The Egyptian Journal of Hospital Medicine (October 2014) Vol. 57, Page 547-553

Correlation between the Level of Vitamin D and Bone Mass Index in Primary Osteoporotic Patients in Taif-KSA

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Abstract:

Osteoporosis (OP) is considered as one of the commonest metabolic bone diseases in orthopedics, characterized by a reduction in bone mass density and micro-architectural deterioration of bone tissue leading to diminished material properties with an increase in bone fragility and susceptibility to minor trauma fractures.

The aim of this cross sectional study was to detect the level of vitamin D in patients suffering from primary osteoporosis and to correlate their levels with bone mass index. This work was performed - at the Orthopedic Outpatient Clinic of King Abdul Aziz specialist Hospital, Taif, (KSA) - on 115 patients (77 females and 38 males) fulfilling WHO revised criteria of 1994 for osteoporosis. The mean age of patients was 67.5± 8.2. A medical history was taken and bony pains, fragility fractures, and loss of height, were elicited, with Inclusion criteria in the form of a T-score ≤ −2.5 SD at the lumbar spine, with exclusion of any patient with secondary osteoporosis. Full physical examination and investigations were done including estimation of serum total vitamin D and X-ray of lumbar and thoracic spine.

Results indicate that the mean total vitamin D and T-score were 19.7±6.6 ng/dl and -2.9± 0.4 respectively. 88.7% of osteoporotic cases were complaining of bone pains, 47% of them complaining of height loss and 47.8% of them had spine fracture in X-ray. Positive strong significant correlation between total vitamin D and T-score (r=0.83, p value <0.0001) was found. **It could be concluded that** there is a significant positive strong correlation between total vitamin D and bone mass index in primary osteoporotic patients in Taif - KSA. It is recommended that adequate intake of calcium and vitamin D during prophylaxis and treatment of osteoporosis is necessary.

Keywords: Vitamin D, BMI, Osteoporosis.

Introduction:

Osteoporosis (OP) is considered as one of the commonest metabolic diseases in orthopaedics, characterized by a reduction in bone mass density and micro-architectural deterioration of bone tissue leading to diminished material properties with an increase in bone fragility and susceptibility to minor trauma fractures .[1]

OP is a silent disease often under recognized and undertreated. Fracture may be the first and only manifestation, making OP a major contributor to morbidity and mortality worldwide. [2]

Postmenopausal osteoporosis is a primary type 1, while primary type 2 osteoporosis called senile osteoporosis and occurs after age of 75 years and is seen in both females and males at a ratio of 2:1. Secondary osteoporosis can arise at any age and affects both men and women equally. [3]

Secondary osteoporosis may arise secondary to chronic disease or prolonged use of medications such as chronic use of corticosteroids. [4]

Osteoporosis develops due to imbalance between bone formation and bone resorption. The main mechanisms by which osteoporosis develop are an inadequate formation of new bone during remodeling, excessive bone resorption, and inadequate peak bone mass. Disturbances of these three mechanisms lead to the occurrence of this metabolic bone disease. [5]

Risk factors for osteoporotic fractures include advanced age, deficiency of fat-soluble vitamins ,low dietary calcium , phosphorus, iron ,magnesium, zinc , copper, fluoride, boron, proteins, under weight, lack of weight bearing exercise, tobacco smoking, female athletes, amenorrhea, heavy metals and soft drinks may increase risk of osteoporosis, especially in women. [6]

The risk of osteoporotic fractures can be reduced by changing the life style of the patient (diet, exercise, etc.). [7]

DOI: 10.12816/0008487

Adequate utility of calcium and vitamin D is essential. Bisphosphonates are useful in those with previous fractures from osteoporosis than those with no previous fractures. [8]

Vitamin D is one of the fat-soluble vitamins and hormone precursor, it has two forms: ergocalciferol (vitamin D_2) and cholecalciferol (vitamin D_3). It is important in the health of bone and neuromuscular transmission. [9]

The major source of vitamin D is obtained by exposure to sunlight`s ultraviolet B (cutaneous synthesis). Another source is through the diet (seafood, shrimp, mushroom, egg yolk and fortified milk). [10]

Vitamin D deficiency leads to secondary hyperparathyroidism in response to decreased serum calcium. It also results in increased bone turnover, bone resorption and the development of osteopenia, leading to rickets in childhood period and both osteomalacia and osteoporosis in adults. [11]

The World Health Organization (WHO) developed a classification of bone mineral density (BMD) according to the standard deviation (SD) difference between a patient's BMD and that of a young-adult reference population that known as T-score. If the T-score is equal to or less than -2.5 a diagnosis of osteoporosis is considered, a T-score between -1.0 and -2.5 is the (osteopenia), and a T-score of -1.0 or higher is normal. [1]

a)
b)
c)

The main problem:

The deficiency of vitamin D is considered as major health problem in many countries. It is considered a silent disease of females and males who are under recognized and undertreated. Osteoporosis has an increased morbidity and mortality rate due to its serious consequences.

Aim of the work:

The aim of the work is to assess the level of total vitamin D in patients already diagnosed as primary osteoporosis and to correlate their levels with bone mass index.

Patients and methods:

Study design: a cross sectional study was performed at Orthopedic Outpatient Clinic in King Abdul Aziz specialist Hospital (KSA) in Taif during the period from April 2013 – October 2013. The study was carried out on 115 patients (77 female and 38 male) fulfilling WHO revised criteria of 1994 for osteoporosis. [1] Patients were included into the study after obtaining an informed consent. A medical history including bony pains, fragility fractures, and loss of height, were elicited.

Inclusion criteria: All patients who had BMD defined as a T-score (determined by DEXA) ≤ -2.5 SD at the lumbar spine.

Exclusion criteria: All patients with primary hyperparathyroidism, inflammatory bowel disease, and those having a history of bowel resections, chronic pancreatitis which is associated with malabsorption of vitamin D. Patients taking medications (rifampicin, ketoconazole, phenytoin, valproic acid, or corticosteroids), patients with a$\leq$50 ml/min creatinine clearance and patients having secondary osteoporosis, or significant hepatic or thyroid dysfunction were also excluded.

Tools of data collection: Patients were subjected to:

1- Full history taking.
2- Physical examination.
3- Investigations including:

a) Estimation of serum total vitamin D by Competitive quantitative ELISA. [12]

Principle :unknown amount of 25-OH Vitamin D in the patient sample and a known amount of biotin-labelled 25-OH vitamin D compete for the antibody binding sites in the microplate wells plate. Unbound 25-OH vitamin D is removed by washing. For the detection of bound biotin-labelled 25-OH vitamin D, a second incubation is performed using peroxidase-labelled streptavidin. In a third incubation using the peroxidase substrate tetramethylbenzidine (TMB) the bound peroxidase promotes a colour reaction. The colour intensity(at a wavelength of 450 nm) is inversely proportional to the 25-OH vitamin D concentration.

b) X-ray of lumbar and thoracic spine.

Statistical analysis:

Data were analyzed using SPSS version 20. Normality of distribution was computed by W Shapiro-Wilk's test. Numerical

variables were expressed in means ± S.Ds and ranges. Categorical variables were expressed in frequencies and percentages. Correlation figure was drawn for assessing relationship between T-score and total vitamin D. Statistical significance was set at 0.05 levels.

Results:

The study was carried out on 115 patients (77 females and 38 males) fulfilling WHO revised criteria of 1994 for osteoporosis. The mean age of patients was 67.5± 8.2, their mean Vitamin D and T-score were19.7 ±6.6 and -2.9± 0.4 respectively. There was a 67% of participants were females, and33% of them males. No significant difference between male and female osteoporotic cases in their Vitamin D or T scores. 88.7% of osteoporotic cases were complaining of bone pains, 47% of them complaining of height loss and 47.8% of them had spine fracture in X-ray. Total vitamin D was significantly higher in all asymptomatic cases. T-score was significantly higher in all asymptomatic. Strong significant positive correlation between total vitamin D and T-score (r=0.83, p value <0.0001) was found.

Discussion:

Osteoporosis, a public health problem, increasingly prevalent with the aging of the population. It is characterized by compromised bone strength, which predisposes the individual to an increased risk of fractures. [5]

According to Bassil *et al.* the highest rates of vitamin D deficiency disorder where found in the Middle East and North Africa, with varying rates from 30%-90%. They also stated that significant predictors of hypovitaminosis D increasingly among female advancing age, multi-parity; urban socio-economic status, clothing style, season. [13]

A similar study done in India by Agrawal & Sharma who studied the prevalence of osteoporosis in 200 otherwise healthy Indian males above 50 years old and found that osteoporosis affects 8.5 % of them. They also assumed that the deficiency of Vitamin D is common in such group. [14]

In Ardawi *et al.* cross-sectional study of vitamin D deficiency among Saudi Arabian males was 87.8%. Ardawi and his group attributed this high prevalence to advanced age, sedentary lifestyle, obesity, ignorant people, and inadequate exposure to sunlight, smoking, and improper dietary supplementation. [15] [16]

Osteoporosis is recognized as the disease of postmenopausal females; however, males are also affected and have serious consequences. In this study female to male ratio was about 2:1 (77 female patients and 38 male patients). However, there was no significant difference between male and female osteoporotic cases in their Vitamin D or T score.

Bonnick, 2006 agreed with this finding as he found that prevalence of osteoporosis is greater in women, with the controversy of that mortality after fracture is higher among men. Bonnick also found that in both sex, increases the incidence of vertebral fracture with the advancing of age. [17]

Senile osteoporosis in men is also an important public health problem with significant morbidity and mortality. According to Watts' study, Osteoporosis affects approximately 2 million men in the US and accounts for an estimated 600,000 fractures each year. [18]

As regards correlation between BMD and total level of vitamin-D, there was a positive strong significant correlation between total vitamin D and T-score with r = 0.83, p value <0.0001. Total vitamin D and T-score were found to be significantly lower in all symptomatic cases (presenting with bone pain, height loss and fractures) when compared with a symptomatic ones.

This finding in the present study agree with Ardawi *et al.* in which there was positive correlation between total vitamin-D and BMD values at lumbar spine (L1-L4) with P value < 0.023 . [19]

Conclusion:

Osteoporosis presents an important public health problem with significant morbidity and mortality in Taif area. Large surveys should be performed to pre and postmenopausal women and men over 50 years old for discovering population at risk of fracture.

The correlation between total vitamin D and T-score in primary osteoporotic patients

in TAIF-KSA was strong, significant and positive.

Lifestyle management, including adequate calcium consumption and vitamin D intake, with increase in the physical activity, and avoidance of the risk factors is recommended to prevent osteoporosis.

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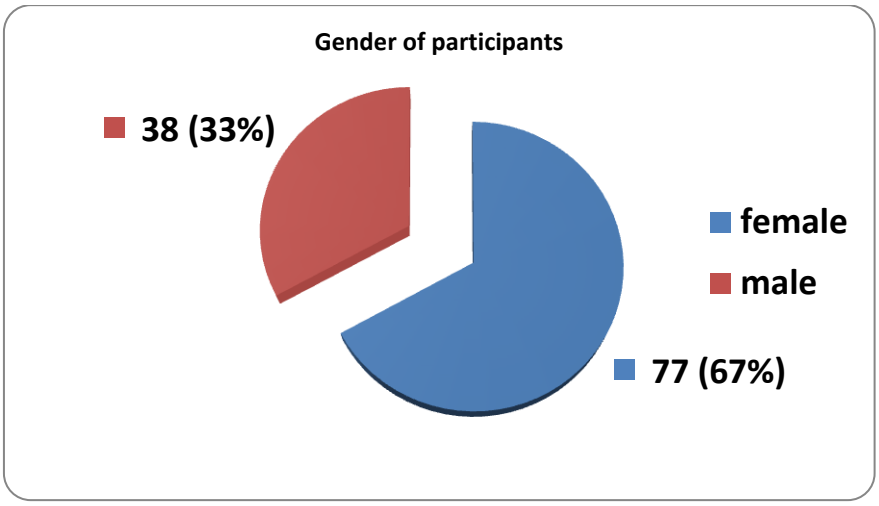

Figure (1): gender of participants
Shows (67%) of participants were females, while 33% were males.

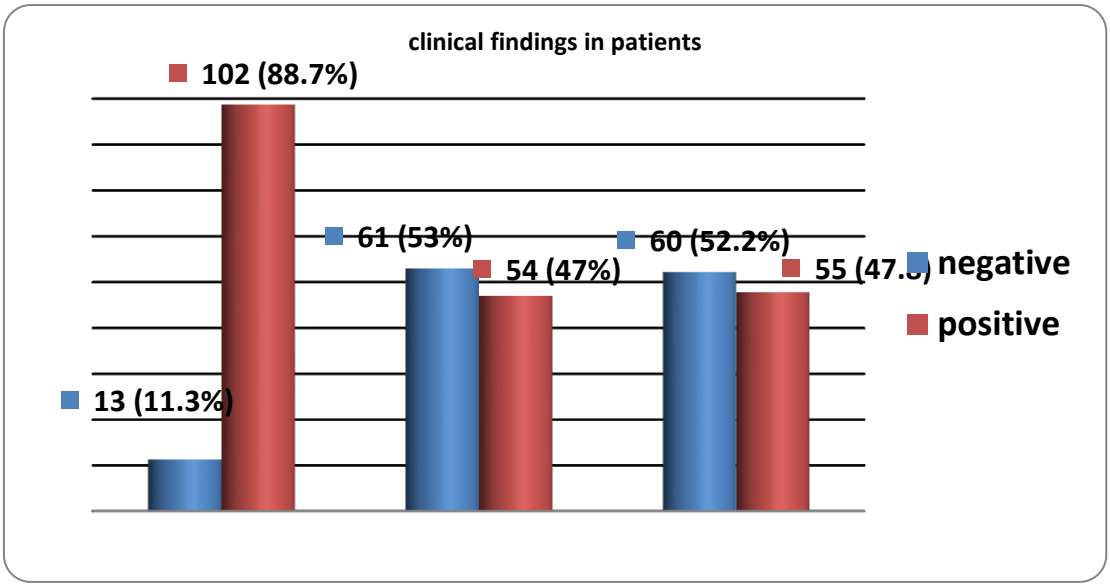

Figure (2): clinical findings among patients
Shows (88.7% of osteoporotic cases were complaining of bone pains, (47%) of them complained of height loss and (47.8%) of them had spine fracture in X-ray.

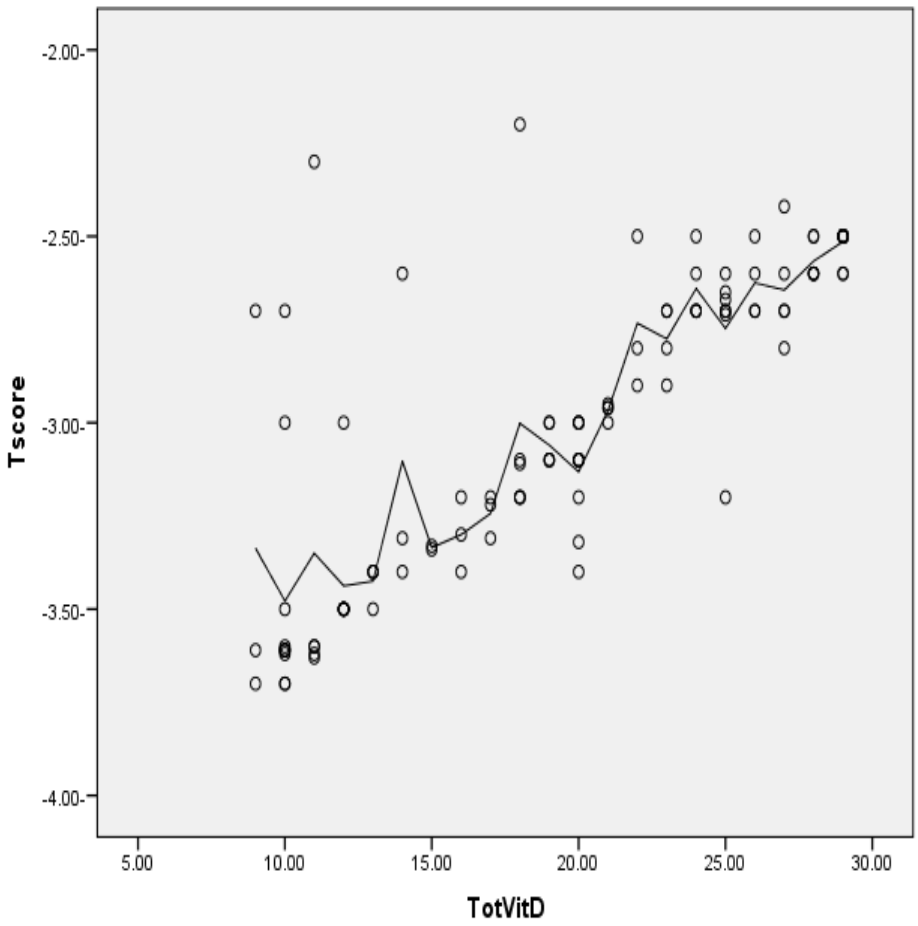

Figure (3): correlation between Total Vitamin D and T-score in patients
Shows strong significant positive correlation between total vitamin D and T-score (r=0.83, p value <0.0001).

Table (1): Demographic data.
Shows mean age of patients in the study was 67.5± 8.2, their mean Vitamin D and T-score were 19.7 ±6.6 and -2.9± 0.4 respectively.

Table (1): Demographic data.

	Patients (number = 115)	
Variables	patients (Number = 115)	
	MEAN±SD	RANGE
Age	67.5± 8.2	56-83
Total vitamin D (30-74 ng\dl)	19.7 ±6.6	9 - 29
T-score	-2.9± 0.4	(-2.5)-(-4)

Table (2): Represents relationship between clinical presentations of osteoporotic cases and their vitamin D:

Shows total vitamin D was significantly higher in all asymptomatic cases.

Clinical presentations:	Total Vitamin D Mean ± SD	Z of Mann Whitney test	P value
Bone pain: Positive negative	 18.9 ± 6.6 25.8 ± 2.9	3.5	<0.0001
Hight loss Positive negative	 14.5 ± 4.9 24.3 ± 4.1	7.7	<0.0001
Spine fracture Positive negative	 14.5 ± 4.9 24.5 ± 3.9	7.9	<0.0001

Table (3): Represents relationship between clinical presentations of osteoporotic cases and their T score:

shows T-score was significantly higher in all asymptomatic cases.

Clinical presentations:	T-score Mean ± SD	Z of Mann Whitney test	P value
Bone pain: Positive negative	 -3.04 ± 0.44 -2.66 ± 0.15	2.9	0.003
Hight loss Positive negative	 -3.2 ± 0.38 -2.7 ± 0.28	6.2	<0.0001
Spine fracture Positive negative	 -3.3 ± 0.38 -2.8 ± 0.27	6.4	<0.0001

Table (4): Relationship between gender of osteoporotic cases and their Vitamin D and T score:

shows no significant difference between male and female osteoporotic cases in their Vitamin D or T score.

Parameters	Gender		Z of Mann Whitney test	P value
	Male Mean ± SD	Female Mean ± SD		
Total Vitamin D	21.3 ± 5.5	18.9 ± 7.1	1.6	0.099
T-score	-2.9 ± 0.38	-3 ± 0.42	0.78	0.432