cPrevalence of (25) Vitamin - D Deficiency among Premenopausal Women Working In Fayoum University

Mohamed Mashahit[1], Haidy Michel [1]*, Emad El Moatasem [2] Mohamed El Basel[2] and Nagwa k. Roshdy[3]

[1]Department of Internal Medicine, Faculty of Medicine Fayoum University
[2]Department of Internal Medicine, Faculty of Medicine,Cairo University [3]Department of Medical Bio-chemistry and Molecular Biology, Faculty of Medicine Cairo University
mashahit@hotmail.com

Abstract: Vitamin - D deficiency is a worldwide problem and the prevalence of deficiency reaches more than 50% of the population in most of the studies and causes of deficiency are either inadequate intake of food containing vitamin - D or inadequate exposure to sun light which plays an important role of biosynthesis of vitamin- D from the skin, vitamin -D deficiency is linked to many diseases like cancer, diabetes, bone disorders, hypertension, obesity, dyslipidemia and many other disorders and correction of 25 -vitamin - D deficiency which is very simple and available and not expensive improves those disorders significantly. **This work aimed to** screening for vitamin 25- D deficiency among premenopausal women working in Fayoum University. **Subjects and methods**: two hundred healthy premenopausal non pregnant non lactating females aged 40-50 years old working at Fayoum University, subjected to thorough medical history and clinical examination, stressing on color of the skin BMI and style of clothing and all patients are screened for 25- vitamin D using ELISA. **Results**: Our results showed that 45 females of 200 were sufficient (22.5%), 91 females were insufficient (45.5%), 64 females were deficient (32%). Vitamin D deficient females subdivided into deficient (82.8%) and severely deficient (17.2%). there was significant difference between the mean of vitamin -D in the different BMI, in normal body weight subjects the mean of vitamin D level was 77.9 ± 21.7 in overweight was 51.4 ± 15.5 in obese (40 ± 22.4) and the difference is highly statistically significant ($p < 0.001$). The mean vitamin -D level for western wearing clothes was 66.8 ± 16.4, for ladies wearing Higab was 62 ± 23.2), and for ladies wearing Niqab 28.3 ± 16.3 and the difference is highly statistically significant ($p < 0.001$). The mean of vitamin D level in dark skinned subjects was 57.2 ± 21.2 while in white skinned subjects was 96.2 ± 33.8 and the difference is highly statistically significant ($p < 0.001$)**. Conclusion:** More than 75 % of the premenopausal women working in Fayoum University had either vitamin –D deficiency or insufficiency. obesity, darker skin and insufficient sun exposure are the main factors leading to or associated with 25 – vitamin - D deficiency

[Mohamed Mashahit, Haidy Michel, Emad El Moatasem Mohamed El Basel and Nagwa k. Roshdy. **Prevalence of (25) Vitamin - D Deficiency among Premenopausal Women Working In Fayoum University.** *Life Sci J* 2012;9(4):3332-3337]. (ISSN: 1097-8135). http://www.lifesciencesite.com. 492

Key words: Vitamin- D – Deficiency - Skin color - BMI - Diet - Sun exposure

1. Introduction:

Vitamin D deficiency is a growing worldwide problem with many health consequences (Michael and Tai, 2008).

It is an increasing prevalent disease in many areas all over the world such as: in United States 41.6% (Forrest and Stuhldreher, 2011), in Australia 67.3% (van der Mei *et al.,* 2007), in China 69.2% (Lu *et al.,* 2009), in India 66.3% (Arya *et al.,* 2004), in Germany 58% (Hintzpeter *et al.,* 2007), in Morocco 90% (Allali *et al.,* 2009), in Tunisia 47.6% (Meddeb *et al.,* 2005).

Vitamin D deficiency may be due to reduced skin synthesis as a result of inadequate exposure to sunlight, decreased bioavailability as in malabsorption and obesity, decreased activation as in hepatic and renal failure, increased catabolism due to some drugs (Anticonvulsants, glucocorticoids) and breast-feeding (Michael and Tai, 2008).

Vitamin D deficiency was found to be linked to many diseases such as: osteoporosis (Bell *et al.,* 2010), multiple sclerosis (Munger *et al.,* 2006), autoimmune diseases (Kriegel *et al.,* 2011), SLE (Azza *et al.,* 2011) influenza (Cannell *et al.,* 2006), tuberculosis (Nnoaham and Clarke, 2008), connective tissue-associated interstitial lung diseases (Hagaman *et al.,* 2011), HIV (Mehta *et al.,* 2010), high blood pressure and cardiovascular risk (Pittas *et al.,* 2010), peripheral artery disease (Melamed *et al.,* 2008), type 1 diabetes mellitus (Holick, 2005), cancers: colon, breast, ovarian and pancreatic cancers (Garland *et al.,* 2006) and increased mortality (Michaëlsson *et al.,* 2010).

Aim of the work

The aim of this work is screening prevalence of vitamin D deficiency among healthy premenopausal females aged 40-50 years old working at Fayoum University.

2. Subjects & Methods

Cross sectional study for two hundred healthy premenopausal females aged 40-50 years old working at Fayoum University.Exclusion criteria are, post menopausal females, pregnant & lactating females. Vegetarians, presence of mal-absorption disorders like Crohn's disease, celiac disease and cystic fibrosis, presence of any endocrinal disorder, presence of renal and hepatic disorders.

All subjects will be subjected to full history and clinical examination stressing on the color of the kin, body mass index and style of clothing either western style or if Hijab or Niqab is used. Liver and kidney functions. estimation of serum 25-hydroxyvitamin D using ELISA technique.

Statistical analysis

Collected data were computerized and analyzed using Statistical Package for Social Science (SPSS) version 16. Descriptive statistics were used to describe variables; percent, proportion for qualitative variables. Mean, SD, range for Quantitative variable. Comparison between groups was done using chi-Square test for qualitative variables, independent t- test and ANOVA test for quantitative variables. Pearson correlation was done between two quantitative variables to test association between variables. *p* values with significance of less than 5% were considered statistically significant.

3. Results

This study included 200 healthy premenopausal females between 40-50 years old, working at Fayoum University.

Demographic data of study group:

Study subjects divided into groups according to their BMI, color of skin and style of their clothes.

As shown in table (**1**), 76 out of the **200** females were of normal weight (**38%**), **93** females overweight (**46.5%**), **31** females obese (**15.5%**).

Table (1): Showing number and percent of different BMIs of study group. (Normal weight 18.5–24.9, overweight 25–29.9, obesity ≥ 30.)

BMI	Number	Percent
Normal	76	38%
overweight	93	46.5%
Obese	31	15.5%
Total	200	100%

Table (2): Showing frequency and percent of different color of skin of study group.

Color of skin	Number	Percent
Dark	187	93.5%
White	13	6.5%
Total	200	100.0%

As shown in table **2**, 187 out of the **200** females, **187** (**93.5%**) were of dark skin color and **13** (**6.5%**) had white color.

As shown in table **3**, 174 out of the **200** females, were wearing higab **(87%), 15** wearing niqab (**7.5%), 11** wearing western clothes **(5.5%).**

As shown in figure **1**, prevalence of vitamin D deficiency in the study group was as follow: **45** females out of **200** were **sufficient (22.5%)**, **91** females were **insufficient (45.5%)**, **64** females were **deficient (32%).**

Vitamin - D was considered insufficiency if serum 25(OH) D levels are between **20** and **29.99** ng/ml (**50**nmol/L and **74.99**nmol/L), deficiency below **20**ng/ml (**50**nmol/L), and severe deficiency below **10**ng/ml (=**25**nmol/L)

As shown in figure **2**, vitamin -D deficient females subdivided into deficient (**82.8%**) and severely deficient (**17.2%**).

As shown in figure **3**, there was significant difference between the mean of vitamin -D in the different BMI, in normal body weight subjects the mean of vitamin D level was **77.9 ± 21.7** in overweight **51.4 ± 15.5** in obese (**40 ± 22.4**) with statistically significant ($p < 0.001$).

As shown in figure **4**, the mean vitamin -D level for western wearing clothes was **66.8 ± 16.4**, for ladies wearing Higab were **62 ± 23.2**, and for ladies wearing Niqab were **28.3 ± 16.3**, with statistically significant ($p < 0.001$).

As shown in figure **5**, mean of vitamin D level in dark skinned subjects was (mean ± SD = **57.2 ± 21.2**), while in white skinned subjects was **96.2 ± 33.8**, and the difference is highly statistically significant ($p < 0.001$).

As shown in table (**4**), BMI, clothes and color of skin were significant predictors for vitamin D deficiency with significant $p < 0.005$.

Table (3):Showing frequency and percent of different styles of clothes of study group

.Style of Clothes	Number	Percent
Higab	174	87%
Niqab	15	7.5%
Western	11	5.5%
Total	200	100%

Table (4): Multiple linear regression model to show predictors of vitamin -D values
(Dependent Variable: Vitamin -D (nmol/ml)

Model	Un-standardized Coefficients		Standardized Coefficients	t	*P* value
	B	Std. Error	Beta		
(Constant)	68.9	7.5		9.1	.000
BMI	-23.7-	2.6	-.476-	-9.1-	.000
Clothes	-26-	4.7	-.284-	-5.6-	.000
Color of skin	29.1	5	.298	5.8	.000

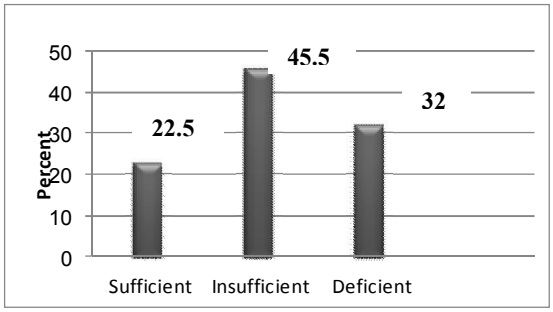

Figure (1): Showing values of vitamin -D in the studied group:

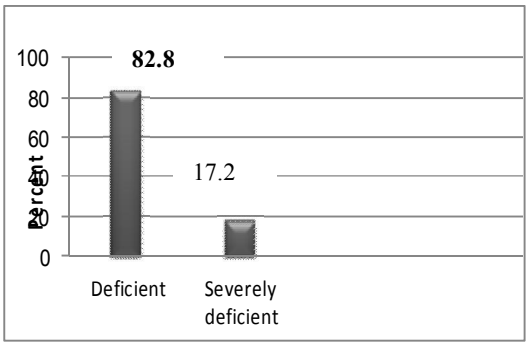

Figure (2): Showing percent of vitamin D deficient group:

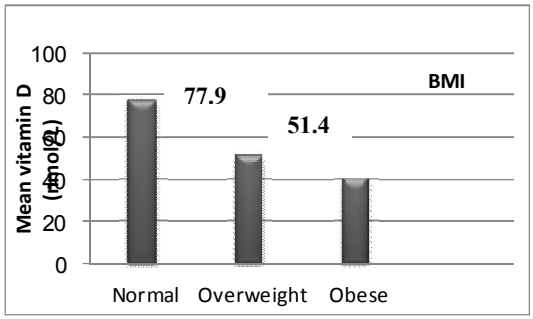

Figure (3): showing relation between BMI and mean of vitamin.D:

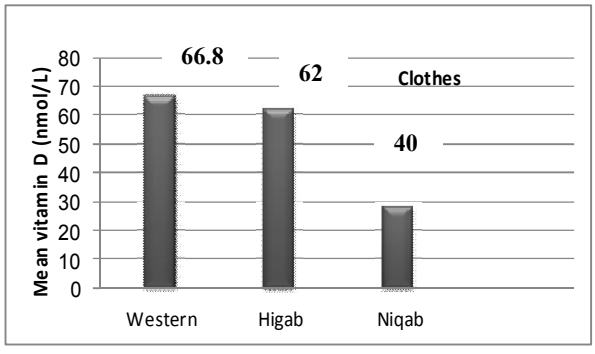

Figure (4): showing relation between different styles of clothes of study group and mean of vit D:

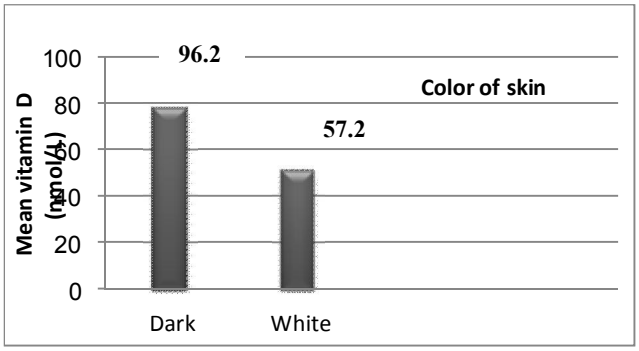

Figure (5): showing relation between color of skin and mean of vitamin D:

4. Discussion

Vitamin D insufficiency has been defined as a 25(OH) D concentration of 50–75nmol/L (20–30ng/ml) (The Endocrine Society, 2011). Vitamin D deficiency can be further classified as mild 25–50nmol/L (10–20ng/ml), moderate 12.5–25nmol/L (5–10ng/ml), and severe <12.5nmol/L (5ng/ml) (Stroud *et al.,* 2008). Recently hypo-vitaminosis D includes three categories according to cutoff values: insufficiency if serum 25(OH) D levels are between 20 and 29.99ng/ml (50nmol/L and 74.99nmol/L), deficiency below 20ng/ml (50nmol/L), and severe deficiency below 10ng/ml (25nmol/L) (Pérez-Lopez *et al.,* 2011).

Many factors can explain the high prevalence of vitamin -D deficiency, homebound individuals, women who wear long robes and head coverings for religious reasons, and people with occupations that limit sun exposure are unlikely to obtain adequate vitamin D from sunlight (Institute of Medicine, 2010). Greater amounts of the pigment melanin in the epidermal layer result in darker skin and reduce the skin's ability to produce vitamin D from sunlight, various reports consistently show lower serum 25(OH) D levels in persons identified as black compared with those identified as white (Institute of Medicine, 2010). As a fat-soluble vitamin, vitamin D requires some dietary fat in the gut for absorption. Individuals who have a reduced ability to absorb dietary fat might require vitamin D supplements. Fat malabsorption is associated with a variety of medical conditions including some forms of liver disease, cystic fibrosis, and Crohn's disease (Holick, 2006).

in this study we aimed to get an idea if the prevalence and possible relevant etiological factors for vitamin (25) –D deficiency. Two hundred healthy premenopausal non pregnant non lactating females aged 40-50 years old working at Fayoum University, subjected to thorough medical history and clinical examination, stressing on color of the skin, BMI and style of clothing and all patients are screened for 25-vitamin- D using ELISA.

Our results showed that 45 females of 200 were sufficient (22.5%), 91 females were insufficient (45.5%), 64 females were deficient (32%). Vitamin D deficient females subdivided into deficient (82.8%) and severely deficient (17.2%). there was significant difference between the mean of vitamin -D in the different BMI, in normal body weight subjects the mean of vitamin D level was 77.9 ± 21.7, in overweight 51.4 ± 15.5), in obese (40 ± 22.4) and the difference is highly statistically significant ($p < 0.001$). The mean vitamin -D level for western wearing clothes was 66.8 ± 16.4 for ladies wearing Higab 62 ± 23.2), and for ladies wearing Niqab 28.3 ± 16.3), and the difference is highly statistically significant ($p < 0.001$). The mean of vitamin D level in dark skinned subjects was 57.2 ± 21.2 while in white skinned subjects was 96.2 ± 33.8 and the difference is highly statistically significant ($p < 0.001$).

Vitamin D status has been studied on all continents and in most countries throughout the world. In total, approximately 5,060 epidemiological studies have been done according to a Pub Med search conducted in February 2012. These studies revealed that vitamin D deficiency was prevalent across all age-groups, geographic regions, and seasons (Michael, 2012).

Investigators have reported that in women being administered medications to treat diagnosed osteoporosis, 37% of those in Sweden, 75% of those in the United Kingdom, 68% of those in Germany, 52% of those in the Netherlands, 50% of those in France, 63% of those in Switzerland, 56% of those in Hungary, 65% of those in Spain, 77% of those in Turkey, 85% of those in Lebanon, 92% of those in South Korea, 90% of those in Japan, 47% of those in Thailand, 49% of those in Malaysia, 67% of those in Mexico, 42% of those in Brazil, 50% of those in Chile, and 60% of those in Australia exhibited serum 25-OHD3 concentrations lower than 75nmol/L (Michael, 2012).

In a survey conducted in the central United States, it was found that 67% of women without health insurance exhibited serum 25-OHD concentrations lower than 50nmol/L (Kakarala *et al.,* 2007).

In the Canadian Health Measures Survey (n = 5306), Overall, 5.4%, 12.7%, and 25.7% of the participants had 25(OH) D concentrations below the 30, 40, and 50nmol/L respectively. (Susan *et al.,* 2011).

In Australia, almost one-third of adults over the age of 25 have a Vitamin D deficiency, in a new study from the University of Melbourne. The study involved 11,218 Australians. The overall prevalence of vitamin D deficiency was 31%, with Australian women being more commonly affected (39%, in contrast with 23% in Australian men,) (Daly *et al.,* 2012).

In this study we only screened premenopausal women but in another study done in Egypt, also a random sample of 120 (90 females and 30 males) apparently healthy undergraduate students, Zagazig, Sharkia, were enrolled in cross sectional study, mean serum 25(OH) D level was 23.7 ± 12.681ng/ml using a cutoff point of 30ng/ml, 74.6% of sample (61.7% males and 79.2% females) had low vitamin D status (Maggie *et al.,* 2012).

Despite ample sunshine, vitamin D deficiency is very common in the Middle East and African countries (Alshishtawy, 2011).

The first study to reveal low vitamin D concentrations in people of the Middle East region was conducted by Woodhouse and Norton in 1982 among ethnic Saudi Arabians (Woodhouse and Norton, 1982).

Their results were confirmed in 1983, when Sedrani et al. recorded a mean 25(OH) D concentration ranging between 10–30nmol/L among Saudi university students and the elderly patients values was also deceased (Pietras *et al.,* 2009).

Another study, also conducted in the eastern regions of Saudi Arabia, showed low serum 25(OH) D concentrations among both males and females (25.25nmol/L and 24.75nmol/L, respectively) (Elsammak *et al.,* 2011).

In Oman, according to the 2004 Ministry of Health survey, out of 298 non-pregnant women of child bearing age, 21.4% were found to be vitamin D deficient (<50nmol/L) (Ministry of Health, Oman, 2008).

A more recent study tested serum 25(OH) D concentrations in 41 apparently healthy Omani women of childbearing age. The study indicated that all women had serum 25(OH) D concentrations of <50nmol/L (Al-Kindi, 2011).

Similarly, vitamin D deficiency was found to be highly prevalent in the United Arab Emirates (UAE). The results revealed that most women had vitamin D deficiency (25(OH) D ≤ 50nmol/L at study entry) (Saadi *et al.,* 2007).

A very recent study done by Anouti et al. who investigated a random sample of 208 young Emirati university students in Abu Dhabi, 138 females and 70 males. The mean serum 25(OH) D concentration for female students tested in April was 31.3 ± 12.3nmol/L, while in October, it was 20.9 ± 14.9nmol/L (Anouti *et al.,* 2011).

In Qatar, the mean overall vitamin D concentration among health care professionals working at Hamad Medical Corporation in Doha was found to be 29.3nmol/L. Vitamin D concentration was lower in females (25.8nmol/L) than in males (34.3nmol/L). A total of 97% of all participants had a mean concentration <75nmol/L, while 87% had a

mean concentration of <50nmol/L (Mahdy *et al.,* 2010).

Studies in Turkey and Jordan showed also a strong relationship with clothing, Serum 25(OH) D levels were highest in women who wore Western clothing, decreasing in traditional women wearing a *hijab*, and the lowest levels were measured in completely veiled women who wore a *niqab.*Men in these countries have higher concentrations than women (Mishal, 2001).

In Iran, a population study that included 1,210 men and women between 20 and 69 years old showed that the mean serum 25(OH) D was 20.6nmol/L (Hashemipour *et al.,* 2004).

In Lebanon, vitamin D-inadequacy among the 251 Lebanese postmenopausal osteoporotic women (from both Muslim and Christian communities) who participated in a vitamin D international epidemiological study. Vitamin D inadequacy prevalence (25-hydroxyvitamin D (25(OH) D), less than 30 ng/ml) was 84.9%. Muslim community participants had lower 25(OH) D levels compared with their Christian counterparts (P<0.001). (Gannagé-Yared *et al.,* 2009).

A recent United Kingdom (UK) survey among the white population showed 16% prevalence of insufficiency and 50% deficiency in the winter and spring, the local prevalence, in a multiethnic population, shows much higher rates of deficiency. Among South Asians tested in routine clinical practice, >90% were found to have insufficient or deficient levels (Hypponen and Chris, 2007).

In Morocco group study of 415 women aged 24 to77 years old the prevalence of vitamin D insufficiency (<30ng/mL) was 91%. (Fadoua *et al.,* 2008).

A study done in Tunisia between January and March 2002, 380 subjects aged 20-60 years were included in the study. The accumulated prevalence of hypo-vitaminosis D was 47.6%, increasing with age. Hypo-vitaminosis is highly prevalent in women (P<0.001). Multiparty, menopause, wearing the veil, and calcium and vitamin D dietary intake are factors associated with hypo-vitaminosis D (P<0.05) (Meddeb *et al.,* 2005).

Thus, it seems that the world is facing today what is, in fact, a new endemic disease that was, until recently, totally veiled. The actual percentage of vitamin-D-deficient people seems to be far greater than reported, so identifying the reasons for the dramatic increase in vitamin D insufficiency is not an easy task.

Conclusion:

More than 75 % of the premenopausal women working in Fayoum University had either vitamin –D deficiency or insufficiency. obesity, darker skin and insufficient sun exposure are the main factors leading to or associated with 25 – vitamin - D deficiency

Recommendations:

From this study we recommend further screening for males, to treat those who are vitamin -d deficient or insufficient and to follow them up for detecting any complications or of vitamin d deficiency.

References

1. Al-Kindi M (2011): Vitamin D status in healthy Omani women of childbearing age. SQU Med J; 11:56–61.
2. Allali F., El Aichaoui S., Khazani H *et al.*(2009): "High prevalence of hypovitaminosis D in Morocco". Semin Arthritis Rheumatology.; 38(6):444-51.
3. Alshishtawy M (2011): To be or not to be exposed to direct sunlight: Vitamin D deficiency in Oman. SQU Med J 11:196–200.
4. Anouti F, Thomas J, Abdel-Wareth L *et al.* (2011): Vitamin D deficiency and sun avoidance among university students at Abu Dhabi, United Arab Emirates. Dermatoendocrinol; 3:1–5.
5. Arya V., Bhambri R., Godbole M.M *et al.* (2004):"Vitamin D status and its relationship with bone mineral density in healthy Asian Indians". Osteoporosis International.; 15(1):56-61.
6. Azza A. Darwish H., Rasha M., Amal E., El Basel M., and Mashshit M. (2011). Assessment of vitamine D levels in SLE patients and its correlation to disease parameters.Egyp. Rheumat. Rehab. J. (38)2 305-16
7. Bell T.D., Demay M.B, Burnett-Bowie S.A.M *et al.* (2010): "The biology and pathology of vitamin D control in bone". Journal of Cellular Biochemistry 111 (1): 7–13.
8. **Cannell J.J, Vieth R., Umhau J.C** *et al.* (2006): "Epidemic influenza and vitamin D. "Epidemiol Infection.; 134(6):1129-40.
9. Daly R, Gagnon C, Lu Z *et al.* (2012): Prevalence of vitamin D deficiency and its determinants in Australian adults aged 25 years and older. Clin Endocrinol. (Oxf). 77(1):26–35.
10. Fadoua A, Sihame A, Hamza K *et al.* (2008): High Prevalence of Hypo-vitaminosis D in Morocco, j.semarthrit. 01.009.
11. Forrest K and Stuhldreher W (2011): Prevalence and correlates of vitamin D deficiency in US adults. Nutrition Research 31(1):48-54.
12. Gannagé-Yared M, Maalouf G, Khalife S *et al.* (2009): Prevalence and predictors of vitamin Dinadequacy amongst Lebanese osteoporotic women, Br J Nutr.; 101(4):487-91.

13. Garland C.F, Garland F.C, Gorham *et al.* (2006): "The role of vitamin D in cancer prevention". American journal of public health 96 (2): 252–61.

14. Hagaman J.T, Panos R.J, McCormack F.X *et al.* (2011): "Vitamin D deficiency and reduced lung function in connective tissue-associated interstitial lung diseases"; 139(2):353-60.

15. Hashemipour S, Larijani B, Adibi H *et al.* (2004): Vitamin D deficiency and causative factors in the population of Tehran. BMC Public Health; 4:38.

16. Hintzpeter B., Mensik G., Thierfelder W. *et al.* (2007): "Vitamin D status and health correlates among german adults". European Journal of Clinical Nutrition:1-11.

17. Holick M (2006): Vitamin D. Modern Nutrition in Health and Disease, 10th ed. Philadelphia: Lippincott Williams & Wilkins.

18. Holick M. (2005): "Vitamin D: important for prevention of osteoporosis, cardiovascular heart disease, type 1 diabetes, autoimmune diseases, and some cancers". South Medical Journal.; 98(10):1024-7.

19. Hypponen E and Chris Power (2007): Hypovitaminosis in British adults age 45. Am J Clin Nutr vol. 85 no. 3 860-868.

20. Institute of Medicine, Food and Nutrition Board (2010): Dietary Reference Intakes for Calcium and Vitamin D. Washington, DC: National Academy Press.

21. Kakarala R, Chandana S, Harris S *et al.* (2007): Prevalence of vitamin D deficiency in uninsured women. J Gen Intern Med 22:1180–3.

22. Kriegel MA, Manson JE and Costenbader KH (2011): "Does vitamin d affect risk of developing autoimmune disease? "Semin Arthritis Rheumatology; 40(6):512-531.e8.

23. Lu.L, Yu. Z, Pan A., Hu F.B *et al.* (2009): "Plasma 25-hydroxyvitamin D concentration and metabolic syndrome among middle-aged and elderly Chinese individuals". Diabetes Care; 32(7):1278-83.

24. Maggie M., Enas S. and Nagwa S. (2012): plasma levels of 25-hydroxyvitamin D and dress style in a sample of Egyptian females university students. Life Science Journal; 9(2) 763-767.

25. Mahdy S, Al-Emadi S, Khanjar I *et al.* (2010): Vitamin D status in health care professionals in Qatar. Saudi Med J; 31:74–7.

26. Meddeb N, Sahli H, Chahed M *et al.* (2005): "Vitamin D deficiency in Tunisia".Osteoporosis International; 16(2):180-3.

27. Mehta S., Giovannucci E., Mugusi F.M *et al.* (2010): "vitamin D status in HIV- infected women and it's association to HIV disease progression, anemia, mortality". PLoS ONE 5 (1): e8770.

28. Melamed M.L, Muntner P., Michos E.D *et al.* (2008): "Serum 25-hydroxyvitamin D levels and the prevalence of peripheral arterial disease". Arteriosclerosis, thrombosis, and vascular biology 28 (6): 1179–85.

29. Michael F. Holick m. and Tai C, (2008): "Vitamin D deficiency: a worldwide problem with health consequences" American Journal of Cl. Nutrition; 87:1080S-1086S.

30. Michael J (2012): A 21st century evaluation of the safety of oral vitamin D.Nutrition 28: 344–356.

31. Michaëlsson K., Baron J.A, Snellman G *et al.* (2010): "Plasma vitamin D and mortality in older men: a community-based prospective cohort study". The American Journal of Clinical Nutrition 92 (4): 841–8.

32. Ministry of Health, Oman (2008): Micronutrients Testing, Community Health & Disease Surveillance Newsletter Muscat: Ministry of Health, Pp. 12–13.

33. Mishal A (2001): Effects of different dress styles on vitamin D levels in healthy young Jordanian women. Arch Osteoporos; 12:931–5.

34. Munger K.L,Levin LI, Hollis B.W *et al.* (2006): "Serum 25-hydroxyvitamin D levels and risk of multiple sclerosis". Journal of the American Medical Association 296 (23): 2832–8.

35. Nnoaham KE and Clarke A, (2008): "Low serum vitamin D levels and tuberculosis: a systematic review and meta-analysis". International journal of Epidemiology: 37 (1): 113–9.

36. Pérez-Lopez F, Chedraui P and Fernandez-Alonso A (2011): Vitamin D and aging:beyond calcium and bone metabolism. Maturitas 69:27–36.

37. Pietras S., Obayan B., Cai M. *et al.* (2009): Vitamin D2 treatment for vitamin D deficiency and insufficiency for up to 6 years. Arch Intern Med 169:1806–8.

38. Pittas A.G, Chung M., Trikalinos T; *et al.* (2010): "Systematic review:Vitamin D and cardiometabolic outcomes". Annals of Internal Medicine 152 (5): 307–14.

39. Saadi H, Dawodu A., Afandi B. *et al.* (2007): Efficacy of daily and monthly high dose calciferol in vitamin D deficient nulliparous and lactating women. Am J Clin Nutr; 85:1565–71.

40. Van der Mei IA, Ponsonby AL, Engelsen O. *et al.* (2007): "The high prevalence of vitamin D insufficiency across Australia populations is only partly explained by season and latitude". Environ Health Perspect; 115(8):1132-9.

41. Woodhouse N and Norton W (1982): Low vitamin D level in Saudi Arabians. King Faisal Spec Hosp Med J; 2:127–31.

11/10/2012