

Flat bones, like those of the cranium, consist of a layer of diploë (spongy bone), lined on either side by a layer of compact bone. The two layers of compact bone and the interior spongy bone work together to protect the internal organs. If the outer layer of a cranial bone fractures, the brain is still protected by the intact inner layer(Poe ,2013).

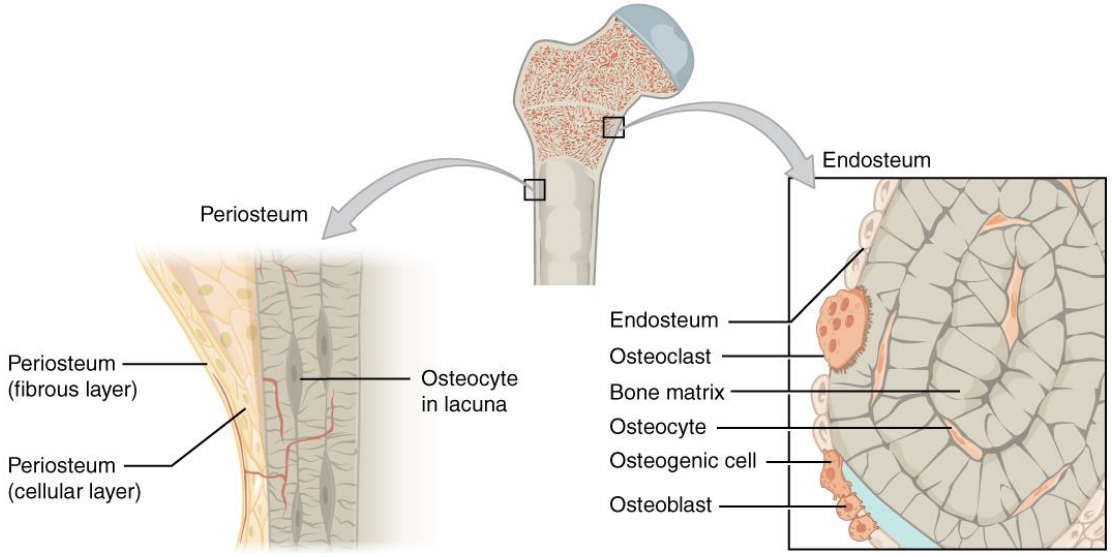


Fig. 2.2 : Periosteum and Endosteum.
Source : Anatomy &Physiology(2023).

2.1.1.2 Bone cells and tissue :

Bone contains a relatively small number of cells entrenched in a matrix of collagen fibers that provide a surface for inorganic salt crystals to adhere. These salt crystals form when calcium phosphate and calcium carbonate combine to create hydroxyapatite, which incorporates other inorganic salts like magnesium hydroxide, fluoride, and sulfate as it crystallizes, or calcifies, on the collagen fibers. The hydroxyapatite crystals give bones their hardness and strength, while the collagen fibers give them flexibility so that they are not brittle. Although bone cells compose a small amount of the bone volume, they are crucial to the function of bones. Four types of cells are found within bone tissue: osteoblasts, osteocytes, osteogenic cells, and osteoclasts (Poe 2013).

2.1.1.3 Bone Cells :

Four types of cells are found within bone tissue. Osteogenic cells are undifferentiated and develop into osteoblasts. When osteoblasts get trapped within the calcified matrix, their structure and function changes, and they become osteocytes. Osteoclasts develop from monocytes and macrophages and differ in appearance from other bone cells(Poe, 2013).

Bone Cells:

- Osteogenic cell.
- Osteoblast.
- Osteocyte.
- Osteoclast.

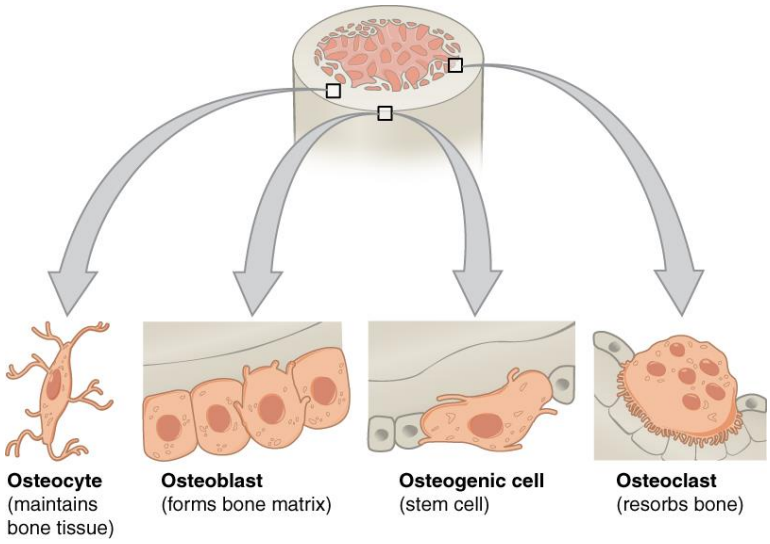


Fig. 2.3 : Bone cells.
Source : Anatomy& Physiology(2023).

2.1.1.4 Bone Tissues:

Bone is living tissue that makes up the body's skeleton. There are 3 types of bone tissue, including the following:

1.Compact tissue. The harder, outer tissue of bones.

2.Cancellous tissue. The sponge-like tissue inside bones.

3.Subchondral tissue. The smooth tissue at the ends of bones, which is covered with another type of tissue called cartilage. Cartilage is the specialized, gristly connective tissue that is present in adults. It is also the tissue from which most bones develop in children(Poe 2013).

The differences between compact and spongy bone are best explored via their histology. Most bones contain compact and spongy osseous tissue, but their distribution and concentration vary based on the bone's overall function. Compact bone is dense so that it can withstand compressive forces, while spongy (cancellous) bone has open spaces and supports shifts in weight distribution(Poe ,2013).

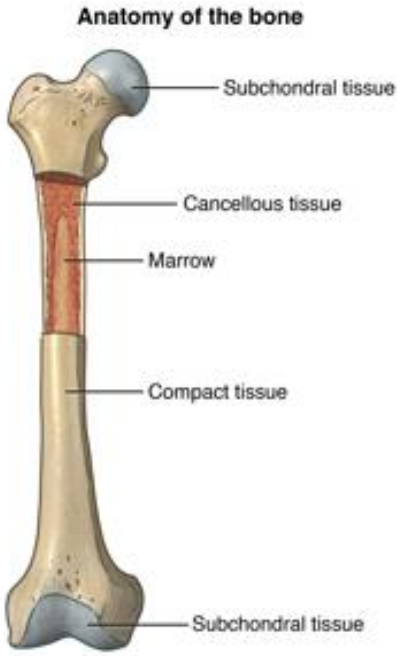


Fig. 2.4 : Bone Tissue.
Source : Anatomy &Physiology(2023).

2.1.1.5Compact Bone:

Compact bone is the denser, stronger of the two types of bone tissue. It can be found under the periosteum and in the diaphysis of long bones, where it provides support and protection. (Poe ,2013).

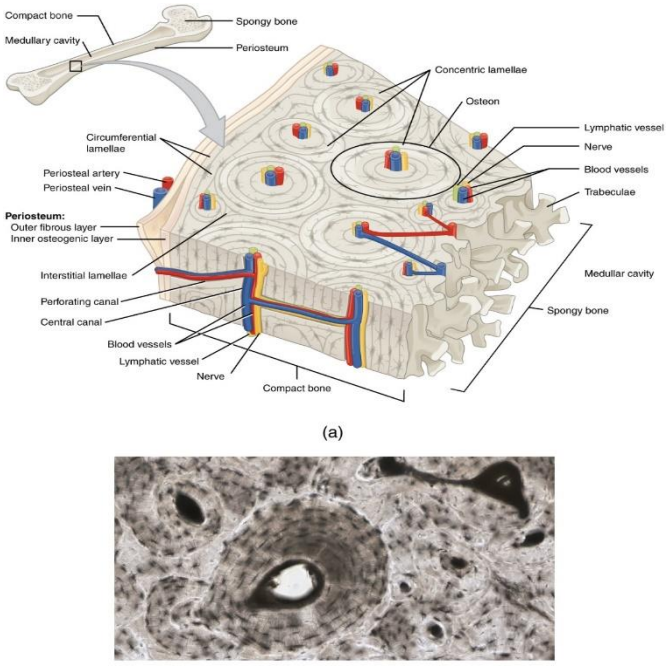


Fig 2.5 : Diagram of Compact Bone**.**
Source : Anatomy& Physiology(2023).

This cross-sectional view of compact bone shows the basic structural unit, the osteon. (b) In this micrograph of the osteon, you can clearly see the concentric lamellae and central canals. The microscopic structural unit of compact bone is called an osteon, or Haversian system. Each osteon is composed of concentric rings of calcified matrix called lamellae (singular = lamella). Running down the center of each osteon is the central canal, or Haversian canal, which contains blood vessels, nerves, and lymphatic vessels. These vessels and nerves branch off at right angles through a perforating canal, also known as Volkmann's canals, to extend to the periosteum and endosteum(Poe ,2013).

The osteocytes are located inside spaces called lacunae (singular = lacuna), found at the borders of adjacent lamellae. As described earlier, canaliculi connect with the canaliculi of other lacunae and eventually with the central canal. This system allows nutrients to be transported to the osteocytes and wastes to be removed from them(Poe 2013).

2.1.1.6 Spongy (Cancellous) Bone:

Like compact bone, spongy bone, also known as cancellous bone, contains osteocytes housed in lacunae, but they are not arranged in concentric circles. Instead, the lacunae and osteocytes are found in a lattice-like network of matrix spikes called trabeculae (singular = trabecula). The trabeculae may appear to be a random network, but each trabecula forms along lines of stress to provide strength to the bone. The spaces of the trabeculated network provide balance to the dense and heavy compact bone by making bones lighter so that muscles can move them more easily. In addition, the spaces in some spongy bones contain red marrow, protected by the trabeculae, where hematopoiesis occurs(Poe, 2013).

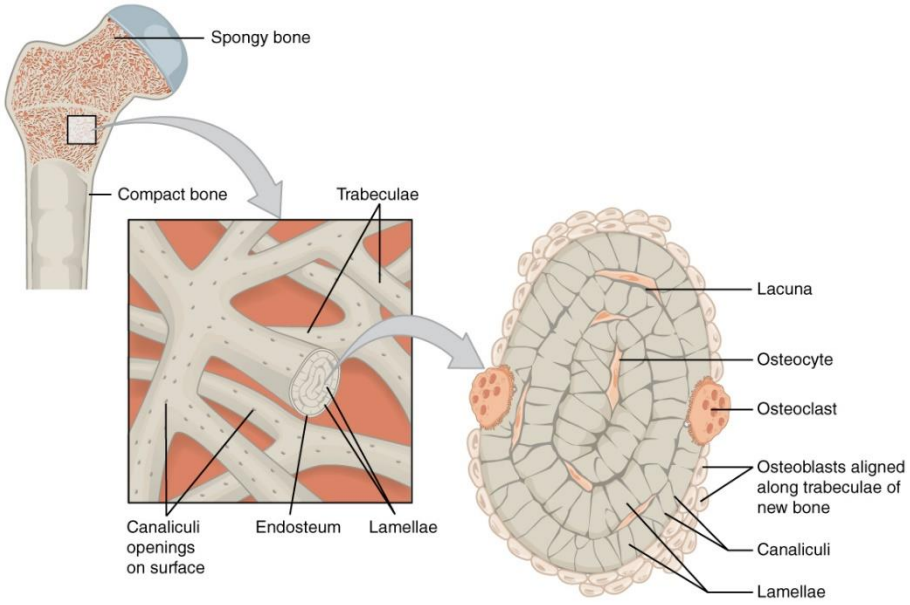


Fig 2.6 : Diagram of Spongy Bone
Source : Anatomy& Physiology(2023).

2.1.2 Anatomy of Lumber:

The lumbar spine consists of 5 moveable vertebrae numbered L1-L5. The complex anatomy of the lumbar spine is a remarkable combination of these strong vertebrae, multiple bony elements linked by joint capsules, and flexible ligaments/tendons, large muscles, and highly sensitive nerves. It also has a complicated innervation and vascular supply.The lumbar spine is designed to be incredibly strong, protecting the highly sensitive spinal cord and spinal nerve roots. At the same time, it is highly flexible, providing for mobility in many different planes including flexion, extension, side bending, and rotation(Kishner ,2017).

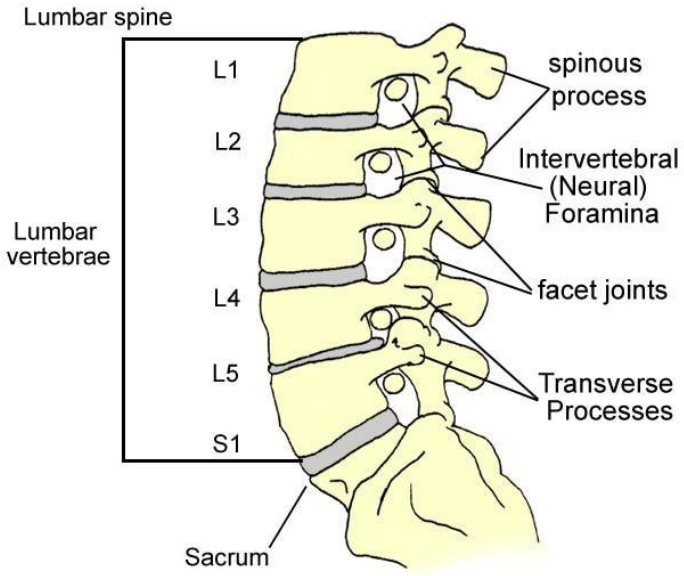


Fig 2.7 : Anatomy of Lumber.
Source : Medscape(2023).

The lumbar vertebrae, numbered L1-L5, have a vertical height that is less than their horizontal diameter. They are composed of the following
three functional parts:

- The vertebral body, designed to bear weight.
- The vertebral (neural) arch, designed to protect the neural elements.
- The bony processes (spinous and transverse), which function to increase the efficiency of muscle action.

The lumbar vertebral bodies are distinguished from the thoracic bodies by the absence of rib facets. The lumbar vertebral bodies (vertebrae) are the heaviest components, connected together by the intervertebral discs. The size of the vertebral body increases from L1 to L5, indicative of the increasing loads that each lower lumbar vertebra absorbs. Of note, the L5 vertebra has the heaviest body, smallest spinous process, and thickest transverse process. Each vertebral arch is composed of 2 pedicles, 2 laminae, and 7 different bony processes (1 spinous, 4 articular, 2 transverse), joined together by facet joints and ligaments(Kishner ,2017).

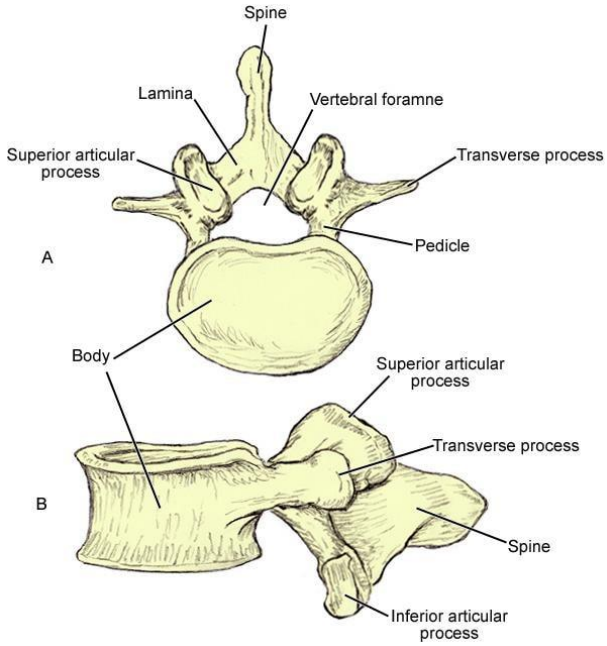


Fig 2.8 : Anatomy of Lumber Vertebra .
Source : Medscape(2023).

The pedicle, strong and directed posteriorly, joins the arch to the posterolateral body. It is anchored to the cephalad portion of the body and function as a protective cover for the cauda equina contents. Beneath each lumbar vertebra, a pair of intervertebral (neural) foramina with the same number designations can be found.. Each foramen is bounded superiorly and inferiorly by the pedicle, anteriorly by the intervertebral disc and vertebral body, and posteriorly by facet joints. The same numbered spinal nerve root, recurrent meningeal nerves, and radicular blood vessels pass through each foramen. Five lumbar spinal nerve roots are found on each side.The broad and strong laminae are the plates that extend posteromedially from the pedicle. The oblong shaped spinous processes are directed posteriorly from the union of the laminae. The facet or zygapophyseal joints are in a parasagittal plane. When viewed in an oblique projection, the outline of the facets and the pars interarticularis appear like the neck of a Scottie dog (see the image below) (Kishner, 2017).

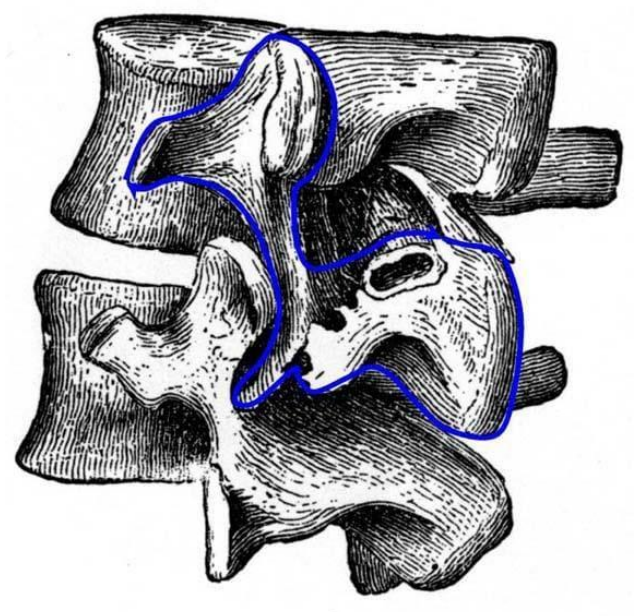


Fig 2.9 : The Appearance of Scotty dog.
Source : Medscape(2023).

2.1.2.1 Lumbar Intervertebral Discs :

Discs form the main connection between vertebrae. They bear loading during axial compression and allow movement between the vertebrae. Their size varies depending on the adjacent vertebrae size and comprises approximately one quarter the length of the vertebral column.Each disc consists of the nucleus pulposus, a central but slightly posterior mucoid substance embedded with reticular and collagenous fibers, surrounded by the annulus fibrosus, a fibrocartilaginous lamina. The annulus fibrosus can be divided into the outermost, middle, and innermost fibers. The anterior fibers are strengthened by the powerful anterior longitudinal ligament (ALL). The posterior longitudinal ligament (PLL) affords only weak midline reinforcement, especially at L4-5 and L5-S1, as it is a narrow structure attached to the annulus. The anterior and middle fibers of the annulus are most numerous anteriorly and laterally but deficient posteriorly, where most of the fibers are attached to the cartilage plate (Kishner 2017).

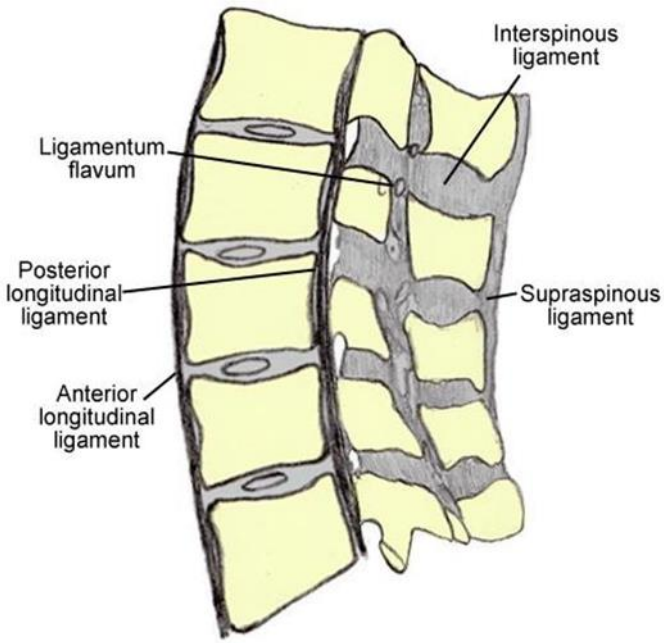


Fig 2.10 : Lumbar Intervertebral Discs.
Source : Medscape(2023).

2.1.2.2 Anatomy of hip :

The hip bone (os coxae) is an irregularly shaped, bilateral bone of the bony pelvis which is also known as the innominate bone, pelvic bone or coxal bone . In reality, it is a compound structure which consists of three smaller bones: the ilium , ischium and pubis (Gray2008).

- **The ilium :**

is the largest and most superior part of the bone.

Component : Body of ilium, ala, gluteal surface, sacropelvic surface, iliac fossa.

- **The ischium :**

is located posteroinferiorly.

Component : Body of ischium, ramus of ischium, ischial spine, ischial tuberosity.

- **The pubis or pubic bone :**

forms the anterior portion of the hip bone.

Component : Body of pubis, superior pubic ramus, inferior pubic ramus.

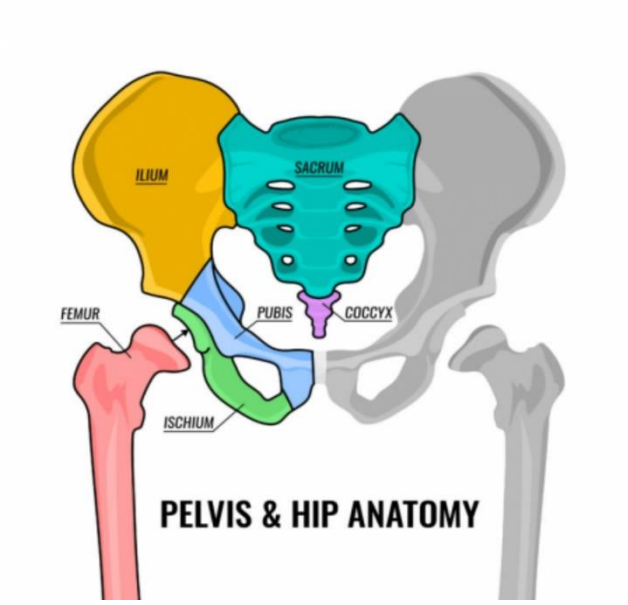


Fig .2.11 : Anatomy of Hip.
Source : Go to ortho(2023).

2.1.2.3 Acetabulum:

The lateral aspect of the hip bone houses the acetabulum, one of the most prominent landmarks of this bone. It bears a socket shaped articular surface that faces anteroinferiorly which articulates with the head of the femur forming the hip joint. The three components of the hip bone unit at the acetabulum, contributing to its formation.The acetabulum itself has a number of anatomical features. The lunate surface is the moon-shaped articular surface for the head of the femur. The acetabular fossa is the non-articular portion of the acetabulum found centrally.The acetabulum delimited by a "C" shaped acetabular margin which incomplete inferiorly at the acetabular notch. The acetabular margin is accentuated by the cartilaginous acetabular labrum and completed inferiorly by the transverse acetabular ligament (Gray2008).

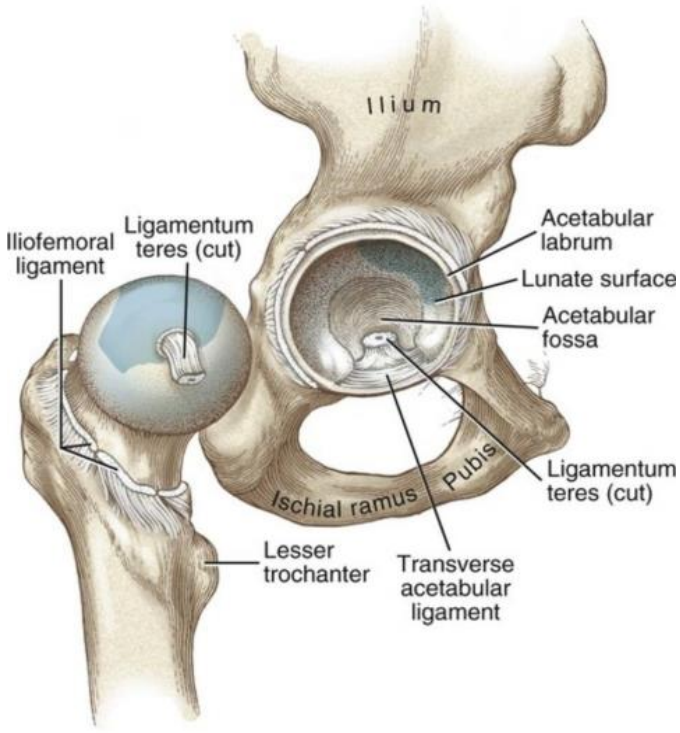


Fig. 2.12: Acetabulum of Hip.
Source : Quizlet(2023).

2.1.2.4 Anatomy of femur:

The femur is the longest, heaviest, and strongest bone in the human body. The main function of the femur is weight bearing and stability of gait. An essential component of the lower kinetic chain.The robust shape of the femur provides many sturdy attachment points for the powerful muscles of the hip and knee that contribute to walking and other propulsive movements. Moore (KL,et al. 2011).

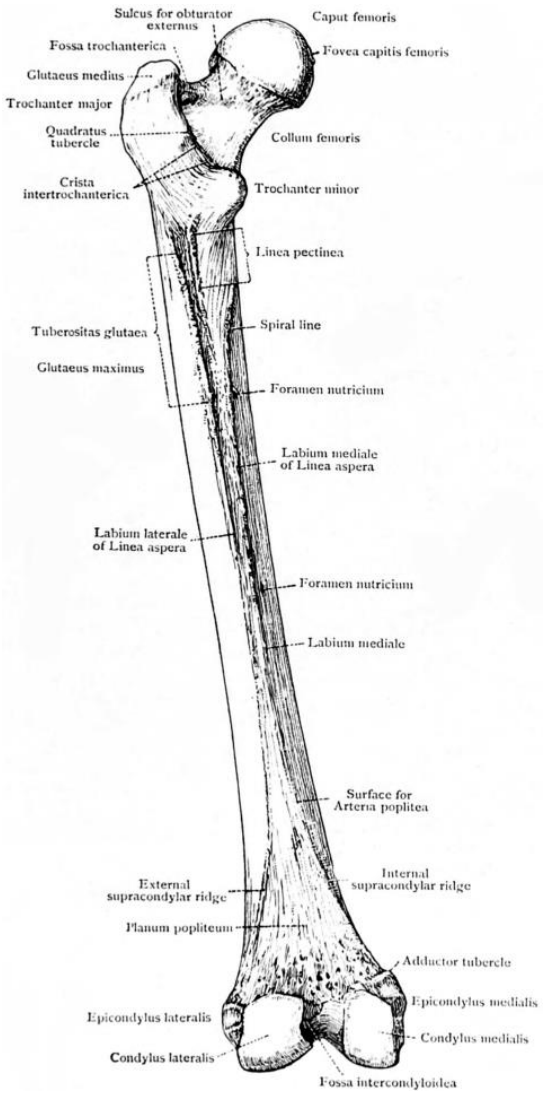


Fig 2.13 : Anatomy of Femur .
Source Physiopedia (2023).

2.1.2.5 Femur Division :

The femur acts as the site of origin and attachment of many muscles and ligaments , and can be divided into three parts; proximal, shaft and distal
(Chang A, et al 2019).

- Proximal Femur:
  Composed of the head, neck, greater trochanter and lesser trochanter. The head of the femur articulates with the acetabulum of the pelvis to create the hip joint.
- Femoral Shaft:
  The femoral shaft is almost cylindrical in form, being slightly broader superiorly and slightly arched, giving it a convexity anteriorly and concavity posteriorly which has a prominent longitudinal ridge of bone, the linea aspera. A variety of muscles have their origins at and insert into the femoral shaft (all, apart from gluteus maximus and vastus intermedius, interact with the posterior surface of the bone).
- Distal Femur:
  Prominent lateral and medial condyles are found at the distal end of the femur. Projecting from each condyle is an epicondyle that act as attachment sites for the collateral ligaments. The lateral and medial condyles are separated by the intercondylar notch.

2.5.2 Relation between hip bone and femur:

The femoral head of the proximal femur articulates with the acetabulum of the pelvis in which the femoral head acts at the ball and the acetabulum as the socket(.Neuman 2010).

2.1.3 Pathophysiology

Osteoporosis refers to excessive bone loss as reflected by the deterioration of bone mass and microarchitecture, which compromises bone strength. It is a complex multifactorial endocrine disease. Its pathogenesis relies on the presence of several endogenous and exogenous risk factors, which skew the physiological bone remodeling to a more catabolic process that results in net bone loss.(Chin et al, 2022). Keep in mind that osteoporosis occurs in many people who have few or no risk factors for this condition. Often, patients who have not sustained a fracture do not report symptoms that would alert the clinician to suspect a diagnosis of osteoporosis; thus, this disease is a "silent thief" that generally does not become clinically apparent until a fracture occurs(Chin et al, 2022).

Osteoporosis may be confused with osteomalacia. The normal human skeleton is composed of a mineral component, calcium hydroxyapatite (60%), and organic material, mainly collagen (40%). In osteoporosis, the bones are porous and brittle, whereas, in osteomalacia, the bones are soft. This difference in bone consistency is related to the mineral-to-organic material ratio. In osteoporosis, the mineral-to-collagen ratio is within the reference range, whereas in osteomalacia, the proportion of mineral composition is reduced relative to organic material content(Elam 2022).

2.1.3.1 Biological Causes of Osteoporosis:

In adults, the daily removal of small amounts of bone mineral, a process called resorption, is balanced by an equal deposition of new mineral in order to maintain bone strength. When this balance tips toward excessive resorption, bones weaken and over time can become brittle and prone to fracture (osteoporosis).This continual resorption and re-deposition of bone mineral, or bone remodeling, is intimately tied to the pathophysiology of osteoporosis. Understanding how bone remodeling is regulated is the key to the effective prevention and treatment of osteoporosis.

Bones have evolved to be light yet strong. These properties are conferred to a large degree by architecture and geometry (Martin ,2010).

The long bones are tubular in shape, with a strong outer shell, or cortical layer, surrounding a spongier core called trabecular bone (Parfitt 2001).

The combination makes these bones strong and light, but flexible enough to absorb the stress – from high impact exercises – without breaking. The vertebrae are similarly constructed, with a thick cortical layer surrounding sheets of trabecular bone. As a unit, each vertebra can compress when temporarily loaded and then return to their original size.

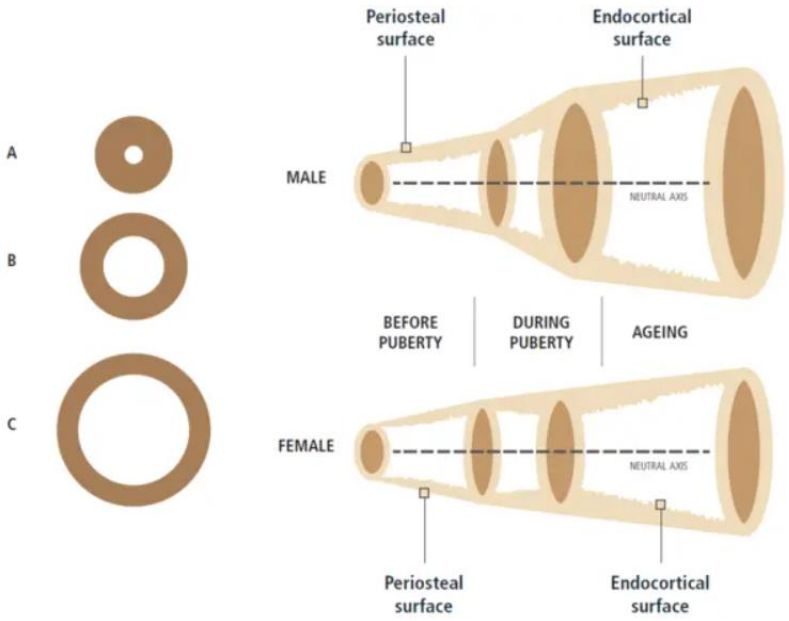


Fig 2.14: The influence of bone geometry on bone strength.
Source :international osteoporosis foundation(2023)

LEFT: For the same areal BMD, bone C has progressively greater bending strength and axial strength than bone B and bone A because the mass of bone C is distributed further away from the center . RIGHT: Sex and ageing differences in periosteal apposition and endocortical resorption in tubular bones(Seeman 2008).

However, a skeleton is alive and must be able to grow, heal, and respond to its environment. This is where bone remodeling plays a crucial role. However, as we age, daily remodeling leads to a gradual resorption of the minerals on the inside of the cortical layer and in the bone cavity itself leads to an inexorable loss of trabecular bone and a widening of the bone cavity. This is partly compensated for by the gradual addition of extra layers of mineral to the outside of the cortical layer (Seeman, 1997).

Continual remodeling, and its effect on bone microarchitecture have a huge impact on the pathophysiology of osteoporosis. For example, young adults with wider femurs might be at higher risk for hip fractures late in life because, on average, wider bones tend to have thinner cortical layers. The thinner this layer is, the more susceptible it will be to resorption later in life(seeman ,2006).

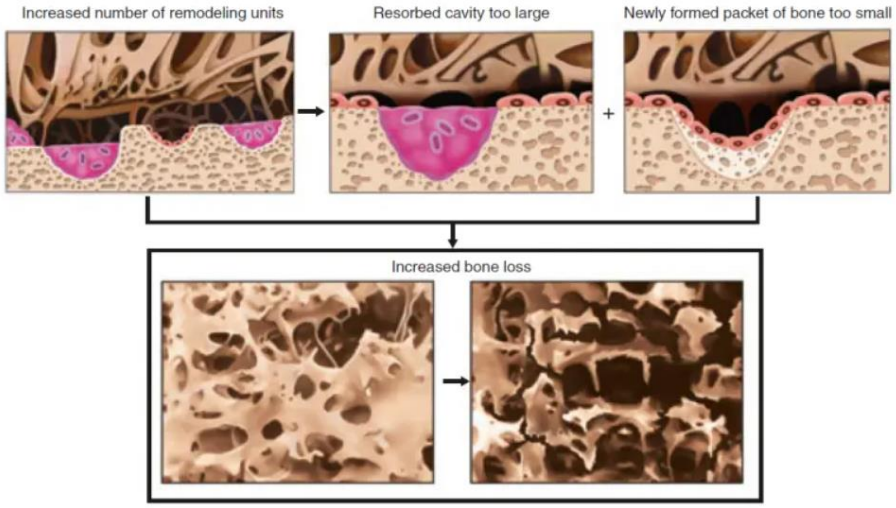


Fig 2.15 : The increase in bone remodeling causes bone loss leading to fragility on bone strength. Source :international osteoporosis foundation (2023)

2.1.3.2 The Cellular Connection:

The balance between bone resorption and bone deposition is determined by the activities of two principle cell types, osteoclasts and osteoblasts, which are from two different origins. Osteoclasts are endowed with highly active ion channels in the cell membrane that pump protons into the extracellular space, thus lowering the pH in their own microenvironment (Blair 1989).

This drop in pH dissolves the bone mineral. They also produce in this microenvironment proteolytic enzymes, among them cathepsin K, which dissolve bone matrix. Osteoblasts, through a yet poorly characterized mechanism, lay down new bone mineral. The balance between the activities of these two cell types governs whether bone is made, maintained, or lost. The activities of these cells are also intimately intertwined. In a typical bone remodeling cycle, osteoclasts are activated first, leading to bone resorption (see bone biology – bone remodeling). Then, after a brief "reversal" phase, during which the resorption "pit" is occupied by osteoblasts precursors, bone formation begins as progressive waves of osteoblasts form and lay down fresh bone matrix(Orwoll 2003). Because the bone formation phase typically takes much longer than the resorption phase, any increase in remodeling activity tends to result in a net loss of bone. At various stages throughout this process, the precursors, osteoclasts, and osteoblasts communicate with each other through the release of various "signaling" molecules(Seeman 2006). How these signaling molecules and various other endogenous (such as hormones) or external (such as diet and exercise) factors influence the cells involved in bone physiology is a topic of intense research activity.

2.1.3.3 Factors Influencing Osteoclasts And Osteoblasts:

2.1.3.3.1 Hormones

Hormones are possibly the most crucial modulators of bone formation. It is well established that estrogen . parathyroid hormone . and to a lesser extent testosterone directly or indirectly via the conversion into estrogen .(Lidsay 1993) are essential for optimal bone development and maintenance. Of these, estrogen is now believed to have the most direct effect on bone cells, interacting with specific proteins, or receptors, on the surface of osteoblasts and osteoclasts.(zallone 2006)This interaction sets off a complex chain of events within the cells, increasing osteoblast activity while at the same time interfering with osteoblast-osteoclast communication – one of the ironies of bone remodeling is that the osteoblasts release factors that stimulate osteoclasts and drive bone resorption, as we shall see below. Estrogen effects are mediated through one specific type of cell surface receptor called the estrogen receptor alpha (ERα), which binds and transports the hormone into the nucleus of the cell where the receptor-hormone complex acts as a switch to turn on specific genes. ERα receptors are found on the surface of osteoblasts, as is estrogen receptor-related receptor alpha (ERRα), which may play an auxiliary role in regulating bone cells . Recent studies also suggest that sex hormone binding globulin (SHBG), which facilitates entry of estrogen into cells, may also play a supportive role . Estrogen, of course, is made and secreted into the bloodstream some distance from bone and it also has profound effects on other tissues, such as the uterus and breast. But there are other, locally produced signaling molecules that have profound effects on bone physiology (Pilbeam et al, 2002).

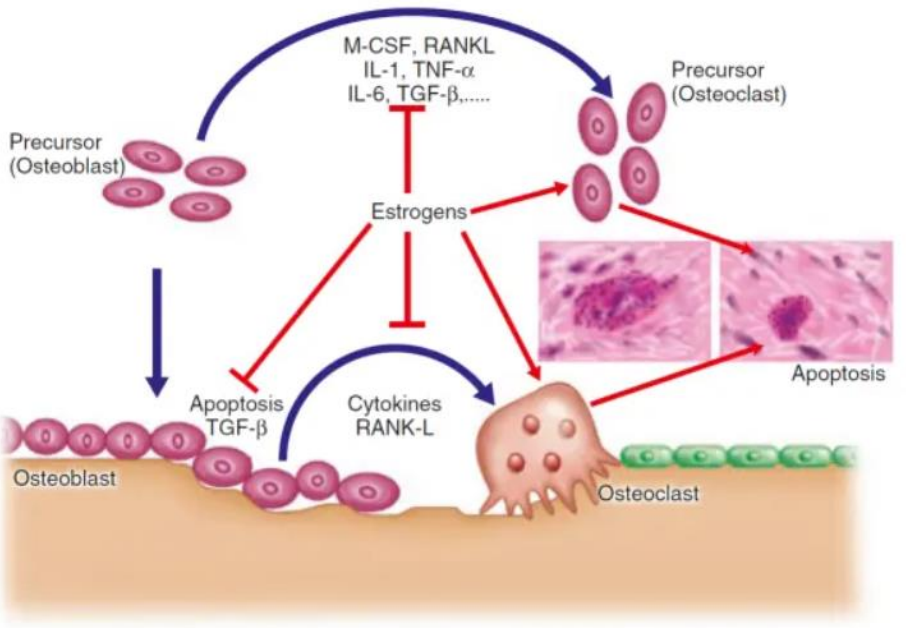


Fig. 2.16 : Cytokine production under the control of estrogen in bone and bone remodeling.
Source : international osteoporosis foundation (2023)

2.1.3.3.2 Calcium deficiency:

Calcium, vitamin D, and PTH help maintain bone homeostasis. Insufficient dietary calcium or impaired intestinal absorption of calcium due to aging or disease can lead to secondary hyperparathyroidism. PTH is secreted in response to low serum calcium levels. It increases calcium resorption from bone, decreases renal calcium excretion, and increases renal production of 1,25-dihydroxyvitamin D (1,25[OH]2 D)—an active hormonal form of vitamin D that optimizes calcium and phosphorus absorption, inhibits PTH synthesis, and plays a minor role in bone resorption(Elam 2022).

2.1.3.3.3 Vitamin D deficiency:

Vitamin D deficiency is prevalent in the older population and can result in secondary hyperparathyroidism via decreased intestinal calcium absorption(Elam2022).

2.1.3.4 The Role of Genetics And Environmental Factors:

Subtle differences in the genetic code might explain why one person's osteoblasts or osteoclasts are more active or responsive to their environment, and it might also lead to the discovery of unknown regulatory mechanisms. Environmental factors can also have an enormous impact on bone physiology.

2.1.3.5 Epigenetics:

Prenatal and postnatal factors contribute to adult bone mass. In one study, the health of the mother in pregnancy, the infant's birth weight, and the child's weight at age 1 year were predictive of adult bone mass in the seventh decade for men and women. It is postulated that growth in the first year of life programs growth hormone secretion, and that this programming is maintained into the seventh decade. Higher birth weight and rapid growth in the first year of life predicted increased bone mass in adults aged 65-75 years. Maternal nutritional imbalance and deficiency may have an effect that is transmitted to the next generation.(Marini et al, 2016)

2.1.3.6 Signs And Symptoms

Osteoporosis does not become clinically apparent until a fracture occurs and so is sometimes referred to as the "silent disease." Two-thirds of vertebral fractures are painless, although patients may complain of the resulting stooped posture and height loss(Elam2022).

2.1.3.6.1 Typical Findings In Patients With Painful Vertebral Fractures May Include The Following:

- The episode of acute pain may follow a fall or minor trauma.
- Pain is localized to a specific, identifiable, vertebral level in the midthoracic to lower thoracic or upper lumbar spine.
- The pain is described variably as sharp, nagging, or dull; movement may exacerbate pain; in some cases, pain radiates to the abdomen.
- Pain is often accompanied by paravertebral muscle spasms exacerbated by activity and decreased by lying supine.
- Patients often remain motionless in bed because of fear of exacerbating the pain.
- Acute pain usually resolves after 4-6 weeks; in the setting of multiple fractures with severe kyphosis, the pain may become chronic.

2.1.3.6.2 Patients Who Have Sustained A Hip Fracture May Experience The Following:

- Pain in the groin, posterior buttock, anterior thigh, medial thigh, and/or medial knee during weight-bearing or attempted weight-bearing of the involved extremity
- Diminished hip range of motion (ROM), particularly internal rotation and flexion
- External rotation of the involved hip while in the resting position.

2.1.3.6.3 On Physical Examination, Patients With Vertebral Compression Fractures May Demonstrate The Following:

- With acute vertebral fractures, point tenderness over the involved vertebra
- Thoracic kyphosis with an exaggerated cervical lordosis (dowager's hump)
- Subsequent loss of lumbar lordosis
- A decrease in the height of 2-3 cm after each vertebral compression fracture and progressive kyphosis

2.1.3.6.4 Patients With Hip Fractures May Demonstrate The Following:

- Limited ROM with end-range pain on a FABER (flexion, abduction, and external rotation) hip joint test
- Decreased weight-bearing on the fractured side or an antalgic gait pattern

2.1.3.6.5 Patients With Colles Fractures May Have The Following:

- Pain on movement of the wrist
- Dinner fork (bayonet) deformity

2.1.3.6.6 Patients With Pubic And Sacral Fractures May Have The Following:

- Marked pain with ambulation
- Tenderness to palpation, percussion, or both
- With sacral fractures, pain with physical examination techniques used to assess
- the sacroiliac joint (eg, FABER, Gaenslen, or squish test)

Balance difficulties may be evident, especially in patients with an altered center of gravity from severe kyphosis. Patients may have difficulty performing tandem gait and performing single-limb stance.

2.1.3.7 Etiology:

Etiologically, osteoporosis is categorized as primary or secondary.

2.1.3.7.1 Primary Osteoporosis:

Primary osteoporosis is the most common form of osteoporosis. It is divided into juvenile and idiopathic osteoporosis; idiopathic osteoporosis can be further subdivided into postmenopausal (type I) and age-associated or senile (type II) osteoporosis. Postmenopausal osteoporosis is primarily due to estrogen deficiency. Senile osteoporosis is primarily due to an aging skeleton and calcium deficiency.

Table 2.1: Primary osteoporosis

Type Of Primary Osteoporosis	Characteristics
Juvenile osteoporosis	• Usually occurs in children or young adults of both sexes • Normal gonadal function • Age of onset: usually 8-14 years • Hallmark characteristic: abrupt bone pain and/or a fracture following trauma
Idiopathic osteoporosis	
• Postmenopausal osteoporosis (type I osteoporosis)	• Occurs in women with estrogen deficiency • Characterized by a phase of accelerated bone loss, primarily from trabecular bone • Fractures of the distal forearm and vertebral bodies common
• Age-associated or senile osteoporosis (type II osteoporosis)	• Occurs in women and men as BMD gradually declines with aging • Represents bone loss associated with aging • Fractures occur in cortical and trabecular bone • Wrist, vertebral, and hip fractures often seen

2.1.3.7.2 Secondary osteoporosis :

Secondary osteoporosis occurs when an underlying disease, deficiency, or drug causes osteoporosis. Up to one-third of postmenopausal women, as well as many men and premenopausal women, have a coexisting cause of bone loss, of which renal hypercalciuria is one of the most important secondary causes of osteoporosis and treatable with thiazide diuretics (Adam et al. 1999).

Table 2.2: secondary osteoporosis

Cause	Examples
Genetic/congenital	• Renal hypercalciuria – one of the most important secondary causes of osteoporosis; can be treated with thiazide diuretics • Cystic fibrosis • Ehlers-Danlos syndrome • Glycogen storage disease • Gaucher disease • Marfan syndrome • Menkes steely hair syndrome • Riley-Day syndrome • Osteogenesis imperfecta • Hemochromatosis • Homocystinuria • Idiopathic hypercalciuria • Hypogonadal states
Hypogonadal states	• Androgen insensitivity • Anorexia nervosa/bulimia nervosa • Female athlete triad • Hyperprolactinemia • Panhypopituitarism • Premature menopause • Turner syndrome • Klinefelter syndrome
Endocrine disorders	• Cushing syndrome • Diabetes mellitus • Acromegaly • Adrenal insufficiency • Estrogen deficiency • Growth hormone deficiency • Hypercortisolism • Hyperparathyroidism • Hyperthyroidism • Hypogonadism • Hypophosphatasia • Pregnancy

Deficiency states and malabsorption syndromes	• Alcoholism • Anorexia nervosa • Calcium deficiency • Magnesium deficiency • Protein deficiency • Vitamin D deficiency • Bariatric surgery • Celiac disease • Cystic fibrosis • Gastrectomy • Malnutrition • Parenteral nutrition • Chronic liver disease
Inflammatory diseases	• Inflammatory bowel disease/Crohn disease • Ankylosing spondylitis • Rheumatoid arthritis • Systemic lupus erythematosus
Hematologic and neoplastic disorders	• Hemochromatosis • Hemophilia • Leukemia • Lymphoma • Multiple myeloma • Sickle cell anemia • Systemic mastocytosis • Thalassemia • Metastatic disease
Medications	• Anticonvulsants • Antipsychotic drugs • Antiretroviral drugs • Aromatase inhibitors • Chemotherapeutic/transplant drugs: cyclosporine, tacrolimus, platinum compounds, cyclophosphamide, ifosfamide, high-dose methotrexate • Furosemide • Glucocorticoids and corticotropin : prednisone (≥5 mg/day for ≥3 mo) • Heparin (long term) • Hormonal/endocrine therapies: gonadotropin-releasing hormone (GnRH) agonists, luteinizing hormone-releasing hormone (LHRH) analogues, depomedroxyprogesterone, excessive thyroxine • Lithium • Proton pump inhibitors • Selective serotonin reuptake inhibitors (SSRIs) • SGLT2- inhibitors • Thiazolidinediones

2.1.3.8 Risk factors:

Risk factors for osteoporosis, such as advanced age and reduced bone mineral density (BMD), have been established by virtue of their direct and strong relationship to the incidence of fractures; however, many other factors have been considered risk factors based on their relationship to BMD as a surrogate indicator of osteoporosis (Elam2022).

2.1.3.8.1 Risk factors for osteoporosis include the following :

- Advanced age (≥50 years)
- Female sex
- White or Asian ethnicity
- Genetic factors, such as a family history of osteoporosis
- Thin build or small stature (eg, bodyweight less than 127 lb [57.6 kg])
- Amenorrhea
- Late menarche
- Early menopause
- Postmenopausal state
- Physical inactivity or immobilization
- Use of certain drugs (eg, anticonvulsants, systemic steroids, thyroid supplements, heparin, chemotherapeutic agents, insulin)
- Alcohol and tobacco use
- Androgen or estrogen deficiency
- Calcium or vitamin D deficiency
- Dowager hump

2.1.3.9 Diagnosis :

2.1.3.9.1 Imaging modality :

Bone mineral density (BMD) and dual-energy x-ray absorptiometry (DXA)

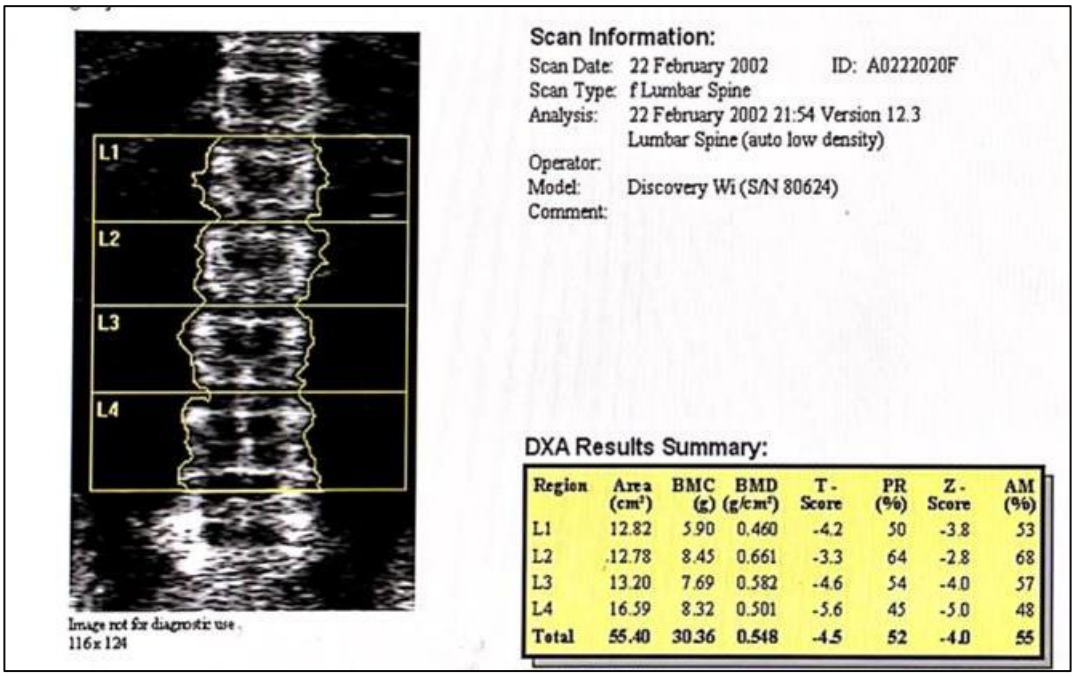
As traditional X-rays cannot measure bone density and can only identify spine fractures, a bone mineral density (BMD) test must be measured by more specialized techniques. The most commonly used BMD test is a densitometric technique called DXA (dual-energy X-ray absorptiometry), which can be measured in vivo and has been validated by many studies for fracture risk assessment . DXA is a fast, quantitative technique that is capable of detecting quite small percentages of bone loss by measuring the attenuation through the body of low radiation X-ray beams with two different photon energies , using hydroxyapatite (bone mineral) and soft tissue as reference materials. To identify the bone outline at particular sites, edge detection software is employed .The bone density of the whole skeleton can be evaluated, but the most commonly measured sites to assess the risk of osteoporosis using DXA are the proximal femur (and femoral neck) and lumbar spine (L1-L4).

DXA provides the patient's T-score, which is the BMD value compared with that of control subjects who are at their peak BMD. World Health Organization (WHO) criteria define a normal T-score value as within 1 standard deviation (SD) of the mean BMD value in a healthy young adult. Values lying farther from the mean are stratified as follows :

- T-score of –1 to –2.5 SD indicates osteopenia .
- T-score of less than –2.5 SD indicates osteoporosis .
- T-score of less than –2.5 SD with fragility fracture(s) indicates severe osteoporosis(Elam 2022).

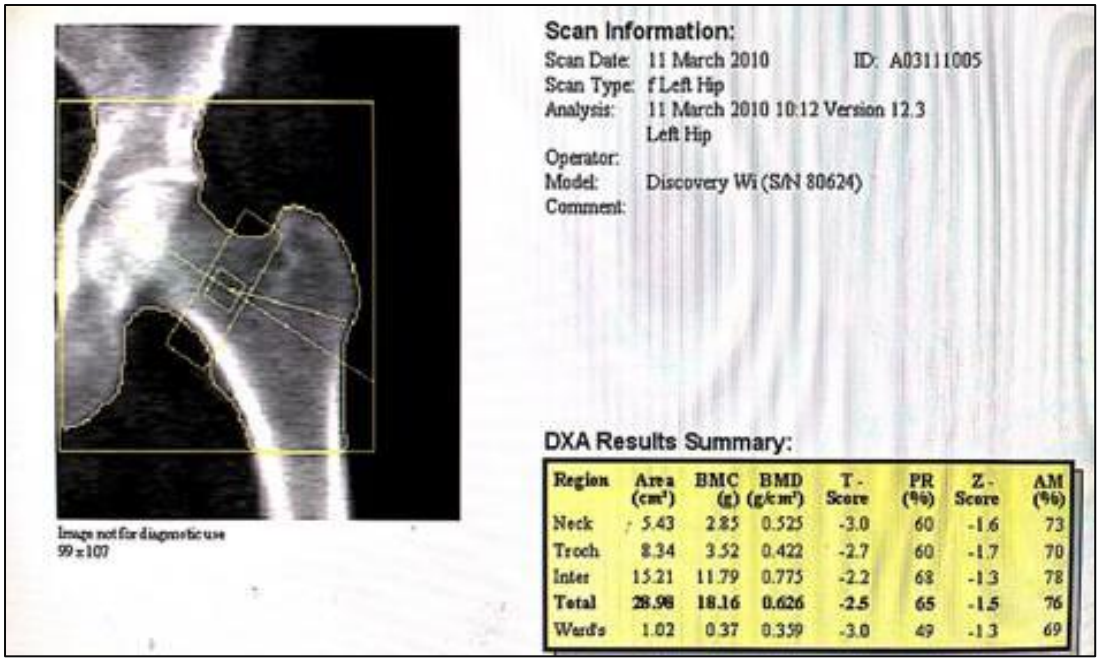
DXA also provides the patient's Z-score, which reflects a value compared with that of persons matched for age and sex. Z-scores adjusted for ethnicity or race should be used in the following patients:

- Premenopausal women .
- Men younger than 50 years .
- Children .



Region	Area (cm^2)	BMC (g)	BMD (g/cm^2)	T-Score	PR (%)	Z-Score	AM (%)
L1	12.82	5.90	0.460	-4.2	50	-3.8	53
L2	12.78	8.45	0.661	-3.3	64	-2.8	68
L3	13.20	7.69	0.582	-4.6	54	-4.0	57
L4	16.59	8.32	0.501	-5.6	45	-5.0	48
Total	**55.40**	**30.36**	**0.548**	**-4.5**	**52**	**-4.0**	**55**

Fig 2.17 : Lumber spine scan (Hologic 2007)



Scan Information:

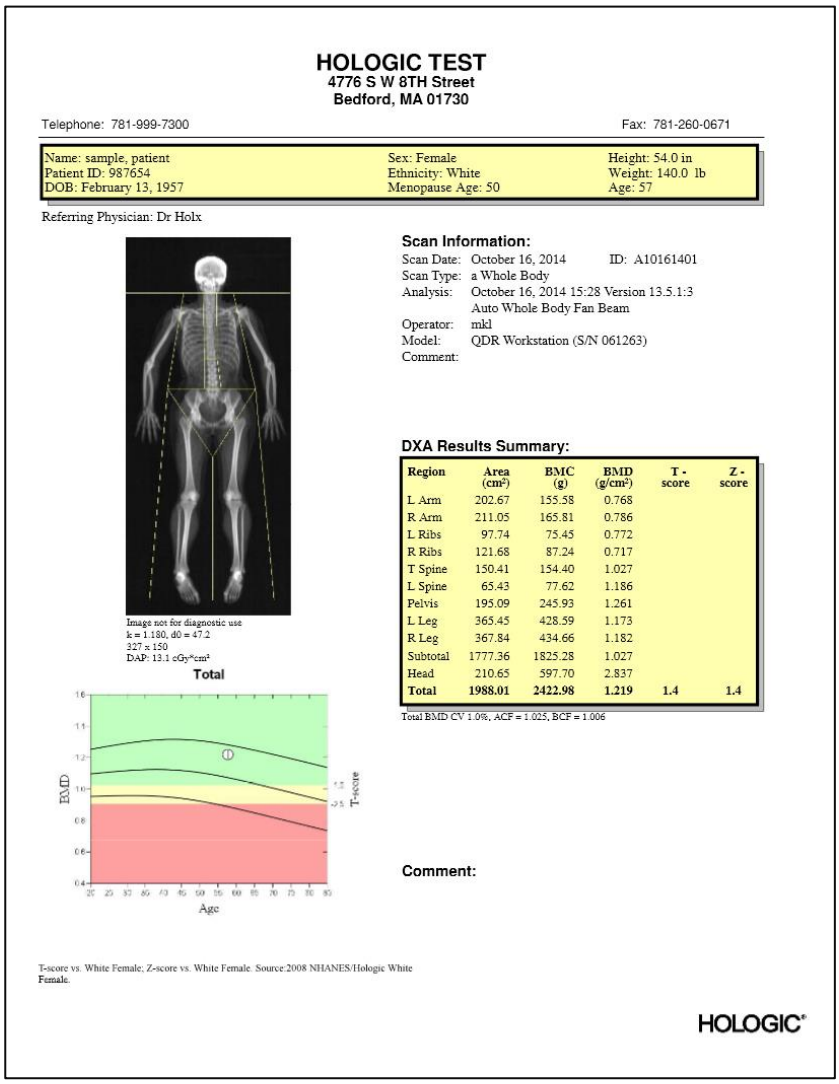
Scan Date: 11 March 2010 ID: A03111005
Scan Type: f Left Hip
Analysis: 11 March 2010 10:12 Version 12.3
Left Hip
Operator:
Model: Discovery Wi (S/N 80624)
Comment:

Image not for diagnostic use
99 x 107

DXA Results Summary:

Region	Area (cm²)	BMC (g)	BMD (g/cm²)	T - Score	PR (%)	Z - Score	AM (%)
Neck	5.43	2.85	0.525	-3.0	60	-1.6	73
Troch	8.34	3.52	0.422	-2.7	60	-1.7	70
Inter	15.21	11.79	0.775	-2.2	68	-1.3	78
Total	**28.98**	**18.16**	**0.626**	**-2.5**	**65**	**-1.5**	**76**
Ward's	1.02	0.37	0.359	-3.0	49	-1.3	69

Fig 2.18 : Hip scan (Hologic, 2007)



HOLOGIC TEST
4776 S W 8TH Street
Bedford, MA 01730

Telephone: 781-999-7300 Fax: 781-260-0671

Name: sample, patient
Patient ID: 987654
DOB: February 13, 1957

Sex: Female
Ethnicity: White
Menopause Age: 50

Height: 54.0 in
Weight: 140.0 lb
Age: 57

Referring Physician: Dr Holx

Scan Information:

Scan Date: October 16, 2014 ID: A10161401
Scan Type: a Whole Body
Analysis: October 16, 2014 15:28 Version 13.5.1:3
Auto Whole Body Fan Beam
Operator: mkl
Model: QDR Workstation (S/N 061263)
Comment:

Image not for diagnostic use
k = 1.180, d0 = 47.2
227 x 150
DAP: 13.1 cGy*cm²

Total

BMD
T-score
Age

DXA Results Summary:

Region	Area (cm²)	BMC (g)	BMD (g/cm²)	T - score	Z - score
L Arm	202.67	155.58	0.768		
R Arm	211.05	165.81	0.786		
L Ribs	97.74	75.45	0.772		
R Ribs	121.68	87.24	0.717		
T Spine	150.41	154.40	1.027		
L Spine	65.43	77.62	1.186		
Pelvis	195.09	245.93	1.261		
L Leg	365.45	428.59	1.173		
R Leg	367.84	434.66	1.182		
Subtotal	1777.36	1825.28	1.027		
Head	210.65	597.70	2.837		
Total	**1988.01**	**2422.98**	**1.219**	**1.4**	**1.4**

Total BMD CV 1.0%, ACF = 1.025, BCF = 1.006

Comment:

T-score vs. White Female; Z-score vs. White Female. Source:2008 NHANES/Hologic White Female.

HOLOGIC®

Fig 2.19 : Whole body scan (Hologic)

2.1.3.10 Management:

Lifestyle modification for the prevention of osteoporotic fractures includes the following (Camacho 2019):

- Increasing weight-bearing and muscle-strengthening exercise to improve agility, strength, posture, and balance, which may reduce the risk of falls.
- Ensuring optimum calcium and vitamin D intake as an adjunct to active anti-fracture therapy and balanced diet.
- Tobacco cessation .
- Limiting alcohol consumption .
- Removing potential risk factors to avoid falls.

2.1.3.11 Treatment :

2.1.3.11.1 Generalities:

Pharmacological treatments for postmenopausal women with osteoporosis are prescribed to decrease the risk of fragility fractures. Many drugs with different mechanisms of action have been approved for the prevention and treatment of osteoporosis, are effective and available worldwide. These medications must be used in conjunction with calcium and vitamin D supplements, recommended lifestyle changes, adequate nutrition and physical activity. (International foundation of osteoporosis)

The commonly available treatments are:

- Bisphosphonates.
- Menopausal hormone replacement therapy (MHT), also known as hormone replacement therapy (HRT), and Selective estrogen Receptor Modulators (SERM).
- Anabolic.

2.1.3.11.2 Treatment Types:

Treatments can be divided into two categories:

- Anti-resorptive agents, which include estrogen, selective estrogen receptor modulators (SERM), bisphosphonates (BP) and denosumab, reduce bone resorption (and subsequently bone formation), preserving bone mineral density (BMD).
- Anabolic agents, which include teriparatide (PTH1-34) and abaloparatide (34 amino acid synthetic analogue of parathyroid hormone-related protein (PTHRP)) stimulate bone formation (and subsequently bone resorption), thereby increasing BMD.

2.1.3.11.3 In Addition to Treatment:

In addition to drug therapy, calcium and vitamin D supplements can be prescribed to ensure maximum effectiveness of the medication.
Health care professionals and patients should also be aware that attention to lifestyle factors (including risk factors, nutrition and exercise) must go hand in hand with any drug treatment prescribed.

2.1.3.11.4 Side Effects:

Each class of medications has different mechanisms of action and its distinct profile of side effects. These are described with each medication. For patients at risk of a side effect, the physician selects the most appropriate treatment, if possible avoiding the one causing the side effect. For people at high risk of fracture, the benefit of a treatment in decreasing the risk of fracture far outweigh the risk of serious side effects.

2.2 Previous studies :

Klingberg, Lorentzon, et al. (2012) aimed to investigate prevalence and risk factors for reduced BMD in a Swedish cohort of AS patients, and to examine how progressive ankylosis influences BMD with the use of dual-energy x-ray absorptiometry (DXA) of the lumbar spine in different projections.This study included 87 women and 117 men in their 50s and above.The results informed that 21% diagnosed with osteoporosis and 44% with osteopenia. women had significantly more lumbar osteoporosis. Osteoporosis and osteopenia is common in AS and associated with high disease burden. Lateral and volumetric lumbar DXA are more sensitive than AP DXA in detecting osteoporosis and are less affected by syndesmophyte formation.

Shin,et al.(2010) aimed to investigate bone mineral density (BMD) profiles, osteoporosis prevalence and risk factors in a community-based cohort in Korea. The study population consisted of 1,547 men and 1991 women aged 40 years and older. Crude prevalence of osteoporosis in the whole subjects was 13.1% for men and 24.3% for women at any site among lumbar spine, femoral neck or total hip Standardized prevalence of osteoporosis between age of 50 and 79 at lumbar spine, femoral neck and total hip was 12.9%, 1.3% and 0.7% in men and 24.0%, 5.7% and 5.6% in women.

Yoon, Kang (2022). This study aimed to T-score discordance between the spine and hip is commonly observed when dual energy X-ray absorptiometry (DXA) is used to diagnose osteoporosis in korea . included 200 patients (37 men, 163 women) treated for thoracic or lumbar compression fractures between January 2015 and August 2021. T-score concordance, minor discordance, and major discordance were observed in 137(68.5%), 59 (29.5%), and 4 (2%) patients spinal T-score was lower than the femoral T-score in all major discordance and 81.3% (48/59) of minor discordant causes. The results of this study showed that a significant number of subjects showed spine-hip discordance, even with a mean age in their 80s.

Mir,et al .(2017). This study aimed to find prevalence of osteoporosis and relation of age, body weight and Body Mass Index (BMI) with Bone Mineral Density (BMD) in postmenopausal Kashmiri women. Nearly 80 % of Kashmiri are osteoporotic at the lumbar spine. While as only one fourth's are osteoporotic with respect to total body BMD and only one fifth's with respect to proximal femur BMD. With increasing age BMD decreases at all the sites. Increase in body weight and BMI have a protective role against osteoporosis with exception of lumbar spine where BMI is not protective. Body weight is a better predictor of BMD than BMI at all the sites.

Salari, et al.(2021) In this study, the prevalence of osteoporosis among elders around the world is examined to gain an understanding of its prevalence pattern. studied the prevalence of osteoporosis in the elders and especially elders' women is very high. Osteoporosis was once thought to be an inseparable part of elders' lives. Nowadays, osteoporosis can be prevented due to significant scientific advances in its causes, diagnosis, and treatment. Regarding the growing number of elderly people in the world, it is necessary for health policy-makers to think of measures to prevent and treat osteoporosis among the elders.

Al Zaid, et al. (2022). this study aimed to prevalence and risk factors of discordance between hip and spinal bone mineral density among Saudi Subjects. reported the osteoporosis in 73 (5.3%) of the participants. Major discordance was documented in 85 (6.1%) of all participant All of these subjects had lumbar spine osteoporosis with normal hip bone mineral density (BMD). Minor discordance was found in 591 patients (42.6%). Obesity (BMI > 30) was found to be a risk factor for both major and minor discordance.

Chapter 3

Methodology

Methodology

3.1Methods

3.1.1 Study design:

This study conduct a retrospective cross-sectional design

3.1.2 Study area :the radiology departments in Sana′a hospitals and diagnostic centers which include :

- Ust hospital (radiology department)
- European hospital (radiology department)
- New scan center
- Al- mamoun center
- Al- razi center
- Al yemen alsaeid hospital (Radiology department)

3.1.3 Study population :

The population of this study was taken from the patients who undergone DEXA since 2012 to 2023 .

3.1.4 Sample size :

The sample size for this study consisted of 1551 patients who undergone DXA for the hip and lumber spine ,738 were osteoporotic in lumber spine and 323 in hip .

3.1.5 Sampling method:

All the data was selected from the PACS of the hospitals and the centers that was selected in this research , for all patient who undergone DEXA for the hip and spine .

3.1.6 Inclusion criteria :

All the patient that undergone DEXA test for the hip and lumber spine .

3.1.7 Exclusion criteria :

The patients with prosthetic joints and any form of metal .

3.1.8 Study Variables:

The study variables include age , height , weight , gender and BMI , Also the probability of hip fracture in 10 and 5 years .

3.1.9 Data analysis:

The data analyzed using SPSS(24version) with the use of correlation ,regression and crosstabulation analysis . The α- level (level of significance) was 0.05 which will considered significant .The hip fracture risk calculator tool was from Garvan Institute Of Medical Research.

3.1.10 Ethical Consideration :

This study was under the guideline of the supervisors and followed the rules and the protocols of the radiology department that provided the data for this study .

Patients privacy and their information was only used for the scientific research purpose .

3.2 Materials :

The data collection tools in this study are DEXA units with three versions and the fracture risk calculator to estimate hip bone fracture risk.

3.2.1 Tools :

3.2.2 DEXA:

Company	Software	Version
Hologic	**QDR Discovery**	**2007**
GE	**Lunar**	**2013**
Osteosys	**Primus**	**2017**

The differences between the two systems that the Hologic systems employ a single-pass wide-angle fan beam, while GE-Lunar systems use a multi-pass narrow-angle fan beam with some overlap between passes. The current DXA software is highly automated for the placement of ROI, while the older software versions were completely manual (Fan, et al 2010). There is no much information available for the Primus software.

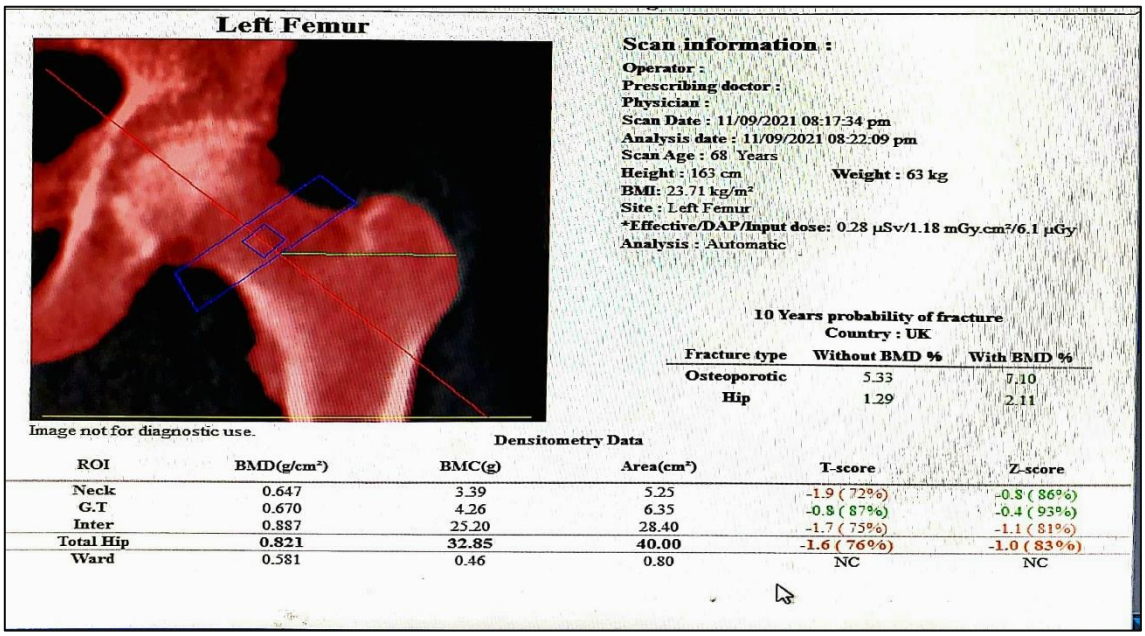


Fig. 3.1: Hologic Software (QDR Discovery 2007)

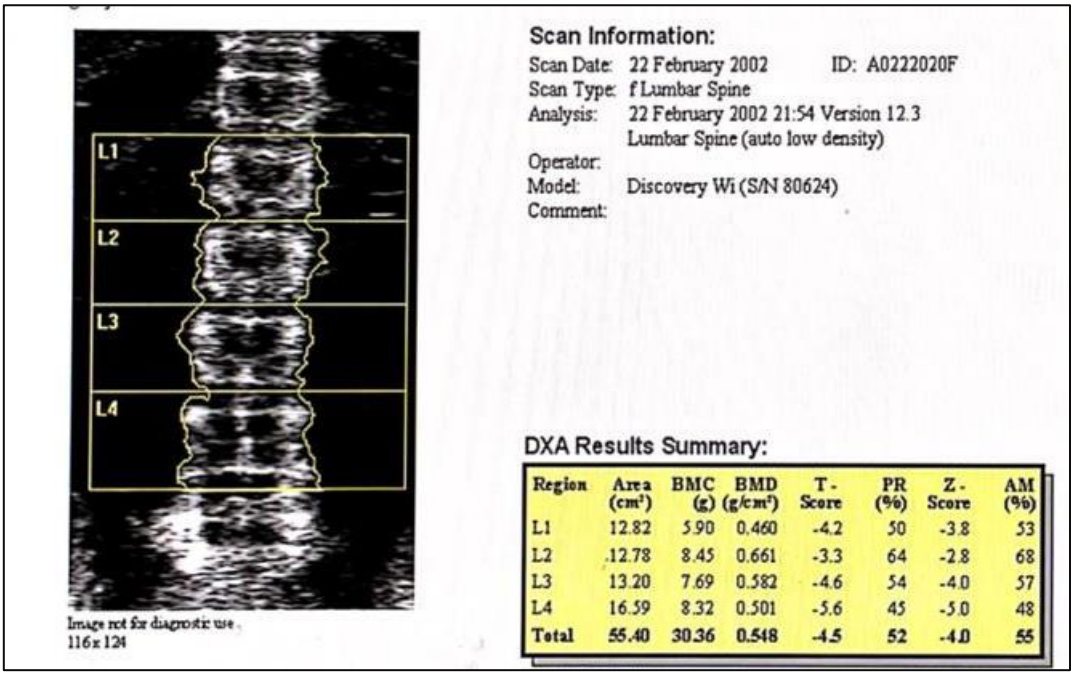


Fig. 3.2: GE Software (Lunar 2013)

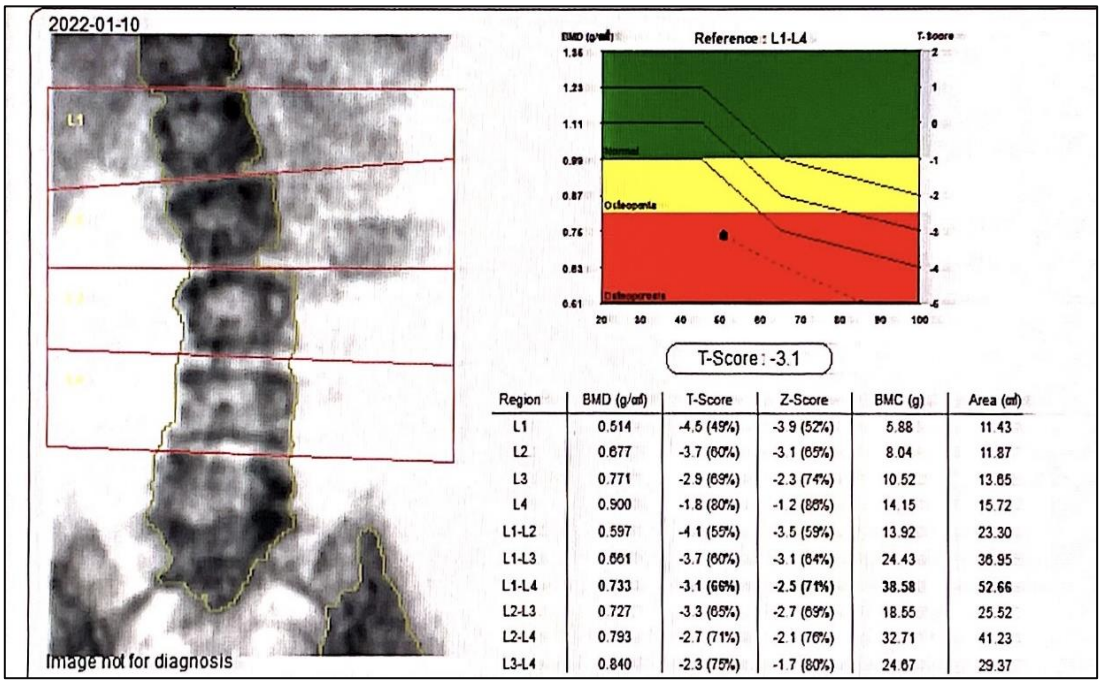


Fig. 3.3: Osteosys Software (Primus 2017)

3.2.3 GARVAN fracture risk calculator:

This tool calculates the hip fracture risk just for the patient above 50 and it provides selection for the two software of Hologic and lunar .

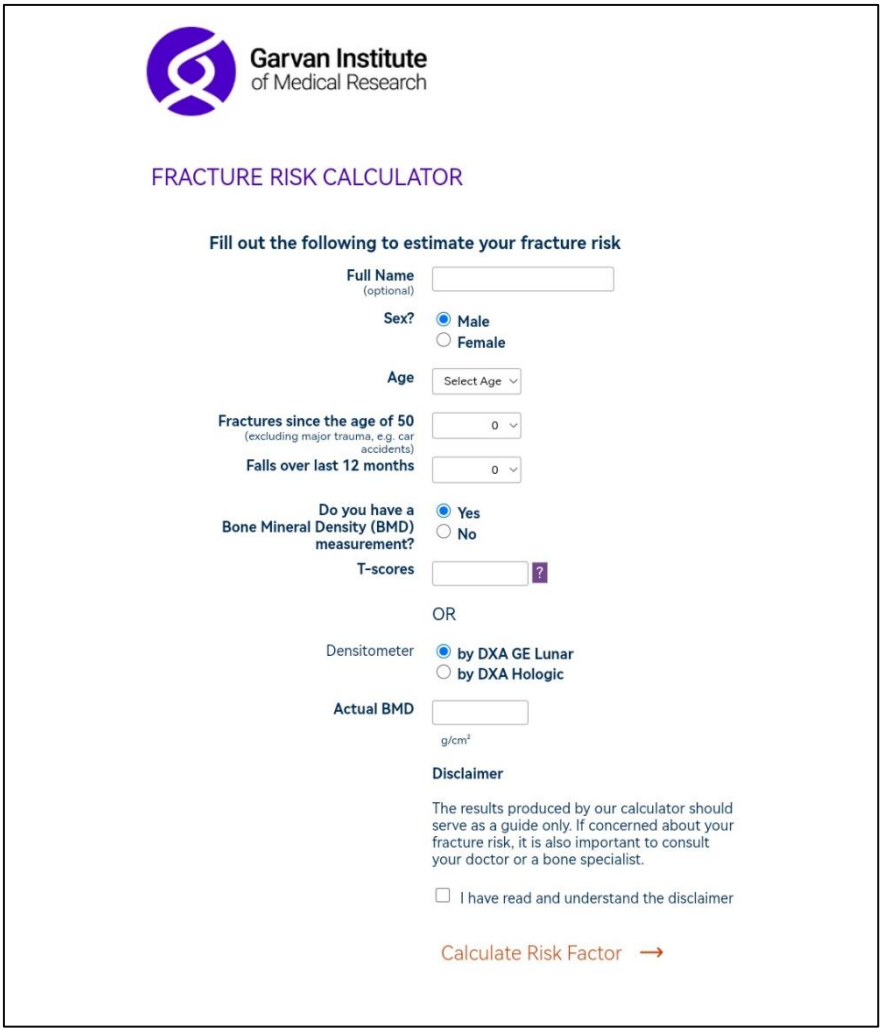


Fig. 3.4: GARVAN fracture risk calculator

Chapter 4

Result & Discussion

4.1 Result :

This cross sectional descriptive study aimed to assess the prevalence of osteoporosis in Yemenis population using DEXA according to their demographic variables.

Table 4.1: Distribution of study sample according to their gender.

Gender	Number	%
Male	93	6%
Female	1458	94%
Total	1551	100%

Table 4.1 Showed the data were as follows : 93 (6%) were males and 1458 (94%) were females which indicated that the most of the sample size was from females with percentage of (94%).

Table 4.2 : Distribution of study sample according to age group .

Age Group	Number	%
Less than 40	245	15.8%
41-50	285	18.4%
51-60	478	30.8%
61-70	363	23.4%
Above 70	179	11.5%
Total	1550	99.9%

Table 4.2 presented the distribution of the sample size which was selected randomly, indicate that the most selected sample size were from 51 to 60 and the second most selected sample size was the age from 61 to 70 .

Table 4.3 : Distribution of study sample according to the state of the cases .

O.p features	State	Number	%
Hip	Normal	786	50.7%
	Osteoporosis	323	20.8%
	Osteopenia	435	28%
	Missing	7	5%
Lumber	Normal	430	27.7%
	Osteoporosis	738	47.6%
	Osteopenia	383	24.7%

Table 4.3 showed the distribution according to the state of the cases which every patient had to examine the hip and the lumber spine, in 7 cases the patient undergone lumber scanning only .The normal cases in the hip were more than the lumber spine cases the , the osteoporotic and osteopenia cases were more in the lumber spine than in hip.

Table 4.4: Distribution of the cases states in the lumber spine and hip together.

		Lumber			
		Normal	Osteoporosis	Osteopenia	Total
Hip	Normal	395	130	261	786
	Osteopenia	29	292	114	435
	Osteoporosis	4	311	8	323
	Total	428	733	383	1544

Table 4.4 showed the states distribution of the cases in the two sites of scanning , the normal cases was seen in 395 patients and the osteoporotic cases was seen in 311 and the osteopenia was seen in 114 patients .The perfect concordance was seen in 784 cases (395 normal , 311 osteoporosis ,114 osteopenia) The major discordance was seen in 134 cases ,The minor discordance was seen in 300 cases .

Table 4.5 : Distribution of study sample according to the state of the cases with the gender for the hip .

Hip		
State	**Male**	**Female**
Normal	63	723
Osteoporosis	3	320
Osteopenia	27	408
Total	93	1451

Table 4.6: Distribution of study sample according to the state of the cases with the gender for the lumber spine.

Lumber Spine		
State	**Male**	**Female**
Normal	**41**	**389**
Osteoporosis	**22**	**716**
Osteopenia	**30**	**353**
Total	**93**	**1458**

Table 4.5 and Table 4.6 indicated the distributions of the cases states according to gender , 25 case of osteoporosis in lumber spine and hip belongs to males and 1036 cases belongs to females , 104 normal cases in males and 1112 cases in females , 57 osteopenia cases in males and 761 cases in females . There is 7 missing cases of all hip cases .

Table 4.7 Distribution of study sample according to the state of the cases with the age group for the spine and hip.

Site	State	Age group					
		Under 40	41-50	51-60	61-70	Above 70	Total
Hip	Normal	169	177	238	150	51	785
	Osteoporosis	25	46	92	106	54	323
	Osteopenia	50	62	147	106	70	435
Lumber spine	Normal	130	108	115	53	24	430
	Osteoporosis	45	107	248	217	121	738
	Osteopenia	70	70	115	93	34	382

Table 4.7 indicated the distributions of the age group according to the states of the cases. Osteoporosis was mostly seen in hip cases with the age group of 61-70 and in spine was seen in the age group of 51-60.

Table 4.8 : Correlation between the BMD and BMC to the osteoporosis features.

Variables	Site	Correlation Factors	Age	Weight	Height	T-score	Z-score
BMD	Lumber	Pearson correlation	-0.004	-0.001	0.015	-0.001	-0.002
		Sig. (2-tailed)	0.884	0.976	0.566	0.971	0.947
	Hip	Pearson correlation	-0.025	0.050	0.014	0.008	-0.008
		Sig. (2-tailed)	0.332	0.052	0.586	0.749	0.760
BMC	Lumber	Pearson correlation	-0.062	0.043	0.015	0.096	0.076
		Sig. (2-tailed)	0.015	0.090	0.544	0.000	0.003
	Hip	Pearson correlation	-0.074	0.080	0.041	0.146	0.114
		Sig. (2-tailed)	0.004	0.002	0.104	0.000	0.000

The table 4.8 indicated the correlation between BMD and BMC with the other variables Age has static significant association with inverse correlation with BMC in the two sites , inverse correlation with no static significant with BMD in the two sites .Height has direct correlation with BMD and BMC in the two sites with no static significant association. Z and T score has direct correlation with static significant associations with BMC in the two sites , inverse correlation with BMD lumber with no static significant association , BMD hip has inverse correlation with Z-score and direct correlation with T-score with no static significant associations. Weight has direct correlation with BMC AND BMD in the two sites except for lumber spine BMD and no static significant associations except for BMC hip there is association.

Table 4.9: Correlation between the T-score and Z-score to the osteoporosis features .

Variables	Site	Correlation Factors	Age	Weight	Height
T-score	Lumber	Pearson correlation	-0.312	0.308	0.196
		Sig. (2-tailed)	0.000	0.000	0.000
	Hip	Pearson correlation	-0.194	0.331	0.102
		Sig. (2-tailed)	0.000	0.000	0.000
Z-score	Lumber	Pearson correlation	0.063	0.305	0.125
		Sig. (2-tailed)	0.013	0.000	0.000
	Hip	Pearson correlation	0.095	0.305	0.073
		Sig. (2-tailed)	0.000	0.000	0.004

Table 4.9 indicated the correlation between the z and t score with the others variables .All variables has direct correlation and static significant associations with Z and T score in the two sites , except the age has inverse correlation with T-score in the two sites .

Table 4.10: Correlation between the hip fracture assessment and osteoporosis features.

Variables	Correlation Factors	Age	Weight	Height	T-score		Z-score	
					Lumber	Hip	Lumber	Hip
Five years assessment	Pearson correlation	-0.161	-0.101	0.063	-0.044	-0.268	-0.122	0.028
	Sig. (2-tailed)	0.000	0.000	0.014	0.082	0.000	0.000	0.268
Ten years assessment	Pearson correlation	-0.157	-0.103	0.062	-0.047	-0.275	-0.123	0.026
	Sig. (2-tailed)	0.000	0.000	0.016	0.063	0.000	0.000	0.311

Table 4.10 indicated the correlation between the five and ten years assessment for hip fracture with the others variables. All variables has an inverse correlation with five and ten years fracture assessment except for the Z-score hip has a direct correlation with both of them , the static significant association is indicated in all variables except in T-score lumber and Z-score hip in both of them .

Table 4.11 : Regression between the age and osteoporosis features .

Age		
O.P Features	$formula$	Sig
BMC Hip	$BMC = -0.223(age) + 39.903$	0.004
BMC Lumber	$BMC = -0.556(age) + 67.275$	0.015
BMD Hip	$BMD = -0.067(age) + 6.060$	0.332
BMD Lumber	$BMD = -0.013(age) + 4.430$	0.884
T-Score Hip	$T\_score = -0.027(age) + 5.633 - 5$	0.00
T-Score Lumber	$T\_score = -0.042(age) + 5.325 - 5$	0.00
Z-Score Hip	$Z\_score = 0.011(age) + 4.485 - 5$	0.00
Z-Score Lumber	$Z\_score = 0.008(age) + 3.667 - 5$	0.013
Ten Years Assessment	$Five\ years = -1.26(age) + 142.34$	0.000
Five Years Assessment	$Ten\ years = -1.234(age) + 143.43$	0.000

Table 4.11 indicated the statically significant association of age with other variables and provides the predictor equation. The age is statically significant associated with BMC in spine and hip ,T and Z score in the two sites and with the ten and five years assessment .The age is not statically significant associated with BMD in spine and hip .

Table 4.12: Regression between the weight and osteoporosis features .

Weight		
O.P features	$formula$	Sig
BMC hip	$BMC = 0.234(weight) + 12.910$	0.002
BMC lumber	$BMC = 0.379(weight) + 21.931$	0.090
BMD hip	$BMD = 0.130(weight) + -5.844$	0.052
BMD lumber	$BMD = -0.003(weight) + 3.874$	0.976
T-score hip	$T\_score = -0.045(weight) + 1.339 - 5$	0.00
T-score lumber	$T\_score = -0.040(weight)0.478 - 5$	0.00
Z-score hip	$Z\_score = 0.036(weight) + 2.836 - 5$	0.00
Z-score lumber	$Z\_score = 0.037(weight) + 1.724 - 5$	0.00
Ten years assessment	$Five\ years = -0.777(weight) + 123.848$	0.00
Five years assessment	$Ten\ years = -0.789(weight) + 124.981$	0.00

Table 4.12 indicated the statically significant association of weight with other variables and provides the predictor equation. The weight is statically significant associated with BMC hip , T and Z sores in two sites and with five and ten years fracture assessment. The weight is not statically significant associated with BMD in the two sites and BMC lumber spine .

Table 4.13 : Regression between the height and osteoporosis features .

Height		
O.P features	$formula$	Sig
BMC hip	$BMC = 0.172(hight) + 1.218$	0.104
BMC spine	$BMC = 0.191(hight) + 16.427$	0.544
BMD hip	$BMD = 0.051(hight) + (-5.543)$	0.586
BMD spine	$BMD = -0.071(hight) + 14.741$	0.566
T-score hip	$T_{SCORE} = 0.019(hight) + 1.178 - 5$	0.000
T-score spine	$T_{SCORE} = 0.036(hight) + (-2.544) - 5$	0.000
Z-score hip	$Z_{SCORE} = 0.012(hight) + 3.240 - 5$	0.004
Z-score spine	$Z_{SCORE} = 0.022(hight) + 0.766 - 5$	0.000
Ten years assessment	$Five\ years = -0.777(hight) + 123.848$	0.016
Five years assessment	$Ten\ years = -0.789(hight) + 124.981$	0.014

Table 4.13 indicated the statically significant association of height with other variables and provides the predictor equation. Height is statically significant associated with every variables except with the BMD and BMC in the two sites .

Table 4.14 : Regression between the BMI and osteoporosis features .

BMI		
O.P features	$formula$	Sig
BMC hip	$BMC = 0.116(BMI) + 24.649$	0.268
BMC spine	$BMC = 0.236(BMI) + 39.628$	0.451
BMD hip	$BMD = 0.080(BMI) + 0.281$	0.396
BMD spine	$BMD = 0.017(BMI) + 3.245$	0.889
T-score hip	$T_{SCORE} = 0.028(BMI) + 3.433 - 5$	0.000
T-score spine	$T_{SCORE} = 0.021(BMI) + 2.485 - 5$	0.000
Z-score hip	$Z_{SCORE} = 0.022(BMI) + 4.513 - 5$	0.000
Z-score spine	$Z_{SCORE} = 0.023(BMI) + 3.494 - 5$	0.000

Table 4.14 indicated the statically significant association of BMI with other variables and provides the predictor equation. BMI is statically significant associated with every variables except with the BMD and BMC in the two sites.

Table 4.15 : The affect of gender on osteoporosis features.

	Gender	N	Mean	St. Deviation	T. Value	Sig. (2-tailed)
BMC_lumber	Male	93	53.8143	17.13505	0.644	0.519
	Female	1456	45.4486	125.08542		
BMD_lumber	Male	93	0.8980	0.20477	-0.583	0.560
	Female	1455	3.8862	49.43136		
BMC_hip	Male	93	33.4839	9.56325	-1.401	0.161
	Female	1444	27.3958	41.83006		
BMD_hip	Male	93	0.9664	0.20806	-0.397	0.692
	Female	1444	2.5095	37.50858		
Five_years_ assessment	Male	93	48.835	55.9846	-4.265	0.00
	Female	1457	76.380	108.0737		
Ten_years_ assessment	Male	91	48.164	55.7258	-4.391	0.00
	Female	1442	76.702	108.1811		
T_score_lumber	Male	93	-1.145	1.8435	4.504	0.00
	Female	1458	-2.11	1.7947		
T_score_hip	Male	93	-0.396	1.3878	3.028	0.003
	Female	1458	-0.856	1.8859		
Z_score_lumber	Male	93	-0.594	1.8676	1.801	0.072
	Female	1458	-0.92	1.6805		
Z_score_hip	Male	93	-0.052	1.3854	-0.965	0.335
	Female	1458	0.116	1.6343		

Table 4.15 indicated the affect of gender on the other variables .T-scores and the fracture assessment have statically significant associations with the gender , the other variables have no static significant associations with the gender . The mean of the T-score in spine in males -1.145 in females -2.11 and the mean in hip is -0.396 for males and -0.856 in females

Table 4.16 : The affect of the cases states on osteoporosis features .

O.P features	State	Number	Mean	St. Deviation	F	Sig
BMC_lumber	Normal	428	56.288	12.427	6.226	0.002
	Osteoporosis	738	34.582	6.290		
	Osteopenia	383	56.303	242.809		
BMD_lumber	Normal	427	3.856	58.118	0.926	0.396
	Osteoporosis	738	5.051	53.482		
	Osteopenia	383	0.948	2.448		
BMC_hip	Normal	425	36.521	75.386	16.300	0.000
	Osteoporosis	731	22.512	6.921		
	Osteopenia	381	28.070	10.146		
BMD_hip	Normal	425	4.563	54.104	1.130	0.323
	Osteoporosis	731	1.955	32.816		
	Osteopenia	381	0.904	0.163		
T_score_lumber	Normal	430	0.323	1.333	2276.042	0.000
	Osteoporosis	738	-3.398	0.751		
	Osteopenia	383	-1.748	0.532		
T_score_hip	Normal	430	0.82	1.623	611.489	0.000
	Osteoporosis	738	-2.053	1.305		
	Osteopenia	383	-0.303	1.271		
Z_score_lumber	Normal	430	0.974	1.392	1049.382	0.000
	Osteoporosis	738	-2.085	1.005		
	Osteopenia	383	-0.721	0.899		
Z_score_hip	Normal	430	1.212	1.644	241.690	0.000
	Osteoporosis	738	-0.616	1.277		
	Osteopenia	383	0.324	1.391		
BMI	Normal	430	27.849	5.447	19.756	0.000
	Osteoporosis	738	25.167	5.057		
	Osteopenia	382	28.642	17.355		

Table 4.16 indicated the affect of cases states on osteoporosis features . BMD in the two sites have no static significant association with the states of osteoporosis , all other variables indicated statically significant associations with the states of the osteoporosis .

4.2 Discussion :

This cross-sectional descriptive study aimed to investigate the prevalence of osteoporosis among Yemeni population using DEXA in the lumber spine and hip .

The results of this study show 93 (6%) of the sample size were males , whereas the majority were females with 1458 (94%) of total patients shown(1551) in Table 4.1 . The age of the sample size have been subdivided to five groups where the majority of the sample were in the (51-60) group with 478 patients, the second majority were in the (61-70) group with 363 patient of the total of 1551 patients. Other age group shown in the Table 4.2.

In this study all patients were selected randomly the majority of the cases were osteoporotic and normal with 1061 case 323(20.8%) was in the hip and 738 (47.6%) in the lumber for osteoporosis ,and 1216 normal case 786 (50.7%) in hip and 430 (27.7 %) in lumber spine .Osteopenia cases were 818 ,435 (28%) case was in hip and 383 (24.7%) case in lumber spine , the states of the cases were demonstrated in the Table 4.3 .

Table 4.4 demonstrate the osteoporotic patients who had osteoporosis in the two sites were 311 patients , osteopenia in the two sites were in 114 patients and who had normal case in the two site were 395 patients. Table 4.4 demonstrate also the discordance of diagnosis of osteoporosis using DEXA , The major discordance was seen in 134 cases ,The minor discordance was seen in 300 cases , and the perfect concordance was seen in 784 cases. The prevalence of major discordance in the study was higher than that in Saudi Arabia **Al Zaid, et al (2022).** And the minor discordance was lower comparing to the same study .

Osteoporotic patients according to gender were mostly females 320 in hip and 716 in lumber spine , males were 25 who had osteoporosis 3 in hip and 22 in lumber spine .our study agrees with **Shin,et al.(2010).** study that females have the majority of osteoporotic cases . other study by **Klingberg, Lorentzon, et al. (2012).** reported that females had significantly more lumbar osteoporosis than men which agreed with our study . All of this data are demonstrated at the Table 4.5 and 4.6**.**

As the majority of this study were the (51-60) age group they were also the majority who had osteoporotic patients with 340 case 92 in hip and 248 in lumber spine , the second majority was (61-70) age group who had 323 osteoporotic case 106 in hip and 217 in lumber spine **Salari , et al. (2021).** study reveled that the older age 50 and above had the majority of osteoporosis which agreed with our study . The major normal cases were indicated in the age group of (51-60) with 353 case 238 in hip and 115 in lumber spine and the second majority were in age group (under 40) with 299 case 169 in hip and 130 in lumber spine .all of these data is demonstrated in the table 4.7.

Age has static significant association with inverse correlation with BMC in the two sites , inverse correlation with no static significant with BMD in the two sites which was reported in the table 4.8 **Havill, et al . (2007).** reported that age has effected BMC and BMD variation which indicate that BMC will decrease as the age increase and this agreed with our study. Z and T score has direct correlation with static significant associations with BMC in the two sites , inverse correlation with BMD lumber with no static significant association , BMD hip has inverse correlation with Z-score and direct correlation with T-score with no static significant associations.Weight has direct correlation with BMC and BMD in the two sites except for lumber spine BMD and no static significant associations except for BMC hip there is association.

The table 4.9 indicated the correlation between T and Z scores with the other variables , all variables has direct correlation and static significant associations with Z and T score in the two sites , except the age has inverse correlation with T-score in the two sites **Moayyeri, et al.(2005).** study reported weight has an effect on T-score which agrees with our study.

All variables has an inverse correlation with five and ten years fracture assessment except for the Z-score hip has a direct correlation with both of them , the static significant association is indicated in all variables except in T-score lumber and Z-score hip in both of them . data is indicated in the table 4.10 which studied the correlation between the five and ten years fracture assessment with age , height , weight T-score and Z-score .

Table 4.11 Table 4.12 and Table 4.13 studied the linear regression and the predictor formula for age, weight and height indicating The age is statically significant associated with BMC in spine and hip ,T and Z score in the two sites and with the ten and five years assessment .The age is not statically significant associated with BMD in spine and hip , weight is not statically significant with BMD as age and significant with the others variables except for BMC hip , Height is statically significant with T and Z sores , ten and five years hip fracture assessment and no signification with BMD and BMC.

Table 4.14 indicates the statically significant association of BMI with other variables and provides the predictor equation. BMI is statically significant associated with every variables except with the BMD and BMC in the two sites **Ellis , et al .(2001)**. reported that BMD and BMC could not reach the statically signification with BMI .

The mean of BMD in males were less in females in the two sites , BMC was greater in males than females **Naganathan V,et al.(2003)** agreed that BMC in males was greater comparing to females . T-score was less in females than males but the Z-score in hip was greater in females comparing with males the mean was (0.116) and we suggest this variation happened because of the sample size variation which it was mostly of females .Z-score BMC and BMD indicated no static significant associations with the gender .All data is demonstrated in the Table 4.15.

Osteoporosis mean in the BMC was 34.582 in lumber spine 22.512 in hip 5.051 in BMD lumber spine 1.995 in hip , this is indicates that osteoporosis is indicated in lumber spine and osteoporosis decrease the mean of BMC and comparing it with osteopenia which the mean was 56.303 , 28.070 in BMC lumber spine and hip . The mean of osteoporosis in BMD is greater than osteopenia the table 4.16 indicated the mean of osteopenia 0.948 in lumber spine and 0.904 in hip which it is less than the osteoporosis .T and Z scores means with osteoporosis were the least comparing it with the osteopenia and normal cases . BMI mean in normal cases was reported to be 27.849 and 28.642 in osteopenia cases 25.167 in osteoporosis and there was a static significant association with BMI and the cases states.

Chapter 5

Conclusion & Recommendation

5.1 Conclusion :

This study demonstrate that , the osteoporosis occur in female more than the males and the risk of having osteoporosis increase with the age which the most effected age group was who aged 50 and above. Lumber spine was the most effected site for osteoporosis and osteopenia which increase the risk of fracture in that site . BMC is effected by the other variables more than BMD in this study. T-score have an inverse correlation with age which indicates that if the age increased the T-score will decrease indicating osteoporosis . Weight and height is correlated with T and Z -scores directly. BMI is statically significant with T and Z-scores and there is no significant with BMC and BMD. There was linear regression between age and all variables except with BMD in the two sites. Weight has a linear regression with all variables except for BMD in the two sites and BMC in the lumber and for the height there was a linear regression with the variables except for BMD and BMC in the two sites, and it is the same goes for BMI. The mean of males in BMD is less in females and the BMC was the opposite T-score means was less in females than males . T and Z scores means with osteoporosis were the least comparing it with the osteopenia and normal cases .

5.2 Recommendations:

For the future studies we recommend some points that can be summarized as follow :

- Including more than one region to study the affect of the environment on Yemenis health and osteoporosis.
- Prospective cases to study the risk factors associated with osteoporosis.
- Laboratory validation such as Calcium blood test ,Vitamin D test and Hormonal tests. to interrupt the results accurately and to determine the accuracy of DEXA.
- Spreading awareness and the necessity of examining osteoporosis.

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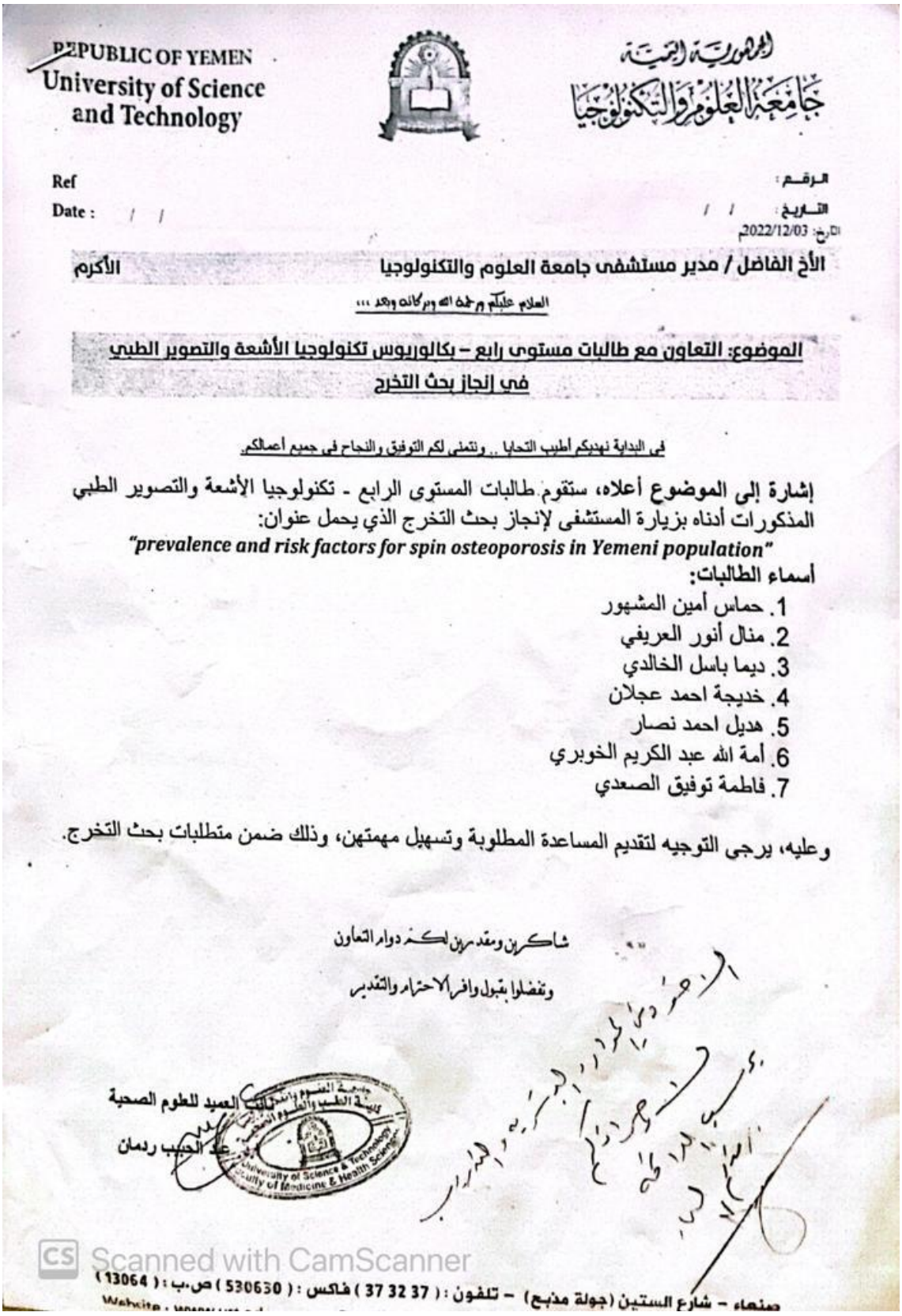
Appendix I



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السلام عليكم ورحمة الله وبركاته وبعد ،،،

الموضوع: التعاون مع طالبات مستوى رابع – بكالوريوس تكنولوجيا الأشعة والتصوير الطبي في إنجاز بحث التخرج

في البداية نهديكم أطيب التحايا .. ونتمنى لكم التوفيق والنجاح في جميع أعمالكم.

إشارة إلى الموضوع أعلاه، ستقوم طالبات المستوى الرابع - تكنولوجيا الأشعة والتصوير الطبي المذكورات أدناه بزيارة المستشفى لإنجاز بحث التخرج الذي يحمل عنوان:

"prevalence and risk factors for spin osteoporosis in Yemeni population"

أسماء الطالبات:

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Non Intervention - غير تدخلي

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Study purpose

Duration

Period

Target Sample

Collecting Data method

Investigators of the study

Supervisor's Name

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1. حماس أمين المشهور
2. منال أنور العريفي
3. ديما باسل الخالدي
4. خديجة احمد عجلان
5. هديل احمد نصار
6. أمة الله عبد الكريم الخوبري
7. فاطمة توفيق الصعدي

وعليه، يرجى التوجيه لتقديم المساعدة المطلوبة وتسهيل مهمتهن، وذلك ضمن متطلبات بحث التخرج.

شاكرين ومقدرين لكم دوام التعاون

وتفضلوا بقبول وافر الاحترام والتقدير

نائب العميد للعلوم الصحية

أ.د. عبد الجبب ردمان

جامعة العلوم والتكنولوجيا
كلية الطب والعلوم الصحية
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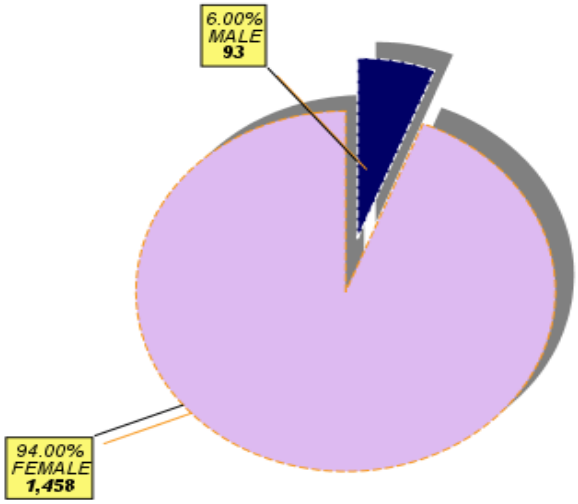
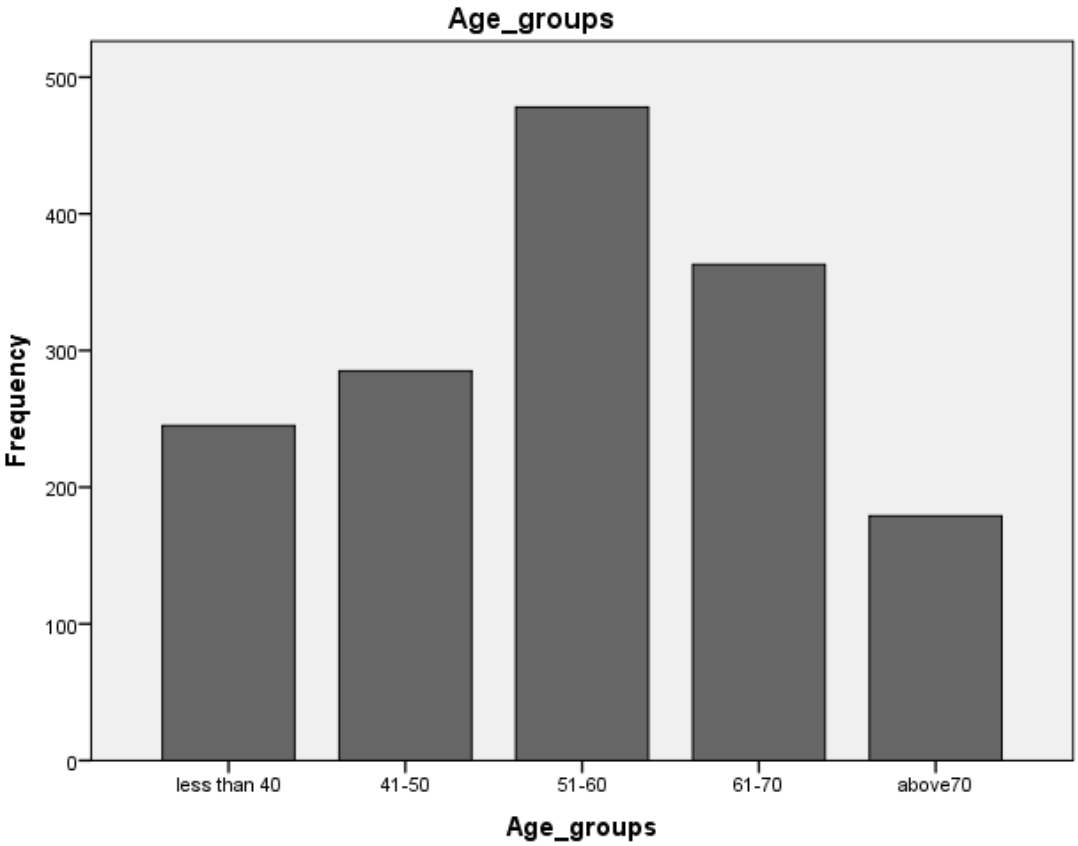
Appendix II


6.00%
MALE
93
94.00%
FEMALE
1,458


Age_groups
Frequency
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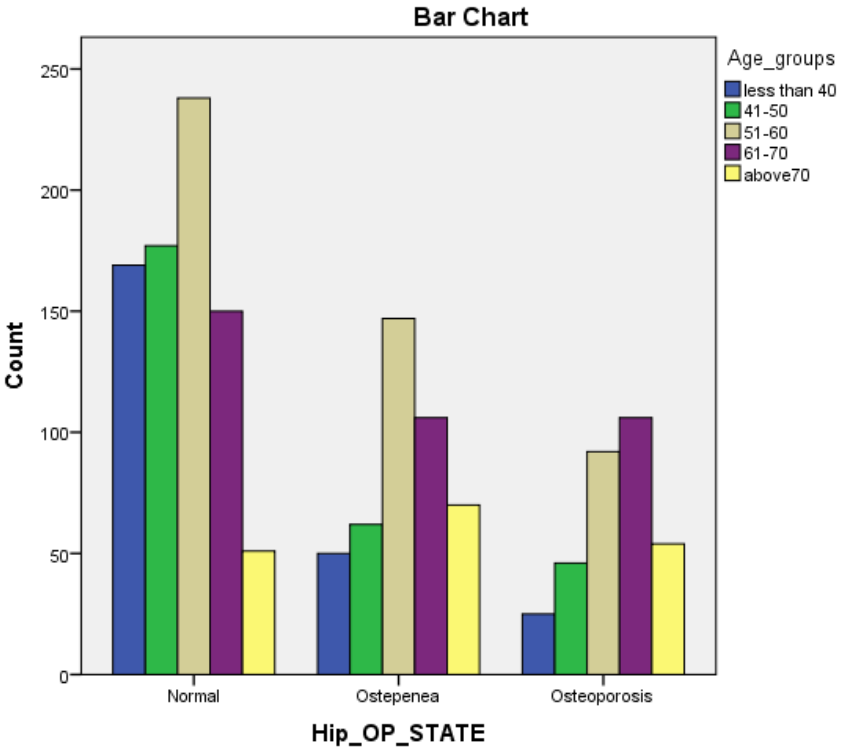
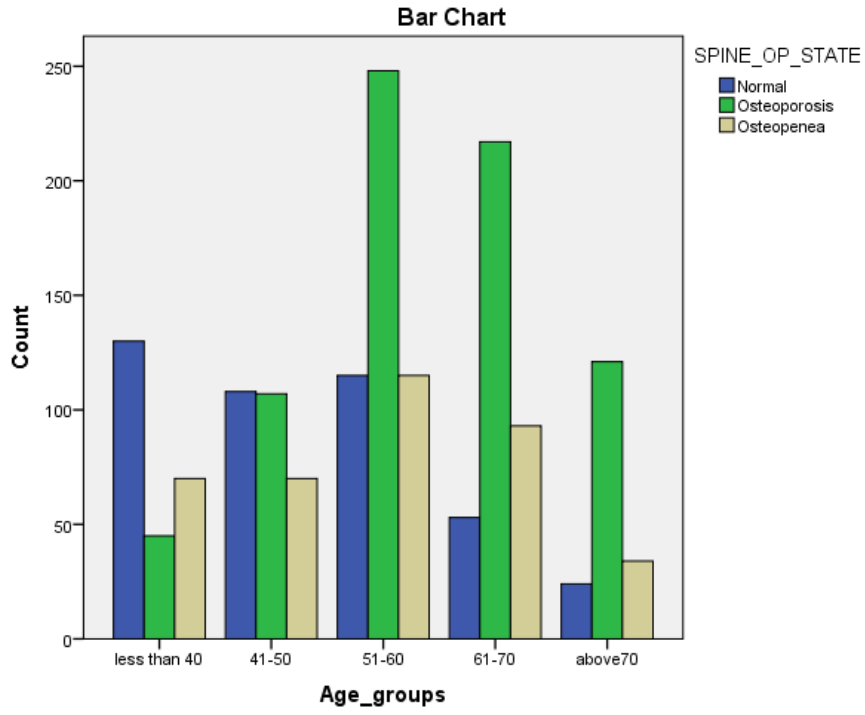
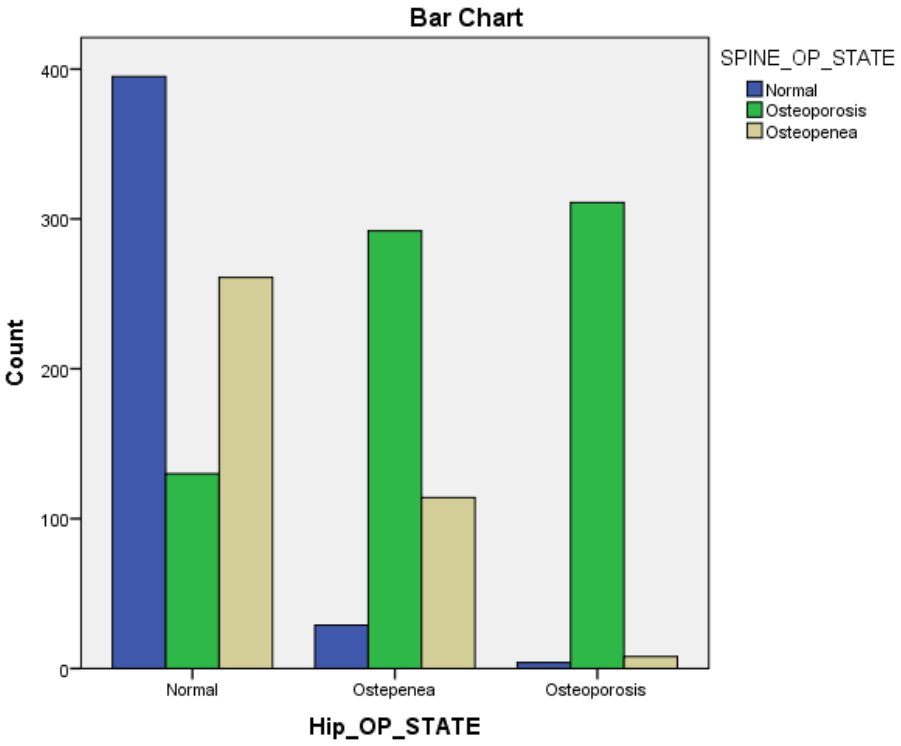
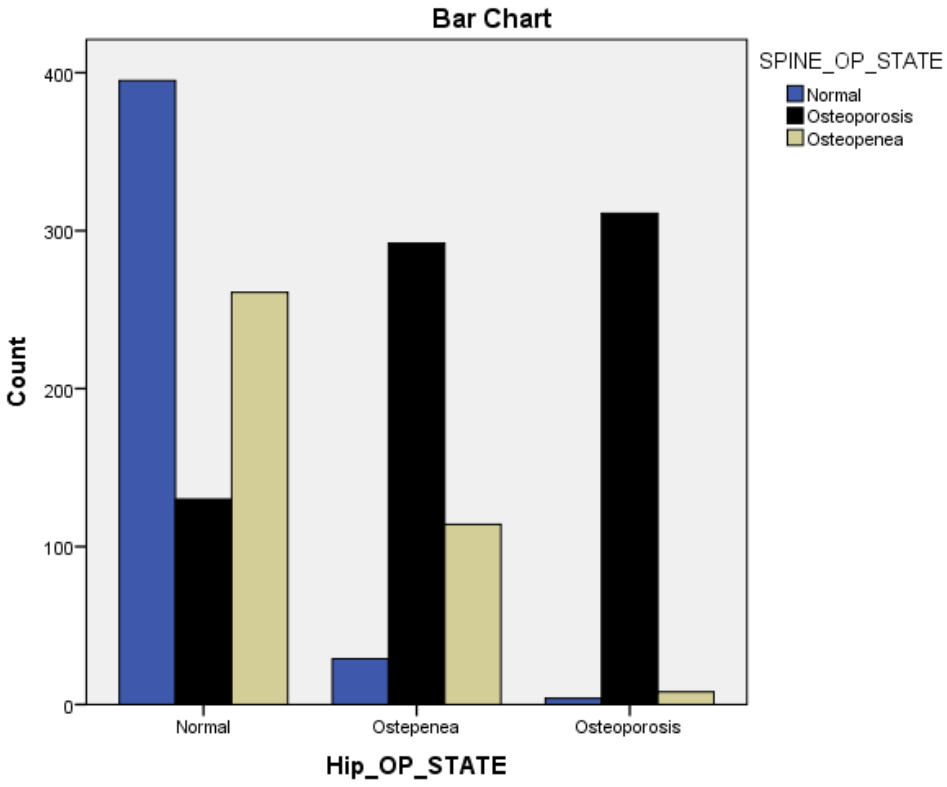
400
300
200
100
0
less than 40
41-50
51-60
61-70
above70
Age_groups


Bar Chart
Age_groups
less than 40
41-50
51-60
61-70
above70
Count
250
200
150
100
50
0
Normal
Ostepenea
Osteoporosis
Hip_OP_STATE


Bar Chart
SPINE_OP_STATE
Normal
Osteoporosis
Osteopenea
Count
250
200
150
100
50
0
less than 40
41-50
51-60
61-70
above70
Age_groups


Bar Chart
SPINE_OP_STATE
Normal
Osteoporosis
Osteopenea
Count
400
300
200
100
0
Normal
Ostepenea
Osteoporosis
Hip_OP_STATE


Bar Chart
SPINE_OP_STATE
Normal
Osteoporosis
Osteopenea
Count
400
300
200
100
0
Normal
Ostepenea
Osteoporosis
Hip_OP_STATE

ملخص الدراسة

تمهيد : تعد هشاشة العظام مشكلة شائعة حيث تصبح العظام فيها ضعيفة، وسهلة الكسر، وتتطور ببطء على مدى عدة سنوات. وغالبًا ما يتم تشخيص المرض عند سقوط طفيف، أو تأثير مفاجئ يسبب كسر في العظام. يُشار إلى أن النساء أكثر عرضة لخطر الإصابة بهشاشة العظام بعد انقطاع الطمث.

منهجية البحث: تم تضمين ١٥٥١ مريض في البحث تم تصنيفهم ٣١١ مريض مصابين بهشاشة العظام في الحوض والعمود الفقري بينما ٧٣٣ مريض مصابين بهشاشة العظام في العمود الفقري فقط و٣٢٢ مريض مصابين بهشاشة العظام في الحوض فقط باستخدام جهاز قياس هشاشة العظام.

النتائج: أظهرت نتائج البحث أن معظم الحالات التي تم تضمينها في البحث كانت من فئة الإناث ١٤٥٨ (٩٤%) حيث كان الذكور ٩٣ بمعدل (٦%) من كافة المرضى في الدراسة. وكانت الفئة العمرية الأكثر اصابةً من ٥١ الى ٦٠ سنة بمعدل (٣٠,٨) و سجلت هشاشة العظام في الفقرات القطنية نسبة أعلى من عظم الحوض حيث أظهرت دراستنا أن للعمر علاقة مع كثافة العظام وفي هذه الدراسة تم حساب معدل خطر الإصابة بكسور عظم الحوض لكل المرضى التي تتجاوز أعمارهم ال ٥٠ لكل ٥ سنوات و ١٠ سنوات. توجد علاقة خطية بين العمر مع قيم ال T-score و Z-score وBMC ومعدل الاصابة بالكسور في الخمسة والعشرة سنين.

الاستنتاج: توضح هذه الدراسة ان حدوث هشاشة العظام يزداد مع تقدم العمر والغالب يكون عند الاناث التي تجاوزن عمر الخمسين مما يسبب زيادة في معدل الإصابة بالكسور لديهن.

REPUBLIC OF YEMEN
UNIVERSITY OF SCIENCE AND TECHNOLOGY
FACTUALITY OF MEDICINE AND HEALTH SCIENCE
DIAGNOSTIC RADIOLOGY TECHNOLOGY DEPARTMENT

Assessment of Osteoporosis Prevalence Among Yemeni Population using Dual Energy X-ray Absorptiometry

دراسة معدل انتشار مرض هشاشة العظام بين السكان اليمنيين باستخدام جهاز قياس هشاشة العظام

Prepared by :

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This Research Submitted in Fulfillment of The Requirement for The Degree of Bachelor in Diagnostic Radiology and Medical Imaging Technology

2023