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Vitamin D Status and Fracture Neck of Femur among Post-Menopausal Women in Gaza Strip: A Hospital Based Study

J. H. Elhissi*, M. M. Elghaffari, M. H. Taleb, A. I. Ahmed, & A. A. Najim.

Faculty of Pharmacy- Al-Azhar University - Palestine

ABSTRACT

Aim: To determine the relationship between vitamin D status and FNOF among postmenopausal women in the Gaza Strip. **Methods:** A case-control study was consisted of 90 participants (45 cases and 45 controls), the study was conducted in the main governmental hospitals in Gaza Strip. Food Frequency Questionnaire (FFQ) was used to assess dietary intake of vitamin D. Anthropometric measurements were done included weight, height, and body mass index was calculated. Serum levels of phosphorus, calcium and Vitamin D were measured in both cases and controls. **Results:** the study revealed the following results; the percentage of both vitamin D deficiency and insufficiency levels were higher among cases with FNOF (66.4%) than among controls (26.6%) with significance statistical differences (P = 0.001). The mean of servings consumed per day from total diet vitamin D was less among cases with FNOF (1.46 ± 0.91) than controls (2.71 ± 0.94). Cases were less likely to be exposed to sunlight (53.3%) than controls (80%) (P = 0.007), on the other hand cases were also less active (2.2%) than control (53.3 %) (P = 0.00). **Conclusion**: Postmenopausal women with FNOF in the Gaza Strip have low serum vitamin D level and low intake of vitamin D.

Key words: *Fracture neck of femur, Vitamin D, Calcium, sun exposure, postmenopausal*

* Corresponding E-mail: jehad1900@yahoo.com

1. Introduction

1.1. Background

A fracture neck of femur is a break in the upper quarter of the femur (thigh) bone. The extent of the break depends on the forces that are involved. The type of surgery used to treat a fracture neck of femur is primarily based on the bones and soft tissues affected or on the level of the fracture. It is often due to osteoporosis (American Academy of Orthopaedic Surgeons [AAOS], 2009). Worldwide, the total number of fracture neck of femur is expected to surpass 6.26 million by the year 2050 (Kannus *et al.,* 1996). Fracture neck of femur substantially increases the risk of death and major morbidity in the elderly (Wolinsky *et al.,* 1997; Bentler *et al*., 2009). That therefore over 7,000 patients per year are suffering from hip fracture in Finland (Kannus *et al*., 2006).

The number of elderly is increasing most rapidly in Asia, Latin America, the Middle East, and Africa. Because fracture treatment is expensive, and rehabilitation is not always successful, effective prophylaxis offers the only hope of alleviating the enormous social burden of fracture neck of femur (Melton *et al.,* 1993).

Little is known about the epidemiology of fracture neck of femur in the Middle Eastern populations. In particular, there are no published reports from any of the Arab countries. Nationally, according to knowledge of researcher there is no available information about the prevalence of fracture neck of femur in the Gaza Strip.

According to the World Health Organization (WHO), osteoporosis is defined as "A systemic skeletal disease characterized by low bone density and microarchitectural deterioration of bone tissue with a consequent increase in bone fragility" (WHO, 2003). Osteoporosis and falls trauma are the most cause of fracture neck of femur. An osteoporotic fracture is typically related to reduced bone strength and falling (Cummings & Klineberg 1994, Cummings *et al.,* 1995). The major cause of illness and death are Osteoporotic fractures in older women, particularly menopausal ones (Norris, 1992).
Menopause is a natural biological process, not a medical illness. It's the permanent end of menstruation and fertility, defined as occurring 12 months after the last menstrual period (National Institute on Aging [NIA], 2012). At around the time of the menopause, fracture neck of femur incidence is about twice as high in postmenopausal than in premenopausal women (Banks *et al*., 2009).

Vitamin D is essential for bone health throughout life. The active metabolite of vitamin D is 1,25 dihydroxyvitamin D (1, 25 (OH) 2D), which regulates calcium absorption from the bowel, mediates the mineralization of osteoid tissue within bone, and plays an important role in muscle contraction (Francis, 1996). The association of low vitamin D levels with increased risk of fracture neck of femur was independent of falls and measures of fragility (Cauley *et al*., 2008). The dietary sources of vitamin D are cod liver oil, fish, eggs, fortified foods and supplements and it can be obtained from the action of sunlight on the skin (Holick, 2007).
The factors affect serum vitamin D levels are aging, skin pigmentation, sunlight exposure, diet, residence, physical inactivity and obesity, moreover there are some diseases may affect vitamin D status such as malabsorption disorders, liver dysfunction and kidney disease (Holick, 2004).

1.2. Research Problem

Fracture neck of femur (FNOF) is a common leading cause of disability and death among the postmenopausal women in the Gaza strip. Osteoporosis is a common cause of FNOF which linked with poor vitamin D status, physical inactivity and hormonal imbalance. Vitamin D deficiency in postmenopausal women is a multi-factorial in origin; lack of vitamin D rich diet, reduced absorption, and decreased exposure to sunlight, and decline in estrogen hormone synthesis. Usually, studies and researches focus on women during their reproductive years. Hence the proposed study intends to concentrate on postmenopausal women to mitigate their suffering, identify their health problems and reduce their burden of diseases. Unfortunately, nutritional assessment of FNOF risk factors are not adequately investigated in Palestine and also in the Middle East countries, therefore, this study could answer important questions related to the nutritional impact of vitamin Status and risk of FNOF.

1.3. Justification of the Study

A little information is available about adequacy of vitamin D intake and risk of fracture neck of femur in Gaza Strip. Even in recent studies, low intake of vitamin D, and risk of fracture neck of femur still a controversy issue. The number neck of femur fracture is increasing rapidly in Gaza Strip, according to observation of researcher the cases admitted to governmental hospital and these phenomena need further investigations.

1.4. Goal of the study

- To determine the relationship between vitamin D status and fracture neck of femur among postmenopausal women in the Gaza Strip.

1.5. Objectives of the study

- To identify the adequacy of dietary Vitamin D intake among postmenopausal women with fracture neck of femur.
- To assess the relationship between serum Vitamin D and postmenopausal women with fracture neck of femur.
- To determine the association between the lifestyle, dietary behavior and fracture neck of femur.
- To raise suggestions and recommendations that might decrease morbidity resulted from fracture neck of femur among postmenopausal women.

2. Subjects and methods

2.1. Study Design

A case-control study was conducted in the main governmental hospitals. The type of this study design is used widely, often in epidemiology. It is a type of observational study in which two existing groups differing in outcome are identified and compared on the basis of some supposed causal attribute. Case-control studies are often used to identify factors that may contribute to a medical condition by comparing subjects who have that condition/disease 'the cases' with individuals who do not have the condition/disease but are otherwise similar 'the controls' (Mann, 2003).

2.2. Setting of the Study

The study was conducted at Al-Shia hospital, Al-Aqsa Martyr's hospital, Nasser Medical Complex, and European Gaza hospital.

2.3. Study Population

The target population is all postmenopausal women who are suffering from fracture neck of femur (FNOF) in the Gaza Strip. They were recruited according to the inclusion criteria of the study after getting their consent.

2.4. Sampling and Sample Size

A Purposeful, non-random sample included 90 participants divided into two groups according to the eligibility criteria; group A (n = 45 cases) with FNOF, and group B (*n* = 45 controls) hospital visitors without any suspicion of bone disease (apparently healthy).

2.5. Study Timeframe and Response Rate

The study was started at the beginning of March 2013 after seeking ethical approval, pilot study conduction and setting up of the administrative procedures. Data collection was started at the beginning of June 2013 and continued to end of September 2014. The entire selected subjects had positively responded, thus, the response rate was 100%.

2.7. Selection Criteria

Subjects who were eligible to participate in the study were those who met the following criteria.

2.7.1. Inclusion Criteria

Cases: postmenopausal women who were suffering from fracture neck of femur diagnosed by a specialist and confirmed by X-ray. Controls: apparently healthy postmenopausal women.

2.7.2. Exclusion Criteria

History of malabsorption syndrome, presence of liver and/or kidney diseases, hyperthyroidism or hyperparathyroidism, sarcoidosis, and those who were taking Vitamin D supplement anticonvulsants, or any hormone replacement therapy.

2.8. Data Collection Tools

2.8.1. Anthropometric Measurements

Height was measured by using standing measuring scale; weight was measured by using weighing scale. Body Mass index (BMI) was calculated using Statistical Package for the Social Sciences (SPSS) program version 21 (International Business Machines [IBM], 2013).

2.8.2. Biochemical Measurements

By spectrophotometer machine with a kit from (DiaSys Diagnostic Systems GmbH - Germany) serum phosphorus and calcium were detected by colorimetric methods in the serum of cases and controls. By spectrophotometer machine with Enzyme Linked Immunoassay (ELISA) with a kit from Germany (DRG * lot NO EIA-3153) is used for the quantitative measurement of the 25-OH Vitamin D in the serum of cases and controls.

3. Results

3.1. Different Ages of Study Participants

3.1.1. Current Age at the Time of Fracture Neck of Femur (FNOF)

The mean age of the study population is (69.76 ± 6.80) years; the minimum is 52 and maximum 80 years. Table 4.1 shows that the difference of age between cases and controls was not reach to be statistically significant (*P* = 0.46). Age of participants was categorized into two groups one of them was < 65 years old, middle age (17.8%) and the other group was ≥ 65 years, old age (82.2%), respectively. The total of participants who were ≥ 65 years, old age was higher than number of participants < 65 years old. The percentage of (FNOF) groups age ≥ 65 years old (84.4%) was higher controls (80%) as shown in (Table 3.1.).

3.1.2. Menopause Age

The mean age at menopause of study population is (48.71 ±3.67) years. The minimum is 35 and maximum is 57 years. Table 3.1 shows that the difference age at menopause between cases and controls was not statistical significant (*P* =0.05, Table 3.1.). Menopause age of participants was classified into three groups < 45 years, 45 – 55 years and >55 years. Most of participants at menopause age were at age 45 – 55 years which represented (86.7%) as shown in (Table 3.1.). The percent of participants with (FNOF) at age < 45 year (11.1%) was higher than controls (8.9%) as shown in (Table 3.1.) without statistical significance.

Table 3.1: Fracture Neck of Femur (FNOF) and Control Groups in Relation to Different Current and Reproductive Ages of Participants

Variable	FNOF Group	Control Group	Total	χ^2	*P-value*
	No (%)	**No (%)**	**No (%)**		
Age **(years)**				0.30	0.58
< 65 middle age	7 (15.6)	9 (20)	16 (17.8)		
≥ 65 old age	38 (84.4)	36 (80)	74 (82.2)		
Total	45 (100)	45 (100)	90 (100)		
Menopause Age **(years)**				2.96[b]	0.20
< 45	5 (11.1)	4 (8.9)	9 (10)		
45 – 55	37 (82.2)	41 (91.1)	78 (86.7)		
>55	3 (6.7)	0 (0)	3 (3.3)		
Total	45 (100)	45 (100)	90 (100)		

χ^2 Chi square test

[b]Fisher's Exact test

3.2. Vitamin D and Calcium Rich Food intake

3.2.1. Fish, dairy products, meat and eggs

The results shown in (Table 3.2) that the mean of servings consumed per day from fish was lower among cases (0.084 ± 0.10) than control Groups (0.146 ± 0.11) and this difference was statistically significant (*P* = 0.00). Regarding the intake of Dairy Products, it was found that the mean of Servings consumed per day from Dairy Products was less among cases (0.85 ± 0.67) than control Groups (1.62 ±0.72) and this difference was statistically significant (*P* = 0.00) .The results revealed that the mean of Servings consumed per day from meat and eggs was lower among cases (0.52 ± 0.34) than control Groups (0.94 ± 0.44) and this difference was statistically significant (*P* = 0.00).

Table 3.2.: Comparison of Mean Scores on Participants Vitamin D and Calcium Rich Food between the Fracture Neck of Femur (FNOF) and Control Groups

Variable	Subject	Number	Mean	SD	t	*P value*
Fish **(Servings/day)**	FNOF Group	45	0.084	0.10	-2.65	0.00*
	Control Group	45	0.146	0.11		
Dairy Products **(Servings/day)**	FNOF Group	45	0.85	0.67	-5.24	0.00*
	Control Group	45	1.62	0.72		
Meat & Eggs **(Servings/day)**	FNOF Group	45	0.52	0.34	-5.0	0.00*
	Control Group	45	0.94	0.44		
Total Diet Vit. D **(Serving/day)**	FNOF Group	45	1.46	0.91	-6.40	0.00*
	Control Group	45	2.71	0.94		
Total Diet Calcium **(Servings/day)**	FNOF Group	45	1.02	0.84	-4.18	0.00*
	Control	45	1.74	0.77		

* Statistically Significant (P < 0.05)

3.2.2. Total Diet Vitamin D and Calcium

In this study, it was found as shown in (Table **3.3**) that the mean of Servings consumed per day from total diet vitamin D was less among cases (1.46 ± 0.91) than control Groups (2.71 ± 0.94) The mean of dietary vitamin D intake was (2.09 ±1.12) Servings/day and minimum was 0.42 maximum 4.42 and this difference was statistically significant (*P* = 0.00). The results revealed that the mean of Servings consumed per day from was total diet calcium lower among cases(1.02 ±0.84) than control Groups (1.74 ±0.77) and this difference was statistically significant (*P* = 0.00).

3.2.3. Daily intake of vitamin D and calcium

Dietary reference intake of vitamin D for females above 50 years old is 10 ug/d (Aplers *et al.*, 2008). Table **3.3** shows that vitamin D intake daily was classified into two group less than 10 (ug/day) and ≥ 10 (ug/day). The percent of FNOF group (62.2%) who consumed less than 10 (ug/day) of Vitamin D Intake was higher than control group (13.3%) and these differences were high statistical significance (*P* = 0.000). Dietary reference intake of calcium for females above 50 years old is 1200 ug/d (Alpers *et al.,* 2008). According to the classification of calcium daily intake in table 4.16, FNOF group shows higher percentage (80%) than control group (53.3%) in consuming less than 1200 (mg/day) of calcium intake, and it was highly statistically significant (*P* = 0.000).

Table 3.3: Fracture Neck of Femur (FNOF) and Control Groups in Relation to Participants Vitamin D and Calcium

Variable	FNOF Group	Control Group	Total	χ^2	*P*-value
	No (%)	**No (%)**	**No (%)**		
Vitamin D Intake (ug/day)				22.87	0.00*
< 10	28 (62.2)	6 (13.3)	34 (37.8)		
≥ 10	17 (37.8)	39 (86.7)	56 (62.2)		
Total	45 (100)	45 (100)	90 (100)		
Calcium (mg/day)				7.20	0.00*
<1200	36 (80)	24 (53.3)	60 (66.7)		
≥1200	9 (20)	21 (46.7)	30 (33.3)		
Total	23 (100)	37 (100)	90 (100)		

χ^2 Chi square test

* Statistically Significant (*P* < 0.05)

3.3. Biochemical Measurements

3.3.1. Serum Vitamin D

The results shown in (Table **3.4**) that the mean of Serum Vitamin D was lower among (FNOF) Group (69.4 ± 51.66) than Control Group (124.6 ± 69.45) and this difference was statistically significant (*P* = 0.00). Table 3.5. shows that the participants were classified into three groups according to their serum vitamin D level: Deficiency (<12) ng/ml, Insufficiency (12-30) ng/ml and Sufficiency (> 30 ng/ml) ng/ml. The percent of vitamin D deficiency level among FNOF Group (22.2%) was higher than Control Group (4.4%). Also Vitamin D deficiency and Insufficiency level among FNOF Group (66.4%) was greater than Control Group (26.6%) and these differences were of high statistical significance (*P* = 0.001).

3.3.2. Serum Calcium

The results shown in (Table **3.4**) that mean of Serum Calcium was lower among (FNOF) Group (8.60 ± 0.68) than Control Group (8.96 ± 0.68) and this difference was statistically significant (*P* = 0.03). The results shown in (Table **3.6**). The participants were categorized into three groups according to their serum Ca level included: low (< 8.6) mg/dL, normal (8.6-10.3) mg/dL and high (>10.3) mg/dL. The majority of participants have "normal" Ca level (53.3%). This was not statistically significant (*P* = 0.32).

3.3.3. Serum Phosphorus

The results shown in (Table **3.4**) that mean of Serum Phosphorus was higher among (FNOF) Group (3.85 ± 0.84) than Control Group (3.84±0.50) and this difference was not statistically significant (*P* = 0.08). In table **3.6**, the participants were categorized into three groups according to their serum Phosphorus level included: low (<2.5) mg/dL, normal (2.5-4.5) mg/dL. and high (>4.5) mg/dL. Percent of serum Phosphorus level was found lower among FNOF Group (17.8%) than controls (2.2%) and this was statistically significant (*P* = 0.03).

Table 3.4: Comparison of Mean Scores on Participants Serum Vitamin D, Calcium and Phosphorus between the Fracture Neck of Femur (FNOF) and Control Groups

Variable	Subject	Number	Mean	SD	t	*P value*
Serum Vitamin D **(nmol/day)**	FNOF Group	45	69.4	51.66	-4.27	0.00*
	Control Group	45	124.6	69.45		
Serum Calcium **(mg/dl)**	FNOF Group	45	8.60	0.68	-2.16	0.03*
	Control Group	45	8.96	-2.16		
Serum Phosphorus **(mg/dl)**	FNOF Group	45	3.85	0.84	-1.74	0.08
	Control Group	45	3.84	0.50		

* Statistically Significant (P < 0.05)

Table 3.5: Fracture Neck of Femur (FNOF) and Control Groups in Relation to Participants Serum Vitamin D Level

Variable	FNOF Group	Control Group	Total	FET[a]	*P-value*
	No (%)	**No (%)**	**No (%)**		
Vitamin D (ng/ml)				13.97	0.001*
Deficiency (<12)	10 (22.2)	2 (4.4)	12 (13.3)		
Insufficiency (12-30)	19 (42.2)	10 (22.2)	29 (32.2)		
Sufficiency (> 30)	16 (35.6)	33 (73.3)	49 (54.4)		
Total	45 (100)	45 (100)	90 (100)		

[a]Fisher's Exact test

* Statistically Significant (P < 0.05)

Table 3.6: Fracture Neck of Femur (FNOF) and Control Groups in Relation to Participants Serum Calcium and Phosphorus Levels

Variable	FNOF Group	Control Group	Total	FET[a]	*P-value*
	No (%)	**No (%)**	**No (%)**		
Serum Calcium (mg/dl)				2.11	0.32
Low (< 8.6)	22 (48.9)	18 (40)	40 (44.4)		
Normal (8.6-10.3)	23 (51.1)	25 (55.6)	48 (53.3)		
High (> 10.3)	0 (0)	2 (4.4)	2 (2.2)		
Total	45 (100)	45 (100)	90 (100)		
Serum Phosphorus (mg/dl)				6.48	0.03*
Low (< 2.5)	8 (17.8)	1 (2.2)	9 (10)		
Normal (2.5-4.5)	33 (73.3)	41 (91.1)	74 (82.2)		
High (> 4.5)	4 (8.9)	3 (6.7)	7 (7.8)		
Total	45 (100)	45 (100)	90 (100)		

[a] Fisher's Exact test

* Statistically Significant (P < 0.05)

3.4. Lifestyle characteristic and Sun Exposure

Table **3.7.** shows the distribution of participants according to the sun-exposed and non-exposed, and the general practice of physical activity which was categorized into four groups: inactive level and lazy, less active with exercise, less active with more exercise and active and smoking exposed or not exposed. The participants were divided into two categories according to the sun-exposed and non-exposed. The percentage of participants who were exposed to sunlight (53.3%) among FNOF group which was less than percent compare to control group (80%) and this difference was statistically significant (P = 0.007). Table **3.7.** shows the distribution of general practice physical activity to participants. That percent of participants who were inactive and lazy (64.4%) among FNOF group which was higher than percent compare to control group (8.9%). Furthermore, the percent of active related to FNOF group (2.2%) was less than control (53.3 %) and these differences were of high statistical significance (P = 0.00).

3.4.1. Smoking

The participants were classified into two categories according to Smoking status: exposed and not exposed. Table **3.7.** shows that most participants who were not exposed to smoking (72.2%) without statistical significance.

Table 3.7: Fracture Neck of Femur (FNOF) and Control Groups in Relation to Participants Lifestyle and Exposure to Sun

Variable	FNOF Group	Control Group	Total	χ^2	*P-value*
	No (%)	No (%)	No (%)		
Sun Exposure				7.20	0.007*
Yes	**24 (53.3)**	**36 (80)**	**60 (66.7)**		
No	**21 (46.7)**	**9 (20)**	**30 (33.3)**		
Total	**45 (100)**	**45 (100)**	**90 (100)**		
Physical Activity				46.4	0.00*
Inactive & Lazy	**29 (64.4)**	**4 (8.9)**	**33 (36.7)**		
Less Active with Exercise	**10 (22.2)**	**8 (17.8)**	**18 (20)**		
Less Active with more Exercise	**5 (11.1)**	**9 (20)**	**14 (15.6)**		
Active	**1 (2.2)**	**24 (53.3)**	**25 (27.8)**		
Total	**45 (100)**	**45 (100)**	**90 (100)**		
Smoking				0.05	0.81
Exposed	**13 (28.9)**	**12 (26.7)**	**25 (27.8)**		
Not Exposed	**32 (71.1)**	**33 (73.3)**	**65 (72.2)**		
Total	**45 (100)**	**45 (100)**	**90 (100)**		

χ^2 Chi square test

* Statistically Significant (P < 0.05)

3.5. Serum Vitamin D Correlations with Vitamin D Intake and Age

Table **3.8.** revealed that there is a positive significant correlation between serum vitamin D level and vitamin D intake.

3.5.1. Serum Vitamin D level and vitamin D intake

A strong positive correlation between vitamin D intake and serum vitamin D level (0.602) which was statistically significant (*P* = 0.00) as shown in (Table **3.8.**).

3.5.2. Serum vitamin D level and Age

A strong positive correlation between serum vitamin D level and age (0.317) which was statistically significant (*P* = 0.002) as shown in (Table **3.8.**).

3.6. Calcium Intake and serum calcium level

Correlation Coefficient between Calcium Intake and serum calcium level (0.152) which was not reach statistically significant (*P* = 0.153) as shown in (Table **3.8.**).

Table 3.8. Correlation between the Vitamin D and Calcium Daily Intake and Serum Vitamin D and Calcium and between Age and Serum Vitamin D

		S. Vitamin D (ng/ml)		S. Vitamin D (ng/ml)		S. Calcium (mg/dl)
Vitamin D Intake (ug/day)	Sample size	90	**Age (years)**	90	**Calcium Intake (mg/day)**	90
	Correlation Coefficient (r)	0.602		-0.317		0.152
	Significance *P value*	0.00*		0.002*		0.153

* Statistically Significant (*P* < 0.05)

4. Discussion

4.1. The Different Ages of the Study Participants

4.1.1. Current Age at the Time of Fracture Neck of Femur (FNOF)

The present study showed a positive relationship between advanced age and the occurrence of FNOF, this agrees with Farmer *et al.,* (1984) estimated that the risk of proximal femur fracture doubles every 5 years after 50 years of age. In addition, the results of this study agrees with Melton & Cooper., (2001) who concluded that the frequency of hip fractures in particular increases exponentially with age, especially after the age of 70, in both men and women, in most regions of the world. This was explained with advancing age, neuromuscular function declines and bone weakens, increasing the risk of fractures, these changes together produce a rapid rise in the risk of fractures (Cummings & Melton, 2002). Also this goes parallel with the normal physiologic changes occurred during life span, as the man becoming older; changes on body systems take place and usually towards declining of the function including bone changes which give the opportunity for increasing the risk of bone fracture.

4.1.2. Menopause Age

The average age of menopause is 51 years, most women go through menopause when they are between 45-55 years old, and about 1% of women go through menopause before the age of 40 (Stöppler, 2013). The present study showed an inverse relationship between menopause age and development of FNOF. This accedes with a study conducted by Gallagher, (2007) concluded that osteoporosis and fragility fracture among women is strongly associated with early menopause. Scientifically, when menopause occurred; hormonal changes take place (estrogen and progesterone) which affecting negatively some of the body systems including musculoskeletal system lead to loss of bone density that become more liable for fracture.

4.2. Vitamin D and Calcium Rich Food intake

The dietary data was obtained from Semi-quantitative Food Frequency Questionnaire (FFQ). The FFQ was based in part on a previous FFQ that evaluated the consumption of vitamin D and calcium-rich foods of postmenopausal women in Gaza Strip.

Fish; The current study showed an inverse relationship between quantity of fish intake and occurrence of FNOF. Burgaz *et al.*, (2007) which demonstrated that fatty fish consumption had the most important effect on vitamin D status 2–3 weekly portions of fatty fish increased serum 25(OH)D concentrations by 45%. One serving of fatty fish (130 g) contains 16 ug vitamin D.

Meat and Eggs: The present study showed an inverse relationship between quantity of meat and eggs intake and development of FNOF. This agrees with study of Gaafar and Badr, (2013) demonstrated that subjects who were consuming milk, eggs, fish, liver and cheese had significantly higher level of vitamin D. From the researcher point of view fish, meat , and eggs in the Gaza Strip is relatively expensive that cases may had limited ability to buy because of their low income and big family size when compared with controls.

4.2.1. Dietary Vitamin D and Calcium

The current study showed an inverse relationship between dietary vitamin D intake and development of FNOF. The results of this study agrees with several studies, Feskanich, *et al*., (2003) conduced study of an 18 years prospective analysis included 72337 postmenopausal women, In this prospective study of postmenopausal women which assessed relations between postmenopausal hip fracture risk and calcium, vitamin D, and milk consumption. Study results revealed women consuming ≥ 12.5 ug vitamin D from food plus supplements had a 37% lower risk of hip fracture (RR = 0.63; 95% CI: 0.42, 0.94) than did women consuming < 3.5 ug/day. Total calcium intake was not associated with hip fracture risk (RR = 0.96; 95% CI: 0.68, 1.34 for ≥ 1200 compared with < 600 mg/d). Milk consumption was also not associated with a lower risk of hip fracture (P for trend = 0.21). They concluded that an adequate vitamin D intake is associated with a lower risk of osteoporotic hip fractures in postmenopausal women. Neither milk nor a high-calcium diet appears to reduce risk. Also agrees with the study of Weatherall, (2000) which concluded that adequate vitamin D is important in the prevention of postmenopausal bone loss. At low-to-moderate intakes, calcium absorption is largely dependent on the action of 1,25-dihydroxyvitamin D for active transport. Insufficient vitamin D leads to reduce calcium absorption, elevate blood concentrations of parathyroid hormone, and increase rates of bone resorption, which over time may lead to bone fracture.

The current study showed an inverse relationship between the quantity of dietary calcium intake and development of FNOF. Dietary reference intake of calcium for females above 50 years old is 1200 ug/d (Alpers *et al*., 2008). Present study showed percent of FNOF group (80%) who consumed less than 1200 (mg/day) of calcium intake was higher than control group (53.3%) and these differences were high statistical significance (P = 0.000). This agrees with the results of cross-sectional study conducted by Tajik *et al*., (2013) that assess the association between BMI and dietary calcium intake with Bone Mineral Density (BMD) among 299 postmenopausal women aged 50-65 years old. They found that low dietary calcium intake had significantly negative effect on BMD at both sides (lumbar spine and femoral neck) among postmenopausal women. And this study also revealed that calcium intake is a protective factor against osteopenia/osteoporosis among postmenopausal women. As result, that Calcium intake is vital for maintaining healthy bones and preventing osteoporosis and insufficient calcium intake leads to bone loss in aging.

4.3. Biochemical Measurements

4.3.1. Serum Vitamin D

The current study showed an inverse relationship between serum vitamin and risk for FNOF. This agrees with the study of Looker & Mussolino in (2008), consisted of 1917 white men and women > or = 65 yrs. of age who were examined in the third National Health and Nutrition Examination Survey (NHANES III, 1988-1994), a nationally representative survey. Incident hip fractures were ascertained using linked mortality and Medicare records that were obtained for NHANES III participants. Serum 25(OH)D values were measured with a radioimmunoassay kit. Their study results revealed that there were 156 incident hip fracture cases in the sample. Cases were older, had lower BMD and body mass index, more prevalent spine or wrist fractures and weight loss before baseline, and ate fewer kilocalories and less calcium than non-cases. Moreover, the current study agrees with Sakuma, (2006) results indicated that about two-thirds (62%) of hip fracture patients had vitamin D insufficiency, suggesting that this condition may be closely associated with hip fracture in elderly people. Therefore, the serum 25-OHD level may be a useful index for the risk of hip fracture in elderly people.

4.3.2. Serum Calcium

Present study showed an inverse relationship between serum calcium and risk for FNOF. This was not statistically significant (P = 0.32). This agrees with Holick, (2006) study that concluded when 25(OH)D levels are low, calcium absorption is insufficient to satisfy the calcium requirements. The body responds by increasing the production and release of PTH into the circulation. The increase in PTH restores calcium homeostasis by enhancing the production of 1,25(OH)2D, increasing tubular re-absorption of calcium in the kidney, and increasing calcium mobilization from the bone.

4.3.3. Serum Phosphorus

The current study showed a positive relationship between serum phosphorus level and development of FNOF. This agrees with Holick, (2004) who mentioned the metabolism of Vitamin D in which phosphorus and PTH regulates production of 1, 25(OH) 2D3 by the kidney.

4.4. Lifestyle characteristic and Sun Exposure

4.4.1. Sun Exposure

The present study showed a direct relationship between the low exposure to sun and the risk for development of FNOF. This agrees with the results of study conducted by Holick, (2004) indicated that most humans depend on sun exposure to satisfy their requirements for vitamin D and its deficiency not only causes rickets among children but also precipitates and exacerbates osteoporosis among adults and causes the painful bone disease osteomalacia. He concluded that vitamin D deficiency and decreased exposure to solar UVB radiation have been demonstrated to increase the risks of osteoporosis, hip fractures, deadly cancers, cardiovascular disease, multiple sclerosis, rheumatoid arthritis, and type 1 diabetes mellitus.

4.4.2. Physical Activity

Present study showed a direct relationship between inactivity and the risk for development of FNOF. This agrees with the results of study conducted by Jeffrey *et al*., (2013) indicated that a step increase in the amount of physical activity performed each day resulted in a positive effect on bone mineral density at the hip. Possible confounding factors such as the use of anti-resorptive therapy, body mass index and age were included in the analysis and suggested that age had a negative effect on bone density while body mass index had a positive effect. Anti-resorptive therapy provided a protective effect against loss of bone density. They concluded that a step increase in the amount of daily activity, and using simple, daily performed tasks, which can help to prevent decreasing in post-menopausal bone mineral density. Physical inactivity among people of the Gaza strip is rationale by unavailability of sport clubs and lack of health education and promotion activities.

4.4.3. Exposure Smoking

The current study showed low percentage of FNOF cases who exposed to smoking. This disagrees with study of Muftic *et al*., (2013) which included 100 female patients with average age 54 in prospective study which involved two groups of patients with osteoporosis. That protocol included: age, body, mass index (BMI), employment, marital status, risk factors (smoking, coffee, physical activity), endocrine causes of osteoporosis and osteoporotic fractures. In II phase for every patient they were using two methods in diagnostics of osteoporosis: ultrasound of calcaneus and DXA. In both methods, they analyzed T score and Z score. 21% patients had 21,12 BMI (low BMI), 58% patients were in menopauses, triad of risk factors (smoking, consumption of coffee, low physical activity) had 32%, 28% of patients had osteoporotic fractures. The lower percentage of smoking in this study reflects the social and cultural constraints on smoking and it is less socially acceptable for Palestinian women to smoke.

4.5. Serum Vitamin D Correlations with Vitamin D Intake and Age

Present study showed that there is a positive significant correlation between serum vitamin D level and vitamin D intake. Our study showed correlation Coefficient between serum vitamin D level and age (0.317) which was statistically significant (P = 0.002). Gaafar & Badr, (2013) were reported that Vitamin D deficiency and insufficiency were significant more frequent among female with age group 60 years and more (P <0.05). A higher proportion of participants with vitamin D

deficiency and insufficiency were involved in indoor work or were house wives or not working; The difference was statistically significant when compared with others involved in field (outdoor) work ($P < 0.0001$). This explained by the fact that elderly people remain homebound and do not receive as much sunlight exposure as those who are younger and also, when the elderly population receive sun exposure, vitamin D production is hindered by decreased capability of the skin to utilize the sunlight received because of decrease of 7-dehydrocholesterol in the skin, which leads to decreased absorption of UVB rays that convert pre-calciferol to cholecalciferol.

4.6. Serum Vitamin D level and vitamin D intake

The researcher found in this study a direct relation between vitamin D intake and serum vitamin D level (0.602) which was statistically significant ($P = 0.00$). Serum Vitamin D level usually affect by the amount of vitamin D intake and other factors like sun exposure (Holick, 2004).

4.7. Calcium Intake and serum calcium level

The current study showed positive relationship between Calcium intake and its serum level. Serum Calcium level usually affect by the amount of Calcium intake, but there are many factors may contribute in serum level like vitamin D status and PTH level (Holick, 2006).

5. Conclusion and recommendations

5.1. Conclusion

Advancing in age may associate with increased risk for development of FNOF, strong statistical a positive relationship was observed between low Serum Vitamin D level and elevated FNOF, with an inverse association between FNOF and participants who were exposed to sunlight. There were highly of significance a positive association was observed between FNOF and participants who consumes less servings of milk, eggs, and fish which are rich with vitamin D and calcium.

5.2. Recommendation

Physicians are recommended to include routinely testing their postmenopausal women for measuring 25(OH)D in serum blood level in the periodic checkups, and inform them about the importance of vitamin D regarding general health, and indorse screening postmenopausal women to prevent FNOF to detecting postmenopausal women with low bone mineral density and that treating osteoporosis can reduce the risk of fractures in postmenopausal women. Researchers may conduct large scale study focus on vitamin D status and FNOF.

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