The Egyptian Journal of Hospital Medicine (April 2014) Vol. 55, Page 251–256

The Prevalence of Vitamin D Deficiency in Ancient Egyptian Population from Baharia Oasis, the Greco Roman Period.

Rokia Abd ElShafy Soliman El-Banna*, , Azza Mohamed Sarry El-Din*, Fatma Ahmed Eid**, Walaa Yousef Mohamed Ali*
*Biological Anthropology Department , National Research Centre.
**Zoology Department, faculty of Science , Al-Azhar University.

Abstract

Background: Vitamin D deficiency is considered to be the most common nutritional deficiency and also one of the most common undiagnosed medical conditions in the world**.** Vitamin D is naturally present only in minor amounts in most foods; the great majority is synthesized by the action of ultraviolet light on chemical precursors in the skin.
The manifestation of vitamin D deficiency in sub adults is referred to as rickets, and in adults, osteomalacia . Rickets and osteomalacia are the sub adult and adult expressions of a disease in which the underlying problem is a failure to mineralize bone protein (osteoid). The most common cause of this disease is a physiological deficiency in vitamin D. The associated problems include deformed bones.
Material and Methods: This study aimed to investigate the skeletal remains of ancient Egyptians from Baharia Oasis population for lesions indicative of vitamin D deficiency (rickets and osteomalacia). The material consisted of 1075 commingled bones (38 sub adults and1037 adults). They were recovered from Baharia oasis.
Results: The results showed that, there was no evidence of rickets in sub adult group. The prevalence of osteomalacia in adult Baharia populations was 7.4% **;** all were adult males.
This result could indicate that this population was subjected to sunlight all over the year and their diet was rich of calcium and phosphorus.
Conclusion: These few cases that were found may be due to mechanical stress during wine and textile production.
Key words: Rickets, Osteomalacia**,** Ancient Egyptians, Greco-Roman Period.

Introduction:

Vitamin D is thought of as the "sunshine vitamin" because it is synthesized by various materials when they are exposed to sufficient sunlight [(1)].During exposure to sunlight, 7-dehydrocholesterol in the epidermis and dermis absorb ultraviolet B radiation resulting in the production of pre-vitamin D3. Pre-vitamin D3 is rapidly converted by thermally induced rearrangement of the double bonds to form vitamin D3 (Figure 1).

DOI: 10.12816/0004511

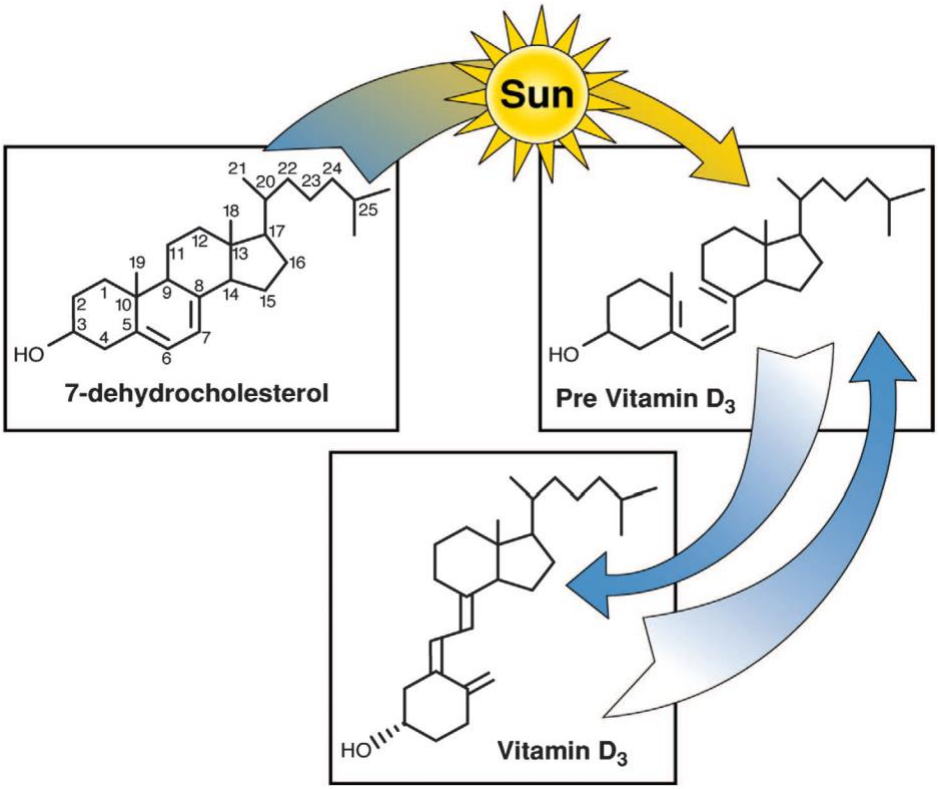

Fig . (1): the conversion of 7-dehydrocholesterol to previtamin D3 by UV light and the temperature-dependent equilibrium between previtamin D3 **(DeLuca, 2014).**

Vitamin D3 enters the circulation and is bound to the vitamin D binding protein. It enters the liver where it is converted to 25-hydroxyvitamin D3 [25(OH) D3]. 25-hydroxyvitamin D3and vitamin D3 is converted to their respective 25-hydroxymetabolites, and is known collectively as total 25-hydroxyvitamin D [25(OH) D]. It is the major circulating form of vitamin D that is measured by clinical laboratories to determine a patient's vitamin D status. Hydroxyvitamin D is biologically inactive and is transported on the vitamin D binding protein to the kidneys where it is converted to 1, 25-dihydroxyvitamin D [1, 25(OH) 2D] which is considered to be the biologically active form of vitamin D. It is responsible for regulating calcium and bone metabolism by enhancing intestinal calcium absorption and mobilizing calcium to the skeleton [(2)].

Vitamin D deficiency causes a decrease in the efficiency of intestinal calcium absorption and results in a decrease in ionized calcium. The calcium sensor in the parathyroid glands immediately recognizes the decrease causing the parathyroid glands to increase the production and secretion of parathyroid hormone (PTH) [(3)].

Rickets is a metabolic bone disease with multiple causes. The most common cause is a vitamin D deficiency. Vitamin D is needed for mineralization of newly formed bone matrix, osteoid. When mineralization is impaired due to a prolonged vitamin D deficiency, the bones become soft and will bend due to weight bearing and muscular tension [(4-7)]. The skeletal effects of rickets are deformity of the inadequately mineralized bone under mechanical forces [(8)].

Osteomalacia is a weakening of the bones due to problems with bone formation or the bone building process. The most common reason that osteomalacia occurs is a lack of vitamin D. Vitamin D is an important nutrient that helps to absorb calcium in the intestine. Vitamin D also helps maintain calcium and

phosphate levels for proper bone formation. It is made within the skin from exposure to UV rays in sunlight, and it can also be absorbed from foods such as dairy products and fish. Low levels of vitamin D mean that you cannot process calcium for use in your bones to give them structural strength. This can result from either a problem with diet, lack of sun exposure, or a problem with the intestines [(9)].
The purpose of this study is to investigate the skeletal remains of ancient Egyptians from Baharia oasis population, for lesions indicative of vitamin D deficiency (rickets and osteomalacia).

Material and methods

The material of this study consisted of 1075 (38 bones for sub adult and 1037 for adult) commingled bones which belonged to the Greco-Roman period. Table (1) shows the number of long bones from the Baharia oasis. This material was recovered from large rocky tombs in the Baharia oasis which is located in the Libyan Desert 180 Km west of the Nile Valley and 350 Km south west of Cairo and transferred to the lab at the Giza plateau (pyramids area) [(10,11)] (Fig.2).

The following procedures were performed on the collection:

1- Sex determination**:** of the adult skeletons was done using diameter of humerus and femur head [(12)].

Sexing of sub adults: sexing of the sub adults can not be estimated macroscobically so they were not sexed

2- Age estimation**:**

Age determination of adult bones was carried out from radiography of the proximal humeri [(13)] and femuri [(14)].

Age determination of sub adult bones was done according to Mark , Facchini and Veschi [(15, 16)] from bone length of femuri and tibiai.

3- The samples were examined macroscopically for any lesions of rickets for sub adults (Tibia and femur) and any lesions of osteomalacia for adults.

Statistical analysis: SPSS V16 program was used for the statistical analysis and also chi square test was used to compare our results.

Table (1): The number of long bones from the Baharia oasis.

	Right	*Left*
Clavicle	20	44
Humerus	94	94
Radius	62	60
Ulna	59	79
Femur	107	107
Tibia	94	95
Fibula	73	49
Sub adult femur	10	11
Sub adult tibia	7	9

Fig. (2): A map of Egypt showing the location of Bahraria Oasis (360 Km southwest of Cairo, in the western desert).

Results:

The sample consisted of 1075 commingled bones (38 sub adults and 1037 adults). Sub adults aged from 0<18. There were no evidences of rickets in sub adult. The adult sample was divided to 8 groups according to age from 20-60 years (table, 2).

The femur bone was the only affected. Both sides (right and left) were affected by osteomalacia. The results showed no incidence of osteomalacia in females.

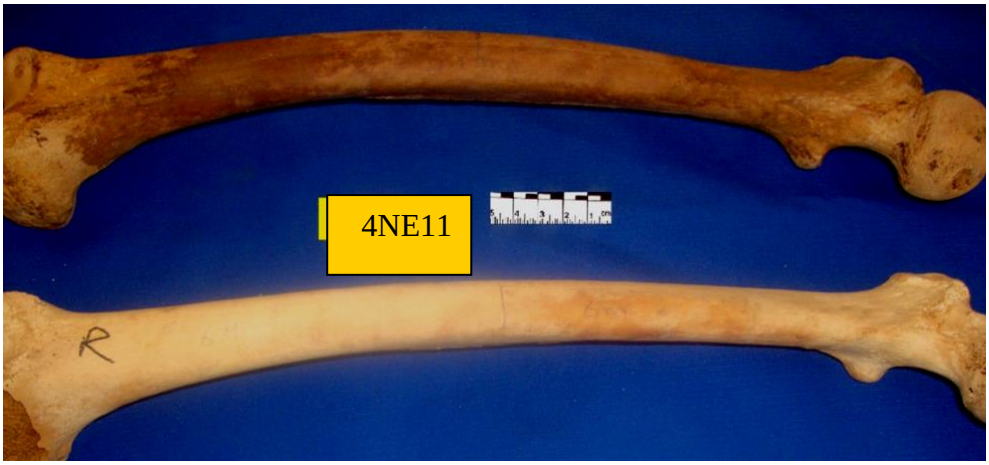

Fig.(3): Difference between normal femur and bowing femur with osteomalacia (4NE11).

Table (2): Incidence of osteomalacia in adult femur.

Right femur **(3/88)**				Left femur **(4/103)**	
Age	Male n/N %	Female n/N %	**P value**	Male n/N %	Female n/N %
20-25	0/1	0/4		0/2	0/12
25-30	2/26 7.6	0/16	**0.37**	3/30 10	0/29
30-35	1/6 16.6	0/9	**0.4**	0/7	0/9
35-40	0/6	0/2		0/3	0/2
40-45	0/2	0/7		1/2 50	0/1
45-50	0/2	0/3		0/3	0/3
50-55	0/1				
55-60	0/3				
Total	3/47 6.3	0/41		4/47 8.5	0/56

n/N= number of affected bones/number of examined bones.

Discussion:

Veselka (2013) [7] reported that the manifestation of vitamin D deficiency in sub adults is referred to as rickets and in adults, osteomalacia. The prevalence of vitamin D deficiency in adult Baharia populations (Osteomalacia) was 7.4% all were adult males. The most important source of vitamin D is dermal synthesis under the influence of sunlight. **Gordina** [17] concluded that rarely, rickets can be caused by factors affecting normal processing of vitamin D in the body, such as kidney and liver disorders, or intestinal malabsorption [5, 2, and 18]. Vitamin D deficiencies (rickets), which are identified in childhood, are associated with osteomalacia in adults [19].

Mechanical stress of work-loads could be one of the causes of osteomalacia. The absence of affected cases with rickets in this group could be attributed either to the few number of sub adult bones found or to the brest feeding of the children. During the Pharaonic period in Egypt, documentary sources indicate that infants were breastfed for up to three years [20- 23] also, during the Pharaonic period the primary foods given to infants at early stage were eggs and animal milk, particularly that of camels, goats, sheep and cows [22].

In 1822 Sniadecki suggested that rickets was caused by lack of exposure to sunlight. He observed that children who lived in inner cities of Warsaw, Poland, had a very high incidence of rickets, whereas children living on the farms on the outskirts of the city essentially were free of this disease. Almost 70 years later Palm concluded from an epidemiological survey that the common denominator in rickets in children was lack of exposure to sunlight [1].
During the end of nineteen century and the beginning of twenty century, rickets due to vitamin D has almost disappeared from the United States and from many countries of Western Europe. However, rickets still exists in a number of countries like Egypt. Egypt, a country where the sun is shining all the year, has still a high prevalence of nutritional or vitamin D deficiency rickets. This high prevalence of rickets in sub adults nowadays might be due to low socioeconomic status,

poverty, ignorance, illiteracy and history of lack exposure to sun light [24].

In conclusion: Ancient Egyptian Population from Baharia oasis, the Greco Roman period was exposed to sunlight all over the year and their diet was rich of calcium and phosphorus. These few cases that we found may be due to environmental factors such as mechanical stress during different works of which wine and textile production.

References:

1) Lee Russell MR (2000): Vitamins in Animal and Human Nutrition. Second edition, Printed on acid-free paper in the United States of America. © 2000 Iowa State University Press; 1989 Academic Press.
Holick MF (2006): Resurrection of vitamin D deficiency and rickets. J Clin Invest. 116: 2062-72.
2) Dusso AS, Brown AJ, Slatopolsky E, (2005): Vitamin D. Am J Renal Physiol. 289: 8-28.
Ortner DJ (2003): Identification of Pathological Conditions in Human Skeletal Remains. San Diego, CA: Academic Press.
3) Brickley M, and Ives R (2008). The Bioarchaeology of Metabolic Bone Disease. Academic Press, London.
4) Waldron T (2009): Paleopathology, Cambridge University Press, Cambridge.
5) Veselka B, Menno LP, Hoogland , Andrea L, and Waters R (2013): Rural Rickets: Vitamin D Deficiency in a Post-Medieval Farming Community from the Netherlands. Int. J. Osteoarchaeol. Published online in Wiley Online Library (wileyonlinelibrary.com).
6) Mays S, BrickleyM, Ives R (2006): Skeletal Manifestations of Rickets in Infants and Young Children in a Historic Population From England. Am J Phys Anthropol. 129:362–374.
7) KrucikG(2012):Osteomalacia.
http://www.healthline.com/health/osteomalacia
8) Iskandar Z (1979): Pharonic Egypt. Arab World printing House, Cairo. A.R.E.
9) Adams B (1988): Egyptian Mummies .Shire Egyptology. Shire Publications limited.
8) Bass WM (1987): Human Osteology: A Laboratory and Field Manual (3rd Ed.). Missouri Archaeological Society, Columbia.
9) Acsadi G, Nemeskeri J (1970): History of human life span and mortality. Akademiac Kiado Budapest. Quoted in Iscan, M. Y. and Loth, S.R. (1989): Osteological manifestations of age in the adult. In Reconstruction of Life from the Skeleton, ed. Iscan, M. Y. and Kennedy, K. (1989). Alan R. Liss, Inc.,New York.
10)Walker RA, Lovejoy CO (1985) : Radiographic changes in the clavicle and proximal femur and their use in the determination of skeletal age at death. Am J Phys Anthropol. 68(1):67-78.
11)Mark M (1990): Long bone growth of Mimbres subadults from the Nan Ranch (LA15049), New Mexico.Athesis submitted to the office of graduate studies of Texas A&M university in partial fulfillment of the requirements for the degree of master of arts.
12)Facchini F, and Veschi S (2004): Age Determination on Long Bones in a Skeletal Subadults Sample (b-12 Years). Coll. Antropol. 28 (1): 89–98. Bologna, Italy.
13)Gordina, Guntis Gerhardsb G, Tina Jakoba T (2013): Nutrition-related health problems in a wealthy 17–18th century German community in Jelgava, Latvia. Int J Paleo. (3) 30– 38.
14)Liberman UA, and Marx SJ (1999): Vitamin D-dependent rickets. In: Favus, M. (Ed.),Primer on the Metabolic Bone Diseases and Disorders of Mineral Metabolism. fourth ed. Lippincott William and Wilkins, Philadelphia: 323–328.
15)Menken CJ (2013) : Epidemiology and etiology of osteomalacia. Literature review. http://www.uptodate.com
16)Balasubramanian S (2013): Vitamin D deficiency in breastfed infants & the need for routine vitamin D supplementation. Indian J Med Res. 133: 250-2.
17)Donadoni S (1997): The Egyptians. University of Chicago Press, Chicago.
18)Fildes V (1986): Bresst Bottles and Babies: A Historv of Infànt Feedinq. Edinburgh University Press, Edinburgh.
19)Robins G (1993) Women in Ancient Egypt. Harvard University Press, Cambridge.
20)Bakeit ZA, and Abdel Megeid FY (2012) **:** Study of Risk Factors of Rickets in Children. World Appl. Sci. J., 17 (11): 1386-1393.