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Estimation of 10- year probability bone fracture using WHO Fracture Risk Assessment Tool (FRAX)

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Dedication

بسم الله و الحمد لله على نعمه و الصلاة و السلام على سيدنا محمد و على اله و صحبه اجمعين .

أما بعد،

أبدأ بكلمة بسيطة اهديها من كل قلبي الى كل من همه و يهمه أمري،

الى من تابعت خطاي في صغري و شجعتني و دأبت في تربيتي الى أمي الفاضلة

الى من هداني الى سبيلي و ايدني بكافة قراراتي الى ابي العزيز

الى جدتي و جدي رحمه الله

الى أخوتي و أخواتي الذين ارتبيت معهم

الى زوجي العزيز الذي شاركني حياتي و دعمني في دراستي و اتمام رسالتي

الي ابني عصام الذي الهمني الصبر و التحدي لاتمام هذه الرسالة

الى أساتذتي الذين اعانوني في توسيع مداركي و تحديد أهدافي و اتمام رسالتي بكافة جوانبها

اليكم جميعا أهدي رسالتي و كل امتناني.

مع حبي و احترامي.

To:

My Father, Mother, Husband, friends and my Brothers for their patience and encouragement. With love and respect.

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Thanks are also expressed to my friends especially for their help and encouragement.

With All Love and Respect.

MAI

الاقرار

أنا الموقع أدناه مقدم الرسالة التي تحمل العنوان:

Estimation of 10- year probability bone fracture using WHO Fracture Risk Assessment Tool (FRAX)

أقر بأن ما اشتملت عليه هذه الرسالة إنما هو نتاج جهدي الخاص، باستثناء ما تمت الإشارة إليه حيثما ورد، وأن هذه الرسالة ككل، أو أي جزء منها لم يقدم من قبل لنيل أية درجة علمية أو بحث علمي أو بحثي لدى أية مؤسسة تعليمية أو بحثية أخرى.

Declaration

The work provided in this thesis, unless otherwise referenced, is the researcher's own work, and has not been submitted elsewhere for any other degree or qualification.

Student's name: **اسم الطالب :**

Signature: **التوقيع :**

Date: **التاريخ :**

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List of abbreviations

Abbreviation	Explanation
BMC	Bone Mineral Content.
BMD	Bone Mineral Density.
BMI	Body Mass Index.
CRFs	Clinical Risk Factors.
CVD	Cardiovascular Disease.
DEXA	Dual Energy X-ray Absorpitometry
DM	Diabetes Mellitus.
EMRC	Endocrinology and Metabolism Research center.
FRAX	Fracture Risk Assessment tool.
GIT	Gastro-intestinal tract.
HF	Hip Fracture.
Ht	Height.
IQR	Inter Quartile Range
IRB	Institutional Review Board.
Kg	Kilograms.
K.S	Kolmgorov-Smirnov test.
MOF	Major Osteoporotic Fracture.
NHANES III	National Health and Nutrition Examination Survey III
NIH	National Institutes of Health.
NOF	National Osteoporotic Foundation.
OCT	Oral Contraceptives
OF	Osteoporotic Fracture
Q	Quartile.
SDs	Standard Deviations.
WHO	World Health Organization.
Wt	Weight.

*** Secondary osteoporosis: If the patient osteoporosis secondary to medical condition or disease. These include type I (insulin dependent) diabetes, osteogenesis imperfecta in adults, untreated long-standing hyperthyroidism, hypogonadism or premature menopause (<45 years), chronic malnutrition, or male absorption and chronic liver disease.

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Abstract

Introduction: Osteoporosis is a disease in which the density and quality of bone are reduced, leading to weakness of the skeleton and increased risk of fracture, particularly of the spine, hip, wrist, pelvis and upper arm[1]. The FRAX® tool has been developed by the World Health Organization to evaluate fracture risk of patients. It calculates 10-year probability of hip or major osteoporotic fracture.

Objectives: As the proportion of aging population rises dramatically in Palestine, osteoporotic fractures have become a crucial health issue that must be addressed urgently. We assessed the prevalence of osteoporosis and estimated the 10-year probability of major osteoporotic fracture (MOF) and hip fracture (HF) among a selected sample above 50 years old.

Methods: A convenient sample of 100 subjects was selected from Al-Rahmah clinic Nablus district during the study period between March 2012 and May 2012. A specially designed questionnaire was filled by the investigator including independent risk factors of osteoporosis selected by FRAX tool, in addition to others mentioned in literature. Dual energy X-ray absorpitometry was performed to measure bone mineral density (BMD),

hip, and vertebral T score. Data extracted was then inserted to FRAX Palestine online WHO tool to calculate 10-year probability of major osteoporotic fracture and hip fracture in the selected sample.

Results: In the total 100 subjects the median hip BMD was 0.82 (0.76-0.92) g\cm^2. Mean vertebral T score was -1.41± 0.13 SDs, and mean hip T score was -0.91± 0.10 SDs. About one fifth of the sample (21%) had vertebral osteoporosis, while only five percent had hip osteoporosis. The median 10-year probability of MOF and HF based on BMD were 3.7 (2.43 – 6.18) %, and 0.30 (0.10 - 0.68) % respectively.

Conclusion: In conclusion osteoporosis is common among Palestinian population above 50 years old (23% measured in our study), making fracture prevention strategies and research a priority in Palestine. Ongoing studies of fracture rates in Palestine should be followed up. Further studies on the accuracy and feasibility of the FRAX algorithm are essential for its clinical applicability.

1. McCloskey, E., *FRAX® Identifying people at high risk of fracture.*, L.M. Judy Stenmark, Editor. 2009, international Osteoporosis Foundation: Switzerland.

Chapter One

Introduction

1.1 Overview

Osteoporosis is a disease in which the density and quality of bone are reduced, leading to weakness of the skeleton and increased risk of fracture[1]. Osteoporosis and associated fractures are an important cause of mortality and morbidity. The FRAX® tool has been developed by the World Health Organization to evaluate fracture risk of patients. It calculates 10-year probability of hip or major osteoporotic fracture based on individual patient models that integrate the risks associated with clinical risk factors, with or without bone mineral density (BMD) at the femoral neck.

In this study the 10-year probability of hip and major osteoporotic bone fracture among a selected group of people above fifty years in Palestine were calculated using the WHO FRAX tool especially designed to be used in Palestine.

This study is a descriptive analytical study. A convenient sample of 100 subjects was selected from Al-Rahmah clinic Nablus district during the study period between March 20\2012 and May 10\2012. A questionnaire was filled by the investigator including the 11 independent variables sited in FRAX tool in addition to hip Bone Mineral Density value, vertebral T score, and hip T score measured by Hologic Dual Energy X-ray Absorpitometry (DEXA). Then based on DEXA the subjects were classified into normal, had Osteopenia, or had osteoporosis whether

vertebral or hip osteoporosis. Data was entered and analyzed using FRAX tool to calculate Body Mass Index (BMI), the 10-years probability of major osteoporotic fracture, the 10-years probability of hip fracture, and the calculated hip T score. Further analysis was done using SPSS program version 16. Descriptive analysis for continuous variables was performed (mean ±SD). Spearman correlation was used to correlate BMD with the 10 year probability of osteoporotic fracture.

1.2 Background and definitions

Osteoporosis is a worldwide health problem [2]. The burden of disease and related fractures increases with increased life expectancy [3]. It is estimated that osteoporosis affects 75 million people in Europe, USA and Japan, and this is estimated to increase by 240% by 2050 [4].

Osteoporosis is a progressive silent disease affecting bone mass and structure, leading to increased susceptibility to fractures; it's typically diagnosed after fracture occurs[2]. Osteoporosis was defined by the WHO as a "disease characterized by low bone mass and micro-architectural deterioration of bone tissue, enhanced bone fragility and an increase in fracture risk" [5].

Fragility or osteoporotic fractures, the most challenging consequence of osteoporotic bony change, are pathological fractures due to non-traumatic falls from standing height or less, and are associated with

significant morbidity and increased mortality to elderly patients, and result in increased costs to the healthcare system[2, 6].

The incidence of osteoporotic fractures (annual estimate in all age groups) is higher than the incidence of heart attack (annual estimate in women >29 years), stroke (annual estimate in women > 30 years), and breast cancer (new cases in women at all age groups) combined [3, 7]. These fractures affect approximately half postmenopausal women (aged 50 or more), compared with 1 of every 5 men aged 50 or more. So osteoporosis is not only women's disease [8] .Osteoporosis and its associated fractures are more prevalent in post menopausal women over 50 years than men over 50 years; however, the impact of osteoporosis among older men is commonly underestimated [8]. It affects more men than prostate cancer does (the most common cancer in men) and is more likely to result in disability or death [8, 9].

The most common sites for osteoporotic fractures are the spine, hip, and wrist [3]. Hip fractures are particularly devastating, with significant increased risk of morbidity and mortality following the fracture occurrence [7]. Many risk factors, some modifiable and others non-modifiable, are associated with fragility fractures. Clearly, the higher the number, duration and intensity of these factors the greater the risk of developing osteoporosis [10].

1.3 Assessing osteoporosis using BMD

The World Health Organization (WHO) clinically defines normal bone density as a bone mineral density (BMD) or bone mineral content (BMC) score between ± 1 standard deviations (SDs) from the young adult mean, as measured by central (hip or spine) dual energy x-ray absorpitometry (DEXA) scan [2, 11]. Osteopenia is clinically defined as a BMD score between -1 and -2.5 SDs and osteoporosis as a BMD score 2.5 SDs or more below the young adult mean [2].The previous definition and osteoporotic guidelines and treatment focused on BMD monitoring ,as low BMD is an indicator and a strong risk factor for osteoporotic fractures [11]. Since osteoporosis is a multifactorial disease, using BMD only captures the minority of fracture risk, then the combination of clinical evaluation of risk factors that add information on fracture risk independently of BMD with BMD screening produces the most effective risk assessment for osteoporotic fractures as opposed to assessment of any one risk factor alone [12, 13].

1.4 Factors for osteoporotic fractures

Careful risk assessment plays a crucial role in identifying patients who are at risk for developing osteoporosis and might benefit from intervention. Many risk factors, some are modifiable and others non-modifiable, and then further classified as major or minor risk factors are associated with osteoporotic fractures. The major non-modifiable risk

factors include advanced age, a personal history of fractures as an adult, and a history of fracture in a first degree relative [14, 15]. Major modifiable risk factors include a low BMD, chronic oral corticosteroid use (more than 3 months of use), history of recurrent falls, and a low body weight (less than 58 kg) [14-17]. Minor risk factors for osteoporotic fractures include, but are not limited to, inadequate nutritional supplementation of vitamin D and calcium, impaired eyesight despite correction, high alcohol and tobacco consumption, and immobilization [12, 18, 19].In addition, elderly patients often present complex medical problems requiring multiple medications [18]; an issue that contribute to secondary causes of osteoporosis in adults. Extrinsic modifiable factors, such as the absence of mobility aids, or bathtubs and showers without grab bars and non-slip mats, also increase the risk for falls in the elderly [20]. Since most osteoporotic fractures result from falls [8], fall prevention is an important component of patient education.

1.5 Fracture Risk Assessment Tool

The World Health Organization recently (WHO Collaborating Centre for Metabolic Bone Diseases) designed a web-based tool for estimating 10-year probability of a hip fracture and the 10-year probability of a major osteoporotic fracture (vertebral, hip, forearm or humerus fracture) called FRAX, it was not published until 2008 [21]. The estimate is based on 11 risk factors that are independent of Bone Mineral Density (BMD), plus the hip BMD T-score (which is the number of standard

deviations by which the patient's BMD differs from the mean peak BMD for young normal subjects of the same gender) if available combined with country specific fracture and survival data [21]. These risk factors include age, sex, weight, height, a prior fragility fracture, parental history of hip fracture, current tobacco smoking, long-term use of glucocorticoids, rheumatoid arthritis, other causes of secondary osteoporosis and daily alcohol consumption [8].

FRAX is intended for use in postmenopausal women and men over the age of 50 who have not taken osteoporosis medications. The tool is available online at http://www.shef.ac.uk/FRAX/tool.aspx?country=52 [8]. The National Osteoporosis Foundation (NOF) in 2008 had developed guidelines based on FRAX and currently recommends starting treatment in individuals with any one of the following criteria: (1) history of hip or vertebral fracture, (2) T-score ≤ -2.5 at femoral neck or spine, (3) T-score between -1.0 and -2.5 and 10-year probability of ≥ 3% for hip fractures, or ≥ 20% for major osteoporotic fractures at the femoral neck [8, 22]. Subjects with probabilities of ≥ 20% for any major osteoporotic fracture or ≥ 3% for a hip fracture were defined as being at high risk of fracture [23].

Unfortunately, osteoporosis receives low attention in primary health care programs in most underdeveloped countries, where most women are largely unaware of the serious complications associated with osteoporosis [8]. Evidently, minimizing the risk of acquiring the disease begins by modification of individuals' life style to combat related risk factors, and

identification of patients at high risk to reduce future fractures; this is for what FRAX has been developed. As public health specialists, it is important that we: be familiar with osteoporosis risk factors and screen patients accordingly, identify and effectively educate individuals at risk, understand the benefits, risks, and optimal use of all treatment options, so they can be proactive about their care [8].

1.6 Statement of the problem

Osteoporosis is a major public health problem because of the fractures that could occur. Unfortunately, osteoporosis receives little attention in primary health care programs in Palestine, where no educational programs are focusing on this issue. As a result most women are largely unaware of the risk factors, symptoms, serious complications associated with osteoporosis.

Even at the level of early detection of the disease, it requires measuring BMD in the susceptible patient which is relatively difficult because few DEXA instruments are available in addition to the high cost of the procedure. So the disease continues to progress silently in the individuals resulting osteoporotic fracture and affecting their quality of life. This rise the need for an alternative easy, inexpensive, accessible, and reliable tool to calculate future probability of fracture based on clinical risk factors without the need to calculate BMD, and therefore give the decision to treat or not before fracture occurs. This is for what FRAX tool was

developed to provide a clinical case finding strategy for those at high risk so the adequate procedure can be taken.

1.7 Objectives of the study

Main objective

To calculate 10-years probability of hip and major osteoporotic fractures among selected sample of Palestinian men and women older than 50 years attending Al-Rahmah clinic in Nablus district using FRAX Palestine online tool.

Specific objectives

1- To identify individuals at increased risk of fracture.

2- To measure bone mineral density for the sample, and accordingly the prevalence of osteoporosis.

3- To examine the association and correlation between most of the independent risk factors, and 10-year probability of MOF and HF.

4- To test the association and correlation between bone mineral density and 10- year probability of major osteoporotic fracture and hip fracture.

1.8 Significance of study

Osteoporosis is a major public health concern because of the fractures that could occur. Hip fractures increase morbidity and mortality affecting quality of life and entailing high socio-economic costs, in addition to the patient's suffer (pain, hospitalization, and early death). The burden of fractures is increasing in direct correlation with life expectancy. The life expectancy of Palestinians has remarkably increased in the last decades; it reaches 72.4 by the beginning of 2011 [24], with elderly population > 65 years forms 3.3% of the total population in the mid of 2010 in the west bank [25, 26]. This may lead to increased fractures susceptibility.

Many risk factors that are associated with osteoporotic fractures are present in the Palestinian society including low calcium intake, Vitamin D deficiency, lack of exercise and sedentary life style, lack of awareness toward osteoporosis risk and medications among elderly [27, 28], all these factors increase incident of fracture in the Palestinian society.

FRAX tool provides an easy, inexpensive, accessible, and highly reliable case finding strategy that captures the majority of cases who are at high risk of developing hip and major osteoporotic fractures based on clinical risk factors even without measuring BMD value. The resulting 10-year probability of HF or MOF calculated by FRAX highly affects the decision to intervene for treatment or not to prevent first and subsequent fractures.

According to the investigator knowledge only one study has been published on osteoporosis in Palestine[27]. Furthermore no study is available about FRAX in Palestine, so this will be the first study of its type for estimation of 10-years probability of osteoporotic fractures among Palestinian population ≥ 50 years old. Eventually, the extended aim of this work was to estimate the prevalence of osteoporosis in the Palestinian society using the study sample as an approximate.

1.9 The expected outcomes of the study

The expected outcome of the study is to convince health policy makers and physicians at all levels whether Ministry of health or Nongovernmental health organizations to apply FRAX tool based on clinical risk factors alone without BMD as a screening tool for all individuals above 40 years attending all types of clinics, and as a prescreening tool for DEXA (to reduce expenses) to calculate the 10-year probability of fractures, detecting those at high risk and recommending immediate treatment as soon as possible for them following the next protocol.

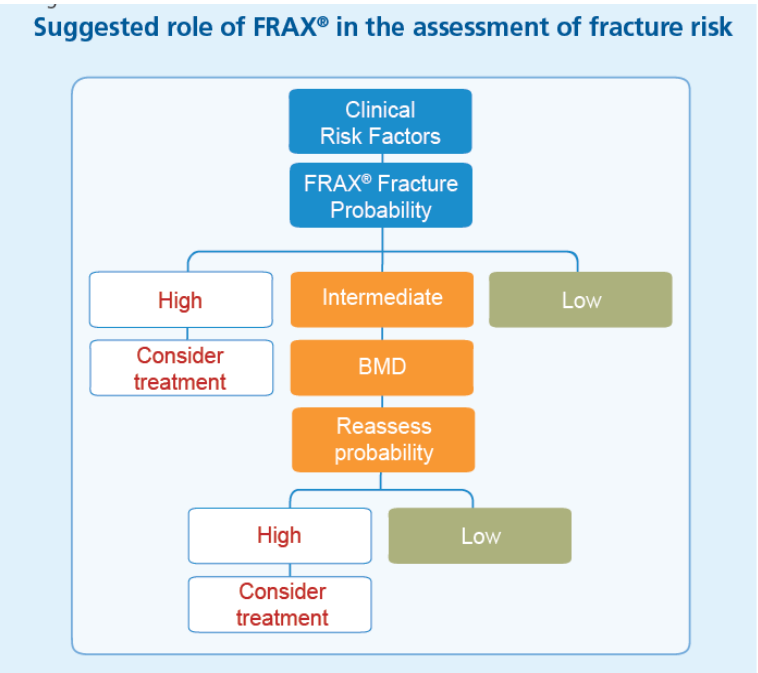

Figure 1.8.1: the suggested protocol for using FRAX tool.

1.10 Limitations of the study

The main expected limitation of the study was related to small sample size. In addition data was limited to one district which is Nablus this can be justified by the high cost of the DEXA which is the main diagnostic tool for osteoporosis. This factor limited our sample size into an affordable number which was 100 subjects.

Chapter Two
Literature review

2.1 Epidemiology of osteoporosis

Osteoporosis is a worldwide health problem [2]. The burden of disease and related fractures increases with increased life expectancy [3]. The osteoporosis problem will soon be of greater importance in developing countries due to the increase in life expectancy [29]. In the Middle East, the burden of this disease is expected to increase, taking into account the steady growth of the ageing population. Iran in which the present population is estimated to be 76 million (of this 14% (11 million) is 50 years of age or over and 3% (2.6 million) is 70 or over), it is estimated that two million people are at risk of fracture according to the Endocrinology and Metabolism Research Center (EMRC), making osteoporosis as one of the chief health problems in the country [30]. According to the Ministry of Health, the yearly cost of hip fractures in Iran is between 8 and 16 million US dollars. In a 2008 study by Hosseinapanah et al., 11% of 245 randomly selected postmenopausal women with a mean age of 57.7 ± 7 years were found to be osteoporotic in the femoral neck and 25.3% were osteoporotic in the lumbar spine [31]. In a cross-sectional investigation aimed at assessing risk factors for osteoporosis, ninety women aged 48.5 ± 8.3 years, 27.8% were found to be osteopenic at the lumbar spine and 35.6% at the femoral neck. The prevalence of osteoporosis was 13.3% [32]. A prospective survey was conducted by Moayyeri et al. in 9 provinces across the country, the age-standardized annual incidence rates of hip fracture

were estimated at 127.3/100000 and 164.6/100000 for males and females respectively [33].

In Lebanon several studies have been conducted. A study conducted on healthy young Lebanese between 25-35 years in Beirut showed a lower BMD and higher prevalence of osteoporosis compared with USA [34].

A recent survey was conducted in Lebanon to determine risk factors for osteoporosis in the Lebanese female population. Sample was composed of postmenopausal women with at least one risk factor for developing osteoporosis. The mean number of risk factors reported was 6±3. The results showed that the more risk factors the patient had, the lower the BMD. The study found that back pain, low physical activity, family history of osteoporosis or hip fracture, loss of height, early menopause, heavy smoking (>20 cigarettes per day), thin and small built, history of rheumatoid or thyroid disease, previous administration of corticosteroids chronically and chronic alcohol consumption were associated with increased osteoporotic fractures. The mortality rate of hip fracture is 7% in the Lebanese population after one year and 18% after 5 years [35].

In Saudi Arabia the prevalence of osteoporosis was studied in a group of randomly selected males and females aged 20-79 years. The prevalence of osteoporosis in women ≥ 50 years was 28.2% , while in men of the same age category it was 37.8% using Saudi reference [36]. Another study from the region revealed low vitamin D levels; which is a minor risk factor for

osteoporotic fractures; in the Saudi population [37]. In that study performed in 321 Saudi young women with a mean age of 35.4 years old, severe Hypovitaminosis D (25-hydroxy-vit D level </=8 ng/ml) was present in 52% of the subjects [37].

In a study carried out in Qatar [38], on healthy females aged 20 to 70, risk factors for osteoporosis were similar to those known to influence BMD in other populations; female sex, age, early menopause, and excessive smoking. In addition this study suggested other risk factors of great importance in the Qatari population and in the Gulf region, including: high number of pregnancies, prolonged lactation and vitamin D deficiency; the author hadn't stated a specific definition for prolonged lactation [38]. In another study conducted on 821 postmenopausal women in Qatar the prevalence of osteoporosis was 12.3%. BMI was significantly higher among postmenopausal women ($P < 0.001$) compared with premenopausal women. The subjects who consumed dairy products regularly had better BMD at spine, neck and ward sites ($P < 0.05$). Those doing regular household work for 3–4 hours a week had higher BMD compared with those who did not do [39].

In Palestine a study was conducted in 2004 by Abd-Alhameed, Saba, and Darwish with the efforts of Palestinian society for osteoporosis on prevalence and awareness to osteoporosis among 569 randomly selected post menopausal women (≥ 49 years) [27]. Osteoporosis at lumbar spine, neck and total hip was 24%, 14% and 29.7% respectively. BMD declined

0.48%, 0.57% and 0.67% per year respectively at the three indicated sites. This decline was in relation to the number of years after menopause. This study was the first of its kind among Palestinian women in this region and strongly indicates the urgent need of a comprehensive national program to control the spread of the disease among the population. Postmenopausal osteoporosis was significant among the Palestinian population with poor awareness of the disease risk factors (12% aware, 61% reasonably aware and 27% were basically unaware of the disease and the relevant risk factors). BMD was higher in subjects who were aware of the disease (lumbar spine 0.893 g/cm^2, femoral neck 0.746 g/cm^2) than in those unaware of the disease (lumbar spine 0.835 g/cm^2, femoral neck 0.712 g/cm^2) [27]. According to Abd-Alhameed et al. level of awareness of osteoporosis was significantly associated with age, educational level, residency and the use of dietary supplements (calcium, vitamin D, and multivitamin) and milk consumption. Data indicated that only a 19% of the study sample (post menopausal women $\geq$ 49 years) took calcium supplement while only 12% used vitamin D supplement. Small fraction realized the significance of risk factors associated with acquiring osteoporosis [27].

A master thesis was conducted at Al-Najah University on osteoporosis among inhabitance of Jenin district that suffered from fractures and was referred to orthopedic clinic in 2003. It showed that higher rate of fracture was in spine followed by hip, wrist and ribs.

Fractures were more in females than males. Risk increased by age, family history, early menopause and low physical activity [40].

2.2 literature review

FRAX tool was applied in many countries to identify people at increased risk of disease and therefore to reduce risk of subsequent fractures; FRAX was applied in Taiwan to estimate 10-years probability of osteoporotic fractures among postmenopausal women [41].

In Taiwan a self administered questionnaire was used to get the risk factors, while BMD was measured using DEXA. The mean 10-year probabilities of major osteoporotic and hip fracture were 13.8%, and 2.2% respectively. For women above 70 the probability for major osteoporotic fracture was 24.3%. In total about 17% of the sample were at high risk of major osteoporotic fractures while 20.4% were at high risk of hip fractures. Vegetarian women posses higher risk of fractures [41].

Poland had several studies on FRAX tool too. A study was performed on the predictive value of FRAX tool in evaluation of fracture risk in postmenopausal osteoporotic outpatient clinic women in Poland [42]. Study group were divided into 4 age subgroups 50-59, 60-69, 70-79, and ≥80. None of the participant was eligible for treatment according to arbitrarily threshold was set for Polish. Value of FRAX in fraction prediction was shown to be the lowest in the 50-59 year old women, and

including BMD in FRAX calculation was associated with increased sensitivity in fracture prediction.

Another study was performed in Poland to assess how FRAX with and without BMD can identify women for therapy regarding intervention threshold proposed in Poland [43]. Sample was divided into 4 age subgroups similar to the previous study. Results showed that intervention thresholds proposed in Poland cannot be reached in women aged 50–69 when fracture probability was assessed on the basis of Clinical Risk Factors (CRFs) alone, while in ≥80 females FRAX based only on CRFs was sufficient to start therapy. BMD test was valuable particularly in 50–59 and 70–79 year olds to identify the substantial proportion of women eligible for treatment [43].

A third study was carried out in Poland to calculate 10-year probability of osteoporotic fracture in 2012 postmenopausal Polish women using FRAX tool from March 2008 till April 2009 [44]. All subjects were subjected to BMD measurements at the hip. Probability was 22.2±12.1% and 5.3±6.7% for major osteoporotic and hip fractures respectively.

A study was conducted in Bulgaria to explore the epidemiology of osteoporosis in Bulgarian women (>50 years). Of the women included in the study, 16.8% had osteoporosis and 46.5% had osteopenia at the femoral neck. The mean 10-year risk of MOF and HF using FRAX was

13.4%±9.2% and 2.8%±5.2% respectively. This study was the largest Bulgarian epidemiological osteoporosis trial [45].

In Portugal a study was conducted on the use of FRAX and if the calculated risk will reflect bone mechanical probabilities and bone turnover markers [46]. The 76 subjects were patients submitted to hip replacement surgery. The mean probability of major osteoporotic fracture calculated by FRAX was 12.7±11.1% and for hip fracture was 5.9±8.1%. The absolute risk of fracture calculated by FRAX was strongly related to bone mechanical behavior like strength and stiffness but not to turnover markers.

FRAX tool was also implicated in Italy [47]. In a study applied on renal transplant patients to calculate absolute fracture risk using FRAX, BMD and clinical risk factors were measured. The mean 10-year probabilities of hip and major osteoporotic fractures were 5.2±5.1% and 12.3±7.3% respectively. The study showed that in half of the patients an effective anti-fracture treatment is recommended.

FRAX was applied early in The United Kingdom. Treatment decision in osteoporosis was previously made on basis of BMD using DEXA. A study was conducted to determine FRAX ability to predict or exclude the diagnosis of osteoporosis [48]. FRAX scores in the sample were related to the presence or absence of osteoporosis detected by DEXA based on WHO criteria showing that FRAX was significantly predictive of osteoporosis at femoral neck as well as at the spine ($p<0.001$) . In addition

FRAX may be used as a pre-screen to detect and identify patients at increase risk who don't require DEXA.

In France a descriptive study was conducted in 494 untreated women aged 45–60 years interviewed for the first time at a menopause clinic. Risk factors, physical findings, and bone mineral density (BMD) values determined by dual-energy X-ray absorpitometry were gathered. At the end of the clinic visit, 128 (26%) women were prescribed medications. Then, the 10-year fracture probability was estimated using the FRAX® tool. The mean 10-year probability was 3.9% ± 2% for major osteoporotic fractures and 0.8% ± 0.9% for hip fractures. Women who were prescribed medications had significantly ($P < 0.001$) higher probabilities than the other women [49].

Another study was conducted in France. Its aim was to compare the predicted fracture probabilities and the observed incidence of fracture in French women during a 10-year follow-up. The probabilities of fracture at four major sites (hip, spine, shoulder, or wrist) and at the hip were calculated with the FRAX tool in 867 women aged 40 years and over from the Os des Femmes de Lyon (OFELY) cohort. The incidence of fracture was observed over 10 years. Among all women, the predicted mean probabilities calculated without and with BMD were, respectively, 6.6%±7.3% and 5.9%±6.3% for MOF and 2.4%±5.1% and 1.8%±4.3% for hip fracture. They all increased with age. In women aged at least 65 years (n =229), the 10-year predicted probabilities of fracture with BMD were

13% for MOF and 5% for hip fractures, contrasting with 3.6% and 0.5% in women younger than 65 years (p <.0001). The predicted probabilities of both MOF and HF were significantly higher in women with lower BMD. In French women from the OFELY cohort, the observed incidence of fragility fractures over 10 years increased with age following a pattern similar to the predicted probabilities given by the FRAX tool. However, in women aged at least 65 years with low BMD, the observed incidence of fractures was substantially higher than the predicted probability [50].

Most of the published studies are done after 2008; because FRAX wasn't published until 2008. FRAX calculator is published for four Arabic countries only; including Lebanon, Jordan, Tunisia, and Palestine. FRAX Lebanon was launched in Sept 2009, FRAX Jordan in Feb 2011 [51]. FRAX Palestine was launched in Sept 2012.

According to the investigator knowledge no Arabic country has published any study about FRAX especially that FRAX wasn't launched for all Arabic countries.

Chapter Three

Material and Methodology

3.1 Study design and setting

This study was a descriptive analytical study carried out on men and women above 50 years. A convenient sample of 100 participants was selected from patients attending Al Rahmah clinic, which is a nongovernmental organization that provides medical services for general public. It contains outpatient specialist clinics, pharmacy, radiology department and laboratory in the same building. It has a relatively high workload. It's the only center that provides DEXA in Nablus district and in the north of Palestine.

3.2 Study population and sample size

Men and women above 50 years in Nablus, Palestine were the target population. The study sample consisted of 100 women and men above 50 years of age selected conveniently from Al-Rahmah clinic in Nablus city. Sample size was calculated using the Mendenhall equation (1983):

$S = 4Z^2 P (I-P)/w^2$

- Z value is derived from our anticipated confidence level. Recommended value of Z score is 1.96 to give confidence level of 95%.
- W is the confidence interval intended width which was suggested to be 20%.

- P was derived from the prevalence of osteoporosis which was obtained from the average of the three types of osteoporosis in Abd-Alhameed et al, 2004 study which is equal 22.5%.
- The minimum sample size according to this equation was 76cases
- A convenient sample of 100 patients was considered.

The investigator had visited Al-Rahmah center daily from March– May / 2012 and stayed at the center from 9 a.m. - 1 p.m. The investigator asked people attending the center to voluntarily participate in the study by measuring their BMD and filling a specially designed questioner. The recruitment of subjects continued daily.

A total 120 subjects were invited to participate during the study period; About 12 of them didn't meet the inclusion criteria or refused to participate from the beginning of the study, another 8 rejected to do the DEXA. Finally a net total sample of 100 subjects met the inclusion criteria, did the DEXA using Hologic DEXA machine, and filled the study questionnaire.

3.3 Data collection and tool

Patients attending the clinic during the study period were invited to participate in the study. If they met the inclusion criteria and agreed then they were interviewed by the investigator to fill a specially designed questionnaire that covered risk factors of osteoporotic fractures included in FRAX electronic calculator, in addition to others mentioned in literature review, and they performed a DEXA using Hologic DEXA machine.

The tool is the FRAX WHO electronic calculator, to which you either inserted BMD, or not. In addition you answered with yes or no for eleven risk factors for osteoporosis independent of BMD. These data are integrated and analyzed electronically to calculate 10-years probability for hip and major osteoporotic fractures whether with or without inserting BMD.

3.4 Assessment and measures

Dual energy x-ray absorpitometry was performed at Al-Rahmah clinic radiology department to measure hip bone mineral density, hip and vertebral T score, all are highly correlated to osteoporosis. Further classification was made based on WHO classification for osteoporosis (BMD value is 2.5 SD or more below the mean for young adult mean) and Osteopenia (BMD value between -2.5 SD and -1 SD) to classify the subjects according to vertebral and hip osteoporosis. Weight was measured by the researcher for the whole sample using the same apparatus. Height was measured also by tape measure for the whole sample. In addition, other risk factors were collected by the investigator using a specially designed questionnaire. All these data was entered to FRAX Palestine tool. This online tool will calculate 10 years probability of hip and major osteoporotic fractures (MOF) whether with or without measured bone mineral density T score at the femoral neck (hip T score). So we have two probabilities for each hip or major osteoporotic fracture, one based on BMD, and the other is calculated without it. In addition the FRAX tool can calculate the

theoretical hip T score for the selected sample subjects after selecting Hologic DEXA tool and inserting BMD value.

3.5 The questionnaire

The questionnaire consisted of four parts: 1) socio-demographic information including sex, age, educational, and marital status, 2) anthropometric measures including height, weight, and bone mineral density, vertebral T score, hip T score, 3) the medication administered by the subjects, and the remainder 4) dichotomous risk factors of FRAX tool and some other risk factors from literature. The questionnaire was filled by the investigator taking into consideration FRAX risk factors as defined by the calculator.

3.6 Inclusion and exclusion criteria

Inclusion criteria

Male or female above 50 years not necessarily having osteoporosis, not using osteoporotic medication except for calcium and vitamin D.

Exclusion criteria

Male and female below 50 years, or those above 50 but diagnosed with osteoporosis and taking osteoporotic medications, or those having recent osteoporotic fracture\s were excluded.

3.7 Ethical consideration

Ethical approval from Al-Najah University Institutional Review Board (IRB) was taken. In addition approval from Al-Rahmah clinic administration, and consent forms from subjects also were taken. Participants were assured their privacy and confidentiality. All collected data was kept in private place and no one had the right to see them except for the investigator. No names only file numbers were used. Participants can quit the study at any time.

3.8 Data analysis

All statistical analyses were conducted using Statistical Package for Social Sciences (SPSS) version 16.0 for Windows. Normality was tested using Kolmgorov-Smirnov (K.S) test. Descriptive analysis for continuous variables were performed, means and standard deviations or medians and percentiles for the numerical variables were calculated, whether they followed a normal distribution or not, respectively. Frequencies and percentages were calculated for nominal variables. Spearman correlation was used to correlate BMD with the 10-year probability of osteoporotic fracture. Mann-Whitney U test was used to test association between groups for variables that were not normally distributed. Differences were considered significant if the P-value was less than 0.05.

3.9 Variables:

Dependent variable: 10 years probability of osteoporotic fracture and hip fracture calculated by FRAX tool from WHO site (continuous variable).

Independent variables are

Age (continuous from 50 to 90 years)

Sex (nominal variable either male or female)

Marital status (nominal variable with 4 choices: single, married, widowed, and divorced)

Parity and oral contraceptives (OCT) administration in females: (parity is continuous variable, OCT administration is a nominal variable with two choices yes or no)

Weight and Height (both are continuous wt in kg while ht in centimeters in order to calculate body mass index)

Level of education (nominal with 4 choices: illiterate, basic education (1^{st} to 10^{th}), secondary education, or University) basic education and secondary education were integrated into school education.

Administered medications (nominal variable with the following choices: diabetes, hypertension, heart, gastrointestinal, supplement, hormones, or other medications). (Hypertension and heart were integrated into cardiovascular medications)

Hip bone mineral density (continuous variable in gram\cm^2 computed by Hologic Dual Energy X-rays).

Vertebral T score and hip T score (continuous variable in SD from young adult mean).

Others: dichotomous variable (nominal with two choices yes or no) including: history of previous fracture, history of parental fracture, alcohol administration, tobacco smoking, chronic glucocorticoids medications administration, rheumatoid arthritis, other 2ry causes of osteoporosis, and exercise. (Exercise was defined as waking or exercising at least 30 minutes 3 times a week).

** 2ry osteoporosis: If the patient has a disorder strongly associated with osteoporosis (osteoporosis that results secondary to medical condition or disease). These include type I (insulin dependent) diabetes, osteogenesis imperfecta in adults, untreated long-standing hyperthyroidism, hypogonadism or premature menopause (<45 years), chronic malnutrition, or male absorption and chronic liver disease.

FRAX tool risk factors

Risk factors in FRAX tool were filled according to special definition by the WHO. A yes or no response is asked for. If the field was left blank, then a "no" response would be assumed.

The risk factors used are the following:

- Age: The model accepts ages between 40 and 90 years. If ages below or above are entered, the programme will compute probabilities at 40 and 90 year, respectively.

- Sex: Male or female. Enter as appropriate.

- Weight: This should be entered in kg.

- Height: This should be entered in cm.

- Previous fracture: A previous fracture denotes more accurately a previous fracture in adult life occurring spontaneously, or a fracture arising from trauma which, in a healthy individual, would not have resulted in a fracture. Enter yes or no.

- Parent fractured hip: This enquires for a history of hip fracture in the patient's mother or father. Enter yes or no.

- Current smoking: Enter yes or no depending on whether the patient currently smokes tobacco.

- Glucocorticoids: Enter yes if the patient is currently exposed to oral glucocorticoids or has been exposed to oral glucocorticoids for more than 3 months at a dose of prednisolone of 5mg daily or more (or equivalent doses of other glucocorticoids).

- Rheumatoid arthritis: Enter yes where the patient has a confirmed diagnosis of rheumatoid arthritis. Otherwise enter no.

- Secondary osteoporosis: Enter yes if the patient has a disorder strongly associated with osteoporosis. These include type I (insulin dependent) diabetes, osteogenesis imperfecta in adults, untreated long-standing hyperthyroidism, hypogonadism or premature menopause (<45 years), chronic malnutrition, or malabsorption and chronic liver disease.

- Alcohol 3 or more units/day: Enter yes if the patient takes 3 or more units of alcohol daily. A unit of alcohol varies slightly in different countries from 8-10g of alcohol. This is equivalent to a standard glass of beer (285ml), a single measure of spirits (30ml), a medium-sized glass of wine (120ml), or 1 measure of an aperitif (60ml).

- Bone mineral density (BMD): Select the type of DXA scanning equipment used and then enter the actual femoral neck BMD (in g/cm2). Alternatively, enter the T-score based on the NHANES III female reference data. In patients without a BMD test, the field should be left blank.

In case of oral corticosteroid administration the investigator asked the subjects whether they currently used oral corticosteroid medication or had used it previously for at least 3 months, but regarding dose this was affected by the awareness and level of education of the subject. Some subjects didn’t Know the name or either the dose but the answer by yes because they only knew that they used cortisone. The investigator inserted these cases as yes for cortisone use and calculated the 10-year probability accordingly.

Chapter Four

Results

4.1 Descriptive analysis results

4.1.1 Basic demographic and clinical characteristics of the study sample

Age showed positive skewness with a median (Q1- Q3) age of 61.5 (55 - 67) years. The maximum age was 80 years. The majority (79%) of the study sample was females. Among females the median number of children they have was 7 (4 - 9) children, and 10% of the females were null parity. Table 4.1.1 shows that ninety one percent of the study subjects were married. The majority (58%) of the study subjects had a school education. The mean body mass index (BMI) of the study sample was 32.20 ± 0.47. Nineteen percent of the study sample was current tobacco users, and none of the subjects consumed alcohol. 38% of the study subjects did exercise routinely at least 30 minutes a day three times a week.

Table (4.1.1): Sociodemographic information for the study subjects.

Variable name	Statistics Mean ± SD or median (Q1-Q3)\ (N) frequency
Age category **50< Age ≤65** **Age >65**	 72 (72%) 28 (28%)
Age*	61.5 (55 - 67)years
Gender **Male** **Female**	 21 (21%) 79 (79%)
Marital status **Married** **Others (single, widows, and divorced)**	 91 (91%) 9 (9%)
Parity for females **Nulliparity** **Have ≤ 6 children** **Have > 6 children**	Among females: 8 (10.13%) 29 (37.05%) 42 (53.16%)
Education **Illiterate** **School educated** **Achieved university degree**	 18 (18%) 58 (58%) 24 (24%)
Current tobacco use **Yes** **No**	 19 (19%) 81 (81%)
Weight	81.82 ± 1.21 kilogram
Height*	159.0 (154 - 165) cm
Body mass index BMI (total) **For males** **For females**	32.20 ± 0.47 g\cm^2 28.92 ± 4.91 g\cm^2 33.07 ± 4.26 g\cm^2
Exercise **Yes** **No**	 38 (38%) 62 (62%)

*: not normally distributed based to K.S test.

Abbreviations: SD= standard Deviation; IQR=Inter Quartile Range; Q1-Q3= quartile 1, quartile 3.

Regarding medications, table 4.1.2 shows that more than the half of the females (53 %) in the study reported using oral contraceptives in the past. Twenty two percent of the sample subjects had currently used oral corticosteroids during the study period or had been exposed previously to oral glucocorticoids for more than 3 months at a dose of prednisolone of 5mg daily or more. While regarding diseases they suffered, Twenty two percent of the sample subjects suffered from previous fracture, and 15% of them had at least one parent with previous hip fracture. From the entire sample 15% had conditions related to secondary osteoporosis, and 25% suffered from rheumatoid arthritis. Table 4.1.2 shows the clinical characteristics of the study sample (diseases and medications).

Table (4.1.2): Clinical characteristics (Diseases and medications) of the study subjects.

Variable name	Statistics Mean ± SD or median (Q1-Q3)\ (N) frequency
Previous fracture	
Yes	22 (22%)
No	78 (78%)
Previous parents' hip fracture	
Yes	15 (15%)
No	85 (85%)
History of OCT use among females	Among females:
Yes	37 (53.16%)
No	42 (46.84%)
History of oral corticosteroid use	
Yes	22 (22%)
No	78 (78%)
Conditions associated with 2ry osteoporosis	15 (15%)
Yes	85 (85%)
No	
Diabetes mellitus	
Yes	29 (29%)
No	71 (71%)
Cardiovascular diseases	
Yes	60 (60 %)
No	40 (40 %)
Gastrointestinal tract disorders	
Yes	32 (32%)
No	68 (68%)
Rheumatoid arthritis	
Yes	25 (25%)
No	75 (75%)
Vitamins intake	
Yes	43 (43%)
No	57 (57%)

Abbreviations: SD= standard deviation; IQR=Inter Quartile Range; Q1-Q3= quartile 1, quartile 3; OCT: oral contraceptives.

4.1.2 Dual energy X-ray Results

After performing dual energy X-ray test, the median bone mineral density (BMD) of the study subjects was 0.82 (0.76 - 0.92) (Figure 3.1.1). The mean vertebral T score was -1.41 ± 0.13 (figure 3.1.2), and the mean hip T score was -0.91 ± 0.095 (figure 4.1.3). Following the WHO criteria, 21% of the subjects presented vertebral osteoporosis, and 29% had vertebral Osteopenia. While only 5% presented hip osteoporosis. In the total sample 23% had osteoporosis whether hip or vertebral, or both. Table 4.1.3 shows bone tests and data extracted from Dual Energy X-rays (DEXA).

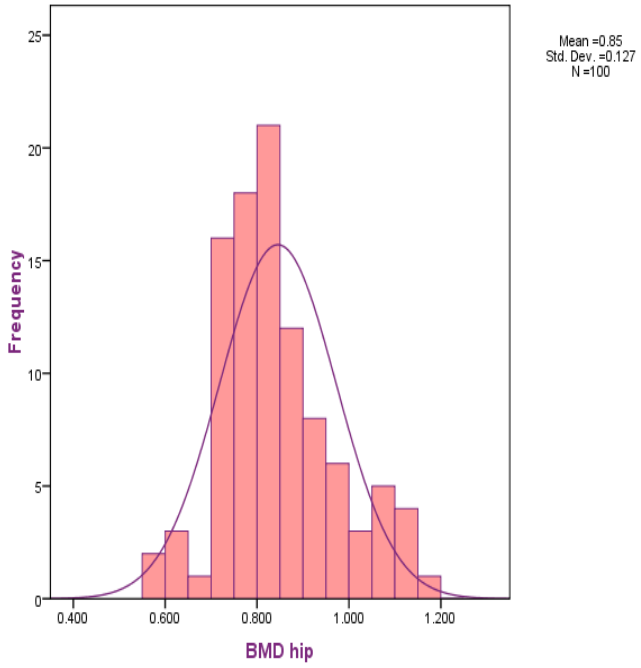

Figure 4.1.1: Bone Mineral Density BMD Histogram for the study subjects

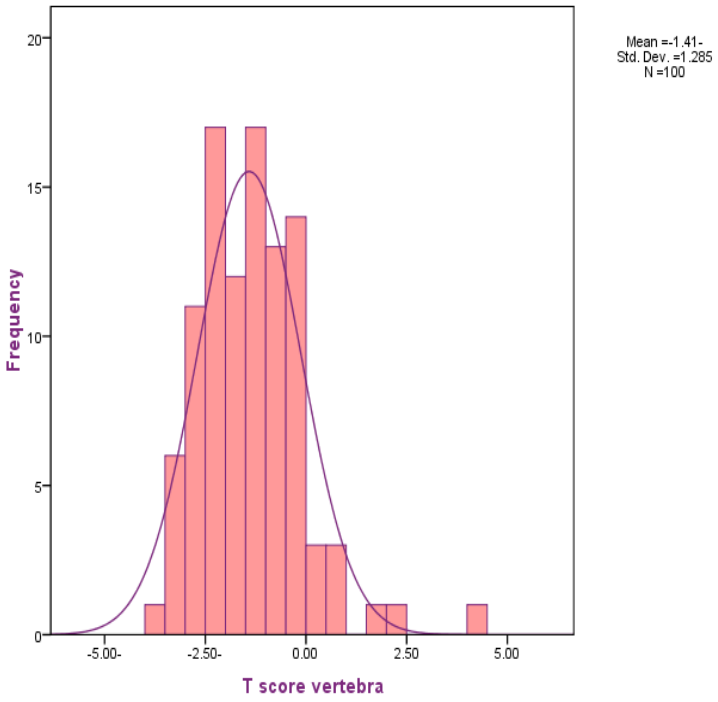

Figure 4.1.2: Vertebral T score Histogram for the study subjects

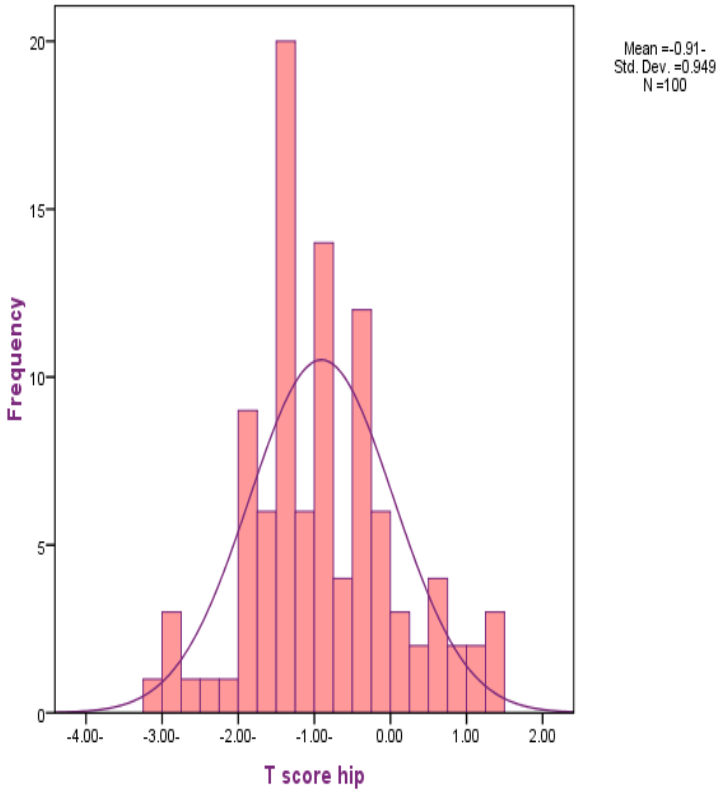

Figure 4.1.3: Hip T score Histogram for the study subjects

Table (4.1.3): Bone tests and data extracted from Dual Energy X-rays (DEXA) for the study subjects.

Variable name	Statistics Mean ± SD or median IQR (Q1-Q3)\ (N) frequency
Bone mineral density (hip)*	0.82 (0.76 - 0.92) g\cm^2
Vertebral T score	-1.41 ± 0.13 SDs
Hip T score	-0.91 ± 0.095 SDs
Vertebral osteoporosis classification Normal Vertebral Osteopenia vertebral osteoporosis	 50 (50%) 29 (29%) 21 (21%)
Hip osteoporosis classification Normal Hip Osteopenia Hip osteoporosis	 72 (72%) 23 (23%) 5 (5%)

*: not normally distributed based on K.S test.

Abbreviations: SD= standard deviation; IQR=Inter Quartile Range; Q1-Q3= quartile 1, quartile 3.

4.1.3 Fracture risk assessment tool FRAX results

After insertion of the collected data into fracture risk assessment tool (FRAX), table 4.1.4 shows that for our sample the median 10 - year (quartile 1, quartile 3) probability of major osteoporotic fracture without BMD was 4.40 (2.80 – 7.70) %, while with BMD was 3.7 (2.43 – 6.18) %.On the other hand the median 10 years probability of hip fracture without T score was 0.80 (0.40 - 1.90) %, while with BMD was calculated to be 0.30 (0.10 - 0.68) %. Calculated hip T score was different somehow from the practical measured hip T score extracted from the DEXA but

highly correlated with it (p=0.000, r =0.97). The median calculated hip T score was -0.25 (-0.78 - 0.50) SDs. Two cases of the hundred subjects were at high risk of MOF (≥20%) (But one of them had T score ≤-2.5), and Four cases were at high risk of hip fracture (≥3%) (But all of the four cases had T score ≤-2.5) based on National Osteoporosis Foundation (NOF) definition of high risk. According to NOF criteria at least 24 individuals need immediate treatment. First criteria regarding previous hip or spine fracture wasn't taken into consideration, since the questioner asked about general previous fracture not specific for hip or spine.

Table (4.1.4): data extracted from Fracture Risk Assessment Tool FRAX

Variable name	Statistics Mean ± SD, median IQR (Q1-Q3)\ (N) frequency
Calculated hip T score*	-0.25 (-0.78 - 0.50) SDs
10- year probability of MOF without T*	4.40 (2.80 – 7.70) %
10- year probability of MOF with T*	3.7 (2.43 – 6.18) %
10- year probability of Hip fracture without T*	0.80 (0.40 - 1.90) %
10- year probability of Hip fracture with T score*	0.30 (0.10 - 0.68) %

*: not normally distributed based on K.S test.

Abbreviations: SD= standard deviation; IQR=Inter Quartile Range; Q1-Q3= quartile 1, quartile 3.

4.2 Univariate analysis results

4.2.1 Basic demographic and clinical characteristics of the study sample

Table 4.2.1 shows that the median 10-year probability of MOF calculated based on hip BMD for those who were 65 years old and younger was 3.20 (2.20 – 6.08) %, while the median 10-year probability of HF calculated based on hip BMD for the same group was 0.20 (0.00 – 0.48) %. The median 10-year probability of MOF for those who were at least 65 years old was 4.90 (3.65 – 6.50) %, and the median 10-year probability of HF for the same age group was 0.50 (0.40 – 0.98) %. Age >65 years was significantly associated with 10-year probability of MOF and HF. Women had significantly higher risk of MOF than men. While female gender was not significantly associated with 10-year probability of HF (p=0.087). Marital status wasn't significantly associated with 10-year probability of MOF or HF (p=0.470, 0.088 respectively). Regarding parity, women who had more than 6 children were at higher risk of developing both MOF and HF in the coming 10 years (p=0.003, 0.002 respectively). Illiterate subjects were at higher risk of developing MF (p=0.01), and HF (p=0.005) in the following 10 years. Table 4.2.1 shows the association and correlation between 10-year probability MOF and HF, with sociodemographic information.

Table (4.2.1): The association and correlation between 10-year probability of MOF and HF with sociodemographic information for the study subjects.

Variable name	Median (Q1-Q3) 10-y prob. of MOF	P value, correlation	Median (Q1-Q3)10-y prob of HF	P value, correlation
Age category 50< Age ≤65 Age >65	 3.20 (2.20 – 6.08)% 4.90 (3.65 – 6.50)%	 0.008[a]	 0.20 (0.00 – 0.48)% 0.50 (0.40 – 0.98)%	 < 0.001[a]
Age *		<0.001[c] , r = 0.408		<0.001[c] , r = 0.577
Gender Male Female	 3.00 (1.65 – 4.65)% 3.80 (2.70 – 6.50)%	 0.024[a]	 0.20 (0.00 -0.45)% 0.40 (0.10 - 0.70)%	 0.087[a]
Marital status Married Others	 3.50 (2.30 – 6.20)% 4.50 (3.20 – 5.55)%	 0.470[a]	 0.30 (0.10 – 0.60)% 0.60 (0.25 – 0.95)%	 0.088[a]
Parity Null parity Have ≤ 6 children Have > 6 children	 3.80 (2.58 - 4.40)% 3.00 (2.30 – 5.30)% 5.30 (2.95 – 7.50)%	 0.003[b]	 0.50 (0.15 – 0.60)% 0.10 (0.08 – 0.40)% 0.50 (0.25 – 1.00) %	 0.002[b]
Education Illiterate School educated Achieved university degree	 5.40 (3.78 – 7.35)% 3.40 (2.30 – 6.28)% 2.90 (2.15 – 3.98)%	 0.01[b]	 0.55 (0.40 – 1.05)% 0.30 (0.10 – 0.70)% 0.20 (0.10 – 0.40) %	 0.005[b]
Current tobacco use Yes No	 3.40 (2.60 -5.60)% 3.80 (2.30- 6.40)%	 0.802[a]	 0.40 (0.20 – 0.70)% 0.30 (0.10 – 0.60)%	 0.199[a]
Weight		0.07[c] , r = -0.182		0.02[c] , r = -0.233
Height *		0.161[c] , r = -0.141		0.005[c], r = -0.281
Body mass index		0.576 [c] , r = 0.057		0.798 [c] , r = -0.026
Exercise Yes No	 3.10 (1.88 – 5.70)% 3.80 (2.78 – 6.35)%	 0.066[a]	 0.20 (0.00 – 0.63)% 0.40 (0.10 – 0.73)%	 0.098[a]

*: not normally distributed based on K.S test, Level of significance is

P<0.05

[a] Statistical significance of differences estimated with the Mann-Whitney U test..

[b] Statistical significance of differences estimated with the Kruskal-Wallis test.

[c] Statistical significance of differences estimated with the Spearman's correlation coefficient.

Table 4.2.2 shows that subjects with previous fracture had significantly higher risk of developing MOF and HF in the coming 10 years ($p < 0.001$ for both), while subjects with previous parents' hip fracture had significant higher 10-year probability of developing MOF only but not HF ($p = <0.001$, 0.211 respectively). Women with history of use of oral contraceptives were at lower risk of developing MOF in the coming 10 years. Subjects with gastrointestinal tract problems (GIT) and those with diabetes mellitus (DM) had significantly higher risk of developing HF in the coming 10 years ($p=0.031$, 0.024 respectively). Subjects who previously received oral corticosteroid medications had significantly higher risk of developing both MOF and HF in the future. Sample subjects who had conditions related to secondary osteoporosis, or rheumatoid arthritis, or those who didn't used to take supplementary vitamins and minerals had significantly higher risk of developing MOF and HF in the next 10 years. Table 4.2.2 shows the association between 10-year probability of MOF and HF, with clinical information.

Table (4.2.2): The association between 10-year probability of MOF and HF with clinical information.

Variable name	Median (Q1-Q3)10-y prob. of MOF	P value	Median (Q1-Q3)10-y prob. of HF	P value
Previous fracture **Yes** **No**	**6.75 (5.58 - 10.45)%** **3.20 (2.20 - 4.80)%**	**< 0.001**	**0.70 (0.38 – 1.43)%** **0.20 (0.10 – 0.50)%**	**< 0.001**
Previous parents' hip fracture **Yes** **No**	**7.20 (5.70 -13.00)%** **3.30 (2.30 – 5.30)%**	**< 0.001**	**0.30 (0.30 – 1.10)%** **0.30 (0.10 – 0.65)%**	**0.211**
History of OCT **Yes** **No**	**3.40 (2.45 – 5.33)%** **3.90 (2.90 – 7.20)%**	**0.031**	**0.30 (0.10 – 0.63)%** **0.40 (0.15 – 0.80)%**	**0.115**
Corticosteroid **Yes** **No**	**6.70 (5.20 – 10.70)%** **3.05 (2.20 – 4.83)%**	**< 0.001**	**0.55 (0.20 – 1.03)%** **0.30 (0.10 – 0.50)%**	**0.031**
2ry osteoporosis **Yes** **No**	**5.40 (3.90 – 7.20)%** **3.40 (2.30 – 5.65)%**	**0.013**	**0.50 (0.30 – 1.20)%** **0.30 (0.10 – 0.60)%**	**0.034**
DM **Yes** **No**	**4.90 (2.75 – 6.50)%** **3.40 (2.30 – 5.50)%**	**0.12**	**0.40 (0.20 – 0.95)%** **0.30 (0.10 – 0.50)%**	**0.024**
CVD **Yes** **No**	**3.90 (2.50 – 6.18)%** **3.30 (2.30 – 6.05) %**	**0.418**	**0.40 (0.10 – 0.70)%** **0.30 (0.10 – 0.60)%**	**0.665**
GIT disease **Yes** **No**	**4.90 (2.90 – 6.68)%** **3.35 (2.30 – 5.93)%**	**0.09**	**0.50 (0.13 – 0.95)%** **0.25 (0.10 – 0.50)%**	**0.031**
Rheumatoid arthritis **Yes** **No**	**5.30 (3.65 – 7.50)%** **3.30 (2.30 – 5.60)%**	**0.002**	**0.60 (0.40 – 1.10)%** **0.20 (0.10 – 0.50)%**	**0.003**
Vitamins & minerals intake **Yes** **No**	**4.50 (2.90 – 6.70)%** **3.30 (2.15 – 6.05)%**	**0.043**	**0.40 (0.10 – 0.80)%** **0.20 (0.05 – 0.50)%**	**0.033**

*: not normally distributed based on K.S test, Level of significance is $P<0.05$

All statistical significance of differences were estimated with the Mann-Whitney U test.

4.2.2 Dual energy X-ray Results

Data analysis showed that hip bone mineral density is significantly correlated with both 10-year probability of MOF ($p < 0.001$, $r = -0.609$) and HF ($p < 0.001$, $r = -0.845$). As hip BMD value decreases, the 10-year probability of fractures increases. As vertebral T score and hip T score decrease both 10-year probability of MOF and HF significantly increase. Accordingly the WHO classification of osteoporosis is significantly associated with future risk of MOF and HF. Table 4.2.3 shows the association and correlation between 10-year probability of MOF and HF, with bone tests and data extracted from Dual Energy X-rays (DEXA).

Table (4.2.3): The association and correlation between 10-year probability of MOF and HF with bone tests and data extracted from DEXA.

Variable name	Median (Q1-Q3)10-y prob. of MOF	P value, correlation	Median (Q1-Q3)10-y prob. of HF	P value, correlation
Bone mineral density* BMD hip		< 0.001[c] , r = -0.609		< 0.001[c] , r = -0.845
Vertebral T score		< 0.001 [c] , r = -0.637		< 0.001 [c] , r = -0.656
Hip T score		< 0.001 [c] , r = -0.603		< 0.001 [c] , r = -0.860
Vertebral osteoporosis classification Normal Vertebral Osteopenia vertebral osteoporosis	 2.60 (2.10 – 3.68)% 5.60 (3.25 – 7.25)% 6.20 (3.90 – 8.00)%	< 0.001[b]	 0.10 (0.00 – 0.40)% 0.40 (0.20 – 0.75)% 0.80 (0.55 – 1.30)%	< 0.001[b]
Hip osteoporosis classification Normal Hip Osteopenia Hip osteoporosis	 3.05 (2.20 – 5.38)% 4.80 (3.50 – 7.10)% 8.20 (6.05 – 18.00)%	< 0.001 [b]	 0.15 (0.00 – 0.40)% 0.80 (0.50 – 1.10)% 3.00 (2.55 – 6.95)%	< 0.001 [b]

*: not normally distributed based on K.S test, Level of significance is P<0.05

[b] Statistical significance of differences estimated with the Kruskal-Wallis test.

[c] Statistical significance of differences estimated with the Spearman's correlation coefficient

4.2.3 Fracture risk assessment tool FRAX results

Calculated T score observed from FRAX tool, 10-year probability of MOF and HF calculated without insertion of hip BMD value in the FRAX tool were highly significantly correlated with 10-year probability of MOF and HF calculated by FRAX tool based on BMD. Both 10-year probability of MOF and HF calculated based on BMD were highly correlated with each others as one increases the other increases, and vice versa ($p < 0.001$, $r = .791$). Table 4.2.4 shows the association and correlation between 10-year probability of MOF and HF, with data extracted from Fracture Risk assessment tool FRAX.

Table (4.2.4): The association and correlation between 10-year probability of MOF and HF, with data extracted from FRAX tool.

Variable name	P value with 10-years prob. of MOF based on hip BMD, r (correlation)	P value with 10-year prob. of HF based on hip BMD, r (correlation)
Calculated hip T score*	< 0.001 , r = -0.602	< 0.001, r = -0.380
10- year probability of MOF without T*	< 0.001 , r = 0.919	< 0.001, r = 0.715
10- year probability of MOF with T*		< 0.001, r = 0.791
10- year probability of HF without T*	< 0.001, r = 0.814	< 0.001, r = 0.810
10- year probability of HF with T score*	< 0.001, r = 0.791	

*: not normally distributed based on K.S test, Level of significance is $P<0.05$

All statistical significance of differences were estimated with the Spearman's correlation coefficient

Chapter Five

Discussion and Conclusions

Discussion

This study aimed at investigating the 10 year probability of MOF and HF in a selected sample above fifty years in Nablus district, to be used as an approximate for 10 year probability in the West Bank and wider for Palestine. The median (Q1-Q3)10 - year probability of major osteoporotic fracture without BMD was 4.40 (2.80 – 7.70) %, while with BMD was 3.7 (2.43 – 6.18) %. On the other hand the median 10 years probability of hip fracture without BMD score was 0.80 (0.40 - 1.90) %, while with BMD was calculated to be 0.30 (0.10 - 0.68) %. This is the first study to be conducted to measure 10-year probability of MOF or HF using FRAX algorithm specially designed for the Palestinians based on their specific fracture and survival data.

Several studies in Europe and Asia were carried out to assess the 10-year risk probability for bone fracture using FRAX but none were carried out in Arab world. Table 5.1.1 summarizes previous studies mentioned in literature review on using FRAX tool to calculate 10-year probability of MOF and HF:

Table 5.1.1: summary of previous studies on FRAX tool

Country	Target sample	Sample size	10-y prob. of MOF	10-y prob. of HF
Bulgaria	Bulgarian women ≥ 50 years	1,331	13.4 ± 9.2%	2.8 ± 5.2%
Taiwan	postmenopausal women	475	13.8%	2.2%
Poland	postmenopausal women	2012	22.2±12.1%	5.3±6.7%
Portugal	patients submitted to hip replacement surgery	76	12.7±11.1%	5.9±8.1%
France	Women (45-60)years	494	3.9 ± 2%	0.8 ± 0.9%
France	Women ≥40 from OFELY cohort	867	5.9±6.3%	1.8±4.3%
Recent study Palestine	Men and women ≥ 50	100	3.7 (2.43–6.18) %	0.30 (0.10-0.68)%

Comparing 10-year probability of MOF and HF based on BMD found in our study with other studies demonstrates that there is a great variation in fracture risk between the different countries. Our probabilities were almost close to those in France, but low compared with other countries like Poland, Bulgaria, and Taiwan. These differences could be attributed to variations in ecological, socio-economic, environmental, cultural, genetics or nutritional patterns in different parts of the world. Another explanation is the heterogenicity in mortality rates all over the

world, especially that FRAX tool computes fracture probability based on hazards of death and fractures.

This study also aimed at measuring the bone mineral density, vertebral T score, and hip T score of the sample subjects, and accordingly investigating the prevalence of osteoporosis. According to our study the median bone mineral density (BMD) of the study subjects was 0.82 (0.76 - 0.92) g\cm^2, the mean vertebral T score was -1.41 ± 0.13 SDs, and the mean hip T score was -0.91 ± 0.095 SDs. Based on these values we classified the subjects into normal, osteopenia, and osteoporosis. In this study 21% sample subjects were diagnosed with vertebral osteoporosis, and 5% with hip osteoporosis based on DEXA. In total 23% of the sample subjects had osteoporosis either vertebral or hip or both. This number is close to that found by Abd-Alhameed, Saba, and Darwish in 2004 if we took the average of the three types of osteoporosis they measure (average prevalence in their study was 22.5)[27]. This prevalence was higher than osteoporosis prevalence in Iran (13.3%) and in Qatar (12.3%) [32, 39], while it was lower than osteoporosis prevalence in Saudi Arabia (28.8%) [36].

In majority of the subjects' cases (77%) T-score vertebral was lower or equal to T-score hip. This was also clear from number of cases of vertebral osteopenia and osteoporosis (29, 21 respectively), and hip Osteopenia and osteoporosis (23, 5 respectively). These findings do agree with the results found in Jenin district by Hejawi in 2003; it showed that

higher rate of fracture was in spine followed by hip [40], and our T scores give the same indicator that vertebral fractures are more probable than hip fracture.

Bone mineral density was highly conversely correlated with 10-year probability of major osteoporotic fracture and hip fracture ($p<0.001$) in our study. On the other hand some subjects may had low BMD but low risk of fracture or vice versa had high BMD and high fracture risk, also according to BMD T score values only 23 subjects had osteoporosis (had vertebra or hip T-score $\leq$-2.5) and require immediate treatment, but based on NOF also those who had previous hip or spine fracture, and those who had hip T-score between –1 and -2.5 and 10-year probability of $\geq$ 3% for hip fractures or $\geq$ 20% for major osteoporotic fractures based on FRAX tool also need immediate treatment. This proves that BMD alone doesn't catch all the cases of osteoporosis or osteopenia, and it's better to integrate both BMD and clinical risk factors using FRAX tool to have a comprehensive assessment for future fracture risk. In all cases insertion of BMD in FRAX tool increase its sensitivity in fracture prediction. So as public health specialists we can apply FRAX which is an easy, inexpensive, reliable tool to calculate the 10-year probability of HF and MOF whether using BMD value or not as a case finding strategy for those at high risk at all levels and in all bodies including MoH and NGO's in order to treat them immediately before any fracture occurs or to prevent subsequent fracture.

Applying the National Osteoporosis Foundation criteria on the sample subjects, at least 24 subjects met the second (have vertebra or hip T-score ≤-2.5) (23 subjects) and third (T-score between –1 and -2.5 and 10-year probability of ≥ 3% for hip fractures or ≥ 20% for major osteoporotic fractures) (1 subject) criteria, but first criteria can't be applied since previous fracture data collected were about fractures in general not specific in hip or spine. Resulting in at least 24 subjects require immediate treatment and intervention. These findings show that substantial proportion of our subjects was at risk of osteoporotic fracture, this will raise many questions: where we are in addressing this issue? How this issue should be handled? What cost effective threshold should be set for treatment and immediate intervention especially in those with T-score between -1 and -2.5? Is NOF threshold enough for our society or a specific threshold should be set for the Palestinian society? What changes are needed to be made in current policies? Is treatment of current cases is enough or a more comprehensive policies should be applied to delay the onset and slow the prognosis of the disease, especially that there is limited evidence supporting the efficacy of medical treatment of osteoporosis in termination of the disease and its associated fractures (since these medications have shown to reduce risk of subsequent fracture by 25-70%, rather than 100%. Unfortunately this means that there will be a number of individuals who comply with therapy and continue to Fracture) [52], and that the elderly populations are increasing rapidly in our society due to increased life expectancy.

By utilizing several clinical risk factors with and without BMD value, 10-year probability of osteoporotic fracture increased with age. This means that fracture risk is essentially higher among elderly as most of the previous studies indicate including those in Qatar, and the study performed by El-hajj Fuleihan in the Middle East [14, 30, 40], especially those who already have osteoporosis and osteopenia. So we recommend the application of FRAX Palestine tool in the primary health care for those above 40 with high risk factors as a preventive measure; since FRAX can calculate MOF and HF starting with this age; this will provide early inspection for the probability of future fracture. Using FRAX, the fracture risk can now be easily assessed in clinical settings.

Being female is considered a risk factor for osteoporotic fracture, especially those with higher parity. Our results emphasize this; the 10-year probability of MOF for women ranged between 2.70 % and 6.50 %, while for men was between 1.65 % and 4.65 %. The 10-year probability of HF for women was between 0.10 % and 0.70 %, and for men was between 0.00 % and 0.45 %. Women had significantly higher 10-year probability of osteoporotic fracture than men. Women with higher parity were at higher risk of MOF and HF. All these results are consistent with literature and with previous studies including those carried out in Qatar and the Middle East [8, 30, 40].

In our study age, gender, and number of parity for women can simultaneously be used to assess osteoporosis and fracture risk when no

information on other clinical risk factors is available. In the study carried out in Taiwan to estimate 10-probability of osteoporotic fracture in postmenopausal Taiwanese women using FRAX, both age and BMI can be used as indicators, but this doesn't apply in our study since BMI wasn't significantly associated with 10-year probability of MOF or HF. This can be due to increased weight range and obesity in the elderly population, and accordingly increased BMI in most of the sample subjects making BMI not a distinctive risk factor for osteoporotic fractures.

Having previous fracture, factors related to 2ry osteoporosis, rheumatoid arthritis, chronic administration of corticosteroid, lack of administration of supplemental vitamin D and calcium all these risk factors were in our study significantly associated with 10-year probability of HF and MOF similar to literature and to the survey carried out in Lebanon [14, 16, 17, 27].

In our study one in four subjects reported having a history of previous fracture, and one in six subjects have had a history of parental hip fracture. These high proportions of previous or parental fracture raised some concerns. It is possible that these findings were affected by recall bias. On the other hand this relatively high proportion of parental fracture insures that osteoporosis have a genetic component. Those results highlight the need for further research on the genetic characteristics of the disease in Palestine

Although FRAX tool use a variety of risk factors in addition to BMD, but other essential factors are associated with falls or low bone mass such as; type ɪɪ diabetes, cardiovascular disease (CVD), use of hormone replacement therapy, use of anti-depressants and sedatives, and parity were not accounted in FRAX. Most of these factors were considered in our questionnaire and were tested for their association with 10-year probability of osteoporotic fracture.

Smoking, performing exercise, and having cardiovascular diseases, all these risk factors were not significantly associated with 10-year probability of osteoporotic fracture. This may be due to small sample size that makes it difficult to obtain statistical difference.

In our study history of administration of oral contraceptives was significantly associated with lower risk of developing MOF. This can be illustrated by the fact that estrogen deficiency at an early age is one of the risks factors of osteoporosis [30], and that estrogen has an antiresorptive effect on bone [4]. These results are not in consistent with what was published by Vestergaard et al. in 2006; they found that oral contraceptives are not associated with an increase or a decrease in fracture risk, and change in fracture risk may be due to confounders [53].

Gastrointestinal diseases and diabetes mellitus were significantly associated with 10-year probability of HF. This may be due to their

contribution to occurrence of secondary osteoporosis in this region, increasing the rates of hip fracture.

Despite the strengths, our study has several limitations. First the sample was limited to one district. It would be better if we could have sample from the whole west bank, but high cost of the DEXA was one of the barriers. In addition two thirds of our sample were females since most of the attendants in Al-Rahmah clinic were females, seems that females concern about their health more. This may affect the generalization of our results to the entire population. Second, there may be some issues related to spectrum of bias, especially in recalling certain events like reproductive history or previous fracture since our sample are old people, or any bias due to misunderstanding of some asked question, so questions were illustrated sufficiently. FRAX Palestine is a new tool and further studies need to evaluate the applicability accuracy and feasibility of FRAX in Palestinian population.

Conclusions

The main conclusions of this study were:

1. The median 10 - year probability of major osteoporotic fracture without BMD was 4.40 (2.80 – 7.70) %, while with BMD was 3.7 (2.43 – 6.18) %. On the other hand the median 10 years probability of hip fracture without T score was 0.80 (0.40 - 1.90) %, while with BMD was calculated to be 0.30 (0.10 - 0.68) %.

2. According to our study the median bone mineral density (BMD) of the study subjects was 0.82 (0.76 - 0.92) g\cm^2, the mean vertebral T score was -1.41 ± 0.13 SDs, and the mean hip T score was -0.91 ± 0.095 SDs.

3. Following the WHO criteria, 21% of the subjects presented vertebral osteoporosis, 29% have vertebral Osteopenia, and the rest are normal. While only 5% presented hip osteoporosis, 23% have hip Osteopenia, and 72% are normal. In the total sample 23% have osteoporosis whether hip or vertebral.

4. Our study showed that hip bone mineral density was significantly correlated with both 10-year probability of MOF ($p < 0.001$, $r = -0.609$) and HF ($p < 0.001$, $r = -0.845$).

5. Two cases of the hundred subjects were at high risk of MOF (>20%), and four cases were at high risk of hip fracture (>3%) based on National Osteoporosis Foundation (NOF) guidelines. According to NOF criteria at least 24 individuals or more need immediate treatment.

6. Having previous fracture, higher parity, age, 2ry osteoporosis, rheumatoid arthritis, administration of corticosteroid, lack of administration of supplemental vit D and calcium all these risk factors were in our study significantly associated with 10-year probability of HF and MOF.

Recommendations

All these strategies can be effective in controlling the disease in our Palestinian society

1. Urgent need of a comprehensive national program at all levels including Ministry of Health and Non Governmental health bodies to control the incidence of the disease among the population by early identification of susceptible individuals using FRAX tool follow them routinely and manage cases as soon as possible effectively.

2. Designing medical-pharmaceutical educational programs that target the suspected individuals or their caregiver, spreading information brochures to educate them about the disease, its risk factors, complications, treatment options and preventive measures, so they can be proactive about their care.

3. More care and attention should be targeted toward elderly and especially postmenopausal female with respect to preventive measures such as Hormonal replacement therapy.

4. More efforts on the level of ministry of health to apply FRAX tool as a screening tool for all individuals above 40 years attending all types of clinics, before making DEXA as an approximate of risk of fracture following the next diagram.

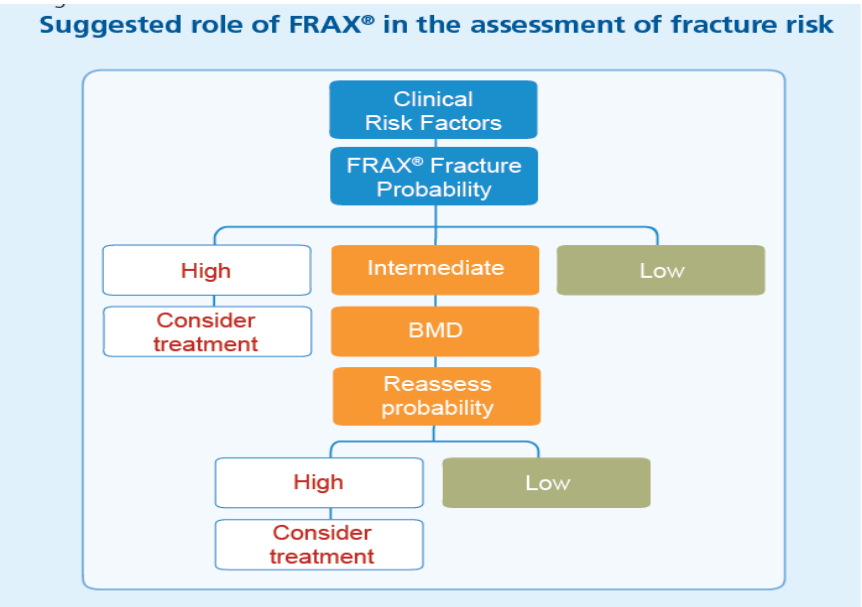

Figure 5.3.1: Suggested role of FRAX in the assessment of fracture risk**.**

5. Performing routine DEXA examination for those above 40 or those who have high risk factors of the disease.

6. Minimizing the risk of acquiring the osteoporosis begins by modification of individuals' life style to combat related risk factors like smoking and promoting healthy living habits that prevent or at least reduce risk factors of osteoporosis.

7. Increase awareness toward osteoporosis and prevention strategies in the general population and particularly in older population.

8. Advising all patients or even healthy individuals on the importance of administration dietary or supplementary calcium and vit D.

9. Further research and studies regarding fracture rates, genetic component of osteoporosis, and evaluation of the applicability accuracy and feasibility of FRAX in Palestinian population.

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Appendices

a) FRAX Palestine WHO online tool:

b) The study questionnaire:

دراسة لقياس و تقدير احتمال حدوث كسور الحوض و كسور هشاشة العظام خلال العشر سنوات القادمة باستخدام اداة منظمة الصحة العالمية FRAX .

هدف الدراسة :هذا البحث يقوم به طالب ماجستير في الصحة العامة – جامعة النجاح الوطنية لقياس احتمال حدوث كسور الحوض و كسور هشاشة العظام خلال العشر سنوات القادمة باستخدام اداة منظمة الصحة العالمية FRAX لدى الاشخاص الذين تزيد اعمارهم عن خمسين عام في مستوصف الرحمة في مدينة نابلس. هذه المعلومات ستستخدم لأغراض البحث العلمي فقط ولن يتم استخدامها لأي أغراض أخرى.

رقم الاستبيان:----------.

التاريخ:----------\----------\----------.

القسم الاول:المعلومات الاجتماعية و الديموغرافية

1) الجنس : a) ذكر b) انثى

• في حال كان الجواب انثى

a. كم طفل انجبتي: ----------

b. هل تناولتي حبوب منع الحمل

i. نعم

ii. لا

2) العمر : ----------.

3) مستوى التعليم :

a) أمي

b) تعليم اساسي (من الصف الاول حتى العاشر)

c) تعليم ثانوي

d) جامعة

4) الحالة الاجتماعية :

1) أعزب 2) متزوج

3) مطلق 4) ارمل

القسم الثاني :القياسات الجسمانية

5) الطول :---------- متر.

6) الوزن :---------- كيلوغرام.

7) كثافة المعدن في العظم : ---------- غرام\سم^2.

القسم الثالث: الادوية المستعملة لدى المريض

8) ما نوع الادوية التي تتناولها :

1) سكري

2) قلب و ضغط

3) الجهاز الهضمي

4) هرمونات غيرحبوب منع الحمل

5) فيتامينات و معادن

6) غيرها (وضح: ----------)

القسم الرابع : عوامل الخطر الاخرى الموجودة في اداة FRAX

9) هل عانيتاي من كسور سابقة

i. نعم

ii. لا

10) هل لدى احد والديكاي كسر في الحوض

i. نعم

ii. لا

11) هل انت مدخن حالي

i. نعم

ii. لا

12) هل تستخدم ادوية تحتوي على كورتيزون

i. نعم

ii. لا

13) هل تعاني من التهاب المفاصل الروماتيزمي

i. نعم

ii. لا

14) هل تعاني من مرض يساهم في حدوث هشاشة العظام كمرض ثانوي (سوء تغذية المزمن او سوء الامتصاص ،زيادة افراز الغدة الدرقية، انقطاع الطمث المبكر، قصور الغدد التناسلية، مرض الكبد المزمن، مرض السكري النوع الاول)

i. نعم

ii. لا

15) هل تمارس الرياضة بواقع 30 دقيقة يوميا بما لا يقل عن 3 مرات اسبوعيا

i. نعم

ii. لا

16) هل تتناول الكحول

i. نعم

ii. لا

جامعة النجاح الوطنية

كلية الدراسات العليا

تقدير احتمالية حدوث كسور العظام خلال العشر سنوات القادمة باستخدام اداة منظمة الصحة العالمية لتقييم مخاطر الكسور (FRAX)

اعداد

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اشراف

أ.د. وليد صويلح

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قدمت هذه الأطروحة استكمالاً لمتطلبات درجة الماجستير في الصحة العامة بكلية الدراسات العليا في جامعة النجاح الوطنية في نابلس- فلسطين.

2013

تقدير احتمالية حدوث كسور العظام خلال العشر سنوات القادمة باستخدام اداة منظمة الصحة العالمية لتقييم مخاطر الكسور (FRAX)

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الملخص

المقدمة:هشاشة العظام هي مرض فيه تنقص كثافة وجودة العظم، مما يؤدي الى ضعف الهيكل العظمي وزيادة فرصة الاصابة بالكسو، خاصة في منطقة العمود الفقري، الورك، المعصم، الحوض، والعضد.أداة الفراكس (FRAX)(أداة تقدير احتمالية حدوث الكسور) تم تطويرها بواسطة منظمة الصحة العالمية لتقييم امكانية حدوث كسور لدى المرضى. هذه الأداة تحسب امكانية حدوث الكسور الناتجة عن هشاشة العظام بشكل عام وفي منطقة الورك بشكل خاص خلال العشر سنوات القادمة.

الاهداف: طالما ان نسبة شيخوخة السكان في فلسطين في تزايد مستمر بشكل محسوس ومثير، أصبحت الكسور الناجمة عن هشاشة العظام قضية صحية حاسمة يجب التطرق اليها و استهدافها بشكل عاجل. في دراستنا قمنا بتقييم مدى انتشار مرض هشاشة العظام و بتقدير احتمال حدوث كسر هشاشة العظام وكسر الورك خلال العشر سنوات القادمة لدى عينة مختارة أعمارها تتجاوز الخمسين عام.

الأساليب: تم اختيار عينة ملائمة لهدف الدراسة تتألف من 100 مشارك من مستوصف الرحمة في محافظة نابلس خلال فترة الدراسة التي استمرت في الفترة بين شهر مارس ومايو من عام 2012. تم تعبئة الاستبيان الذي تم تصميمه خصيصا لهذه الدراسة والذي يحوي عوامل الخطر المستقلة الخاصة بمرض هشاشة العظام بواسطة الباحث، سواء تلك التي ذكرت في أداة تقدير احتمالية حدوث الكسور أو عوامل أخرى تم ذكرها في الدراسات السابقة. تم اجراء صور مقطعية مزدوجة (صورة هشاشة) لكافة المشاركين لحساب كثافة المعدن في العظم في منطقة الورك

وحساب الانحرافات في كثافة المعدن في عظم فقرات العمود الفقري وعظم الورك عن المتوسط الطبيعي. تم ادخال كافة البيانات المستخلصة سابقا الى اداة تقدير احتمالية حدوث الكسور الخاصة بدولة فلسطين عبر موقع منظمة الصحة العالمية على الانترنت لحساب احتمال حدوث كسر هشاشة العظام وكسر الورك خلال العشر سنوات القادمة لدى العينة المختارة .

النتائج: في مجموع المئة مشارك الذين تم اختيارهم للمشاركة كان الوسيط الحسابي لكثافة عظم منطقة الحوض هو0,82 (0,76 – 0,92) غم|سم^2 . كان الوسط الحسابي لانحراف كثافة المعدن في عظم منطقة فقرات الظهر عن المتوسط الطبيعي −1,41 ± 0,13 انحراف معياري، والوسط الحسابي لانحراف كثافة معدن عظم منطقة الورك عن المتوسط الطبيعي −0,91 ± 0,10 انحراف معياري. حوالي خمس العينة كانت تعاني من هشاشة العظام في منطقة فقرات الظهر، بينما فقط خمسة بالمئة من العينة كانت تعاني هشاشة العظم في منطقة الورك. كان الوسيط الحسابي لاحتمال حدوث كسر هشاشة العظام وكسر الورك خلال العشر سنوات القادمة مع ادخال قيمة كثافة المعدن في العظم في اداة تقدير احتمالية حدوث الكسور بالترتيب كالاتي3,7% (6,18−2,43)% و0,30% (0,10−0,68)%.

الخلاصة: في المحصلة مرض هشاشة العظام هو مرض شائع في السكان الفلسطينيين فوق عمر الخمسين عام (حوالي 23% كما تم قياسه في دراستنا)، مما يجعل من الاستراتيجيات والسياسات والابحاث المتعلقة بمنع حدوث الكسور والوقاية منها أولوية في فلسطين. كما وينبغي تتبع ومواكبة الدراسات المتتابعة والمتعلقة بمعدلات حدوث الكسور في فلسطين. من الاساسي اجراء دراسات أعمق على دقة وجدوى خوارزمية تقدير احتمالية حدوث الكسور لما لها من تطبيق سريري