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Determinants of osteoporosis among a group of postmenopausal women in the old city of Jerusalem

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Dedication

I would like to dedicate this humble study to my family who have supported me in all phases of this thesis particularly to my wife, father and mother whose help will not be forgotten.

Firas Yousef Al-Shawish.

Declaration

I certify that this thesis submitted for the degree of master is the result of my own research, except where otherwise acknowledged, and that this thesis (or any part of the same) has not been submitted for a higher degree to any other university or institution.

Signed: Firas Al-Shawish.
Date: 25 / 02/ 2008.

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Firas.

Definitions

Acute pain: pain which starts suddenly; may be described as severe or sharp.

Amenorrhea: a loss of menstrual periods (usually for a period of 6 months or more).

A traumatic fracture: a broken bone caused by falling from your own height (caused without trauma).

Body Mass Index: a measure of weight that takes into account your height.

Bone densitometry: a method of measuring bone density and strength; a bone density test is used to diagnose osteoporosis

Bone mineral density (BMD): an indication of bone strength. BMD is measured in grams per square centimeter (gm/cm2) using Dual Energy X-ray Absorptimetry (DEXA).

Bone remodelling: replacing old bone with new bone tissue.

Bone turnover: replacing old bone with healthy new bone.

Calcitonin: a hormone secreted by the thyroid gland; available as a medication in an injectable form and as a nasal spray; used to treat osteoporosis and relieve pain caused by spinal fractures.

Calcitriol: the active form of vitamin-D which is available as a medication; used to improve calcium absorption.

Calcium absorption (or calcium bioavailability): the amount of calcium the body absorbs and uses.

Collagen - a protein substance found in skin, tendons, bone and cartilage.

Colles fracture: a fracture of the wrist.

Cortical bone: the type of bone found mainly in the appendages (e.g. arms, legs).

Corticosteroids (CS): type of steroid drug often used for asthma and rheumatoid arthritis.

Chronic pain: ongoing, recurring pain.

Dual Energy X-Ray Absorptiometry (DEXA): the gold standard test for measuring bone density; uses low energy x-ray to measure the strength of bones.

Estrogen: the major female sex hormone (responsible for reproduction and the development of secondary female sex characteristics).

Estrogen Replacement Therapy (ERT): given to postmenopausal women to replace the hormone no longer produced by their ovaries.

Heel ultrasound: a technique which uses ultrasound to measure the bone quality or bone density in the heel.

Hormone Replacement Therapy (HRT): the use of estrogen and progestin/progesterone in postmenopausal women.

Hypogonadism: decreased activity of the male/female sex organs.

International units: a standard unit of measure, used worldwide.

Kyphosis: also known as dowagers hump — the curving forward of the upper spine.

Menopause: when the ovaries shutdown and stop producing estrogen and progesterone.

National Osteoporosis Foundation (NOF): an organization based in the United States that is dedicated to helping people with osteoporosis.

Osteoblast: a type of cell involved in bone remodelling that helps to build bone.

Osteoclast resorption: osteoclasts are the cells that chew up bone; reabsorption is the term used to describe this process.

Osteogenesis imperfecta: a genetic disorder that causes brittle bones that break very easily.

Osteopenia: a mild bone loss as measured by DEXA when the T-score ranged between [-1] to [-2.5].

Osteoporosis: a disease in which bones become brittle due to a loss of bone mass (density) and a change in bone structure.

Osteoporosis Society of Canada (OSC): an organization dedicated to helping those with osteoporosis.

Parathyroid Hormone (PTH): a substance secreted by the parathyroid gland which regulates calcium levels in the body.

Phosphorus: a mineral active in bone and tissue growth; found in many foods.

Physiological: normal bodily functioning of organs and systems.

Postmenopausal: after menopause - describes a woman whose periods have ended, whose ovaries have stopped producing eggs, and whose hormonal levels have decreased.

Postmenopausal osteoporosis (PMO): bone loss due to reduced levels of hormones.

Quantitative Computed Tomography (QCT): a restricted test used to measure true mineral density.

Quantitative Ultrasound (QUS): a method of assessing bone strength that uses high frequency sound waves.

Resorption: chewing up of old bone by the osteoclasts.

Secondary osteoporosis: osteoporosis that is caused by a medication the person is taking or by a medical condition that the person has.

Standard Deviation (SD): a consistent unit of measure above or below the average of a comparison group.

T-score - a measuring system used to detect standard deviations for a specific group - on a DEXA, compares a person to a group of young adults of the same sex.

Weight bearing exercise: exercise in which a person supports her own body weight (e.g. walking, dancing).

World Health Organization (WHO): an international organization whose mission is attainment of the highest possible level of health for all peoples.

Acronyms

BC	Before Christ
BMD	Bone Mineral Density
BMI	Body Mass Index
Cm	Centimeter
DXA	Duel-Energy X-Ray
HRT	Hormonal Replacement Therapy
IOF	International Osteoporosis Foundation
QC	Quality Control
QUS	Quantitative Ultrasound
QCT	Quantitative Computed Tomography
NIS	New Israeli Shekel
SD	Standard Deviation
WHO	World Health Organization

Abstract

Osteoporosis is a disease affecting the skeletal system causing a reduction in bone density and it's mass as a result of decreased calcium level in the body. The bones become fragile and prone to fractures. In addition, osteoporosis is a wide-spread disease which increases rapidly, affecting both women and men, but the symptoms appear more rapidly and strongly in women because of psychological, physiological, and hormonal differences between them.

This disease has many negative impacts on public health and society in terms of high rate of morbidity and mortality, as well as high financial expenditure related to this disease on an individual level and on the society as a whole. The quality of life for patients suffering from this disease is negatively affected as well, because most of them become incapacitated and dependent on others as result of fractures, kyphosis, and back and shoulder pain. Osteoporosis has been documented in many populations in all over the world, particularly in women, and its risk factors, protective factors, and early diagnosis have been well-studied. However, osteoporosis among Palestinian women has not been extensively studied.

The purpose of this study was to determine the frequency of osteoporosis among a sample of postmenopausal women in the old city of Jerusalem age [>45]. In addition, different risk factors for osteoporosis were investigated including socio-economic status , demographic factors, educational level, knowledge about different determinates of the disease, lifestyle factors such as physical activity and smoking, and calcium intake.

A cross-sectional study was done to determine the frequency and determinates of osteoporosis among postmenopausal women in the old city of Jerusalem. The sample consisted of 100 postmenopausal women from the old city of Jerusalem. The women were selected using a purposive non-random sample from three centers and invited to undergo free test to measure bone mineral density (BMD) with the device Sahara Hologic Ultrasound Heel Bone Densitometer. Questionnaires and medical test were used to collect data in this study. Following the World Health Organization criteria, women were classified as osteoporotic if their T-score was less than [-2.5], osteopenic if their T-score ranged between [-1] to [-2.5] and normal if their T-score was more than [-1.0]. SPSS version 13 was used to analyze the data.

Of the 100 women screened, 50 women (50%) had osteoporosis, 44 women (44%) had osteopenia and only 4 women (4%) were normal. The following factors were found to be positively associated with osteoporosis: demographic factors [age (P=0.007)], physical parameters [weight (P=0.000), height (P=0.000), and BMI (P=0.033)], socio-economic factors [economic status (P=0.000), parity, and passive smoking (P= 0.000)], life style factors [low physical activity (P=0.00), high caffeine intake (P=0.032), and cigarette smoking (P=0.029)]. There was a negative association with nutrition factors [low consumption of milk (P=0.000), and vitamin-D such as fish and fortified milk (P= 0.000), low consumption of daily dairy products (P=0.000) and home design for sun entry (P=0.04).

The result showed that the level of knowledge about osteoporosis was high. In addition, the study showed that there is a difference between belief and practice. A significant number of participants recognized the importance of factors such as sport activities, calcium intake, and regular testing for osteoporosis. Nevertheless, a small number of them practice what they believe in. For example, the majority of participants recognized the importance of calcium intake in order to strengthen bone. However, a small percentage took the recommended daily quantity of milk.

This study shows that the prevalence of osteoporosis among a group of postmenopausal women in the old city of Jerusalem, determined by QUS, is relatively high. According to the survey results, a considerable number of Palestinian women in the old city have adequate knowledge about osteoporosis and are generally aware of the risk factors and consequences of this disease. Based on the above mentioned results, prevention must be focused on postmenopausal women. It is imperative to work hard to have made changes in their lifestyles of these women through advertisements, lectures, and public health educational programs.

ملخص الدراسة

دراسة حول العوامل المحددة لمرض هشاشة العظام لمجموعة من النساء في سن ما بعد انقطاع الدورة الشهرية في البلدة القديمة لمدينة القدس.

هشاشة العظام مرض يؤثر على الهيكل العظمي مسببا انخفاض في كثافة العظام وكتلته، نتيجة لانخفاض الكالسيوم في الجسم، وعلية تميل العظام للانحناء والكسر، بالإضافة لذلك فان هشاشة العظام مرض ينتشر بسرعة ويؤثر على الرجال والنساء على حد سوء ويكمن الاختلاف في أعراضة التي تظهر بشكل جلي لدى النساء عن الرجال لاختلاف العوامل النفسية والفسيولوجية والهرمونية. ولهذا المرض الكثير من التأثيرات السلبية على الصحة والمجتمع بسبب ازدياد نسبة انتشاره وازدياد عدد الوفيات الناتجة عنه. ومن ناحية أخرى فان إلانفاق المالي و العبء الاجتماعي المرتبط بهذا المرض يؤثر على المستويين الفردي والمجتمعي، حيث أن حياة المصابين تتأثر بشكل سلبي لاعتمادهم على الآخرين نتيجة لكسور وآلام الظهر والكتف المرافقة له، و اعتمادهم المادي على الآخرين و انخفاض الإنتاجية لديهم. و قد تم توثيق هذا المرض لدى الكثير من دول العالم ومن خلال الجمعيات المعنية، بالإضافة إلى التشخيص المبكر فيها على خلاف مجتمعنا الفلسطيني والذي تتأخر فيه الدراسات وعمليات الكشف المبكر لهذا المرض ومسبباته ونتائجه.

تهدف هذه الدراسة إلى تحديد مدى انتشار مرض هشاشة العظام لدى مجموعة من النساء في البلدة القديمة لمدينة القدس، خاصة بعد انقطاع الدورة الشهرية، حيث تم البحث في العوامل والمخاطر المحتملة لهشاشة العظام، من خلال دراسة الوضع الاجتماعي والاقتصادي والعوامل الديمغرافية والمستوى العلمي والمعرفي، والمحددات المختلفة للمرض والتي تتعلق بأنماط الحياة المختلفة، مثل النشاط الجسدي والتدخين وتناول الكالسيوم.

وقد تم إجراء دراسة مقطعية لتحديد مدى انتشار المرض بين النساء في منطقة البلدة القديمة، من خلال عينة دراسية شملت (100) امرأة. تم اختيار العينة بطريقة مقصودة غير عشوائية من ثلاث مراكز، وذلك بدعوة النساء للخضوع لفحص مجاني لكثافة العظام باستخدام جهاز الأمواج فوق الصوتية الذي يقيس كثافة العظم عن طريق كاحل القدم. كما تم استخدام الاستبيان والاختبار الطبي لجمع بيانات الدراسة. ولتحليلها تم استخدام البرنامج الإحصائي (SPSS).

وبناء على معايير منظمة الصحة العالمية، تم تصنيف النساء، حسب علامة الاختبار (T-score)، إذا كان اقل من (−2.5) تعاني من هشاشة عظام، بين (−1)، (−2.5)، تعاني من لين العظام، أكثر من (−1) لا تعاني من شيء.

أظهرت النتائج أن 50 امرأة (50%) عينة الدراسة، تعاني من هشاشة العظام، 44 امرأة (44%)، تعاني من لين العظام، و4 نساء (4%)، لا تعاني من شيء. كما أظهرت الدراسة أن العوامل الديمغرافية مثل العمر والمعايير الجسدية مثل الوزن، والطول، ومؤشر كتلة الجسم، والعوامل الاقتصادية والاجتماعية مثل الوضع الاقتصادي والتدخين السلبي، وعوامل نمط الحياة مثل النشاط الجسدي المتدني، وارتفاع نسبة تناول الكافيين والتدخين، تشكل الأسباب الرئيسية لمرض هشاشة العظام. ومن ناحية أخرى أظهرت الدراسة أن هناك ترابط سلبي مع عوامل التغذية، الاستهلاك المتدني للحليب، و فيتامين –د مثل السمك والحليب المدعم بفتامين –د، والاستهلاك المتدني لمنتجات الألبان، وقلة تعرض المنزل لأشعة الشمس.

أظهرت الدراسة أيضا أن انتشار هشاشة العظام لدى النساء في البلدة القديمة –باستخدام جهاز الأمواج فوق الصوتية – مرتفع نسبيا، وحسب النتائج فان عدد كبير من النساء الفلسطينيات لديهن معرفة عالية حول هشاشة العظام ويدركن العوامل المؤثرة على هذا المرض، إلا أن هناك اختلاف بين المعتقدات والممارسة، إذ أن عدداً كبيراً من المشاركات أدركن أهمية النشاطات الرياضية وتناول الكالسيوم لهشاشة العظام، ورغم ذلك فان عدد صغير منهن يمارسن ما يعتقدن به. فمثلا أغلبية المشاركات أدركن أهمية تناول الكالسيوم لتقوية العظام، إلا أن نسبة قليلة منهن شربن كمية الحليب الموصى بها يوميا. وبناءاً على النتائج المذكورة فان الوقاية يجب إن تركز على النساء من خلال تغيير أنماط حياتهن ومن خلال الإعلانات والمحاضرات وبرامج الصحة.

List of Tables

List of Figures

----------Table of Contents----------

Chapter 1

1.1 Background

Health-related quality of life is a particularly important issue among women. Women usually report worse health condition than men in the Palestinian society due to political situation, poverty, early marriage, violence, and other factors (Giacaman, 2005). Health care of older women became an important issue in developing countries including Palestine, due to limited facility and budget allowance. However, the Ministry of Health (MOH) is trying to improve the health services and quality of life of women during all stages of their lives; therefore, it has established the Women's Health and Development Directorate in July 1995 (MOH, 2001).

Osteoporosis is most common in women after menopause; so far, some data is available on the number of women suffering from osteoporosis in West Bank and Jerusalem. One reason for the absences of data is mainly due to shortage in human and financial resources, which are required for obtaining such data, for example each diagnostic test cost about (100-200NIS) (Issa, 2005). There are multiple risk factors involved in increasing the risk of osteoporosis. This disease is prevalent among postmenopausal women due to (lack of estrogen hormone, smoking, genetic factors, physical properties, etc…) (Ayalon and Simkin, 1996); however, enough calcium intake, regular exercise, and avoiding smoking can prevent osteoporosis (Leggett, 2000).

A correlation has been proved between many preventable diseases and higher level of education. Educated people are usually knowledgeable about different medical conditions. People, who are open to different sources of information are supposed to be well informed about the prevention of different disease (Studying Education's Effect on Health, 2002).The prediction is that educational attainment is expected to lower the rate of osteoporosis (Magnus, et al., 1996). However, although this prediction appears rational and self-evident, it needs to be proved as other factors such as culture and socio-economic status can reverse this prediction.

Factors such as educational level , socio-economic and demographic status were studied in addition, other risk factors such as lifestyle, smoking, calcium intake, body build, physical activity, were also assessed. Knowledge about different determinates (diagnosis, prevention and risk factors) of osteoporosis was also evaluated among these women. The purpose of this study is to determine the frequency of osteoporosis among a sample of postmenopausal women in the old city of Jerusalem age [>45] and to determine the risk factors associated with this condition.

1.2 Problem Statement

Until the present, no data or information is available on how many women have osteoporosis in Palestine and especially in Jerusalem. The absence of available data on this disease mainly due to shortage in human and financial resources that required for obtaining such, for example each diagnostic test costs (60-100) NIS. By the absence of available data on osteoporosis, mostly among postmenopausal women, and therefore the size of the problem and the prevalent risk factors in the Palestinian society is totally unknown which

hinders any effective effort to improve the health condition of women and limit the occurrence of disease until late age with minimum effect. This study represents the first serious effort to evaluate osteoporosis situation in the old city of Jerusalem to promote a major change in social practices that leads to improve the well-being of women, including number of children, education, income, and nutrition. In addition, low levels of knowledge have detrimental effects, knowledge is needed to combat many diseases especially diseases which can be prevented by raising public awareness, including osteoporosis.

1.3 Aim of the Study

This study aims to determine the frequency of osteoporosis among a selected sample of postmenopausal women in the old city of Jerusalem and its determinants. A special attention was paid to evaluate the women's knowledge about osteoporosis and its risk factors.

1.4 Research Questions

1) Is osteoporosis common among postmenopausal women living in the old city of Jerusalem?

2) What are the determinants of osteoporosis, demographic factors, physical variables, socio-economic factors, life style, nutritional factors and medical history among postmenopausal women age [>45] years in the old city of Jerusalem.

3) Do women living in the old city of Jerusalem have enough knowledge about osteoporosis?

1.5 Limitations

1. This study is cross-sectional. The exposure is measured at the same time as the health condition of the subject, which makes it difficult to correctly establish a causal relation.

2. Osteoporosis screening test is expensive. Therefore, the sample size taken is small and not representative.

3. The results of this study cannot be generalized because of the small sample size and limited geographical area studied.

1.6 Assumption

The assumptions upon which this study is based include (1) Palestinian women will respond to research questionnaire truthfully and thoughtfully. (2) High rate of osteoporosis in postmenopausal Palestinian women is expected. (3) Medical centers and their personnel will help in facilitating the research process.

1.7 Summary

Few studies have focused on postmenopausal women in Palestine, additional studies have been recommended to determine the factors affecting osteoporosis. This is the first study

conducted in the old city of Jerusalem using quantitative heel ultrasound to determine the prevalence of osteoporosis among Palestinian women in the old city of Jerusalem. Also, to examine knowledge about osteoporosis among postmenopausal women in the old city of Jerusalem. In addition, other risk factors (nutritional factors, demographic factors, vitamin-D intake, socio-economic status, family history, and physical activity) were examined.

1.8 Overview on the Thesis Chapters

This study includes five main chapters; introduction, literature review, conceptualization, operationalization methodology, results, and finally discussion, conclusion and recommendations. The introduction chapter starts with background information followed by statement of problem and ends with the study objectives limitations, assumptions and summery. The literature review chapter included contextualization, a description of previous studies related to this study, also risk factors and its possible determinants were discussed separately and details. Conceptualization included some theories and definitions for the study risk factors. Operationalization included operation definition of disease, risk factors and knowledge about different determinants of disease. Finally, conceptual framework, include developed figure of framework for analysis depend on several sources of literature review. The methodology chapter included description of study design, data collection methods, and statistical analysis. The sixth chapter included results of the study. Finally, the discussion chapter included the discussion of main results and possible interpretations of the study findings. This chapter ended with conclusion and recommendations for decision makers and for further research.

Chapter 2

Literature Review

2.1 Introduction

In this chapter, I will present some of studies related to the topic under study. This includes studies about the prevalence of osteoporosis, risk factors, knowledge and osteoporosis.

2.2 Prevalence of Osteoporosis

Osteoporosis is the most prevalent metabolic bone disease in the United States and other developed countries. Fracture prevalence refers to the number of people in the population who at a given time have already had fractures related to osteoporosis (Wasnich, 1999). The incidence of osteoporosis in postmenopausal women continuous to increase with progressively aging population. In United state and European Union, about [30%] of all postmenopausal women have osteoporosis, and it has been predicted that more than [40%] of them will suffer one or more fragility fractures during their lifetime. (Reginster and Burlet, 2006). According to study about 40% of women aged 50 years are predicted to have at least one fracture in the remainder of lifetime, of whom 20% are expected to suffer from multiple fractures. The prevalence of osteoporosis increases as the world's population ages (Les Laboratories Servier, 2006). Currently, it is estimated that over (200) million people worldwide have osteoporosis. (Reginster and Burlet, 2006).

Another study was done among postmenopausal women in Sri Lanka. The aim of this study to estimate the prevalence of osteoporosis among postmenopausal women selected from seven provinces in Sri Lanka. The study was a community-based cross-sectional survey of a group of 1642 community-dwelling postmenopausal women in seven provinces, except the North and East, in Sri Lanka. Phalangeal bone mineral density (BMD) was measured in all subjects using a DEXA. In a subgroup of 150 women BMDs in the spine from L2–L4 and proximal femur were measured using a Norland Eclipse central DXA machine. In this subgroup, the diagnosis of osteoporosis was made according to the WHO criteria based on T-scores of the spine or femoral neck. The result showed that osteoporosis is a prevalent disease among postmenopausal women in Sri Lanka. Similar prevalence figures have been reported from other Asian countries (Lekamwasam et al., 2007).

In 2003, conducted cross-sectional survey was the conducted to determine the prevalence of osteoporosis and related factors in Vietnamese adult women by using quantitative ultrasound at the heel bone (calcaneus). A total of 2,232 adult women aged ≥20 years, living in Hanoi City, and free of illnesses affecting bone metabolisms were randomly selected to participate in the study. Subjects' bone mass was assessed by speed of sound at the calcaneus, referred to as quantitative ultrasound measurement. The T-score threshold, defined as ≤–1.8, was used to identify subjects with osteoporosis**.** The crude prevalence of osteoporosis in Hanoi City was 15.4%; after adjustment for age, it was 9.0%. Among premenopausal women, the crude prevalence of osteoporosis was higher in the urban areas compared with the rural areas. By contrast, postmenopausal women in the rural areas had a higher prevalence of osteoporosis. Results suggest that osteoporosis is a noteworthy problem in Vietnam, and intervention strategies should be considered to control it, especially in high-risk populations (Hein et al., 2004).

Few studies have been done on our region. A recent pilot study was conducted in Saudi Arabia to estimate the prevalence of osteopenia and osteoporosis in postmenopausal Saudi women. Lumbar spine bone density was measured in 830 postmenopausal Saudi women (50-80) years of age (average 59 years), using dual x-ray absorptiometry (DXA) at the King Khalid University Hospital, in Riyadh between 1989 and 1999. In conclusion, osteopenia and osteoporosis were common among postmenopausal Saudi women and was recommended to be considered as a matter of public health. In the postmenopausal women between the ages (50-59) years 58% were found to have osteopenia and osteoporosis and

the rate increased to 89% in the age of (60-69) years and it increased more in the female group of age (70-80) years to reach 94 % (El-Desouki, 2003).

In the Palestinian society**,** very limited data is available on the epidemiology of osteoporosis in the West Bank and Jerusalem district (Jabari, 2006*).* Study about osteoporosis was conducted by Miss Eman Shawish from Al-Quds University shows that the prevalence rate among Palestinian women, (Osteoporosis [81(24%)], osteopenia [127(38%)], normal BMD [130(38%)] from total sample 388 cases (Al-Shaweesh, 2003).

Another study was conducted by Miss Intissar M.Issa from Al-Quds University in Bethlehem district shows that the prevalence of osteoporosis proved to be very alarming with 29.7% at lumber spine, 22% at femoral neck, 14% at total hip, and 40.6% at any site. About 80% of postmenopausal women expressed interest to learn more about osteoporosis, since the women lacked knowledge about risk factors, prevention, and diagnosis about osteoporosis as reported by a study *(*Issa, 2005*).*

2.3 Clinical Consequences

The most useful way of comparing osteoporosis prevalence among populations is to use fracture rates in older people, because the worldwide variation in the incidence and prevalence of osteoporosis is difficult to determine, this refer to problems with definition and diagnosis osteoporosis. (WHO, 2006) Fractures of the hip, vertebral body, distal forearm (coll's fracture) have long been regarded the three most common osteoprotic fractures (Stevenson and Marsh, 2000).

2.3.1 Hip Fracture

Hip fracture is the most serious consequence of osteoporosis; nearly three-quarters of all hip fracture occur in women due to having a tendency to fall more often. In addition, women live longer than men and lose more bone as they age. (Jordan and Cooper, Dec2002)**.** Approximately [7%] of all women aged [35-40] years and [33%] of women older than 65 years have involutional osteoporosis (Khan, 2004).

The incidence of hip fractures increases exponentially with age (Cooper and Sambrook, 2006) as shown in figure (1). Regardless of geographical location and ethnic group, Hip-fracture rates are higher in white populations. In contrast hip fracture rate are lower among black in the United States, South Africa and also among Japanese (Wasnich**,** 1999). Countries in economic transition, such as Hong Kong Special Administrative Region (SAR) of China, have seen significant increases in age-adjusted fracture rates in recent decades, while the rates in industrialized countries appear to have reached a plateau (WHO, 2006). Approximately (1.6) million hip fractures occur worldwide each year, by 2050 this number could reach between (4.5) million and (6.3) million (International Osteoporosis Foundation 2005).

2.3.2 Vertebral Fractures

The epidemiology of vertebral fractures is less well characterized, compare with hip fracture due to lack of accepted diagnostic criteria (Jordan and Cooper, 2002)**.** The incidence of vertebral factures increases with age in both sexes. Most studies indicate that the prevalence of vertebral facture in men is similar to, or even greater than, that seen in

women to age [50 or 60 years]. (International Osteoporosis Foundation, 2005). Prevalence of vertebral fracture has been more similar across regions than that seen for hip fracture. Vertebral fracture is as frequent in Asian as white women, it is also appears to be less common in African-American and Hispanic populations. (Jordan and Cooper, 2002).

2.3.3 Wrist Fracture

Distal radius fractures, usually of the Colles' type, are the third most common type of osteoporotic fractures as shown in figure (1). By the time women reach age 70, about 20% have had at least one wrist fracture (Osteoporosis, 2001).

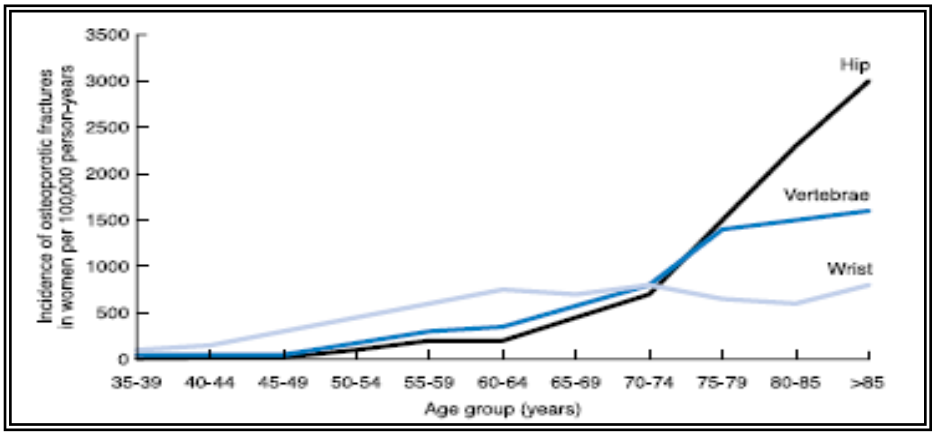


Figure (1): Incidence of osteoporotic fractures in women.
Source: (Jordan and Cooper, 2002).

2.3.4 Economic Burden

Osteoprotic fractures also impose a major economic burden on health-care systems worldwide. More recently, the combined annual costs of all osteoprotic fractures have been to be ($20) billion in the USA and about ($30) billion in the European Union (Cooper and Sambrook, June 2006). Most of this money [63%] went for care of hip fractures, but [37%] of the dollars were spent on other types of fractures (Goddard and Kleerekoper, 1998).These already high costs will increase further with continued aging of the population. In addition, the population explosion in underdeveloped countries will change the demography of osteoporosis (Riggs and Melton, 1995).

2.4 Risk Factors

A cross-sectional study was conducted to assess the effect of aging on bone mineral metabolism and bone mass among 77 Native American women aged 19 to 85 years. The main objective of this study was to examine the effect of age on mineral metabolism and bone mineral density (BMD) of the hip and spine in Native American women. The results of this study showed that Serum 25 hydroxyvitamin- D was related inversely to age ($r = -0.32$; $P < .05$) and was less than 15 ng/mL in 7% of the subjects. Serum osteocalcin was higher ($P < .001$) in postmenopausal than in premenopausal subjects. In postmenopausal subjects, serum osteocalcin was related to age ($r = .59$, $P < .001$). BMD was lower ($P < .001$) in postmenopausal than in premenopausal subjects. Age, BMI, and serum 25OHD

together accounted for 70% of the variance in BMD at these sites. The use of T-scores indicated femoral bone density was higher ($P < .05$) in premenopausal Native American women, and lower ($P < 0.05$) in postmenopausal subjects, compared with white women. The conclusion of this study indicates a reduction in bone density and a sustained increase in bone turnover postmenopausally. BMI and serum 25OHD are significant determinants of BMD. In addition, peak BMD may be higher, and the postmenopausal rate of bone loss greater, than that in white women (Perry et al., 1998).

Other Studies were conducted in developed countries to study the relationship between formal education and osteoporosis. In Italy, a study was conducted by the University of Milan on 160 postmenopausal women. The prevalence of osteoporosis showed an inverse relationship with level of education ranging from 18.3% for the most educated to 27.8% for the least educated. Using the lowest educational level as a reference category, increases in educational status were significantly associated with a reduced risk for osteoporosis. This study proves the protective role of increased education (Varenna et al., 1999).

A population-based study was done at Kuopio University Hospital, in Finland. The purpose of study to evaluated the effects of menopause and certain putative behavioral risk factors on bone mineral density (BMD). Spinal and femoral neck BMD were measured with dual X-ray absorptiometry (DXA) from 1600 perimenopausal women aged 48-59 years (mean 53.2 years) with no diseases or medications known to affect bone metabolism. They found that menopause had a major effect on BMD, postmenopausal women had significantly lower BMD in both spine (-6.2%) and femoral neck (-3.9%) as compared with premenopausal women. Multiple regression analysis showed that weight, menopausal status, age, and grip strength were significant independent predictors of both spinal and femoral BMD. Additionally, physical activity was found to be a significant predictor of femoral BMD, and alcohol consumption was a significant predictor of spinal BMD (Kröger et al., 1994).

A study was done to asses the relationship between bone mineral density and socio-economic level in two healthy population groups of Spain women with similar characteristics but with different socio-economic levels. Bone mineral density (BMD) of the lumbar spine was measured in 1116 individuals of both sexes in two selected groups: (A) 832 volunteers in the urban Barcelona area and (B) 284 volunteers from a suburb with lower socio-economic level. The results showed that the Individuals of group A have greater spine BMD than group B. The patterns of bone loss in both groups were similar in onset, rate and quantity, suggesting a possible developmental cause for this difference. Bone loss in women began before the menopause and increased considerably in the following years. The BMD values show that most people at advanced age from the low socio-economic group cross the fracture threshold earlier than the first group (Del Rio et al., 1992)

A study was conducted to examine Bone status of Indian women from a low-income group and its relationship to the nutritional status. This study was therefore carried out with 289 women in the 30-60-year age group to estimate the prevalence of osteoporosis and measure the bone parameters by dual energy X-ray absorptiometry (DXA). The prevalence of osteoporosis at the femoral neck was around 29%. Bone mineral density (BMD) and T scores at all the skeletal sites were much lower than the values reported from the developed countries and were indicative of a high prevalence of osteopenia and osteoporosis. BMD showed a decline after the age of 35 years in cases of the lumbar spine and femoral neck.

This was largely due to a decrease of bone mineral content (BMC). The nutritional status of women appears to be an important determinant of bone parameters. BMD and BMC at all the skeletal sites and whole body increased significantly with increasing body weight and BMI of women (P<0.05). In the multiple regression analysis, apart from body weight, age, menopause and calcium intake were the other important determinants of BMD (P<0.05). In addition to these, height was also an important determinant of BMC. Finally this study highlights the urgent need for measures to improve the nutritional status, dietary calcium intake and thus the bone health of this population (Shatrugna et al., 2005)

A survey study was done among 730 postmenopausal women in Moroccan. The aims of the study were to determine: (1) the relationship between parity and bone mineral density (BMD); (2) the relationship between parity and osteoporotic peripheral fractures. Patients were separated into four groups according to the number of full term pregnancies, group 1: nulliparae, group 2: one to three pregnancies, group 3: four to five pregnancies, and group 4: six and more pregnancies. Additionally, patients were separated into three groups according to their ages, as <50 years, 50-59 years and >or=60 years. The results of this study showed that the patients with parity greater than six had spine and hip BMD values significantly lower than values in the other groups (p<0.001). After adjustment for age and body mass index (BMI), decreased lumbar and total hip BMD were still associated to increased parity (analysis of covariance(ANOVA) , (p=0.04) and 0.023, respectively). The relation between parity and lumbar BMD was highly significant among women aged <50 years (age-adjusted p=0.022), while there was no parity-spine BMD association in the other age groups. The relation between parity and hip BMD was seen only in the group 50-59 years (age-adjusted p=0.042). A positive history for peripheral fractures was present in 170 (23%) patients. In summery the present study suggests that the BMD of the spine and hip decreases with an increasing number of pregnancies, and this situation shows variations in different age groups. However, there was no correlation between parity level and peripheral fractures (Allali et al., 2001).

A cohort study was conducted among Chinese women. This study assessed the association of habitual dietary calcium intake and bone loss in early postmenopausal women. Four hundred fifty-four healthy postmenopausal Chinese women were enrolled for this 18-month cohort study. The subjects were 48–62 yr of age and within 12 yr of natural menopause. Dietary intake was assessed by the food frequency method, and bone mass was measured using dual energy x-ray absorptiometry. In conclusion, habitual dietary calcium intake had a beneficial effect on bone loss at the whole body and some regions of the hip.The study findings suggest that an intake exceeding 900 mg calcium/d was helpful in the prevention of cortical bone loss among early postmenopausal Chinese women (Ho et al., 2004).

A Cross sectional study was done to study the relationship between milk consumption and bone mineral density in middle aged and elderly women. The aim of this study was to assess the effects of historical milk consumption on current bone mineral density at the hip and spine. A 284 community based women aged 44-74 years recruited from four general practice age-sex registers in Cambridge. Subjects categorized their average milk consumption up to age 25, from age 25-44, and from age 44 to the present time as >=1 glass/day, <1 glass/day but >1 glass/week, or <1 glass/week. Main outcome measures, bone mineral density at the hip and spine measured by dual energy X- ray absorptiometry. The Results of this study indicated that milk consumption up to age 25 years were available for 252 women. There was a consistent trend in bone mineral density at all sites with increasing historical milk consumption (total hip, femoral neck, trochanter, intertrochanter,

P<0.05; Ward's triangle, *P*=0.005). The effects of milk consumption from age 25-44 and from age 44 to the present were similar in direction though not statistically significant. Finally, Frequent milk consumption before age 25 favorably influences hip bone mass in middle aged and older women (Murphy et al., 1994).

A descriptive survey was done at Woolmanbill hospital; in United Kingdom in 2001 among 320 older women aged from 60 to 80 years using heel scan .The aim of this study that to investigate the lifestyle practices of a group of older women who had received lifestyle advice a year previously whilst participating in research identifying the individual risk of osteoporosis. The primary method of data collection was postal questionnaire. Additional qualitative data obtained from a telephone interview of a small number of respondents were content analyzed. The findings of this study showed that the majority of women were non-smokers, had no alcohol problems and were participating in regular weight-bearing exercise. However, most had not been taking a calcium-rich diet in the previous year, and only 21% had changed their diet following identification of risk of osteoporosis. In conclusion, a statistically significant finding was that women at high risk of osteoporosis were the least likely to have made changes in lifestyles and focus on other issues such as treatment and prevention of falls to avoid fractures (Sandison et al., 2004).

A cohort was done at Rancho Bernardo in California to asses the relationship between family history of osteoporosis and bone mineral density at the axial skeleton. The aim of this study was to determine whether a family history of osteoporosis identifies individuals with low bone mineral density (BMD). Family history data on biologic parents and full sisters were obtained by questionnaire. BMD of the lumbar spine and hip was measured using dual-energy x-ray absorptiometry. After adjustment for age, body mass index, history of cigarette smoking, and estrogen use, men and women with a family history of osteoporosis had lower BMD than those with a negative family history. In men, a positive family history was associated with lower BMD at the hip ($p = 0.01$), whereas in women a significant association was observed for the spine ($p = 0.02$) (Soroko et al., 1994).

A pervious study was done among Iranian women in Australia. The objective of this study was to estimate the modifiable distribution and determinants of bone mineral density (BMD) among Iranian women in Australia. Ninety women aged 35 years and older completed a questionnaire on socio-demographic and lifestyle factors. BMD was measured at the lumbar spine (LS) and femoral neck (FN) using DXA and was expressed in g/cm2 as well as T-score. The results of study showed that the LS and FN BMD in smokers was 8% lower than that in non-smokers. Further analysis of interaction between BMI and smoking revealed that the effect of smoking was only observed in the obese group ($P = 0.029$ for LS BMD and $P = 0.007$ for FN BMD), but not in the overweight and normal groups.

Using T-scores from two bone sites the prevalence of osteoporosis (T-scores <or= -2.5) was 3.8% and 26.3% in pre-and post-menopausal women, respectively. Among current smokers, the prevalence was higher (31.3%) than that among ex-smokers (28.6%) and non-smokers (7.5%).These data, for the first time, indicate that apart from advancing age and lower body mass index, cigarette smoking is an important modifiable determinant of bone mineral density in these Caucasians of non-European origin (Baheiraei et al., 2005).

In addition, the University of Dicle in Turkey conducted a study. 569 postmenopausal women aged (45-86) were separated into four groups according to the level of education (no schooling, elementary, high school, university).Bone Mineral Density (BMD) test was

performed on all participants, the results showed a significant correlation between educational level and Bone Mineral Density (BMD) Thus, prevalence of osteoporosis showed an inversed relationship with level of education, ranging from 18.6% for the most educated to 34.4% for the uneducated (Gur et al., 2004).

A relevant descriptive retrospective analytical study about osteoporosis in Palestinian women was conducted by a master student from Al-Quds University for the degree of master of Maternal Child Health which evaluated the specific different risks and protective factors affecting osteoporosis (nutritional factors, estrogen level, vitamin-D, body build, ethnic group, genetic factors, and physical activity). The study has not evaluated other factors such as level of education and knowledge (Al-Shaweesh, 2003). Nevertheless, level of education and knowledge done in another study *(*Issa, 2004). As mention below.

2.5 Knowledge and Osteoporosis

A relevant study was conducted by the University Hospital of Tromsø in Norway in 1514 Norwegian menopausal women aged (16-79) to investigate knowledge of osteoporosis and attitude towards prevention of disease. The result showed that increased knowledge of osteoporosis was correlated to high level of education. Multiple regression analysis confirmed univariate analysis, and education was the strongest predictive factor for knowledge about risk factors, protective factors and treatment (Magnus et al., 1996).

National Taipei College of Nursing, Taipei, Taiwan a cross-sectional survey was done to asses the relationship between calcium intake in relation to knowledge of osteoporosis and beliefs in young adult women. This investigation found that young adult women (n = 265) were very likely (80.6%) to have accurate knowledge about osteoporosis but also typically had a low calcium intake (454 mg/day). The women in this study believed that they were at risk of osteoporosis but felt that prevention was difficult. Meanwhile, they held the opinion that osteoporosis is not serious and that taking preventative measures would not be worthwhile. The factors that most strongly affected the intake of calcium by women were, in order, knowledge, number of children, self-rated health score, Body Mass Index, graduation from high school, experience of bone density examination and family history (Chang, 2006).

Another study was indicate that about 80% of postmenopausal women expressed interest to learn more about osteoporosis, since the women lacked knowledge about risk factors, prevention, and diagnosis about osteoporosis as reported by a study conducted by Miss Intissar M.Issa from Al-Quds University in Bethlehem district *(*Issa, 2004*).*

2.6 Summary

In this chapter, I have reviewed some studies that are related to the current study. In summary, the prevalence of osteoporosis was different between various countries. Demographic factors such as age, level of education, socio-economic level such monthly income, parity; life style factors and family history were found to be the most determinant of Bone Mineral Density (BMD) and related to osteoporosis. Moreover, knowledge about different determinants of the disease such as prevention, diagnosis and risk factors are very important to reduce the occurrence of osteoporosis.

Chapter 3

3.1 Introduction

The purpose of this chapter is to provide an overview of the human skeletal system, and to give a detailed account of osteoporosis; definition, risk factors, in addition to diagnostic and treatment approaches related to this condition. Furthermore, the text contains a wide variety of figures that are clear and allow easy understanding of the text. Moreover, dealing with a subject that is highly technical in nature, this chapter attempts to explain bone biology in terms that a lay person can generally understand.

3.2 Skeletal System

Skeletal system is composed of bones and cartilages. Bone is a living tissue which is a highly specialized hard form of connective tissue that forms most of skeletal system and is the chief supporting tissue of the body (Moore and Dalley, 1999). Bones provide protection of vital structure; support for body the mechanical base of movement, a continuous supply of new blood cells and storage of salts (e.g., calcium) (Thibodeau and Patton,1997). The human skeleton is divided into two components, these are the (1) appendicular skeletal which consists of the hip, shoulder girdles and bones of the limbs (Moore and Dalley, 1999). (2) The axial skeletal, comprising the vertebral column—the spine—and much of the skull. (Encyclopedia Britannica, 2006).

3.3 Microscopic Structure of Bone

The average human adult skeleton consists of 206 bones .We are actually born with more bones (about 300)**,** attached to the muscles by tendons. These will fuse together by the age of twenty or twenty-five into the 206 hard, permanent bones (Partners in Assistive Technology Training and Services, 2000).

There are two different type of bone tissue based on texture of cross sections which can be classified as follows:

Compact and sponge or cancellous depend on relative amount of solid matter and on the number and the size of space they contain (Moore and Dalley, 1999). Eighty percent of skeletal bone mass compact bone and twenty percent of bone mass sponge (Sam brook, 2001).The structural units of compact bone are osteons, the central of each osteon contain a hollow canal acts as a central pass way for blood vessel and nerves. Spongy bone is composed of honeycomb network of bone called trabeculate that act as supporting beam (Encarta Online Encyclopedia, 2006).The spongy bone of the femur, humerus, and sternum contains yellow marrow at the center which is used to store fats; red marrow, producing red blood cells (which carry oxygen), and white blood cells (which fight infection); or platelets (that help stop bleeding) (Partners in Assistive Technology Training and Services, 2000).

This cortical shell is essential because it provides strength, sites for firm attachment of the tendons and muscles, and protection from excessive weight. The inner trabecular provides a large bone surface for mineral exchange. In addition, trabecular bone helps to maintain skeletal strength and integrity. The shape and size of both cortical and trabecular bone can respond to different kinds of stress produced by physical activity. Bones do not work in isolation, but rather are parts of the musculoskeletal system weakness of the muscles can lead to loss of bone and joint damage (Carmona et al., 2004).

3.4 Bone Tissue Classification

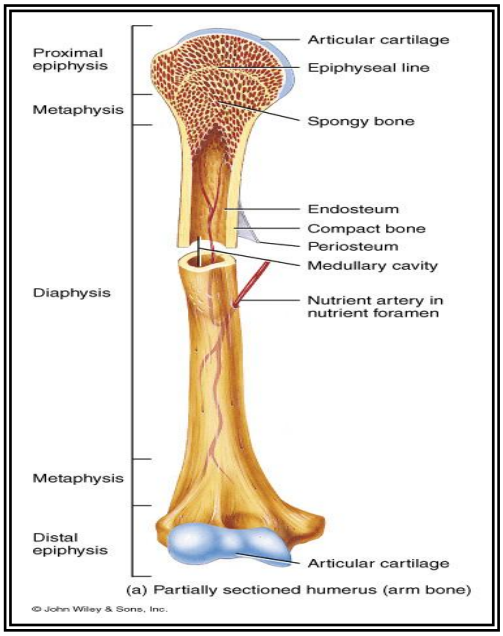
Based on matrix arrangement, bone tissue can be classified as follows:

1) Lamellar bone (secondary bone tissue): in compact bone, they are concentrically organized around a vascular canal, termed a haversian canal (Yang Y.et al. 2002). Whereas in sponge bone, lamellar has arranged parallel fibers and is much stronger (Wikipedia, the free encyclopedia, 2006).

2) Woven bone (primary bone tissue): containing smaller amounts of mineral substance and a higher proportion of osteocytes than lamellar bone woven bone is temporary and eventually is converted to lamellar bone (Yang et al., 2002).Woven bone is put down during growth or repair. It is so called because its fibers are aligned at random, as a result has low strength (Wikipedia, the free encyclopedia, 2006). All bones are lined on both internal and external surface by layers of tissue containing osteoginc cells, endosteum on the internal surface and periosteum on external surface (Junqueira and Carneiro, 2003).

3.5 Long Bone

Consists of the epiphysis, the metaphysis, which is the development zone and the diaphysis.In growing bone a layer of cartilage termed growth palate is found between epiphysis and metaphysic (Vaughan, 2003). Figure (2).



Figure(2): Partially sectioned humerus (arm bone)
Source: (Tortora, Grabowski, 2001).

3.6 Components of Bone.

The main components of bone are:

1- Bone Matrix, Which is Divided into Two Components

First, osteiod the organic part of matrix makes up approximately one-third of matrix including proteoglycans, glycoprotein, and collagen fibers. These organic substances, particularly collagen, give bone its strength. In addition they contribute to the bone structure.

Second, the inorganic compound makes up sixty five of bone mass consists of mineral salts largely calcium phosphate, and inorganic substances which make bone hard. Both organic and inorganic mineral component are involved in bone turn over (Marieb, 1995).

2- Bone Mineral

The mineral component of bone is basically an inorganic calcium compound called hydroxyapatite, made up of calcium ions, phosphate ions and hydroxyl ions in the ratio Ca5 (Po4)3(OH) (Prentice, Bonjour, Branca, et al. 2003). As these salts are deposited by osteoblastes around the collagen fibers of the matrix, the tissue hardens. The hardening process is called calcification (Tortora, 1997).

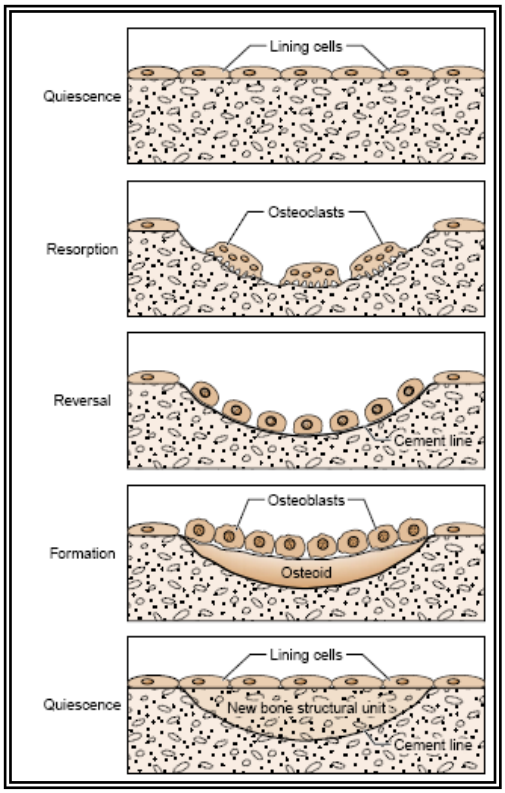
3 - Bone Cells

1. Osteoblasts: are the cells that secrete the extracelluar matrix of the bone. Once the cell is surrounded with its secreted matrix, it is referred to as osteocyte (Ross, Kaye, and Pawlina, 2003).

2. Osteyocyte: mature bone cells, are the main cells in bone tissue and maintains its daily metabolism such as the exchange of nutrients and wastes with the blood. Both osteoblasts and osteyocyte do not undergo cell division (Tortora, 1997).

3. Osteoprogenitor: cells undergo mitosis to become osteoblasts.They are found in periosteum, endosteum, and canal in bone that contain blood vessels (Tortora, and Grabowski, 2001).

4. Osteoclasts: A large multinucleated cell found in growing bone, also called osteophage (Medical dictionary, 2004) ,is found on surface on the bone and function in bone resorption (destruction of matrix), which is important in the growth and repair of bone (Tortora and Grabowski, 2001). As shown in figure (3).



Figure(3): Bone cells.
Source: (Sam brook**,** 2001).

3.7 Bone Growth and Development: Modeling and Remodeling

Resorption of bone occurs continuously throughout life, first as part of skeletal growth and modeling, and later in the process of bone-remodeling in the adult skeleton (Athanasou**,** 1996). Bones continues to regenerate long after we reach our full height every three years. There are two reasons for this phenomenon. First, bones supply tissues throughout our bodies with calcium, serving a vital role in keeping us alive and healthy. Second, bones regenerate to replace old bones. Regeneration ensures that bones remain strong and flexible (Snow Brand Milk Products company, 2006). A consideration of the normal process of bone modeling and remodelling is fundamental to the understanding of the pathogenesis of osteoporosis. Bone loss in osteoporosis results from an imbalance between the two components of the bone renewal process – bone resorption and bone formation (Russell**,** 2003).

3.7.1 Bone Modeling.

During development and growth, bone is produced by two main processes, intramembranous ossification, and the source of most of flat bones such as skull. Endochondral ossification involving the growth plate, as occurs in short and long bones. In both process, the bone tissue that appears first is primary, or woven. Primary bone is a temporary tissue and is soon replaced by the definitive lamellar area of resorption during growth, or secondary bone. Area of secondary bone appears side by side during growth (Junqueira and Carneiro, 2003). As shown in figure (4).

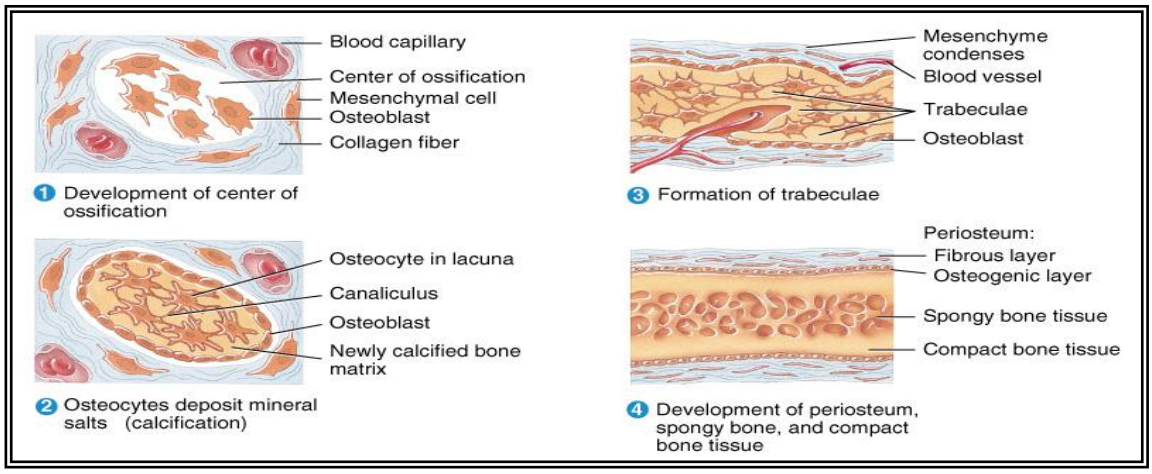


Figure (4): Partially sectioned humerus (arm bone).
Source: (Tortora and Grabowski, 2001).

3.7.2 Bone Remodeling

Bone remodeling is a couple processes in which there is localized removal of old bone (resorption) and replacement with newly formed bone. In normal adults, there is a balance between the amount of bone resorbed by osteoclasts and the amount of bone formed by osteoblasts. The figure below (5) shows the stages of normal bone remodeling cycle, which includes resorpative phase, reversal phase, formative phase, and resting phase. Systemic calcium regulating hormones, parathyroid hormone (PTH), 1, 25 dihydroxy vitamin D (calcitriol) and calcitonin, acting in concert with local regulatory mediators. It is very important to achieve the control of calcium metabolism and of skeletal remodeling (Hill, 1998).

In postmenopausal women the gradual loss of trabecular and cortical bone, accompanied by deterioration in their structural integrity, leads to impairment of the ability to resist mechanical loading leading to fracture due to loss of estrogen, there is an increase in remodeling activity in both cortical and trabecular bone. This because there is a failure for all the bone removed during bone resorption to be replaced by an equivalent amount of new bone (Mueller and Russell, 2003).

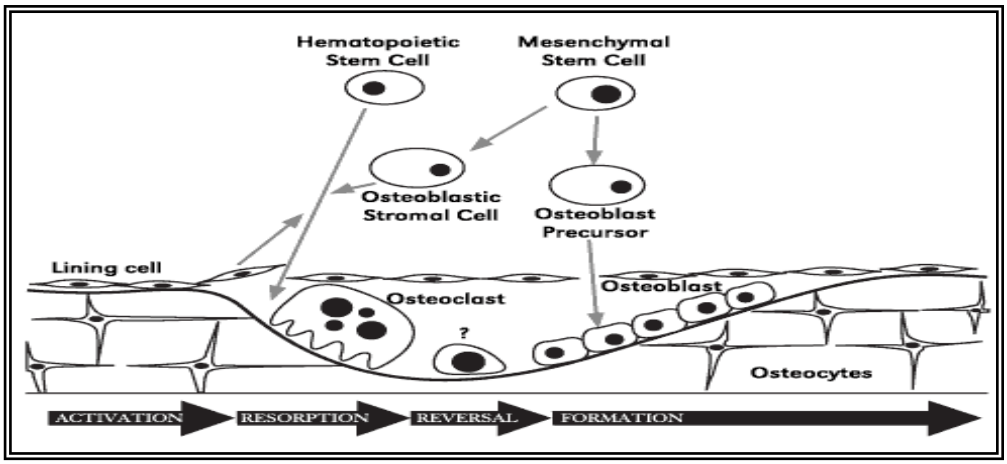


Figure (5): Bone Remodeling.
Source: (Carmona et al., 2004).

3.8 Osteoporosis

Osteoporosis is defined as a systemic skeletal disease characterized by low mass and microarchitural deterioration of bone tissue, which leads to enhanced bone fragility and consequent increase in fracture risk (Nelson et al. 2001) .This definition emphasizes that, in addition to bone mass, the structure of bone is an important factor in the pathogenesis of fracture (Nelson, et al. September 2002). The World Health Organization developed a system for grading a bone loss based on the use of T-score. The person's T-score falls into three categories: normal [>-1], osteopenia (low bone mass) between [-1] to [-2.5] and osteoporosis [< -2.5] (Wronty, 2005). Osteoporosis leads to Spinal or vertebral fracture which also has consequences including loss of height, deformity and severe back pain (National Osteoporosis Foundation, 2005). Historically, Sir Astly Cooper recognized osteoporosis over 150 years ago, when he observed that hip fractures might result from an age-related reduction in bone mass or quality However, the term of osteoporosis was first introduced in the medical field in France and Germany in nineteenth century as a histologic description for age human bone and later evolved to describe bone with reduced quantity and normal mineralization (Cooper, 1999).

3.8.1 Osteoporosis Types

3.8.1.1 Primary Osteoporosis

There are two primary kinds of osteoporosis:

1. Type I osteoporosis (high turnover) because it causes a rapid loss of the spongy inner part of the bone (called trabecular bone).It occurs in women 15 -16 years after menopause (Depuy spine, Inc .2006). Due to sudden postmenopausal decrease in estrogen levels, this results in a rapid depletion of calcium from the skeleton. This type is associated with fractures of the hip, wrist, or forearm caused by falls or minor accidents, and fractures that occur when the vertebrae compress together causing a collapse of the spine (The New York Times Company Inc., 2006).

2. Type II osteoporosis (low turnover), with primary type II osteoporosis there is a simultaneous loss of both the outer bone and the spongy tissue inside the bone because the rate of bone turn over is much lower. It occurs typically between the ages 70-80 years. Hip fractures are the most common result of this type of osteoporosis (Depuy spine, Inc .2006). It is also known as age-related or senile osteoporosis. Older women can have both type I and type II osteoporosis (The New York Times Company Inc., 2006).

3.8.1.2 Secondary Osteoporosis

It is caused by identifiable agents such as glucocorticoids, or by diseases such as hyperthyroidism or myeloma (Limpaphayom, 2003).

3.9 Postmenopausal Osteoporosis

Osteoporosis is a skeletal disorder characterized by compromised bone strength, which predisposes a person to increased risk fracture (Gass and Dawson-Hughes, 2006). Osteoporosis is a normal part of ageing. In reality we would all develop osteoporosis if we lived long enough (The Jean Hailes Foundation for Women's Health**,** 2006). In general, the gradual loss of skeletal mass begins in women in the fourth decade. This bone loss accelerates in women following the menopause, as shown below (Richardson, 2000).

There are many causes of osteoporosis but the most common by far is due to the decease in the amount of bone which occurs after menopause, this is called postmenopausal osteoporosis (Christiansen and Riis, 1990)**.** Postmenopausal osteoporosis is a common disease with a spectrum ranging from asymptomatic bone loss (Rosen, 2005). Progressive loss of bone tissue which is characterized postmenopausal osteoporosis that begins after natural ^{or} surgical menopause and leads to fracture within [15–20] years from the cessation of the ovarian function. A hormone-dependent increase in bone resorption and accelerated loss of bone mass in the first [5or10] years after the menopause appears, although age-related bone loss and low peak bone mass suboptimal skeletal development may be contributing factors (Pacifici**,** 1998). Women lose about 0.75 - 1.0 % of their skeletal mass per year after age (35) this may accelerate to as much as 2 - 3 % per year following the menopause (Richardson, 2000). As shown in figure (6).

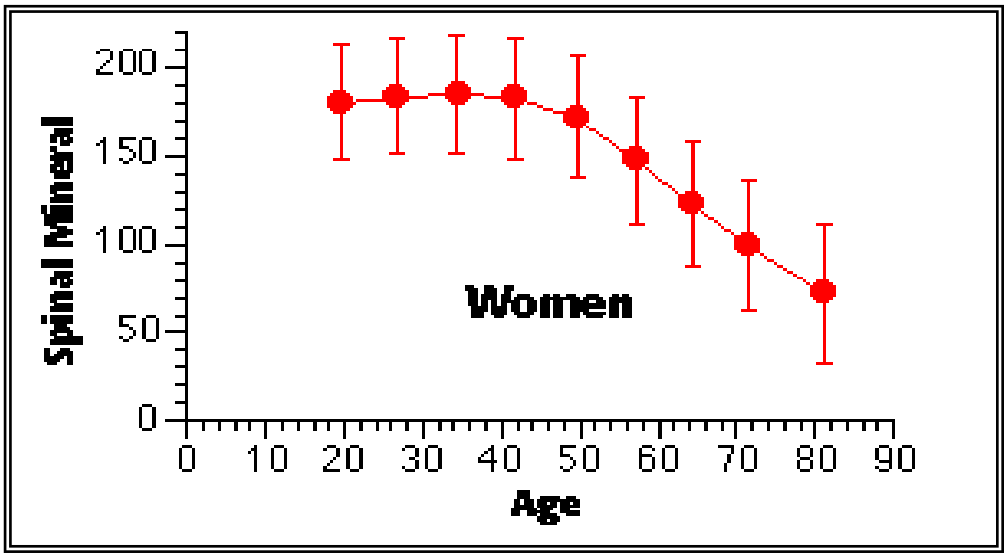


Figure :(6) Spinal mineral levels by age.
Source: (Richardson, 2000).

3.10 Risk Factors

Osteoporosis is multi-factorial disease. There are many factors, referred to as risk factors, which influence bone mineral density and increase the probability of developing the disease (Ferniza, 2002). A risk factor is a habit, condition or set of circumstances which predisposes a person to develop a given disorder. Like osteoporosis, this may be symptom less for many years. These factors can be divided into three categories:-

3.10.1 Risk Factors Unpreventable

Age and sex: Bone loss begins during the fourth decade of life, after age of 30.But at all ages; women are four or five times more likely to suffer from osteoportic fractures than men because of the changes involved in menopause.

Ethnic group: Surveys conducted in several continents have shown that osteoporosis is more common among Caucasians and Oriental than among of African origin.

Genetic factors: Women whose mothers or sisters suffer from osteoporosis seem to be more susceptible .Studies in twins reveals that around [50%] of the variance in peak bone mass is genetically determined .In addition, genetics effects appear to be stronger in lumbar spine than in the femoral neck or distal forearm (Ayalon and Simkin, 1996).In our study we did not concentrate on these factor but we ask about it in general.

3.10.2 Risk Factors which are Partly Modifiable

Body weight: It has been shown in a number of studies that there is a negative correlation between low body mass index and peak bone mass .Moreover, low body mass index and weight loss are strongly associated with fracture risk (Christodoulou and Cooper, 2003)**.**

Early menopause: Bone loss increases sharply for a few years after the menopause .This true whether the menopause occurs around age of (50) or whether it occurs earlier after surgical removed of ovarian for example. An early menopause, at or below the age of (45), can be quite spontaneous or it may be a symptom of some other condition, in which case medical advice should be sought. The main hormones produced by ovarian is estrogen lack of this hormone is a single cause leading to osteoporosis. So as a rule, the earlier menopause women, was more likely to suffer from osteoporosis (Christodoulou and Cooper, 2003).

Other disorders and drugs: Osteoporosis is sometimes secondary to other disorder which directly or indirectly affects the whole metabolism of the body. Conditions which cause osteoporosis include endocrine disorders such as hyperparathyroidism, malignant disease such as lymphoma, myoloma, miscellaneous disorders such as connective tissue disease and chronic renal failure. Furthermore, some drugs such as corticosteroids and heparin associated with osteoporosis (Ayalon and Simkin, 1996).

3.10.3 Risk Factors which can be Preventable

Physical inactivity: Regular exercise is known to help prevent bone loss in older adults, while the lack of regular exercise or immobilization will lead to bone loss (Leggett, 2000).

Lack of calcium in the diet: Number of studies have shown a positive association between the intake of dairy products and bone mineral density during the skeletal growth , maturation stage of childhood and early adulthood .In addition , other studies have found that in middle-aged and post-menopausal women, possibly correlating with calcium intake. Calcium is considered one of the most important constituents of bone. The absorption of calcium from the diet relies on two mechanisms, with low intakes; calcium absorption relies on an active transport system in the intestinal mucosa which is vitamin-D dependent. Therefore a low calcium intake combined with low vitamin-D availability would greatly

impair the amount of calcium available for bone formation. However, with a high calcium intake most calcium is absorbed passively from the gut (Leggett, 2000).

Alcohol, tobacco, caffeine and animal protein: Alcohol is an important risk factor; chronic abuse of alcohol is very often associated with osteoporosis in men as well as in younger postmenopausal women. The effect of alcohol on bone may be due to its effects on vitamin- D metabolism or to direct toxic action on bone cells. Cigarette smoking a risk factor for at least four reasons, female cigarette smoker is thinner, they have earlier natural menopause, and they have a higher catabolism of exogenous estrogen, and may inhibit osteoblast. Although excessive consumption of caffeine found in tea, cola drink, chocolate as well as coffee is also thought to be contributory factor. There has also been a correlation between osteoporosis and consumption of large amount of animal protein (Ayalon and Simkin, 1996).

Table (1): Optimal calcium requirements

Group	Optimal daily Intake(mg)*
Infants	
Birth – 6 months	400
6 months – 1 year	600
Children	
1-5 years	800
6-10 years	800 - 1200
Adolescents/ young adults	
11-24 years	1200 - 1500
Men	
25-65 years	1000
Over 65 years	1500
Women	
25-50 years	1000
Over 50 years	
Receiving estrogens	1000
Not receiving estrogens	1500
Over 65 years	1500
Pregnant and nursing	1200 - 1500

Source: (Schussheim and Siris**,** 1998).

3.11 Prevention and Treatment

The aim of prevention should be to increase peak bone mass and to reduce subsequent rate of bone loss (Peel and Eastell, 1995).The best way to prevent osteoporosis is to get enough calcium of dairy products which are rich in calcium. Other foods such as figs and almonds are high in calcium. In addition, drinks and foods such as orange juice, cereals, and breads often have added calcium. Vitamin-D is also necessary for your body to use calcium. They recommended getting around (800 IU) to prevent osteoporosis (Misner, 2000). As shown in table (1).

Physical activity is also important to prevent osteoporosis. Routine weight-bearing exercise such as walking, climbing stairs, jogging, weight training, and playing tennis are important in building strong bones. Moreover, they help us keep to our balance so we are less likely to fall as we get older (The Healthy Journey, 2006).

The National Osteoporosis Foundation recognized the variety of conditions conferring risk of osteoporosis and recommended to the physician to advice patients to avoid smoking and cut down alcohol, which helps to prevent osteoporosis. Moreover, postmenopausal women younger than [65 years] who have one or more risk factors for osteoporosis in addition to menopause is recommended to do Bone Mineral Density (BMD) test. It is recommended that a woman discuss with her doctor the possibility of taking a hormone replacement therapy or a long-term steroid after menopause (Jeannette, 2001).

There are four major goals in the treatment of osteoporosis: prevention of fracture; reduce the risk of bone loss; alleviate patient's symptoms and skeletal deformity; maximizing physical function. The US Surgeon General has recommended a pyramidal approach to treatment to achieve these goals. The base of the pyramid consists of three levels, first level, life style changes, second level addresses secondary causes of osteoporosis, third level includes pharmacotherapeutic interventions to improve bone density and reduce the risk of fracture, Figure (7). According to Food and Drugs Association there are three drugs for the prevention of osteoporosis (estrogens, alendronate, andraloxifene), as well as three for the treatment of established osteoporosis (estrogen, alendronate, and calcitonin). (Gass and Dawson-Hughes, 2006).

In addition, there are a recent pharmoctherapy for the secondary prevention of osteoporotic fragility fractures in postmenopausal women such as bisphosphonates (alendronate,etidronate, risedronate), selective oestrogen receptor modulators (raloxifene) and parathyroid hormone (teriparatide). Have been show to be effective in the treatment and well tolerated in the treatment of women with established postmenopausal osteoporosis (National Institute for Clinical Excellence, 2005).

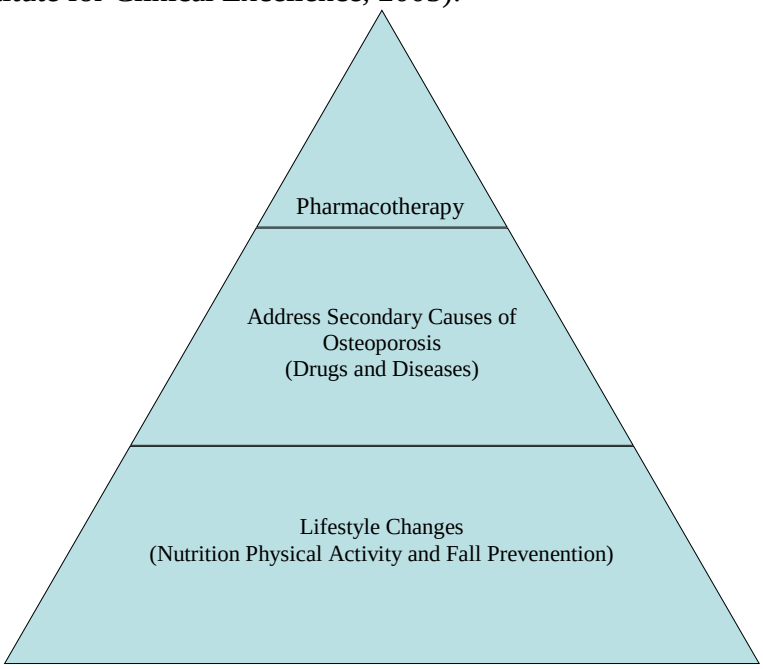


Figure (7): Pyramidal approach to treatment of bone disease.
Source: (Gass and Dawson-Hughes, 2006).

3.12 Diagnosis and Detection

The WHO established diagnostic criteria for osteoporosis on the basis of BMD T-scores. However, T-scores were developed for the estimation of the prevalence of osteoporosis across populations not for the assessment of osteoporosis in specific patients (Sam brook, 2001). See figure (8).

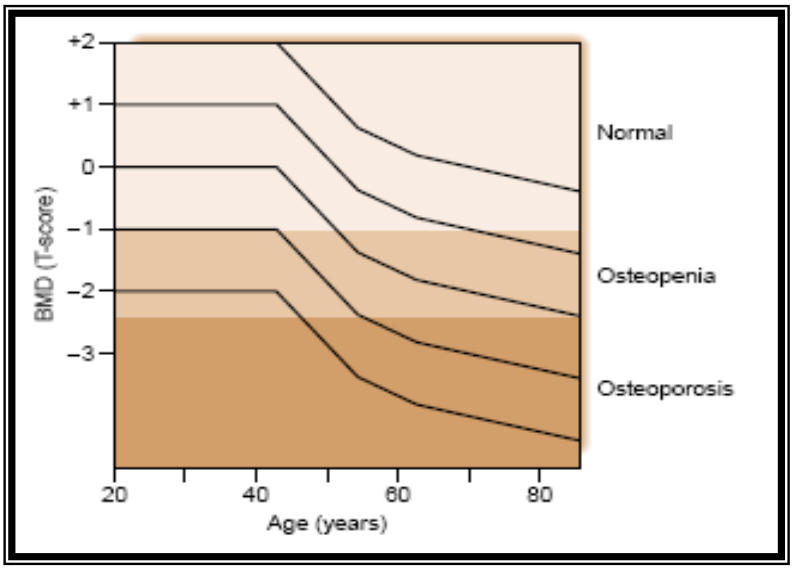


Figure (8): World Health Organization criteria for osteoporosis.
Source: (Sam brook, 2001).

The ultimate goals when evaluating and diagnosing patients for osteoporosis based on existing bone mass, is to determine the fracture risk based on this clinical assessment, and to make decisions regarding the appropriate therapeutic intervention (Lane, 2006). Table (2) shown indication for bone density measurement, where assessment would influence management of diseasae.

T- scores were based originally on assessment of BMD at the hip by dual-energy x-ray absorptiometry (DXA).They also have been applied to define diagnostic thresholds at other skeletal sites. In addition newer measures of bone strength, such as ultrasound, have been introduced using quantitative ultrasound (QUS) of the heel have predicted hip fracture and all no vertebral fractures nearly as well as DXA at the femoral neck (Osteoporosis Prevention, Diagnosis, and Therapy, 2001). Bone density tests can predict your chances of fracturing in the future, detect low bone density before a fracture occurs, determine your rate of bone loss and/or monitor the effects of treatment if the test is conducted at intervals of a year or more. Moreover these tests are painless, noninvasive, and safe. (National Institutes of Arthritis and Musculoskeletal and Skin Disease, 2006).

Table (2): Indication for Bone Density Measurement.

Indications for bone density measurement recommended by the Royal College of Physicians, where assessment would influence management

- Radiographic evidence of osteopenia and/or vertebral deformity.
- Previous fragility fracture.
- Prolonged corticosteroid therapy (prednisolone >7.5 mg daily for six months or more).
- Premature menopause (natural or surgical menopause before the age of 45 years).
- Prolonged secondary amenorrhoea (>1 year).
- Primary hypogonadism.
- Chronic disorders associated with osteoporosis**.**
- Maternal history of hip fracture.
- Low body mass index (<19 kg/m^2).

Source: *(*Tuck and Francis, 2002).

3.13 Public Health Impact of Osteoporosis

Osteoporosis is a skeletal disease characterized by low bone mass and microachitectural deterioration with resulting increase in born fragility and hence susceptibility to fracture (Cooper and Sambrook, 2006**).** Osteoporosis is considered to be a major public health hazard because of the fact that osteoporotic fractures lead to disability; in addition osteoporosis is a common disease among the elderly. An improvement in health care the lifetime expectancy in developed countries has increased and decrease consequences that result from osteoporosis (Kipersztok, 1997).

The adverse outcomes of osteoporotic fracture fall into three broad categories: mortality, morbidity, and cost (Cooper and Sambrook, 2006). In addition it has physical and psychosocial consequences, which significantly affect the individual as well as the family and community (Nucleus Catalog Medical Reference Library, 2006).Osteoporosis is a significant cause of morbidity and mortality worldwide, the risk of death in women with hip fracture is approximately (2-4) times greater in the year after hip fracture than in women without hip fracture(Khan, 2004). Following a hip fracture, there is [10%-20%] mortality over the subsequent (6) months, [25%] will require long-term domiciliary care and [50%] of sufferers will be unable to walk without assistance (Riggs and Melton, 1995). In addition, about [20%] of patients with wrist may be hospitalized. Potential complications of wrist fractures include secondary arthritis, chronic pain, limitation of motion, and physical deformity(Khan, 2004).

Hip fracture has a profound impact on quality of life including adverse effects on physical health (impact of skeletal deformity). An osteoporotic fracture is associated with increased difficulty in activities of daily life, one-third require nursing home placement (Nucleus Catalog Medical Reference Library, 2006). Fear, anxiety, and depression are frequently reported in women with established osteoporosis (Khan, 2004).

3.14 Operationalization

The operational definition of osteoporosis is based on the assessment of bone mineral density (BMD). Moreover, the diagnostic criteria that were established by the WHO for the classifications of women require an accurate measurement of bone mineral density (Kohlmeier, 1998).

Table (3): WHO definitions for osteopenia, osteoporosis and established osteoporosis.

Osteopenia BMD between (1.0 -2.5) standard deviations below peak bone mass (at age 30), T-score of (-1.0) to (-2.5). Osteoporosis BMD at least 2.5 standard deviations (SD) below peak bone mass, T-score of (-2.5) or lower. Established osteoporosis T-score of (–2.5) or lower and fracture Physician: Before starting treatment for one or any of these conditions, secondary causes of bone loss should be ruled out and any abnormal underlying condition treated if the BMD is one or more standard deviations below age-matched normals. The following tests may be ordered: 1) Serum calcium + phosphate, creatinine, TSH. 2) CBC, liver function tests and SPEP. 3) 24-hr. urine calcium, creatinine clearance and cortisol 4) PTH intact, 25-hydroxyvitamin D, urine UPEP.

Source :(Kohlmeier, 1998).

Some of terms utilized in this study have definitions unique to this effort. Those definitions are provided in the following section.

3.14.1 Demographic variables

Among the demographic information it was classified into:-

1- Age: defined as postmenopausal women (< 45), (45-55), (56-65), (66-75), and (≥ 76) years of age.
2- Educational level: no education, school education, and high education.
3- Marital status: indicate the civil status of postmenopausal women, and was classified into single, married divorced and widowed.

3.14.2 Socio-economic Status

The second section generated information on socio-economic status

1-Income status: it was classified by the criteria of Israel Economic Ministry.
2-Parity: numbers of children of women were born.

3-Number of rooms: how many rooms in there house.

3.14.3 Physical Parameters

Section three addressed physical parameters (BMI, height, and weight).

1- Body mass index (BMI): body size was determined by calculating the body mass index (BMI) (kg/m^2).
2- Height: actual measurement of height was taken.
3- Weight: actual measurement of weight in light clothing and without shoes was taken.

3.14.4 Knowledge about Different Determinates of the Disease

Section four twenty one questions designed to assess knowledge about different determinates of the disease such as various risk factors, prevention, diagnosis and symptoms of osteoporosis. Answers of twenty one questions were scored. The women final score was calculated by dividing (total score) on the total number of questions, multiplied by 100%.

3.14.5 Life Style Factors

Section five it was classified into:

1- Participating in sport activities: at early, middle and current age (e.g. walking, shopping, garden work, etc…).
2- Caffeine consumption: the subjects were asked to estimate frequency of caffeine consumption cups/day such as (coffee, tea, and cola).
3- Smoking cigarette: women were asked about smoking cigarette or other form, frequency per day, age of smoking onset and cessation.
4- Passive smoking: any smoker on there house environment, where the women were live.

3.14.6 Nutritional Factors

Section six produced information on diet: dietary and non dietary items including (diary products, vitamin-D, early and current consuming of milk, supplements consumption), the women were asked to estimate frequency of consumption per day.

3.14.7 Medical History

Final section generated information about:

1- Family history: osteoporosis in first degree relative, (mother, sister, aunt, etc...).
2- Hysterectomy: the women who did hysterectomy or not.
3- Overectomy: the women who did overectomy or not. Also the women were asked about number of ovarian removal one or two and years following overectomy.
4- Years following menopause: the number of years after menopause.

3.15 Conceptual Framework

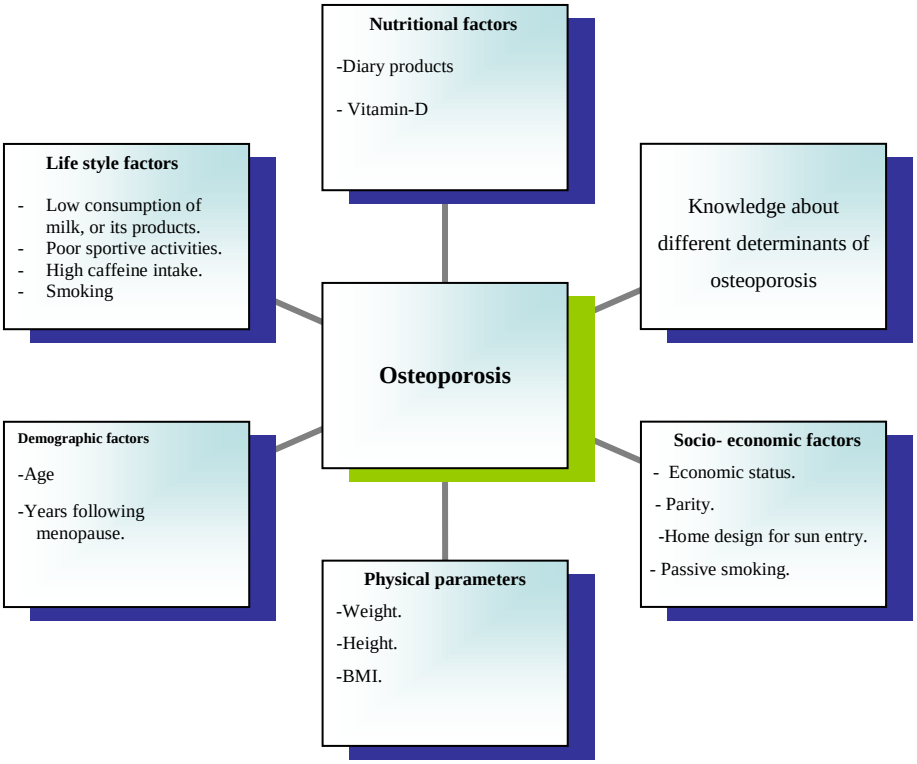


Figure (9): Osteoporosis is a multifactorial disease
Source: Based on literature.

The risk factors for osteoporosis are divided into two categories: those that unpreventable such as gender, race, and family history and those that can be preventable such as alcohol consumption, smoking, and calcium intake. Depending on the aforementioned literature review, we developed this figure of framework analysis. The determinants risk factor such as socio-demographic, socio-economic and environmental factors can influence bone positively or negatively. These selected risk factors were associated with many of non-communicable disease such as osteoporosis.

Now we are going to talk about some of potential determinants of selected risk factors in some details as we depending in our study analysis:

3.15.1 Demographic Variables

1- Age: defined as postmenopausal women (< 45), (45-55), (56-65), (66-75), and (≥ 76) years of age.
2- Educational level: include no education, school education, and high education.
3- Marital status: single, married divorced and widowed.

3.15.2 Socio-economic Status

1-Income status: include low income (3700 NIS), medium income (3700-4000 NIS), and high income (>4000 NIS).
2-Parity: (1-2), (3-4).and more than 4 children.
3-Number of rooms: (1-2), (3-4).and more than 4 rooms.

3.15.3 Physical Parameters

1- Body mass index (BMI): under weight (BMI <20), normal weight (BMI 20-24.9), over weight (BMI 256-29.9) and obese (BMI ≥30).
2- Height: less than 130cm, (130-139) cm, (140-149) cm, (150-159) cm and more than 160cm.
3- Weight: less than 50 kg, (50-59) kg, (60-69) kg, (70-79) kg, (80-89) kg, (90-99) kg and more than 100kg

3.15.4 Knowledge about Different Determinates of the Disease

Knowledge about various risk factors, prevention, diagnosis and symptoms of osteoporosis. See table (15, 16,17and 18).

3.15.5 Life style Factors

1- Participating in sport activities: at early, middle and current age (e.g. walking, shopping, garden work, etc…).
2- Caffeine consumption: 7 cups / days, 4-6 cups/ days, 1-3 cups/ days and no coffee consumption
3- Smoking cigarette: current smokers, ex-smokers and never smoking.
4- Passive smoking: yes or no.

3.15.6 Nutritional Factors

Frequency of consumption per day (diary products, vitamin-D, early and current consuming of milk, supplements consumption).

4.15.7 Medical History

1- The women have osteoporosis: family history and no family history
2- Hysterectomy: yes or no.
   - Years following hysterectomy: less than 15 y, (16-20) y, (21-25) y and more than 25y.
3- Overectomy: yes or no.
   - Number of Ovaries Removal and Osteoporosis: one ovary and two ovaries.
   - Years following Overectomy: less than 15 y, (16-20) y, (21-25) y and more than 25y.
4- Years following menopause: classified into five categories (< 5), (5-10), (11-15), (16-20), more than 20 years of age.

3.16 Summary

No single cause for osteoporosis has been identified. However, certain factors seem to play a role in the development of osteoporosis. We call these factors "risk factors" because each factor influences our risk of developing the disease. Several of these factors have been shown to be stronger predictors of bone loss than others and are therefore considered major risk factors. Other conditions that may also lead to bone loss are considered minor risk factors.

Chapter 4

Methodology

4.1 Study Design

This is a descriptive cross- sectional study that was conducted to assess the frequency of osteoporosis and to identify the risk factors affecting osteoporosis among Palestinian women in the old city of Jerusalem. Data from cross sectional studies is helpful in assessing the health care needs of populations (Beaglehole et al., 1996). Cross sectional studies are relatively easy and economical to conduct and useful for investigating exposures that are a fixed characteristics of the individual (Beaglehole et al., 1996).

4.2 Target Population

The study sample came from three centers, in the old city of Jerusalem:-

1) Mother and Child Care center (the Greek Catholic Society).

2) Austrian –Arab Society (Al-Maqased Charitable Society).

3) Martin Luther Elderly Day Care Center.

The study sample included only postmenopausal women over 45 years of age.

4.3 Sample Size

A 100 post-menopausal women over 45 years of ages were selected to participate in this study. A detailed history was taken from all participants including lifestyle, risk factors and knowledge about disease. In case of the participants did not meet the study criteria (age more than 45 years and postmenopausal women) these women were excluded.

4.4 Sampling Technique and Sample Settings

Initially, seven centers have been selected from the old city of Jerusalem. These centres have been contacted by telephone. Four centers rejected to participate in this study since the study age group is not among their patients or either they are not interested to have the research team in their place. Three centers accepted to participate. The first center is the Mother and Child Care Center (the Greek Catholic Society). In this center, there was several health educational programs in mother and child health in addition to some medical services. The second center Austrian-Arab Society (Al-Maqased Charitable Society) which is offers medical services for old city inhabitants, and several medical lectures conducted there in various fields, in addition to services by specialists and family doctors. The third center (Martin Lauther Elderly Day Care Center) it is a center caring for old aged people. It provides social entertainment programs such as sport and social activities.

A purposive non-random sample was used based on the following criteria: An invitation was extended to the community centers to participate and help us in our study in coordination with Patient's Friends Society-Jerusalem to attend. Furthermore, a letter explaining the nature of the study was sent or given to the postmenopausal women over 45 years of ages to ask them if they would like to participate in the study by these centers. Those who agreed to participate were asked to come and participate in the study. Those participating were given a structured interview by the researcher and by some personnel from these centers and employees from Patient's Friends Society-Jerusalem. In addition, screening test of quantitative heel ultrasound was done on participants who completed the questionnaire and returned it to the researcher.

4.5 Data Collection

Data was collected through a person to person interview with all participants. In addition, all participants answered an identical questionnaire. The aim of the interview was to obtain information on demographic, lifestyle, productive and menstrual histories of each participant.

Data collection was achieved in two stages:

4.5.1 Questionnaire Design Content

The questionnaire was initially formulated in English. Its questions were derived from several references .It was then translated to Arabic. A pilot study was done on the Arabic form of the questionnaire. The questionnaire included open-ended questions by which respondents answered these in their own words. Moreover, closed questions with nominal scale, a series of questions aiming at assessing personal knowledge about osteoporosis, and other risk factors. Unclear words, complex, and inappropriate questions were avoided.

The questionnaire basically comprised of four main parts.
Part one included nine questions on personal information of subjects like (age, educational level, height, weight, etc…).
Part two included socio-economic factors question :(1-6).
Part three included knowledge about the disease and divided into three categories:
First: Knowledge about risk factors of osteoporosis: (1-9).
Second: Knowledge about prevention from the disease: (10-17).
Third: Knowledge about diagnosis and symptoms: (18-23).
Part four included risk factors of osteoporosis: (1-19).

4.5.2 Diagnostic Testing

Quantitative ultrasound (QUS) of bone uses ultrasound waves of frequency range between (200) kHz and (1.5) MHz. It was introduced in clinical practice as a method for the investigation of bone tissue in postmenopausal women. Therefore, research has focused on its performance in terms of detecting osteoporotic subjects with and without fracture and the assessment of fracture risk (Gambacciani et al., 2004). Quantitative ultrasound measurement of the calcaneus has been shown to be a good predictor of fracture risk and is increasingly being used to screen for osteoporosis (Saadi et al., 2003). This method has several advantages (lack of ionizing radiation, portable machines, and relatively low costs) and provides data on bone mass and bone quality (Drozdzowska and Pluskiewicz, 2001). Currently, bone mass density (BMD) is recognized as the best and the most easily measure factor for the diagnosis of osteoporosis, according to WHO definition as see in the table below (Panichkul et al., 2004).

Between (7 and 21) December 2006 measurement of bone density of the heel. WHO values of BMD using ultrasound will be adopted in our screening of osteoporosis for postmenopausal women.

Figure 10(A): An imaging quantitative ultrasound (QUS) system

Source :(Preventing Osteoporosis Improving Quality of life. 2002)

Figure 10 (B): patient positioning for calcaneus measurement.

Source: (Njeh and Genant, 1999).

Table (4): WHO definitions of osteoporosis based on BMD or BMC value.

Normal	A value of BMD/BMC greater than ISD below the average value of a young adult (T>-1).
Low bone mass (osteopenia)	A value of BMD/BMC more than ISD below the young adult average but not more than 2.5 SD below (-2.5<T<-1).
Osteoporosis	A value of BMD/BMC more than 2.5SD below the young adult average value (T<-2.5)
Severe(establishes) osteoporosis	A value of BMD/BMC more than 2.5SD below the young adult average and there has been one or more osteoporotic fractures.

Source: (Panichkul et al., 2004).

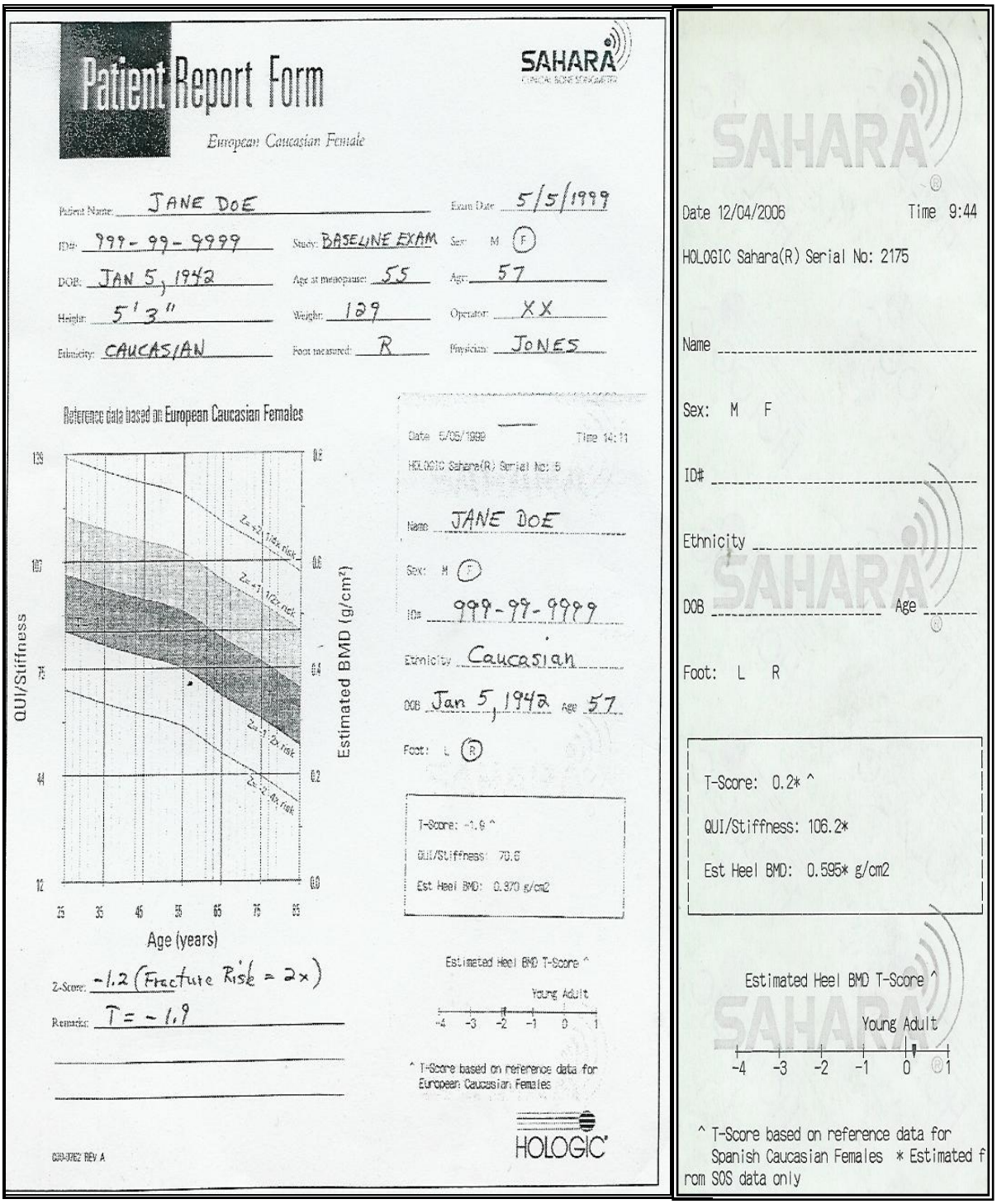


Figure (11): Standard patient report form and test result for QUS.
Source: Sahara Clinical Bone Sonometer. (1999). User Gide .Hologic, Inc.U.S.A.

4.6 Measurement Site

Usually the measurement sites analyzed by quantitative ultrasound (QUS) were all peripheral: phalanx, calcaneus, radius, and tibia. In our study we focused on screening the calcaneus because it is composed almost entirely of trabecular bone and has the advantage of having external surfaces that are flat, homogeneous, parallel and therefore, suited to the geometry of propagation of the ultrasound beam. Measurement of the calcaneus can be made, according to the device used, by submerging the foot in water or by dry techniques (Gambacciani et al., 2004).

4.7 System Component

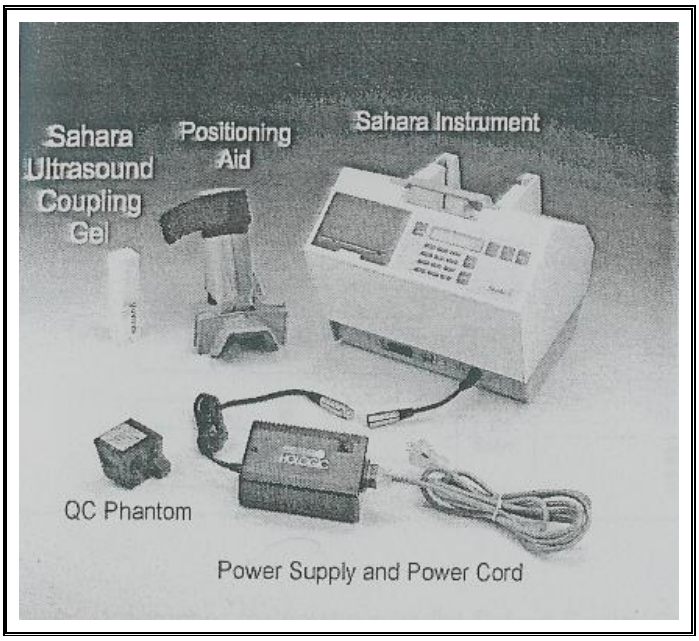


Figure (12): System component
Source: Sahara Clinical Bone Sonometer. (1999).

The Sahara shipping package includes the following:

- Sahara system.
- Power supply and power cord.
- Positioning aid.
- Quality control phantom.
- Training video (Sahara User Video Guide).
- Starter supplies including:
  -Sahara ultrasound coupling gel (2 tubes).
  -Transducer towelettes (1pkg).

-Dry wipes (1 pkg).
-Pinter paper (2 rolls).
-Ultrasound exam paper (1pkg).

4.8 Pilot Study

The pilot study was done prior the data collection process. This study aimed at testing the will of population to participate, acceptability of questions, clarity of language used, reliability of questionnaire, and expected time-table to complete the questionnaire .In order to achieve this goal, 15 postmenopausal women were interviewed and data of these women was not included in our study sample. In addition, some changes done to the questionnaire as follow:-

1. There was a problem concerning the question of whether the participant is married or not .The choices were either "yes" or "no", but we added more choice to include" widow" and" divorced " .
2. A question regarding smoking was amended. The original question was whether the participant is smoker or not .Other choice were added such as "recently yes and "I was to in the past, but I stopped ".In addition, question concerning types and frequently of smoking were added.
3. Two questions that were compound became separated.
4. Some leading questions were changed and rewritten in other simple forms.

The reliability of questionnaire was done by Crobach's Alpha test for all questions. The value of Crobach's Alpha test was (0.731) which higher than (0.70).This means that the stability of questionnaire was good and the questions were suitable for the research.

4.9 Quality Control.

Quality control (QC) is a procedure for verifying that Quantitative Ultrasound is performing properly. This procedure was carried out each day before the first patient was screened for the test or error is generated.

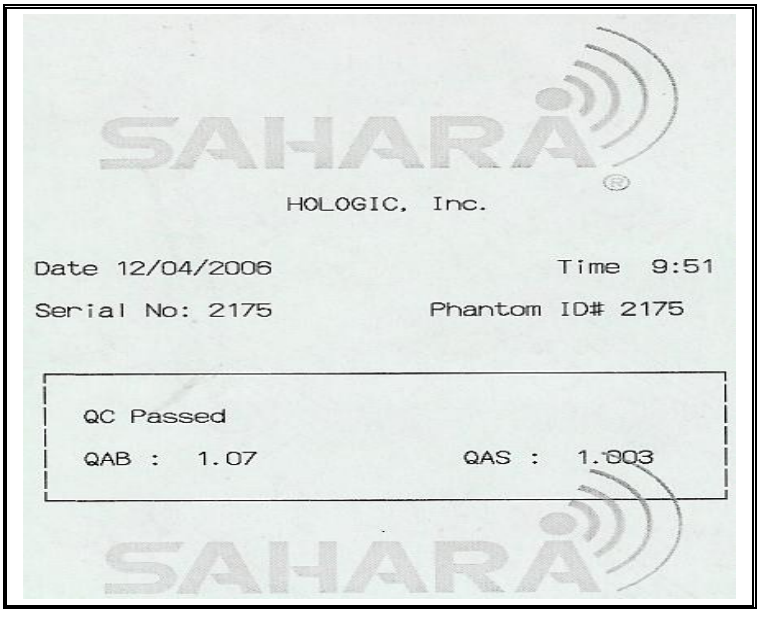


Figure (13): Quality control chart.
Source: Sahara Clinical Bone Sonometer. (1999).

At the beginning of each month, a new QC Log sheet was started by filling in the month, year, institution name, system serial number, phantom serial number, phantom BUA, phantom SOS, and operator name.

It is necessary to mention that the person conducted the test is him self in each time and all centers and the device used in the study quantitative ultrasound (QUS) which we got from Patient Friends Association and brought to these three centers to conduct the required test, where the test has been conducted in the same centers.

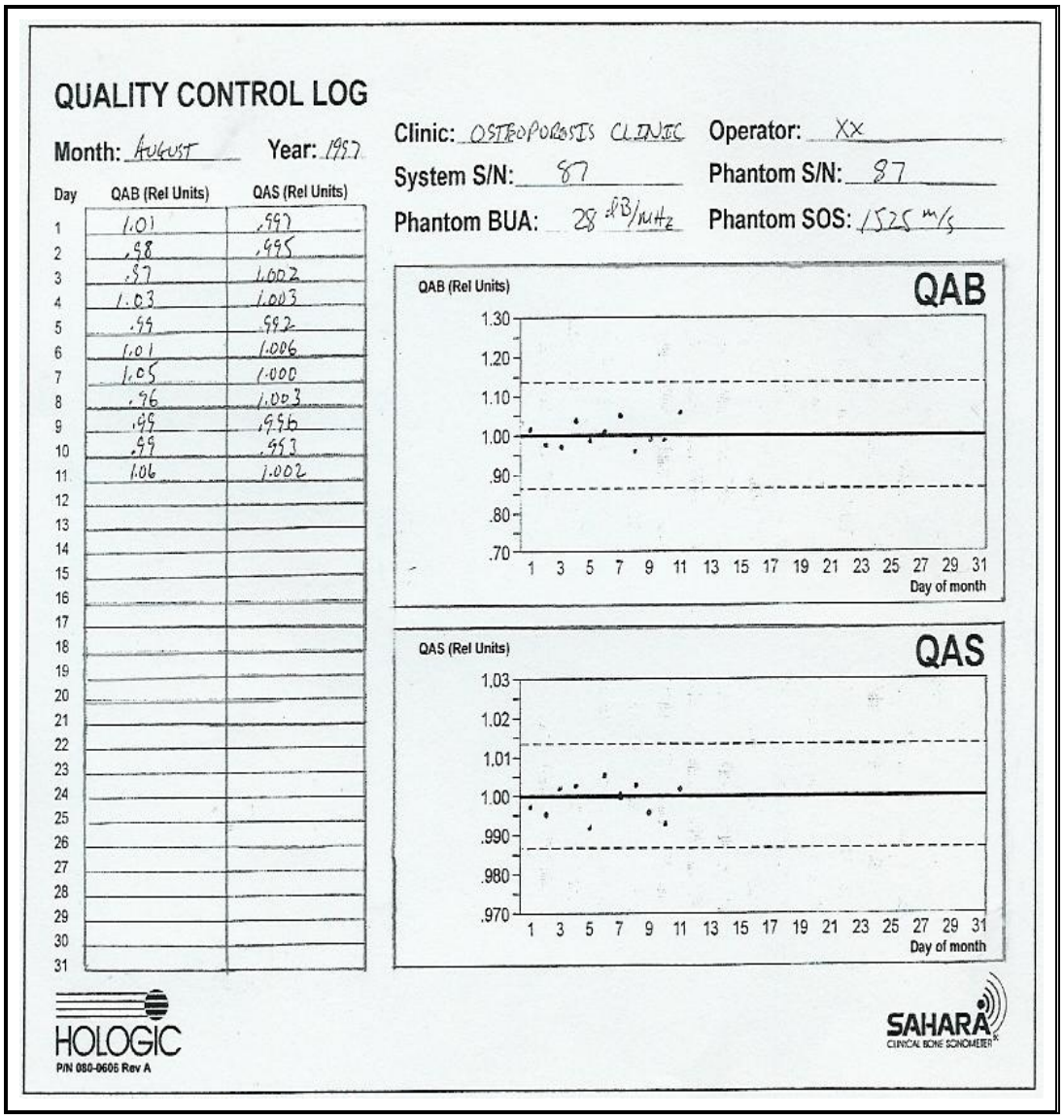


Figure (14): Quality control chart.
Source: Sahara Clinical Bone Sonometer. (1999). User Gide .Hologic, Inc.U.S.A

4.10 Ethical Considerations.

An official letter was sent to Mother and Child Care center (the Greek Catholic Society), Austrian –Arab Society (Al-Maqased Charitable Society) and Martin Luther Elderly Day Care Center. The societies allowed us to conduct our study. The study was conducted with full confidentially of the subject information. In addition, a consent form about the research was provided to all participants before collected data and screening test [Appendix (III)]. The consent form included the following explanation and information:- Who is conducting the study?, aim of the study, confidentially of the collected information and potential benefits from participation in the study. Participants who were diagnosed with osteoporosis were referred to a family doctor for consultation.

4.11 Statistical Analysis

Variables were defined and coded, and the analyses of data were done in different stages. The Statistical Package of Social Science (SPSS version 13) was used to analyze the data, and a P value ≤ 0.05 was considered significant for all analysis. Stage one was done by calculating the frequency and percentage tables for all variables. Stage two was a bivariate statistics; cross-tabulations were reported for all determinants. For all these analysis the statistical significance was determined by chi-square test.

Chapter 5

Results

5.1 Data Analysis

The present study was carried out to investigate the frequency and the determinants of osteoporosis among postmenopausal women in the old city of Jerusalem. The subjects were chosen in a non- random way from three centers. Osteoporosis was assessed by direct measurement of BMD and the results were directly correlated with various factors that are associated with osteoporosis which were collected from subjects included in this study. A total of 100 women from the old city of Jerusalem were interviewed at three centers.This chapter aims to present the results of the study.

5.2 Prevalence of Osteoporosis

The figure below shows the comparison between the prevalence of osteoprotic, osteopenic women, and normal BMD.

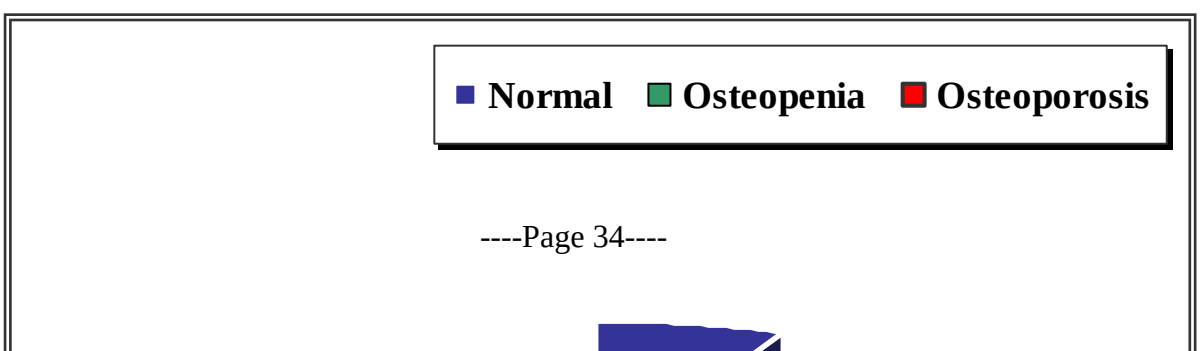


Figure (15): The percentage of osteopenia, osteoporosis, and normal BMD. Total sample 100 cases.

5.3 General Characteristics of Study Population

Table (5): Distribution of the Study Population According to Demographic Variables.

Variables	Number (%)
Age	
(46-55) years	10(10%)
(56-65) years	29(29%)
(66-75) years	29(29%)
(≥76) years	32(32%)
Total percentage:	100(100%)
Educational level	
Non education	35(35%)
School education	50(50%)
High education	15(15%)
Total percentage:	100(100%)

Civil Status	
Married	29(29%)
Single	29(29%)
Widow	20(20%)
Divorced	22(22%)
Total percentage:	100(100%)

The subjects in the study were classified according to age, educational level and civil status shown in table (5). The mean age of the study subjects was 60.25 years ± 10.68(SD). The minimum age was 45 and the maximum age was 91 years. 70% of the subjects were 46-65 years of age. The mean age at menopause was 46.58 ± 6.1(SD) and the maximum menopause age was 60 years. Table (5) also indicates that (35%) of the study subjects had no school education, compared to (50%) who had had school education at various levels.

5.4 Determinants of Osteoporosis

5.4.1 Demographic Determinants

As an overview, tables (6, 7 and 8) show the relationship between T-score of the study participants according to their age, educational level, and civil status. The results are on following sections.

5.4.1.1 Age and Osteoporosis.

The table below shows that osteoporosis increases with age. The respondents who are 76 years old or older had higher percentages of osteoporosis [N (%), 21(42%)] and osteopenia [11(25%)] compared with the younger ones, according to the T-score classification. The prevalence of osteoporosis was higher in women who were older than 66 years of age, with a percentage of [14(31.8%)] with osteoporosis, compared with those who were younger than 55 years. These finding indicate that there is significant association between age and osteoporosis *P* value= 0.032.

Table (6): Age and Osteoporosis.

Age	**T-Score**			**Total**
	(Normal) Number (%)	**(Osteopenia)** Number (%)	**(Osteoporosis)** Number (%)	
(46-55) years	2(20%)	2(4.5%)	6(12%)	10(10%)

(56-65) years	3(50%)	17(36.6%)	9(18%)	29(29%)
(66-75) years	1(16.7%)	14(31.8%)	14(28%)	29(29%)
(≥76) years	0(0%)	11(25%)	21(42%)	32(32%)
Number (%) of total	**6(100%)**	**44(100%)**	**50(100%)**	**100(100.0%)**

[P value= 0.032]

5.4.1.2 Educational Level and Osteoporosis.

Table (7), below indicates that the respondents who were uneducated had a higher prevalence of osteoporosis and osteopenia [17(34%)] and [15(34.1%)] respectively, compared to women who had high education. However, the association was statically insignificant *P* value= 0.268.

Table (7): Educational Level and Osteoporosis.

Educational Level	**T-Score**			**Total**
	(Normal) Number (%)	**(Osteopenia)** Number (%)	**(Osteoporosis)** Number (%)	
Non education	3(50%)	15(34.1%)	17(34%)	35(35%)
School education	2(33.3%)	19(43.2%)	29(58%)	50(50%)
High education	1(16.7 %)	10(22.7%)	4(8%)	15(15%)
Number (%) of total	**6(100%)**	**44(100%)**	**50(100%)**	**100(100.0%)**

[P value= 0.268]

5.4.1.3 Civil Status

Regarding civil status and osteoporosis table (8) indicates that the highest percentage of osteoporosis was found in those who are single [16(32%)].There is no the relationship between civil stats and osteoporosis P value=0.218.

Table (8): Martial Status and Osteoporosis.

Martial status	**T-Score**			**Total**
	(Normal) Number (%)	**(Osteopenia)** Number (%)	**(Osteoporosis)** Number (%)	

Married	4(66.7%)	13(29.5%)	12(24%)	29(29%)
Single	1(16.7%)	12(27.3%)	16(32%)	29(29%)
Widow	0(0%)	12(27.3%)	8(16%)	20(20%)
Divorced	1(16.7%)	7(15.9%)	14(28%)	22(22%)
Number (%) of total	**6(100%)**	**44(100%)**	**50(100%)**	**100(100.0%)**

[P value= 0.218*]*

5.4.2 Socio-economic Status and Osteoporosis

Socio-economic status was determined by monthly income, parity, number of rooms, and home design for sun entry. The result in table (9) shows the relationship between monthly income and osteoporosis. [37(74%)] of those with low income participants have osteoporosis compared to [6(12%)] of high income. The result indicates that there is association between economic status and osteoporosis *P* value = 0.000. Moreover, osteoporosis increases with parity. There is an association between parity and osteoporosis *P* value=0.049. An increase of number of children leads to increase percentage of osteoporosis. Table (10).While no relationship between number of room and osteoporosis *P* value= 0.848, women whose house consists of one to two rooms had percentage of osteoporosis [29(58%)]. In contrast [4(8%)] of women had osteoporosis whose house consists of more than four rooms, table (11).

Table (9): Monthly Income and Osteoporosis.

Monthly income	T-Score			Total
	(Normal) Number (%)	(Osteopenia) Number (%)	(Osteoporosis) Number (%)	
High	6(100%)	13(29.5%)	6(12%)	25(25%)
Medium	0(0%)	23(52.3%)	7(14%)	30(30%)
Low	0(0%)	8(18.2%)	37(74%)	45(45%)
Number (%) of total	**6(100%)**	**44(100%)**	**50(100%)**	**100(100.0%)**

[*P* value= 0.000]

Table (10): Parity and Osteoporosis.

Number of children	T-Score			Total
	(Normal) Number (%)	(Osteopenia) Number (%)	(Osteoporosis) Number (%)	
(1-2)	2(66.7%)	6(18%)	3(7.2%)	11(100%)
(3-4)	0(0%)	12(35%)	14(33.3%)	26(100%)
More than 4	1(33.3%)	16(47%)	25(59.5%)	42(100%)
Number (%) of total	**3(100%)**	**34(100%)**	**42(100%)**	**79(100%)**

[*P* value= 0.049]

Table (11): Number of Rooms and Osteoporosis.

Number of house room	T-Score			Total
	(Normal) Number (%)	(Osteopenia) Number (%)	(Osteoporosis) Number (%)	
(1-2) rooms	3(50%)	22(50%)	29(58%)	54(100%)
(3-4) rooms	3(50%)	18(40.9%)	17(34%)	38(100%)
More than 4 rooms	0(0%)	4(9.1%)	4(8%)	8(100%)
Number (%) of total	**6(100%)**	**44(100%)**	**50(100%)**	**100(100.0%)**

[*P* value= 0.005]

5.4.3 Physical Parameters and Osteoporosis

The distribution of subjects according to physical parameters (weight, height, and BMI) is described in table (12), (13), and (14).The mean BMI of the study subjects was (28.49 kg/cm²) with ± 7.68 SD; ranging from (18 kg/m2 to 64.97 kg/cm²). Regarding underweight of postmenopausal women had high percentage of osteoporosis, compared with obese and over weight women had less percentage of osteoporosis. Which are statically significant *P* value=0.033.

Table (12): Body Mass Index (BMD) and Osteoporosis.

BMI (kg/cm²)	T-Score			Total
	(Normal) Number (%)	(Osteopenia) Number (%)	(Osteoporosis) Number (%)	
[<18.5 kg/cm²] (under weight)	6(100%)	25(56.8%)	22(44%)	53(53%)
[18.5-24.9 kg/cm²] (normal)	0(0%)	15(34.1%)	12(24%)	27(27%)
[25-29.99 kg/cm²] (obese)	0(0%)	3(6.8%)	9(18%)	12(12%)
[30 kg/cm²] (over weight)	0(0%)	1(2.3%)	7(14%)	8(8%)
Number (%) of total	**6(100%)**	**44(100%)**	**50(100%)**	**100(100.0%)**

[*P* value= 0.033]

The followings are the results of quantitative data analysis taking participants' weight as a risk factor for having osteoporosis. Throughout the data analysis, it was found that [2(4%)] of the respondents whose weight was between 60-69 kg have osteoporosis, compared to [3(6%)] of the participants whose weight was between 70-79 kg and [17(34%)] in those who weight was more than 100 kg .Table (13).

Table (13): Weight (Kg) and Osteoporosis.

Weight(Kg)	T-Score			Total
	(Normal) Number (%)	(Osteopenia) Number (%)	(Osteoporosis) Number (%)	
Less than 50 kg	6(100%)	5(11.4%)	0(0%)	11(11%)
(50-59)kg	0(0%)	12(27.3%)	4(8%)	16(16%)
(60-69)kg	0(0%)	10(22.7%)	2(4%)	12(12%)
(70-79)kg	0(0%)	10(22.7%)	3(6%)	13(13%)
(80-89)kg	0(0%)	1(2.3%)	9(18%)	10(10%)
(90-99)kg	0(0%)	3(6.8%)	15(30%)	18(18%)
More than 100kg	0(0%)	3(6.8%)	17(34%)	20(20%)
Number (%) of total	**6(100%)**	**44(100%)**	**50(100%)**	**100(100.0%)**

[*P* value= 0.000]

Table (14) shows the relationship between the women height and the risk of osteoporosis. The results indicate that participants who are taller than 160cm have the highest percentage

of osteoporosis [18(36%)]. While participants shorter than 130 cm have the lowest percentage of osteoporosis [6(12%)].

Table (14): Height (cm) and Osteoporosis.

Height(Cm)	T-Score			Total
	(Normal) Number (%)	(Osteopenia) Number (%)	(Osteoporosis) Number (%)	
Less than 130cm	6(100%)	5(11.4%)	6(12%)	17(100%)
(130-139)cm	0(0%)	10(22.7%)	8(16%)	18(100%)
(140-149)cm	0(0%)	14(31.8%)	8(16%)	22(100%)
(150-159)cm	0(0%)	9(20.5%)	10(20%)	19(100%)
More than 160cm	0(0%)	6(13.6%)	18(36%)	24(100%)
Number (%) of total	**6(100%)**	**44(100%)**	**50(100%)**	**100(100.0%)**

[*P* value= 0.000]

5.5 Knowledge about Different Determinants of Osteoporosis

The results in table (15) indicate that the majority (52%) of subjects are well informed that women are more susceptible to osteoporosis. In addition, about (35%) of subjects do not realize the significance of previous fractures on acquiring osteoporosis.

Moreover, (42%) realized the significance of previous family history on acquiring osteoporosis .Interestingly, most subjects responded correctly when asked about the effect of specific risk factors (caffeine and smoking). Clearly about (33%) of the women realized the low risk of immobilization on developing osteoporosis. However, only (27%) of the subjects knew about the risk of ovarian removal on developing osteoporosis, and (39%) of the women thought that thin and small body makes one less susceptible to osteoporosis. However, (77%) of the subjects are aware of the risk of inadequate calcium intake on developing osteoporosis.

Table (16) describes the study subject's knowledge regarding the significance of various behavioral factors on preventing osteoporosis. The majority of study participants realized the significance of building strong bones at an early age, and even in childhood as basic means to defend against osteoporosis. The benefit of regular exercise on bone density is also well known to the majority of subjects while very high percentage of them are well informed about the positive effect of exposure to sun on having strong and healthy bones.

Table (15): Knowledge of Postmenopausal Women about Various Risk Factors of Osteoporosis.

Variables	Yes	No	Don't Know
	N (%)	N (%)	N (%)
1. Postmenopausal more susceptible to osteoporosis	52(52%)	10(10%)	38(38%)
2. Surgical removal of ovaries decrease the likelihood of developing osteoporosis	12(12%)	27(27%)	61(61%)
3. Previous fractures have no effect on developing osteoporosis	35(65%)	30(30%)	35(35%)
4. Family history has no effect on developing osteoporosis	42(42%)	30(30%)	28(28%)
5. Thin or small body frame contribute to the developing osteoporosis	39(39%)	25(25%)	36(36%)
6. Inadequate calcium intake contribute to the developing osteoporosis	77(77%)	8(8%)	15(15%)
7. Immobilization decrease the likelihood of developing osteoporosis	33(33%)	39(39%)	28(28%)
8. Smoking cigarettes or other forms of tobacco has no effect on developing osteoporosis	33(33%)	43(43%)	24(24%)
9. Caffeine containing beverage (coffee, Tea, and soft drink. like cola.) increase the likelihood of developing osteoporosis	69(69%)	6(6%)	25(25%)

Table (16): Knowledge of Postmenopausal Women Osteoporosis about Prevention.

Variables	Yes	No	Don't Know
	N (%)	N (%)	N (%)
1. Building strong bones, especially before the age 30, represents the best defense against developing osteoporosis.	60(60%)	14(14%)	26(26%)
2. Osteoporosis prevention begins in childhood.	76(76%)	10(10%)	14(14%)
3. Frequent exposure of skin to the sun contribute to the developing osteoporosis	11(11%)	58(58%)	31(31%)
4. Regular exercise such as walking increase bone density	91(91%)	3(3%)	6(6%)

Table (17): General Knowledge of Postmenopausal Women about Osteoporosis.

Variables	Yes	No	Don't Know
	N (%)	N (%)	N (%)
1. Have you heard about osteoporosis?	86(86%)	14(%)	----
2. Osteoporosis can be transmitted from one woman to another (infectious).	----	87(87%)	13(13%)
3. Have you heard about estrogen?	40(40%)	52(52%)	8(8%)
4. Is estrogen important to maintain bone healthy?	26(26.13%)	8(8.1%)	65(65.7%)
5. Do you think that you need more information about osteoporosis?	83(83%)	13(13%)	-----

Regarding general knowledge about osteoporosis, table (17) shows that (86%) of the study subjects heard of osteoporosis and (87%) knew that osteoporosis can not be transmitted from one woman to another. Surprisingly, more than half of subjects heard about estrogen, while (65.7%) do not know the importance of estrogen for bone. Evidently, about (83%) of the women included in this study stated that they are in need of more information about osteoporosis.

Table (18): Knowledge of Postmenopausal Women about Diagnosis and Symptoms of Osteoporosis.

Variables	Yes	No	Don't Know
	N (%)	N (%)	N (%)
1. Bone loss in osteoporosis occurs without symptoms or warning signs.	39(39%)	31(31%)	30(30%)
2. Have you heard about BMD test?	69(69%)	26(26%)	5(5%)
3. Postmenopausal women should test their bones to check if they are at risk of developing osteoporosis	61(61%)	9(9%)	30(30%)

Concerning diagnosis and symptoms of the disease, table (18) indicates that a high percentage of the subjects have heard about bone mineral density test and most of them realized the need of postmenopausal women to check their bones regularly however, about (39%) believed that osteoporosis has warning signs.

5.6 Life Style Factors

The following life style factors were included in our data analysis: participating in sport activities at an earlier and current age, current consumption of dairy products, in addition to current consumption of food rich in vitamin-D and vitamin-D supplement. Were all protective factors for osteoporosis. On the other hand, the consumption of caffeine containing beverages, in addition to current and previous smoking was found to be risk factors for developing osteoporosis.

5.6.1 Participating in Sport Activities at an Earlier and Current Age.

Table (19and 20) shows the relationship between women's participation in various activities such as (walking, shopping, sport, etc...) when they were less than 25 years of age and when they were between(25-52) years of age and osteoporosis. The results show that the percentage of women participating either 3 hours/week or poor sport activities had the lowest prevalence of osteoporosis. On the other hand women who had no sport activities had the highest prevalence of osteoporosis. Which are statically significant at *P* value=0.000.

Table (19): Participating in Sport Activities such as (Walking, Shopping...) at Age (less than 25) Years.

Participating in Sport activities at age < 25 years	T-Score			Total
	(Normal) Number (%)	(Osteopenia) Number (%)	(Osteoporosis) Number (%)	
(3 hours/week)	6(100%)	8(18.2%)	7(14%)	21(21%)
Poor	0(0%)	12(27.3%)	19(38%)	31(31%)
No	0(0%)	24(54.5%)	24(48%)	48(48%)
Number (%) of total	**6(100%)**	**44(100%)**	**50(100%)**	**100(100.0%)**

[*P* value=0.000]

Table (20): Participating in Sport Activities such as (Walking, Shopping...) at Age (25-52) Years.

Participating in sport activities at age (25-52)	T-Score			Total
	(Normal) Number (%)	(Osteopenia) Number (%)	(Osteoporosis) Number (%)	
(3 hours/week)	6(100%)	6(13.6%)	5(10%)	17(17%)
Poor	0(0%)	13(29.5%)	12(24%)	25(25%)
No	0(0%)	25(56.8%)	33(66%)	58(58%)
Number (%) of total	**6(100%)**	**44(100%)**	**50(100%)**	**100(100.0%)**

[*P* value=0.000]

However, was no relationship between participating in sport activities at age more than 52 years and osteoporosis. The percentage of women participating in sport activities 3 hours /week has the lowest percentage of osteoporosis [5(10%)]. On the other hand women who did not have any sportive activities have the highest percentage of with a percentage of [28(56%)], but it statically insignificant *P* value= 0.328. As shown in table (21).

Table (21): Participating in Sport Activities such as (Walking, Shopping...) at Age (more than 52 years).

Participating in sport activities at age (>52)	T-Score			Total
	(Normal) Number (%)	(Osteopenia) Number (%)	(Osteoporosis) Number (%)	
(3 hours/week)	2(33.3%)	8(18.2%)	5(10%)	15(100%)
Poor	3(50%)	14(31.8%)	17(34%)	34(100%)
No	1(16.7%)	22(50%)	28(56%)	51(100%)
Number (%) of total	**6(100%)**	**44(100%)**	**50(100%)**	**100(100.0%)**

[*P* value= 0.328]

5.6.2 Caffeine and Osteoporosis.

Table (22), (23), and (24) shows the relationship between caffeine as risk factor and osteoporosis, according to postmenopausal women regarding different types of current caffeinated drinks.

Table (22): Coffee and Osteoporosis.

Number of caffeine containing beverage(coffee)/Days	T-Score			Total
	(Normal) Number (%)	(Osteopenia) Number (%)	(Osteoporosis) Number (%)	
7 cups / days	0(0%)	20(25.5%)	27(54%)	47(47%)
4-6 cups/ days	0(0%)	9(20.5%)	10(20%)	19(19%)
1-3 cups/ days	4(66.7%)	10(22.7%)	7(14%)	21(21%)
No coffee consumption	2(33.3%)	5(11.4%)	6(12%)	13(13%)
Number (%) of total	**6(100%)**	**44(100%)**	**50(100%)**	**100(100.0%)**

[*P* value= 0.032]

The results indicate that women who were drinking 7 cups of coffee a day have the highest percentage of osteoporosis [27(54%)].While women who drinking 1-3 cups of coffee a day have percentage of osteoporosis [7(14%)].Table (22).

Table (23): Tea and Osteoporosis.

Number of caffeine containing beverage(tea)/Days	T-Score			Total
	(Normal)	(Osteopenia)	(Osteoporosis)	

	Number (%)	Number (%)	Number (%)	
7 cups/days	0(0%)	11(35.5%)	20(40%)	31(31%)
4-6 cups/ days	2(33.3%)	21(47.7%)	19(38%)	42(42%)
1-3 cups/ days	4(66.7%)	8(18.2%)	10(20%)	22(22%)
No tea consumption	0(0%)	4(9.1%)	1(2%)	5(5%)
Number (%) of total	**6(100%)**	**44(100%)**	**50(100%)**	**100(100.0%)**

[*P* value= 0.046]

Moreover, it was found that the women who were drinking 7 cups of tea a day have the highest percentage of osteoporosis [20(40%)] compared with those who were not drinking any cups of tea.

Table (24): Soft Drinks and Osteoporosis.

Number of caffeine containing beverage(Soft drink like cola)/Days	**T-Score**			**Total**
	(Normal) Number (%)	**(Osteopenia)** Number (%)	**(Osteoporosis)** Number (%)	
7 cups/days	0(0%)	16(36.4%)	26(52%)	42(100%)
4-6 cups/ days	0(0%)	18(40.9%)	23(46%)	41(100%)
1-3 cups/ days	6(100%)	6(13.6%)	1(2%)	13(100%)
No cola consumption	0(0%)	4(9.1%)	0(0%)	4(100%)
Number (%) of total	**6(100%)**	**44(100%)**	**50(100%)**	**100(100.0%)**

[*P* value= 0.000]

Concerning drinking cola the result indicate that the women who were not drinking cola any day of week had the lowest percentage of osteoporosis [0(0%)].On other hand the women who were drink cola 7 cups a days had the highest percentage of osteoporosis [26(52%)].

5.6.3 Smoking and osteoporosis.

Concerning cigarette smoking or other forms of tobacco, table (25) indicates that [2(4%)] of the participants non smoker have osteoporosis, while [39(78%)] of participant who current smokers have osteoporosis, and [9(18%)] of the participants ex-smokers having osteoporosis.

Table (25): Smoking Cigarettes or other Forms of Tobacco and Osteoporosis.

Smoking cigarettes or other forms of tobacco	**T-Score**			**Total**
	(Normal)	**(Osteopenia)**	**(Osteoporosis)**	

	Number (%)	Number (%)	Number (%)	
Current smokers	3(50%)	22(50%)	39(78%)	64(64%)
Ex-smokers	3(50%)	15(34.1%)	9(18%)	27(27%)
Non smoker	0(0.0%)	7(15.9%)	2(4%)	9(9%)
Number (%) of total	**6(100%)**	**44(100%)**	**50(100%)**	**100(100.0%)**

[*P* value= 0.029]

The number of cigarette/day has inverse relationship with osteoporosis; increases the number of consumption smoking cigarette per day lead to increase the prevalence of osteoporosis. For example, the participants who smoke (>20 cigarettes/day) having osteoporosis with percentage of [26(61.9%)]. Table (26).

Table (26): Number of Cigarette /Day and Osteoporosis.

Number of cigarette /day on average	**T-Score**			**Total**
	(Normal) Number (%)	**(Osteopenia)** Number (%)	**(Osteoporosis)** Number (%)	
Less than 10 cigarettes	6(100%)	8(20.5%)	7(16.7%)	21(21%)
Between 10-20 cigarettes	0(0.0%)	9(23.1%)	9(21.4%)	18(18%)
More than 20 cigarettes	0(0%)	22(56.4%)	26(61.9%)	48(48%)
Number (%) of total	**6(100%)**	**39(100%)**	**42(100%)**	**87(100.0%)**

[*P* value= 0.000]

Table (27): Years of Smoking Onset and Osteoporosis.

Age of smoking onset	**T-Score**			**Total**
	(Normal) Number (%)	**(Osteopenia)** Number (%)	**(Osteoporosis)** Number (%)	
Less than 15y	6(100%)	14(35.9%)	3(7.1%)	23(23%)
(16-20)y	0(0%)	6(15.4%)	6(14.3%)	12(12%)
(21-25)y	0(0%)	8(20.5%)	15(35.7%)	23(23%)
More than 25y	0(0%)	11(28.2%)	18(42.9%)	29(29%)
Number (%) of total	**6(100%)**	**39(100%)**	**42(100%)**	**87(100.0%)**

[*P* value= 0.000]

Table (28): Years of Smoking Cessation and Osteoporosis.

Age of smoking cessation	**T-Score**			**Total**
	(Normal)	**(Osteopenia)**	**(Osteoporosis)**	

	Number (%)	Number (%)	Number (%)	
Less than 15y	3(50%)	1(6.3%)	0(0%)	4(100%)
(16-20)y	0(0%)	2(12.5%)	2(11.8%)	4(100%)
(21-25)y	0(0%)	2(12.5%)	3(17.6%)	5(100%)
More than 25y	3(50%)	11(68.8%)	12(70.6%)	26(100%)
Number (%) of total	**6(100%)**	**16(100%)**	**17(100%)**	**39(100.0%)**

[*P* value= 0.038]

Concerting the years of smoking onset, table (27) indicates that [3(7.1%)] of the participants that the years of smoking onset less than 15 years having osteoporosis, while [18(42.9%)] of the participants having osteoporosis which is the highest percentage among women that the years of smoking onset are more than 25 years . Which are statically significant *P* value= 0.000. Regarding the years of smoking cessation, table (28) indicates that the prevalence of osteoporosis increase with years of smoking cessation.

Table (29): Passive Smoking and Osteoporosis.

Passive smoking	**T-Score**			**Total**
	(Normal) Number (%)	**(Osteopenia)** Number (%)	**(Osteoporosis)** Number (%)	
Yes	0(0%)	21(47.7%)	30(60%)	51(51%)
No	6(100%)	23(52.3%)	20(40%)	49(49)%
Number (%) of total	**6(100%)**	**44(100%)**	**50(100%)**	**100(100.0%)**

[*P* value= 0.018]

In relation to passive smoking, table (29) indicate that the percentage of osteoporosis increase for women who were live with smokers at home [30(60%)], compared to other group of women who did not have smokers at home [20(40%)] having osteoporosis.

5.7 Nutritional Factors

5.7.1 Current Consumption of Vitamin-D and Osteoporosis.

As for the consumption of vitamin-D such as liver, table (30) shows that 35 of total women did not consumption liver any time having osteoporosis with percentage of [35(70%)] and osteopina with percentage of [31(44.9%)], which indicate that osteoporosis decrease with consumption liver but it statically insignificant *P* value= 0.814.

Table (30): Daily Consumption of Food Containing Vitamin-D (liver) and Osteoporosis.

Number of eating food containing Vitamin-D /day/s(liver)	**T-Score**			**Total**
	(Normal) Number (%)	**(Osteopenia)** Number (%)	**(Osteoporosis)** Number (%)	

0 Day/week (no times)	3(50%)	31(44.9%)	35(70%)	69(69)%
1 Day/week	3(50%)	11(25%)	12(24%)	26(26%)
2 Days/week	0(0%)	1(2.3%)	2(4%)	3(3%)
3 Days/week	0(0%)	1(2.3%)	0(0%)	1(1%)
4 Days/week	0(0%)	0(0%)	1(2%)	1(1%)
Number (%) of total	**6(100%)**	**44(100%)**	**50(100%)**	**100(100.0%)**

[*P* value= 0.814]

Table (31): Daily Consumption of Food Containing Vitamin -D (fish) and Osteoporosis.

Number of eating food containing vitamin-D /day/s(fish)	**T-Score**			**Total**
	(Normal) Number (%)	**(Osteopenia)** Number (%)	**(Osteoporosis)** Number (%)	
0 Day/week (no times)	0(0%)	12(27.3%)	27(54%)	39(39%)
1 Day/week	6(100%)	7(15.9%)	14(28%)	27(27%)
2 Days/week	0(0%)	5(11.4%)	6(12%)	11(11%)
3 Days/week	0(0%)	6(13.6%)	1(2%)	7(7%)
4 Days/week	0(0%)	5(11.4%)	1(2%)	6(6%)
5 Days/week	0(0%)	4(9.1%)	1(2%)	5(5%)
6 Days/week	0(0%)	3(6.8%)	0(0%)	3(3%)
7 Days/week	0(0%)	2(4.5%)	0(0%)	2(2%)
Number (%) of total	**6(100%)**	**44(100%)**	**50(100%)**	**100(100.0%)**

[P value= 0.000*]*

While there is a significant relationship between consumption of fish and osteoporosis which is statically significant at *P* value= 0.000.In addition, table (31) reveals that 14 of the women that consume fish once a day women having osteoporosis with a percentage of (28%) and 7 osteopina with a percentage of (15.9%). However, 27 of women having osteoporosis with a percentage of (54%) and 12 having osteopina with percentage of (27.3%) for women did not consumption fish any time.

Table (32): Daily Consumption of Milk Containing Vitamin-D (Vitamin-D Fortified Milk) and Osteoporosis.

Number of consumption milk /Day/s(vitamin- D fortified milk)	**T-Score**			**Total**
	(Normal) Number (%)	**(Osteopenia)** Number (%)	**(Osteoporosis)** Number (%)	

0 Day/week (no times)	0(0%)	9(20.5%)	34(68%)	43(43%)
1 Day/week	6(100%)	6(13.6%)	2(4%)	14(14%)
2 Days/week	0(0%)	6(13.6%)	5(10%)	11(11%)
3 Days/week	0(0%)	12(27.3%)	1(2%)	13(13%)
4 Days/week	0(0%	5(11.4%)	3(6%)	8(8%)
5 Days/week	0(0%	5(11.4%)	1(2%)	6(6%)
6 Days/week	0(0%)	1(2.3%)	4(8%)	5(5%)
Number (%) of total	**6(100%)**	**44(100%)**	**50(100%)**	**100(100.0%)**

[*P* value= 0.000]

Concerning the consumption of milk containing vitamins (like vitamin-D fortified milk), table (32) reveals 34 of women did not consumption (vitamin-D fortified milk) any time, having osteoporosis with a percentage of (68%) and osteopina with a percentage of (20.5%). Regarded to women who consumption (vitamin-D fortified milk) six days has low percentage of osteoporosis.

Table (33): Home Design for Sun Entry and Osteoporosis.

Home design for sun entry	**T-Score**			**Total**
	(Normal) Number (%)	**(Osteopenia)** Number (%)	**(Osteoporosis)** Number (%)	
Yes	6(100%)	24(54.5%)	23(46%)	53(53%)
No	0(0%)	20(45.5%)	27(54%)	47(47%)
Number (%) of total	**6(100%)**	**44(100%)**	**50(100%)**	**100(100.0%)**

[*P* value= 0.042]

Moreover, there is a significant association between house design for sun entry and osteoporosis P value =0.042. Table (33) shows that [23(46%)] of women had osteoporoses which there house exposed to sun entry and [27(54%)] of women had osteoporosis that there house not proper design for sun entry.

5.7.2 Previous and Current Consumption of Milk by Subjects and Osteoporosis.

Table (34): Amount of Milk Consumption at age (<25) Years.

Amount of milk consuming at (age< 25 Years)	**T-Score**			**Total**
	(Normal) Number (%)	**(Osteopenia)** Number (%)	**(Osteoporosis)** Number (%)	

Three or more glasses a day	6(100%)	8(18.2%)	5(10%)	19(19%)
One to two glasses a day	0(0.0%)	12(27.3%)	12(24%)	24(24%)
Once a week	0(0.0%)	18(40.9%)	10(20%)	28(28%)
Less than once a week	0(0.0%)	6(13.6%)	23(16%)	29(29%)
Number (%) of total	**6(100%)**	**44(100%)**	**50(100%)**	**100(100.0%)**

[*P* value= 0.000]

Table (34) shows amount of milk consumption at age <25 related to osteoporosis. The results indicate that the percentage of osteoporosis was higher among those with low milk consumption at age 25 compared with those who had 3 or more glasses of milk a day.

Table (35): Amount of Milk Consumption between (25-49) Years.

Amount of Milk Consumption Between (25-49) Years	**T-Score**			
	(Normal) Number (%)	**(Osteopenia)** Number (%)	**(Osteoporosis)** Number (%)	**Total**
Three or more glasses a day	6(100%)	11(25%)	5(10%)	22(22%)
One to two glasses a day	0(0%)	15(34.1%)	11(22%)	26(26%)
Once a week	0(0%)	16(36.4%)	14(28%)	30(30%)
Less than once a week	0(0%)	2(4.5%)	20(40%)	22(22%)
Number (%) of total	**6(100%)**	**44(100%)**	**50(100%)**	**100(100.0%)**

[*P* value= 0.000]

Table (35) shows amount of milk consumption related to osteoporosis at age 25-49. This table reveals that [5(10%)] of participants who consume three or more glasses per day have the lowest percentage of osteoporosis, compared with those who were consume less than once a week having the highest percentage of osteoporosis [20(40%)].

Table (36): Amount of Milk Consumption at age (>49) Years.

Amount of Milk Consuming (>45)	**T-Score**			**Total**
	(Normal) Number (%)	**(Osteopenia)** Number (%)	**(Osteoporosis)** Number (%)	
Three or more glasses a day	2(33.3%)	8(18.2%)	5(10%)	15(15%)
One to two glasses a day	0(0%)	7(15.9%)	7(14%)	14(14%)

Once a week	2(33.3%)	3(6.8%)	9(18%)	14(14%)
Less than once a week	2(33.3%)	26(59.1%)	29(58%)	57(57%)
Number (%) of total	**6(100%)**	**44(100%)**	**50(100%)**	**100(100.0%)**

[*P* value= 0.249]

Table (36) shows amount of milk consumption at age 45 years or older and its relation with osteoporosis. This table reveals that 7 of the participants have osteoporosis who consumes one to two glasses of milk per day, whereas 9 of the participants have osteoporosis who consumes a glass of milk per week. In addition, participants who consume three or more glasses a day have the lowest percentage of osteoporosis [5(10%)].

5.7.3 Current Daily Consumption of Diary Products and Osteoporosis.

Table (37): Current Milk Consumption and Osteoporosis.

Consuming of milk (days/week)	**T-Score**			**Total**
	(Normal) Number (%)	**(Osteopenia)** Number (%)	**(Osteoporosis)** Number (%)	
0 Day/week (no times)	0(0.0%)	29(65.9%)	33(66%)	62(62%)
1 Day/week	6(100%)	5(11.4%)	6(12%)	17(17%)
2 Days/week	0(0.0%)	5(11.4%)	5(10%)	10(10%)
3 Days/week	0(0.0%)	3(6.8%)	4(8%)	7(7%)
4 Days/week	0(0.0%)	0(0%)	2(4%)	2(2%)
5 Days/week	0(0.0%)	1(2.3%)	0(0%)	1(1%)
6 Days/week	0(0.0%)	1(2.3%)	0(0%)	1(1%)
Number (%) of total	**6(100%)**	**44(100%)**	**50(100%)**	**100(100.0%)**

[*P* value= 0.000]

Table (37) shows the relationship between current consumption of milk and osteoporosis, as indicated about [33(66%)] of the participants who did not consume milk any day have the highest percentage of osteoporosis. Compare with women who had consumed milk 5 or 6 days/week.

Table (38): Cheese Consumption and Osteoporosis.

Consuming cheese (days/week)	**T-Score**			**Total**
	(Normal) Number (%)	**(Osteopenia)** Number (%)	**(Osteoporosis)** Number (%)	
0 Day/week (no times)	0(0.0%)	4(9.1%)	40(80%)	44(44%)
(1 Day/week)	6(100%)	18(40.9%)	5(10%)	29(29%)
2 Days/week	0(0.0%)	11(25%)	3(6%)	14(14%)

3 Days/week	0(0.0%)	7(15.9%)	2(4%)	9(9%)
4 Days/week	0(0.0%)	2(4.5%)	0(0%)	2(2%)
5 Days/week	0(0.0%)	2(4.5)%	0(0%)	2(2%)
Number (%) of total	**6(100%)**	**44(100%)**	**50(100%)**	**100(100.0%)**

[*P* value= 0.000]

Table (38) shows the results of consumption of dairy products such as cheese. The highest percentage of osteoporosis for women did not consume cheese any day [40(80%)]. While the women who had consumed cheese one day/week have osteoporosis with percentage of [5(10%)]. But the least percentage of osteoporosis for women consumes cheese 4 or 5 days/week.

Table (39): Yogurt Consumption and Osteoporosis.

Consuming yogurt(Days/Week)	**T-Score**			**Total**
	(Normal) Number (%)	**(Osteopenia)** Number (%)	**(Osteoporosis)** Number (%)	
0 Day/week	0(0.0%)	9(20.5%)	10(20%)	19(19%)
1 Day/week	3(50%)	15(34.1%)	14(28%)	32(32%)
2 Days/week	1(16.7%)	3(6.8%)	9(18%)	13(13%)
3 Days/week	2(33.3%)	6(13.6%)	5(10%)	13(13%)
4 Days/week	0(0.0%)	1(2.3%)	6(12%)	7(7%)
5 Days/week	0(0.0%)	3(6.8%)	3(6%)	6(6%)
6 Days/week	0(0.0%)	5(11.4%)	2(4%)	7(7%)
7Days/week	0(0.0%)	2(4.5%)	1(2%)	3(3%)
Number (%) of total	**6(100%)**	**44(100%)**	**50(100%)**	**100(100.0%)**

[*P* value= 0.473]

Table (39) shows the results of consumption yogurt and relation with osteoporosis, as indicated increases of yogurt consumption per day lead to decrease prevalence of osteoporosis .For example, the least percentage of osteoporosis is [1(2%)] for women who have 7 days/ week of yogurt consumption.

Table (40): Consumption other Forms of Diary Products like (Ice-cream) and Osteoporosis.

Consuming other forms (like Ice cream) days/week	**T-Score**			**Total**
	(Normal) Number (%)	**(Osteopenia)** Number (%)	**(Osteoporosis)** Number (%)	
0 Day/week	4(66.7%)	33(75%)	37(74%)	74(74%)

1 Day/week	1(16.7%)	6(13.6%)	7(14%)	14(14%)
2 Days/week	0(0%)	4(9.1%)	2(4%)	6(6%)
3 Days/week	0(0%)	0(0%)	2(4%)	2(2%)
4 Days/week	1(16.7%)	0(0%)	1(2%)	2(2%)
6 Days/week	0(0%)	1(2.3%)	1(2%)	2(2%)
Number (%) of total	**6(100%)**	**44(100%)**	**50(100%)**	**100(100.0%)**

[*P* value= 0.362]

Table (40) shows the results of consumption ice-cream and osteoporosis. The table indicates that number and percentage of women have osteoporosis increase with low consumption of ice-cream. But there is no relationship between consumption ice-cream and osteoporosis *P* value= 0.362 is statically insignificant.

5.8 Current Consumption of Supplements and Osteoporosis.

5.8.1 Calcium Supplement

Table (41): Calcium Supplement Intake.

Calcium supplement	**T-Score**			**Total**
	(Normal) Number (%)	**(Osteopenia)** Number (%)	**(Osteoporosis)** Number (%)	
Yes	6(100%)	22(50%)	22(44%)	50(50%)
No	0(0%)	22(50%)	28(56%)	50(50%)
Number (%) of total	**6(100%)**	**44(100%)**	**50(100%)**	**100(100.0%)**

[*P* value= 0.035]

Table (41) shows the results of participants' consumption of calcium supplements. The results show that 50 of the participants do not consume calcium supplements. About 28 of these women have osteoporosis with percentage of [28(56%)], while 50 of participants who are consuming calcium supplement have lesser percentage of osteoporosis [22(44%)].

5.8.2 Vitamin-D supplement

Table (42) shows the results of consumption of vitamin-D supplements and osteoporosis. [35(70%)] of the participants do not consume vitamin-D supplement having osteoporosis. In addition, [15(30%)] of the participants who consume vitamin-D supplement have lesser percentage of osteoporosis**.**

Table (42): Vitamin-D Supplement Intake.

Vitamin -D supplement	**T-Score**			**Total**
	(Normal) Number (%)	**(Osteopenia)** Number (%)	**(Osteoporosis)** Number (%)	

Yes	6(100%)	21(47.7%)	15(30%)	42(42%)
No	0(0.0%)	23(52.3%)	35(70%)	58(58%)
Number (%) of total	**6(100%)**	**44(100%)**	**50(100%)**	**100(100.0%)**

[*P* value= 0.003]

5.8.3 Daily Multivitamins

Table (43) shows the results of daily consumption of multivitamins supplement and osteoporosis. As shown in the table, 87 of the participants do not consume daily multivitamins. 13 of women have this daily multivitamins supplement. Moreover, a lesser percentage of them are taking daily multivitamins have osteoporosis with percentage of [9(18%)] and (9.1%) osteopenia, compared with other group who do not consume daily multivitamins supplement [41(82%)] have osteoporosis and (90.9%) osteopenia.

Table (43): Daily Multivitamins Supplement Intake.

Daily multivitamins	**T-Score**			**Total**
	(Normal) Number (%)	**(Osteopenia)** Number (%)	**(Osteoporosis)** Number (%)	
Yes	0(0%)	4(9.1%)	9(18%)	13(13%)
No	6(100%)	40(90.9%)	41(82%)	87(87%)
Number (%) of total	**6(100%)**	**44(100%)**	**50(100%)**	**100(100.0%)**

[*P* value= 0.273]

5.9 Medical history

5.9.1 Family History of Osteoporosis

No relationship between family history and osteoporosis at *P* value= 0.171 is statically insignificant. As shown in table (44).

Table (44): The women have osteoporosis.

The women have osteoporosis	**T-Score**			**Total**
	(Normal) Number (%)	**(Osteopenia)** Number (%)	**(Osteoporosis)** Number (%)	

Family history *	6(100%)	18(40.9%)	14(28%)	38(100%)
No family history	0(0%)	26(50.1%)	36(72%)	62(100%)
Number (%) of total	**6(100%)**	**44(100%)**	**50(100%)**	**100(100.0%)**

[*P* value= 0.171]

5.9.2 Hysterectomy and osteoporosis

In regards of Hysterectomy, table (45) reveals that 22 of the participants did hysterectomy have osteoporosis with a percentage of (54.5%). But 73 of them did not have hysterectomy have osteoporosis with a percentage of (77.3%). In the regards to years following hysterectomy, table (46) reveals that (40%) of participants have osteoporosis after more than 25 years since did hysterectomy, osteopina with a percentage of (40%).

Regarding to group who did hysterectomy since 16-20 years the participants have (20%) of osteoporosis. Moreover, 5 of the participants who did hysterectomy since age 21-25 years have osteoporosis with a percentage of (30%). In the regards ovaries removal, table (47) reveals that 27 of the participants who did ovaries removal have osteoporosis with a percentage of (28%) and osteopina with a percentage of (29.5%). But 73 of the participants that did not have ovaries removal have (72%) of osteoporosis and (70.5%) osteopina.

Table (45): Total Hysterectomy and Osteoporosis.

Hysterectomy	**T-Score**			**Total**
	(Normal) Number (%)	**(Osteopenia)** Number (%)	**(Osteoporosis)** Number (%)	
Yes	0(0%)	10(22.7%)	12(54.5%)	22(22%)
No	6(100%)	33(45.2%)	34(77.3%)	73(73%)
Number (%) of total	**6(100%)**	**44(100%)**	**50(100%)**	**100(100.0%)**

[*P* value= 0.397]

***** Family history (osteoporosis in first degree relatives; mother, sister, aunt, etc...).

Table (46): Years following Hysterectomy and Osteoporosis.

Years following hysterectomy	**T-Score**		**Total**
	(Osteopenia) Number (%)	**(Osteoporosis)** Number (%)	
Less than 15 y	1(10%)	1(10%)	2(2%)
(16-20)y	1(10%)	2(20%)	3(3%)
(21-25)y	4(40%)	5(30%)	7(9%)
More than 25y	4(40%)	4(40%)	8(8%)

Number (%) of total	**10(100%)**	**12(100%)**	**20(100.0%)**

[*P* value= 0.967]

Table (47): Ovarectomy and Osteoporosis.

Ovaries removal	T-Score			Total
	(Normal) Number (%)	(Osteopenia) Number (%)	(Osteoporosis) Number (%)	
Yes	0(0%)	13(29.5%)	14(28%)	27(27%)
No	6(100%)	31(70.5%)	36(72%)	73(73%)
Number (%) of total	**6(100%)**	**44(100%)**	**50(100%)**	**100(100.0%)**

[*P* value= 0.303]

In the regards to number of ovaries removal, table (48) reveals that 15 of the participants who have twice ovaries removal have osteoporosis with a percentage of (66.7%) and osteopina with a percentage of (38.5%). But 10 of the participants who have once ovaries removal have osteoporosis with a percentage of (40%).

Table (48): Number of Ovaries Removal and Osteoporosis.

Number of ovaries removal	T-Score		Total
	(Osteopenia) Number (%)	(Osteoporosis) Number (%)	
One ovary	6(46.2%)	4(40%)	10(100%)
Two ovaries	5(38.5%)	10(66.7%)	15(100%)
I don't know	2(15.4%)	0(0%)	2(7.4%)
Number (%) of total	**13(100%)**	**14(100%)**	**27(100%)**

[*P* value= 0.133]

In the regards of years following ovaries removal, table (49) reveals that [10(71.4%)] of the participants having osteoporosis after more than 25 years since did ovaries removal and osteopina with a percentage of [5(38.5%)]. However, [4(28.6%)] of the participants having osteoporosis after 21-25 years since did ovaries removal.

Table (49): Years following Ovarectomy and Osteoporosis.

Years following ovaries removal	T-Score		Total
	(Osteopenia) Number (%)	(Osteoporosis) Number (%)	
(16-20)y	1(7.7%)	0(0%)	1(1%)
(21-25)y	7(53.8%)	4(28.6%)	11(11%)
More than 25y	5(38.5%)	10(71.4%)	15(15%)

Number (%) of total	**13(100%)**	**14(100%)**	**27(100%)**

[*P* value= 0.178]

5.9.3 Female Hormones and Osteoporosis.

In the regards of taking female hormones, the result showed that 53 of the participants taking female hormones having osteoporosis with a percentage of (68%) and osteopina with a percentage of (43.2%). However, 31 of the participants that did not take any female hormones have (47.7%) of osteoporosis and (18%) osteopenia.

Table (50): Estrogen Replacement Therapy and Osteoporosis.

Estrogen replacement therapy	T-Score			Total
	(Normal) Number (%)	(Osteopenia) Number (%)	(Osteoporosis) Number (%)	
Yes	3(50%)	7(15.9%)	16(32%)	26(26%)
No	3(50%)	37(84.1%)	34(68%)	74(74%)
Number (%) of total	**6(100%)**	**44(100%)**	**50(100%)**	**100(100%)**

[*P* value= 0.080]

Table (50) shows the results of participants' who take estrogen replacement therapy, as indicated about 16 of the participants catch osteoporosis and 7 have osteopina out of total frequency 26 with percentage of (61.5%),(26.9%)respectively. This table reveals also that 74 of the participants do not have estrogen replacement therapy out of them 34 having osteoporosis with percentage of (45.9%).

5.9.4 Years following Menopause and Osteoporosis.

Table (51) indicates that the respondents who are at the age less than 5 years following menopause have the lowest percentages of osteoporosis [0(0%)] and [2(4.5%)] of osteopnia. Moreover, respondents who are at the age more than (20) years following menopause have the highest percentage of osteoporosis [19(38%)].In contrast, the respondents who are at the age between 11-15 years following menopause have the intermediate percentage of osteoporosis [12(24%)].

Table (51): Years following Menopause and Osteoporosis.

Years following menopause	T-Score			Total
	(Normal) Number (%)	(Osteopenia) Number (%)	(Osteoporosis) Number (%)	
< 5 years	6(100%)	2(4.5%)	0(0%)	8(8%)
(5-10) years	0(0%)	8(18.2%)	5(10%)	13(13%)
(11-15) years	0(0%)	6(13.6%)	12(24%)	18(18%)
(16-20) years	0(0%)	16(36.4%)	14(28%)	30(30%)
More than 20 years	0(0%)	12(27.3)%	19(38%)	31(31%)

Number (%) of total	**6(100%)**	**44(100%)**	**50(100%)**	**100(100%)**

[P value= 0.000]

5.10 Conclusion

The result was showed that the percentage of osteoporosis (55%) for postmenopausal women, (44%) osteopenic, and only (6%) normal. Moreover, the study has showed that the main causes of this disease related to absence of sport activities, it has been showed that (15%) of women are more than 52 years practice sport 3 hours weekly. In addition, to scarcity of drinking milk which contain a high rate of calcium, it has been showed that (57%) of women they drinking milk over 49 years. From other side, smoking is another factor for this disease as it affects negatively on bone cells and accelerates despair age for women. Moreover, results of the study has showed that (64%) of women smoke either cigarettes or other forms and it has been shown that (51%) of women have been living in a house environment with smokers which exposes them to passive smoking, which is considered a dangerous factor for several chronic diseases. Other investigated factors which contribute in this disease is excess in caffeine consumption represented in coffee, tea and cola that affecting calcium intake efficiency. It has been shown that (47%) of women take coffee daily and shortage in taking nutrients that contain vitamin-D, for example liver, it has been shown that (69%) women do not take it in any day of a week. In addition, the result showed that the level of knowledge about osteoporosis was (58%).

Chapter 6

Discussion

6.1 Introduction

This chapter aims to discuss the results of the study. The findings in our study clearly demonstrate that the prevalence of osteoporosis among postmenopausal women in the old city of Jerusalem is high. The results demonstrate that osteoporosis is significantly associated with age, years following menopause, weight, height, BMI**,** monthly income, parity and passive smoking. Other factors such as participating in sport activities at an earlier age, current consumption of dairy products, in addition to current consumption of food rich in vitamin -D and intake of female hormones, calcium and vitamin-D supplement, were all protective factors for osteoporosis. On the other hand, the consumption of caffeine containing beverages, in addition to current and previous smoking was found to be risk factors for developing osteoporosis. As for the women had adequate knowledge about various aspects of osteoporosis (prevention, diagnosis and prevention) but not practice what they believe in.

6.2 Prevalence of Osteoporosis

Prevalence provides a measure on how common a disease is spread in the population. The finding in our study clearly demonstrate that the prevalence of osteoporosis among postmenopausal women in the old city of Jerusalem reaches 50%, while the prevalence of osteopenia reaches about 44%, whereas only 6% of studied sample were normal.

Osteoporosis is the most prevalent metabolic bone disease in the United States and other developed countries. (Wasnich, 1999).The prevalence of osteoporosis increases as the world's population ages (Les Laboratories Servier, 2006). Currently, it is estimated that over (200) million people worldwide have osteoporosis. (Reginster and Burlet, 2006).

Few studies have been done on our region. A recent pilot study was conducted in Saudi Arabia to estimate the prevalence of osteopenia and osteoporosis in postmenopausal Saudi women. The results showed that the postmenopausal women between the ages (50-59) years 58% have osteopenia and osteoporosis and the rate increased to 89% in the age of (60-69) years and it increased more in the female group of age (70-80) years to reach 94 % (El-Desouki, 2003).

In the Palestinian society**,** very limited data is available on the epidemiology of osteoporosis in the West Bank and Jerusalem district (Jabari, 2006*).*Study about osteoporosis was conducted by Miss Eman Shawish from Al-Quds University shows that the prevalence rate among Palestinian women , (Osteoporosis [81(24%)], osteopenia [127(38%)], normal BMD [130(38%)] from total sample 388 cases (Al-Shaweesh, 2003).Another study was conducted by Miss Intissar M.Issa from Al-Quds University in Bethlehem district shows that the prevalence of osteoporosis proved to be very alarming with 29.7% at lumber spine, 22% at femoral neck, 14% at total hip, and 40.6% at any site. *(*Issa, 2005*).*

6.3 Risk factors

6.3.1 Demographic Factors

One of the findings in this study is the statistically significant association between age and osteoporosis among postmenopausal women. In fact, the prevalence of osteoporosis increased from 18% among 56-65 year olds to 38% among women who were 66-75 to 42% in women who were older than 75, table (6). These results are consistent with other relevant studies; the United States National Health and Nutrition Survey (NHANES) III of postmenopausal women showed that the prevalence of osteoporosis in non-Hispanic white American women was 27% among 50-59 year olds, 32% among 60-69 years and 41% among women older than 70 years (Snelling, et al., 2001). Previous estimation based on data from Rochester, Minnesota indicated a lower, though still high, prevalence 14.8% among 50-59 years, 21.6% among 60-69 years, 38.5% among 70-79 years and 70% among ≥80 years (Melton, 1995). The relation with age can be explained by the fact that bone mineral density decreases with age and consequently the risk of osteoporosis increase. In fact a significant increase in prevalence with each decade after age 60 has been demonstrated in several studies.

A relationship was found in this study between osteoporosis and formal education; the prevalence of osteoporosis was 34% for non-educated, 8% for women who had a high

education. This finding is consistent with another study which was done by Miss Intissar Issa about awareness level and prevalence of osteoporosis among postmenopausal women in Bethlehem district (Issa, 2004). This could be attributed to better-educated individuals tend to exercise more, smoke less, and have better maintenance of body weight. In a population-based, cross-sectional study of postmenopausal Chinese women, the authors reported that a higher level of formal education, in particular tertiary education, was strongly associated with better BMD values at various sites and with lower prevalence of osteoporosis (Suzanne et al., 2005).

Regarding the civil status issue, we notice that the disease is more prevalent among the single women than the married ones. The number of women having osteoporosis in the married group is 24%, and the number of women having osteoporosis in the single group is 32%. Furthermore, the prevalence rate of osteoporosis is higher among the divorced women 28% than the widowed ones 16%. This might be attributed to psychological or physiological factors. But in the analysis of data, it is clearly seen that there is no statistically significant association between civil status and osteoporosis at [*P* value= 0.218], so more studies related to this issue are highly needed.

6.3.2 Socio-economic Factors

A positive association has been found between the following factors: monthly income, parity, number of rooms and osteoporosis. It has been noticed that the number of women having osteoporosis is highest among the low-income group compared to the medium-income and high-income groups table (9). Moreover, this finding is consistent with another study which was conducted on Spanish women. The study showed that the women with lower economic status had significantly lower BMD values than those with higher economic status (Suzanne et al., 2005).

Regarding the relationship between parity and osteoporosis, our finding shows that there is a significant relationship [*P* value= 0.049]. Postmenopausal women with 1-2 children had lower percentage of osteoporosis 7.2% compared with postmenopausal women with more than 4 children 59.5%as shown in table (10). This finding in our study is consistent with findings of a pervious study, which found that number of children is positively related to risk of osteoporosis (Hien et al., 2005). This could be explaining by increased demand for calcium during pregnancy. Firstly stress on maternal calcium stores and an increase in urinary calcium excretion. Yet, the intestinal absorption of calcium is increased during pregnancy. Secondly the body also responds to fetal calcium demands by increasing total 1, 25-dihydroxyvitamin D levels (Pregnancy and Osteoporosis, 2007).

On other hand there is a significant relationship between number of rooms and osteoporosis. The women having osteoporosis increase with low number of room in there house. This could be attributed to lower numbers of rooms are less expose to sun or live in low economic status which increase the number of women having osteoporosis.

6.3.3 Physical Parameters

Body mass index is a measurement of obesity, which is one of the most common factors that influence bone wellbeing. We found an association between BMI and osteoporosis. Moreover, weight showed a pattern similar to the one seen with body mass index .The present study found a relationship between weight and osteoporosis [p value =0.000], table

(13) after taking actual measurement of weight in light clothing and without shoes. The finding in our study shows that [22(44%)] are under weight, [9(18%)] of the participants are obese, [7(14%)] are over-weight and 12(24%) are normal. As shown in table (12), participants with high body mass index have low prevalence of osteoporosis; in contrast, women with low body mass index have high prevalence of osteoporosis. Another study clearly shows that low BMI is negatively correlated with peak bone mass and strongly correlated with fracture risk compared with higher adiposity, which is protective against risk of hip and vertebral fractures (Jordan and Cooper**,** 2002).

The reasons for the link between obesity and lower osteoporosis risk are not fully understood. But this finding could be explained by two points: firstly recent study considered weight as a protective factor against osteoporosis. Moreover, obesity is also associated with both reduced risk and lessened severity of osteoporosis. Moreover, obese women lose relatively little bone at menopause, whereas thin women tend to have a greater risk for osteoporotic fractures. Secondly, some experts postulate that estrogen produced or stored in fat tissue might attenuate bone loss. In addition, having extra body weight means that most movement is "weight bearing" and thus obesity is a powerful determinant of bone mass (Sampson, 2002).

Furthermore, this study found a significant association between height and osteoporosis [*P* value=0.000] as shown in table (14) after taking actual measurement of height. About 19 of postmenopausal women in our study were between 150-159 cm, which is considered as neither tall nor short height. These women had no small body frame or too long bones, both of which render human bones prone to fractures. This group had moderate percentage of osteoporosis 20% compared with other groups.

This result is consistent with the study which suggested a change in a person's height as a method of screening osteoporosis and as predictive tool of osteoporosis (Thornton et al., 2005).In addition, very important point must be mentioned that a positive association between heights at age 25 years was not taken into consideration because our data was subjective and no valid data, such as height on passport, was provided by the participants, so error may be presented.

6.3.4 Life Style Factors

The following life style factors were included in our study: milk consumption, sport activities, caffeine drink, and smoking.

6.3.4.1 Sport Activities and Osteoporosis

In this study, there was a positive relationship between sport (physical) activities in childhood and ages 25-52 developed osteoporosis later in life *[P* value=0.000], whereas sport activity above 52 years of age is not significant [*P* value= 0.328]. Our explanation for these results is that postmenopausal women who perform sport activities, such as walking and shopping, at the age of less than 25 years on the rate of three hours per week had a low percentage of osteoporosis 14% compared to women who had poor or no sport activities who showed higher percentage of osteoporosis 38%, 48% respectively as shown in table (19). On the other hand, postmenopausal women who had sport activities on the rate of three hours per week at ages between 25-52 years showed lower percentage of osteoporosis 10% compared to other women who had no sport activities 66% or poor sport activities

24% as shown in table (20). These results are consistent with other relevant studies, for example, there is a positive relationship between both current physical activities, physical activity in adolescence and BMD has been shown in young Canadian females (18-35) years (Rubin et al., 1999), and in middle-aged Italian women (Bidoli et al., 1998).

Bone adapts according to the physical load and stresses exerted upon it. Physical activity during the first three decades of life increases bone mass and reduce osteoporosis fractures (Jordan and Cooper, 2002). Regular physical activity has numerous health benefits for people at all age the specific physical activity on bone health has been investigated in random clinical trials and observation studies. There is strong evidence that physical activity at an early age of life contributes to increased peak bone mass. In addition, exercise in middle years of life has numerous health benefits and positive effects on BMD (Osteoporosis Prevention, Diagnosis, and Therapy, 2001).

6.3.4.2 Caffeine and Osteoporosis

In our study there is a positive association between caffeine drinks and osteoporosis which is consistent with relevant literature. Caffeine drinks such as coffee, tea, and cola were found significantly associated with osteoporosis table (22, 23, and 24). It has been demonstrated that caffeine increases urinary excretion of calcium after at least three hours of its intake, and that this effect is proportional to the dose of caffeine per lean body mass. The effect is likely to be attributed to reduced renal reabsorption. Thus, a long-term high caffeine intake may involve considerable calcium loss, which reduces bone mineral density (BMD) through decalcification of the skeleton. Some epidemiological studies have found a higher risk of fractures associated with higher coffee or caffeine intake.
For example, middle-aged Norwegians have previously been evaluated and a relationship between caffeine intake and fractures risk was found to be positive in women (Holvik, and Meyer, 2003). Although it has been shown that tea could help in managing the pressures of daily life by lowering the levels of stress hormones in the body (Ungan and Tümer, 2001). However, the caffeine contained in the tea may affect the bone as mentioned previously (Holvik, and Meyer, 2003).

Although cola has high caffeine content, studies have shown that cola effects the risk of osteopoerosis through an additional component present in this drink, namely phosphoric acid, as has recently been reported in a study published in the American Journal of Clinical Nutrition (Tucker et al., 2006).

6.3.4.3 Smoking

Pertaining to the issue of smoking, it is one of the risk factors affecting osteoporosis which is associated with increased bone loss and increased risk fracture of hip in the elderly as a result of reduced intestinal calcium absorption efficiency (Lane, 2006). A meta-analysis of studies looking at the effect of smoking found that BMD in smokers was 2% lower with each increasing decade after menopause than in non-smokers, with a 6% difference at age 80 years (Law and Hackshaw, 1997). Other studies have demonstrated a causal link between heavy smoking and decreased bone mass. Moreover, researchers have suggested several mechanisms by which smoking may affect osteoporosis risk. In postmenopausal women, smoking may speed the breakdown of estrogen, resulting in lower estrogen levels and increased bone loss. Finally, some researchers have reported that among postmenopausal women, smokers lose cortical bone about 50 percent faster than do

nonsmokers (Sampson, 2002). In line with this, our study found a significant association between smoking, number of cigarettes per day, years of smoking onset, and years of smoking cessation, passive smoking and osteoporosis among postmenopausal women. For example, when we compared the group of smokers with the non-smokers one, we found that osteoporosis is more prevalent in the current smoker group 78% while 4% in the non-smoker group as shown in table (25). In addition, in regard to the number of cigarettes per day, increase in number of cigarettes per day leads to increase in prevalence of osteoporosis. Women who smoke less than 10 cigarettes per day had low percentage of osteoporosis 16.7%, but women who smoke more than 20 cigarettes per day had higher percentage of osteoporosis 61.9%. Regard to the age at which smoking started or ended, the prevalence of osteoporosis increases with long duration of smoking as shown in table (25, 26, 27, and 28).

Smoking has long been known to increase the risk of osteoporosis in women. However, consistent exposure to second hand smoking as measured by having a smoker living at home was found to be positively and significantly associated with osteoporosis. In line with this, two new studies, one conducted in Sweden and the other in China, demonstrated, that even second-hand smoking can significantly increase the risk for osteoporosis and fractures. These studies are first in their kind to report the effects of second-hand smoking on bone health. According to previous studies presented at the International Osteoporosis Foundation World Congress on Osteoporosis in Toronto (Clearing the Air-Links between Smoking and Osteoporosis Strengthened, 2006), it was reported that second-hand smoking may alter levels of estrogen, which is a key hormone for bone health in women.

6.3.5 Nutritional Factors

Bone requires many nutrients to develop and remain healthy, including calcium, proteins, vitamins D, K, C, and A. During growth, it is especially important for people to take in enough calcium to build a peak bone mass. Also these nutrients are necessary to replace the calcium which is lost daily through the kidneys, the intestine, and sweat. When calcium is insufficiently taken, it is removed from bone (Sampson, 2002).

6.3.5.1 Consumption of Dairy Products

Concerning the consumption of calcium-rich diet is considered important in the prevention of osteoporosis; many prospective intervention studies have shown a significant effect of high intake of calcium in women after menopause (Ungan and Tümer, 2001). In our study, we found that there is a significant relationship between consumption of cheese and osteoporosis [*P* value= 0.000]. Furthermore, there is a significant relationship between consumption of milk and osteoporosis [*P* value= 0.000], as increase in consumption of milk leads to decreased prevalence of osteoporosis. In contrast, there is an insignificant relationship between consumption of yogurt and ice-cream at [*P* value= 0.473] and [0.362] respectively, possibly due to the small number of women who consumes these items.

Calcium is the nutrient most important for attaining peak bone mass and for preventing osteoporosis. Ideally, calcium intake should be via ingestion of calcium-rich food. Many factors contributes to and affect calcium intake such as restriction of calcium in dairy products, a generally low consumption of fruits, and very high intake of low calcium beverage such as sodas (Osteoporosis prevention, Diagnosis, and Therapy, 2001). In many studies, a significant relationship between dietary intake of calcium and osteoporosis was observed. For example, in one of the studies which were conducted on Salvadorian women,

most of the interviewees had a daily dietary calcium intake of 60% or less than the recommended level, thus increasing the risk of osteoporosis among women participating in this cross-sectional study (Rauda and Garcia, 2004). Furthermore, a similar result was observed in other studies which were conducted on Caucasian, African-American, and Hispanic women in the US (Geller and Derman, 2001), and Asian and Caucasian women in Australia (Liew et al., 2003).

6.3.5.2 Vitamin -D and Osteoporosis

Vitamin-D is required for optimal calcium absorption and for bone healing. During adolescence, consumption of dairy product decreases; as a result, vitamin-D is less likely to be adequate, and this may adversely affects calcium absorption (Osteoporosis prevention, Diagnosis, and Therapy, 2001). In addition, some diseases such as secondary hyperparathyroidism affect vitamin-D leading to reduced calcium absorption and a loss of bone mass (Jordan and Cooper**,** 2002).

In our study we found a significant relationship between daily consumption of dietary products containing vitamin-D such as fish and fortified milk and osteoporosis *[p* value= 0.000], an increase in consumption of food containing vitamin-D leads to a decrease in the prevalence of osteoporosis. However, there was an insignificant relationship for other products such as liver [*P* value= 0.814] this might be due to the fact that only a few number of women consumed liver in our sample. 42% of women in our sample consumed vitamin-D supplements, in addition, there was a significant relationship between vitamin-D supplements intake and osteoporosis [*P* value= 0.003], as postmenopausal women who take vitamin-D supplements had less prevalence of osteoporosis 30%. There is strong evidence that vitamin-D supplementation enhances muscle strength and reduces risk of falling (Rosen, 2005).

In addition, the results indicated a significant association between home design for sun entry and osteoporosis at [*P* value=0.042] .The prevalence rate of osteoporosis is less among the group of women who live in houses which are well exposed to sun penetration 46% compared to women who live in houses which are not well exposed to sun 54%. Table (33). This could be explained by the fact that the sun is a main source of vitamin-D which is highly essential for skeletal maintenance and enhancement of calcium absorption after menopause. In addition, the geographic location of the old city and the structure of its buildings do not permit a sufficient exposure to sun which explains the high prevalence rate of osteoporosis among post-menopausal women in the old city.

6.3.5.3 Milk Consumption and Osteoporosis

Regarding the issue of milk consumption in childhood and ages 25-49 both are highly significant [*p* value=0.000], while milk consumption above the age of 49 is not significant [*P* value= 0.249] Furthermore, low calcium intake during childhood and adolescence is associated with a lower BMD at age 31, and lower milk consumption in childhood is associated with an increased fracture risk (Faulkner, 2005). In addition these facts are consistent with main findings in our study about physical activity and milk consumption at different ages and their relation to osteoporosis.

6.3.6 Consumption of Food Supplements

Calcium, vitamin-D and multivitamins supplementation should be adjunctive treatment for all women with established osteoporosis, and must be a part of a preventive strategy to reduce bone loss. In our study there is a significant relationship between intake of calcium supplements and osteoporosis [*P* value= 0.035], as the postmenopausal women who take calcium supplements had lower risk of osteoporosis 44% than women who did not take them 56%. Meta-analysis of calcium intervention trials involving healthy women and postmenopausal women demonstrated an increase of nearly 2% in spine bone mineral density after two years of intake of calcium supplements (Rosen, 2005). Moreover, there is insignificant relationship between taking a multivitamin supplements and osteoporosis [*P* value = 0.273]. This result might be faulty due to a small number of women in our study who take or have taken these supplements.

6.3.7 Medical History

The results indicated an insignificant relationship between hysterectomy, age at time of hysterectomy, ovarian removal, age at time of ovarian removal, estrogen replacement therapy number of ovaries removal and osteoporosis. This insignificant relationship could be attributed to late ages at which hysterectomy and overectomy were done, which is common in our society (Issa, 2004).

Regarding to take a female hormone there is a positive association with osteoporosis [*P* value=0.000]. Moreover, a higher number of women are taking female hormone (53) have osteoporosis with percentage of 68%, compare with other group who do not taking female hormone 47.7% have osteoporosis. This a logic result since the taking hormone for long time have a negative effects on bone undoubtedly the greatest risk factor for the development of osteoporosis in women is menopause, when estrogen levels drop precipitously (Sampson, 2002). Normally, the breakdown of old is balanced by formation of new bone, recent research has shown that postmenopausal hormone replacement therapy greatly protects against loss in bone density. The menopausal decline in estrogen production is a direct cause of premature aging, increased risk of cardiovascular disease, and increased risk of osteoporosis. Some studies show that estrogen does not cause cancer in the short-term, but in Women taking estrogen and/or a synthetic progestin for more than 10 years, there appears to be a significantly elevated risk of breast, ovarian, and uterine cancers (Health Market place, 2007).

In addition ,menopause is a very significant event related to the state of women bone, as the loss of female hormone (estrogen) causes a marked and more rapid bone loss in early years following menopause (Osteoporosis Prevention, Diagnosis, and Therapy, 2001).In this study significant associations were found between number of years after menopause and osteoporosis. In fact the prevalence of osteoporosis increased from 0% (for the first 5 years after menopause) to 61.3% (after 20 years of menopause onset) as shown in table (51). Late menopause or short time from menopause to BMD measurement is associated with higher BMD. There is consistent evidence that low BMD is associated with early menopause (Melton et al., 1993). Therefore, women with an early menopause should be considered at higher risk of osteoporosis than others at a similar age.

6.3.8 Family History of Osteoporosis

Moreover, there is an insignificant relationship between family history of women and osteoporosis [*P* value= 0.171]. This may be attributed to a small number of family participants on our study had osteoporosis.

6.4 Knowledge about Various Aspects of Osteoporosis

This study is the first comprehensive effort to evaluate the knowledge about various aspects of osteoporosis among postmenopausal women in the old city of Jerusalem. About 58% of postmenopausal women correctly answered questions. Evidently, more than half of participants had an adequate knowledge about osteoporosis, and they were aware that the postmenopausal women are more susceptible to osteoporosis. They were also aware about the following issues related to osteoporosis: the dangers of inadequate calcium intake, protection of bone calcium should begin at an early age at childhood, the importance of exposure to sun light, osteoporosis cannot be transmitted from one women to another, postmenopausal women should test their bones by BMD, and the adversary effects of caffeine intake on bones.

However, only a small percentage of participants who answered correct questions heard about estrogen, were aware of family history, and knew some related facts such as the adversary effects of immobilization on bones and that bone loss occur without symptoms. In addition, a very low percentage of participants knew and/or heard about the importance of estrogen and the adversary effects of surgical removal of ovaries on the production of it, as well as the adversary effects of smoking on the bone wellbeing table (15, 16, 17, and 18). Moreover, 83% of participants expressed their need to know more about osteoporosis, 91% realized the benefits of regular exercise on bone health, and 71% emphasized that osteoporosis prevention begins in childhood.

Despite the above-mentioned facts, most of participants apparently consume less milk than recommended; do not participate in sport activities, and do not consume a balanced diet. These results are very alarming as they show that the participants in our study don not practice what they believe in. Cleary, this might be attributed to several factors such as culture, economic status, family size, and inadequate health education programs, less communication between women and health provider, lack of adequate concern of media from one side and health centers from the other side about the women health after the end of reproductive age. Furthermore, women tend to neglect their health after marriage and focus their attention on their children and husbands. It is clear that there is a conflict between beliefs and practices as a high percentage of osteoporosis and osteopenia was found. Finally, participants' responses regarding the risk factors may have been influenced by their experience since all of them are postmenopausal women.

6.5 Methodological Considerations

Most of postmenopausal women had high percentage of osteoporosis only few (4%) had osteoporosis so valid comparison can not be established .This study is a cross sectional study and therefore is subject to many limitations. The association between osteoporosis and its determinants/ risk factors is carried out at one point in time and therefore causality cannot be established, since there is no clear sequence of events, namely whether exposure occurred before or after the onset of the disease. Furthermore, the results of this study cannot be generalized because of the small sample size and limited geographical area studied**.**

The main strength of the cross sectional design is the ability to estimate the prevalence of disease at one point in time, and that was done in this study. In addition this study design allowed the investigation of a wide range of risk factors including (nutritional, socio-economic factors, physical parameters, etc…). In addition, our study relied on QUS measurements either right or left calcaneum to assess bone properties which has been found to be a good predictor of the bone density and quality that are related to the risk of osteoporosis (Stewart, et al., 2006) ,(Frost et al., 2000),(Thompson et al.,1998), and to the risk of fracture in early postmenopausal women (Hans,1996), (Thompson et al., 1998). Furthermore, this cross-sectional study was relatively inexpensive and took up little time to conduct and can be considered as a pilot study for further research in the future.

6.6 Summary

Osteoporosis is a significant and growing public health problem among the elderly. A significant number of participants recognized the importance of factors such as sport activities, calcium intake, and regular testing for osteoporosis; nevertheless, a small number of them practice what they believe in. Besides interventions such as screening test, treatment of establish osteoporosis, patients at risk should be educated about the little changes in their home environment, and lifestyle that can reduce the risk for falls to a great extent. Moreover, there are numerous risk factors for osteoporosis, and many of these factors are preventable last but not least, healthcare providers should offer people at risk additional sources of information for resources at community, state, or national level.

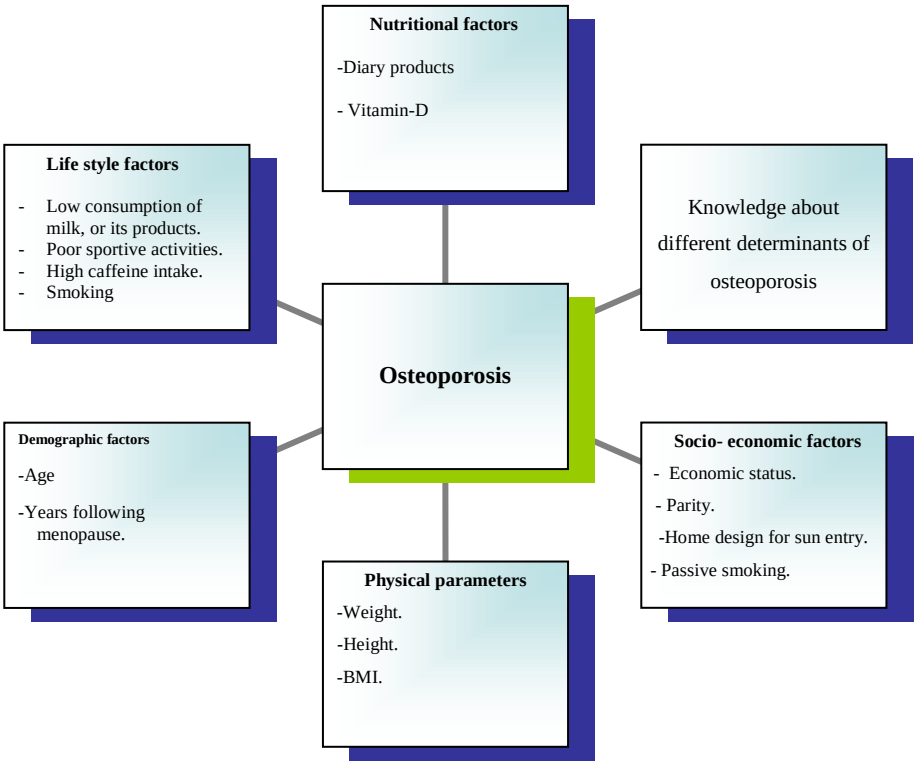
6.7 Conclusion and Recommendation

6.7.1 Conclusion

A cross sectional study was conducted in the old city of Jerusalem to examine and assess the effects of factors such as knowledge, demographic and socio-economic factors, physical variables, life style, nutrition, and medical history on osteoporosis among postmenopausal women age [>45] years. In light of the present findings, the following conclusions can be drawn:

Firstly: Osteoporosis is a major problem among postmenopausal women in the old city of Jerusalem. The prevalence of osteoporosis proved to be very alarming by ultra sound 50%, osteopenia 44%, while only 6% were considered free of the disease.

Secondly: Significant risk factors for osteoporosis in our study sample included: demographic factors (age, educational level and civil status), socio-economic factors (monthly income, number of house rooms and parity), life style factors (low consumption of milk or its products, poor sport activities, high caffeine intake, and smoking), and nutritional factors (dairy products, home design for sun entry, and vitamin-D) as shown below.



Fourthly: Regarding the issue of knowledge about osteoporosis, about (42%) of postmenopausal women lacked adequate knowledge about various aspects of osteoporosis. However, most have expressed interest to learn more about this disease. The study showed that only a small percentage of these women practice preventive health behavior. Conclusively, the results revealed in the present study support the urgent need to raise awareness and increase knowledge about osteoporosis, the major risk factors, management and prevention of disease.

Finally: Osteoporosis is a common problem worldwide which affects seniors and elderly. However, osteoporosis is a preventable disease, so that we may be able to minimize fractures, morbidity, and mortality related to this disease with timely intervention throughout life by: encouraging healthy diets and physical activity in children and adolescents, encouraging postmenopausal women to exercise regularly, avoiding smoking, maintaining adequate calcium and vitamin-D intake; screening appropriately and treating women >65 and those women >60 at increased risk. The study provides clear evidence about the high prevalence of osteoporosis in the old city of Jerusalem

6.7.2 Recommendations

1- 0steoporosis is one of the non-communicable diseases that need immediate intervention both at official and public levels, since it is associated with high costs and lower quality of life.

2- Public health strategies which control or modify risk factors for osteoporosis is worthwhile at population level and high risk groups .These strategies are:

- Public health programs giving advice, knowledge and prevention skills to postmenopausal women about osteoporosis, and various risk factors that can affect their bone.
- Screening tests for osteoporosis, all postmenopausal women above age 65 or those who have one or more risk factors.
- Encouraging physical activity and exposure to sunlight.

3- Continuing osteoporosis research should be encouraged, in particular projects in molecular genetics, osteoporosis in men, follow-up for women with osteoporosis and osteopenia in this study.

6.7.3 Suggestions for Further Studies

1- Studies about epidemiology of fracture, morbidity and mortality and risk factors for osteoporosis should be conducted on a larger scale in Palestine.

2- Studies to explore the quality and quantity of health services provided to women in post reproductive age.

3- Study the relationship between psychological situation of postmenopausal women and osteoporosis.

4- Studies concerning the measurement and assessment of the validity of different modalities for diagnosis of osteoporosis.

5- Study the effects of media on raising the awareness level about osteoporosis.

6- Study the relationship between obesity and osteoporosis among postmenopausal women in Palestine.

7- Palestinian women in the old city have an adequate knowledge about different determinants of osteoporosis but a small number of them practice what they believe in, another study using behavior model approach may be needed.

8- BMD curve of Palestinian population.

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