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**RESEARCH ARTICLE**

# STUDY OF VITAMIN D LEVELS IN ADULT MALES IN DAKAHLIA GOVERNORATE IN EGYPT

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## *Abstract*

**Background:** Vitamin D is a growing endemic problem. Wide proportions of healthy adults are deficient in vitamin D**.** It is very important for skeletal and non-skeletal health. It is now well established that many people have vitamin D levels that are less than currently recommended for optimal health**. Aim of this work:** To assess vitamin-D sufficiency/deficiency in a sample of healthy Egyptian adult males in Dakahlia Governorate in Northern Egypt and correlate it to social status, Sun exposure and Vitamin D intake in food. **Subjects and methods:** This cross-sectional study was conducted on 90 healthy Males selected randomly from the relatives of patients in Outpatient Clinics and Internal Medicine Departement of El-Gamalia General Hospital. Medical History, Dietary Questionnaire and Sun exposure Questionnaire was taken from all participants who were clinically examined as well. Laboratory investigations including hemoglobin, serum creatinine, ionized calcium were measured in all subjects and 25-(OH) vitamin D was measured in 57 subjects. **Results:**. 44 out of 57 subjects (77%) had deficient vitamin D levels (<20 ng/ml), 8 (14%) had insufficient levels (21-30 ng/ml) and 5 (9%) had sufficient levels (>30 ng/ml). 55.6% of our subjects had moderate intake of vitamin D rich foods while 18.9% had high intake and 25.6% had low intake. 53 subjects had indoor occupations while 37 subjects had outdoor occupation. Sun exposure was found to be positively and significantly correlated with vitamin D levels, (r= 0.37, P value 0.005). Vitamin D was positively and significantly correlated to sun exposure in case of moderate intake of vitamin D rich foods (r=0.419, P value 0.021) and in those with indoor activities, (r= 0.451, P value 0.005). **Conclusion:** Our results show a high rate of hypo-vitaminosis D in adult Egyptian Males in Dakahlia Governorate. Sun exposure was found to be the most dependent risk factor for this hypovitaminosis D.

## INTRODUCTION

Vitamin D is a growing endemic problem. Wide proportions of healthy adults are deficient in vitamin D **(Holick, 2007).**

Hypovitaminosis D (HVD) is important for skeletal and non-skeletal health. It is now well established that many people have vitamin D levels that are less than currently recommended for optimal health. Worldwide, vitamin D is predominantly obtained through exposure to ultraviolet B (UVB) radiation in the form of sunlight and cutaneous vitamin D production. Latitude, cultural dress habits, season, sun avoidance, and sunscreen protection can all limit vitamin D production. Gastrointestinal, hepatic, and renal disease may be related to low vitamin D levels (**Kurt et al., 2010).** The vitamin D endocrine system plays an essential role in calcium homeostasis and bone metabolism, but researches during the past two decades have revealed a diverse range of biological actions. These extra-osseous actions include: induction of cell differentiation, inhibition of cell growth, immune modulation, and control of other hormonal systems. Vitamin D itself is a pro-hormone that is metabolically converted to active metabolite 1, 25- dihydroxy- vitamin D **(Dusso et al., 2005).**

25-Hydroxyl-vitamin D is the major circulating form of vitamin D that is used by clinicians to determine vitamin D status **(Holick, 2007).**

Despite that a large part of Africa lies within tropics and subtropics, vitamin D deficiency rickets due to restricted sun light exposure is still seen in infants and young children in many African countries such as: Ethiopia, Egypt, Sudan, Algeria, and Libya **(Thacher et al., 2006).**

In the Middle East, vitamin D deficiency and rickets continues to be a public health problem despite abundant all year sunshine in many of the regions. Infants, adolescent females and pregnant women are particularly at risk. Social and religious customs, which prevent adequate sunlight exposure of pregnant women and their adolescent daughters are major factors in predisposing the children and young infants to vitamin D deficiency and rickets **(Pettifor, 2008).**

Most experts define Vitamin D deficiency as 25-hydroxyl vitamin D level of less than 20 ng per milliliter (50 nmol per liter) **(Holick, 2007).**

Previous studies done in Egypt had demonstrated wide prevalence of hypovitaminosis D in Egyptian females in the child bearing period living in Cairo **(Botros et al., 2011 b)** as well as in different age groups living in Port-Fouad **(Botros et al., 2011 a).**

## Aim of the work

We aimed in this study to assess the status of vitamin-D sufficiency/deficiency in males and correlate it to social status, Sun exposure and Vitamin D intake in food. We chose a northern Egyptian governorate as a representative of a semi-urban community.

## Subjects and methods

This cross-sectional study was conducted at Dakahlia Governorate. It included 90 healthy males selected randomly from the relatives of patients in Outpatient Clinic and Internal Medicine Departement of Elgamalia General Hospital in the period from March to September 2013.

Healthy males aged 20- 60 years were included. Those with chronic systemic diseases(CKD-CLD-CHF) were excluded.

. The study aim was explained and the participants consented to join the study.

## Methods:

All participants were interviewed. Beside history taking and physical examination a dietary and a sun exposure questionnaire was performed.

### I. Full history taking with special emphasis on:

1. **Name, Age, Address and Job.**

**Social status:** classified into A, B and C.

- **A**= Privileged class: Business men and Land owners.
- **B**= Middle social class: Office worker, small business owner and small land owner.

- **C**= Underprivileged class:

  Manual worker, farmer without property, jobless and day worker without permanent job.

2. **Sun exposure hours per week: (Holick, 2011b)**

sun exposure questions:

1) Do you walk to your work? How many hrs/day?
2) Your job outdoor/indoor?
3) You shopping outdoor?
4) Your weekend? Outdoor with family? How many hours?
5) Summer vacation? Beach? Village?

3. **Intake of vitamin D rich food:** classified into H, M and L. **(Catherine et al., 2009)**

**H**= high intake > 3 meals/week.
**M**= moderate intake 2-3 meals/week.
**L**= low intake < 2 meals/week.
Foods rich in vitamin D: Egg, milk, catfish, hering, salmon, sardine, liver & meat.

4. **Occupation:** outdoor / indoor.
5. **Vitamin D and Calcium supplement:** Yes / no.

II. **Past history** of any chronic diseases or drugs:

III. **Physical examination:**

- Pulse, blood pressure (systolic & diastolic)
- Anthropometric measures (weight, height and body mass index)

  Body weight and height were measured by balance and ruler in the hospital.
  Body mass index was estimated according to the equation:
  Body mass index = weigh (kg)/ [height (m)]$^2$

IV. **Systemic clinical examination:**

Cardiac, chest and abdominal examination.

V. **Laboratory methods:**

1- Hemoglobin level.
2- Serum Calcium.
3- Serum Creatinine.
4- 25-hydroxy vitamin D assay using ( RIA ).

Patients were classified according to the Endocrine society guidelines for 2011 into vitamin D deficient if serum 25 OH vitamin D is ≤20 ng/dl and insufficient if it is 21-29 ng/dl and sufficient if it is ≥ 30 ng/dl **(Holick, 2011a)**

**Statistical analysis**:

It was performed using SPSS software package version 18. Data were expressed as mean ± standard deviation. The Students t test was used for comparison of parametric data. A one –way ANOVA with post hoc tests to determine LSD (least significant difference), Pearson correlation coefficient and $X^2$=Chi-Square test were performed.

## Results

The descriptive and laboratory data of all subjects are summarized in (table 1)

In our study, 67.8% of subjects were middle privileged, 31.1% underprivileged and 1.1% as privileged.(figure 1)

80% had hypocalcaemia as defined by ionized calcium level below 1.16mmol/L while 20% had normal calcium level (figure 2)

Vitamin D level was assessed in 57 subjects. 77% had deficient vitamin D as defined by vitamin D level of < 20 ng/ml, 14% with insufficient vitamin D as defined by vitamin D level ranging 20-30 ng/ml, and 9% with sufficient vitamin D as defined by vitamin D level > 30 ng/ml (figure 3)

55.6% of our subjects had moderate intake of vitamin D rich foods while 18.9% had high intake and 25.6% had low intake .(figure 4)

59% had indoor occupations while 41% had outdoor occupation (figure 5). Average sun exposure was 13.1±5.5 hours weekly. There was significant difference between indoor and outdoor occupations as regard sun exposure (9.9±4 hours/week vs 17.4±4.1 hours/week respectively, P value <0.001).

On comparing vitamin D deficient and insufficient groups ( figure 6) , deficient and sufficient groups (figure 7) , un-previliged, middle previliged and previliged groups (igure 8) and low, moderate and high intake of vitamin D groups (figures 9,10,11) as regards the different parameters, there were no significant differences between them except for sun exposure, ( $p < 0.001$,$p=0.008$, $p<0.001$ respectively).

There were significant differences between indoor and outdoor occupations ($p=0.007$, figure 12) as well as among different social classes ( $p<0.001$, figure 13) as regards vitamin D levels.

On doing correlation between the studied variables in the study group we found a positive significant correlation between age and creatinine, sun exposure and vitamin D and between systolic and diastolic blood pressure.(table 2, figure 14)

Through further analysis, vitamin D was positively and significantly correlated to sun exposure in case of moderate intake of vitamin D rich foods ($r= 0.419$, P value 0.021). (Figure 15) and in those with indoor activities, ($r=0.451$, $p= 0.005$).(figure 16)

Table (1): Summarizes the whole group(90 subjects) characteristics

| | **Mean ± S D** |
|---|---|
| Age (in years) | 40.7 ± 12.5 |
| Cr.(mg/dl) | 1.1±0.1 |
| Ca++(mmol/L) | 1.1± 0.1 |
| Vit.D(ng/ml) | 19.2 ± 12.2 |
| BMI (kg/m$^{2)}$ | 28 ± 5.0 |
| Diastolic (mmhg) | 76.7 ± 6.4 |
| Systolic(mmhg) | 118.1 ± 9.5 |
| Sun Exposure(in hours) | 13.1 ± 5.5 |

Table (2): Correlation between studied variables in the study group

| | | **Age** | **Hb%** | **Cr.** | **Ca++** | **Vit.D** | **BMI** | **Pulse** | **Diast.** | **Syst.** | **Sun Exposure** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Age (years)** | **R** | 1 | -.005 | **.324** | -.106 | .039 | .084 | -.151 | .064 | .152 | -.096 |
| | **P** | | .965 | **.002** | .318 | .776 | .431 | .155 | .547 | .153 | .366 |
| **Hb (gm%)** | **R** | -.005 | 1 | -.169 | -.079 | .022 | -.067 | .076 | -.003 | .002 | -.144 |
| | **P** | .965 | | .112 | .457 | .872 | .532 | .479 | .974 | .986 | .175 |
| **Cr.(mg/dl)** | **R** | **.324** | -.169 | 1 | -.055 | -.033 | .124 | -.162 | -.010 | -.019 | -.038 |
| | **P** | **.002** | .112 | | .605 | .807 | .245 | .127 | .929 | .860 | .725 |
| **Ca++** (mmol/L) | **R** | -.106 | -.079 | -.055 | 1 | -.009 | -.083 | -.053 | -.109 | -.012 | .142 |
| | **P** | .318 | .457 | .605 | | .947 | .438 | .619 | .305 | .910 | .182 |
| **Vit.D** (ng/ml) | **R** | .039 | .022 | -.033 | -.009 | 1 | .245 | -.074 | -.073 | .013 | **.370** |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **P** | .776 | .872 | .807 | .947 | | .066 | .586 | .589 | .922 | **.005** |
| **BMI (kg/m$^2$)** | **r** | .084 | -.067 | .124 | -.083 | .245 | 1 | .050 | -.050 | -.025 | .072 |
| | **P** | .431 | .532 | .245 | .438 | .066 | | .639 | .640 | .812 | .499 |
| **Pulse (beat/min)** | **r** | -.151 | .076 | -.162 | -.053 | -.074 | .050 | 1 | -.071 | -.062 | .080 |
| | **P** | .155 | .479 | .127 | .619 | .586 | .639 | | .505 | .562 | .451 |
| **Diast. (mmHg)** | **r** | .064 | -.003 | -.010 | -.109 | -.073 | -.050 | -.071 | 1 | **.628** | -.019 |
| | **P** | .547 | .974 | .929 | .305 | .589 | .640 | .505 | | **.000** | .856 |
| **Syst. (mmHg)** | **r** | .152 | .002 | -.019 | -.012 | .013 | -.025 | -.062 | **.628** | 1 | -.008 |
| | **P** | .153 | .986 | .860 | .910 | .922 | .812 | .562 | **.000** | | .940 |
| **Sun Exposure (in hours)** | **r** | -.096 | -.144 | -.038 | .142 | **.370** | .072 | .080 | -.019 | -.008 | 1 |
| | **P** | .366 | .175 | .725 | .182 | **.005** | .499 | .451 | .856 | .940 | |

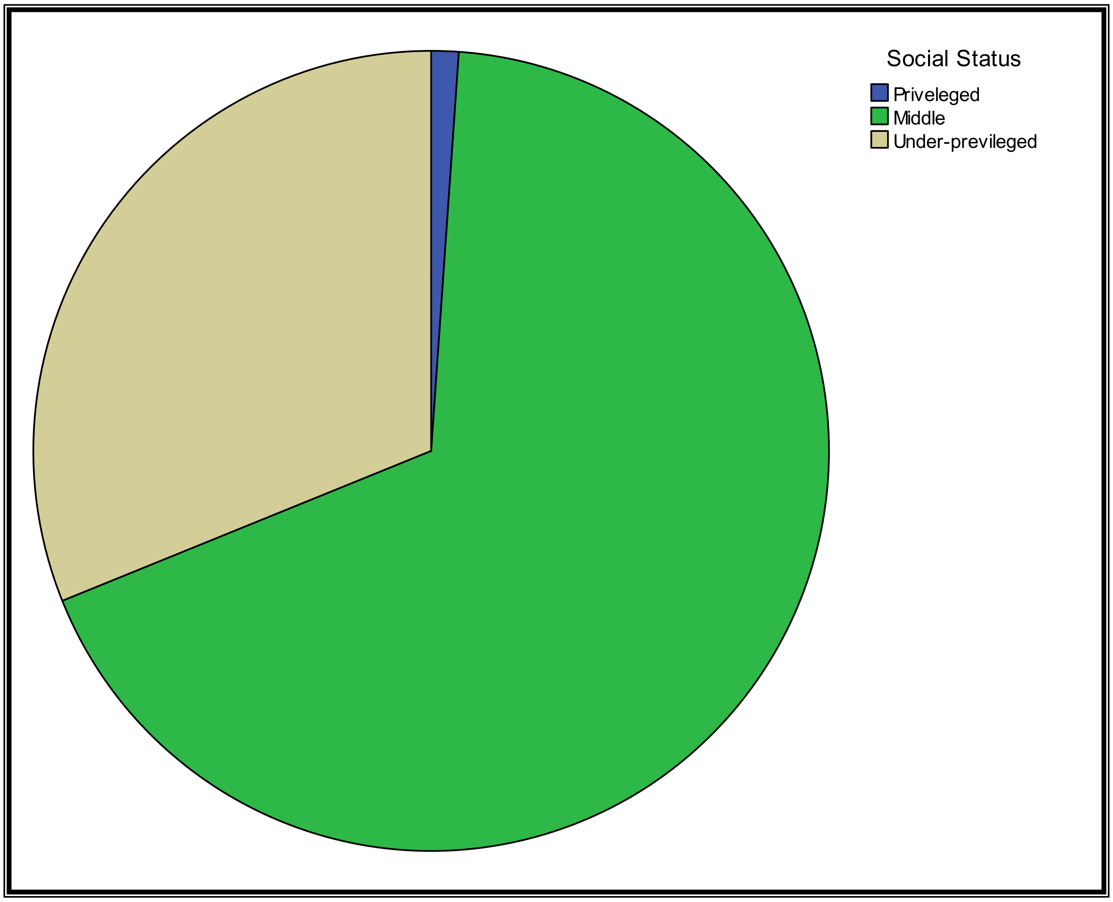

Fig. (1): Study subjects classified according to social class status

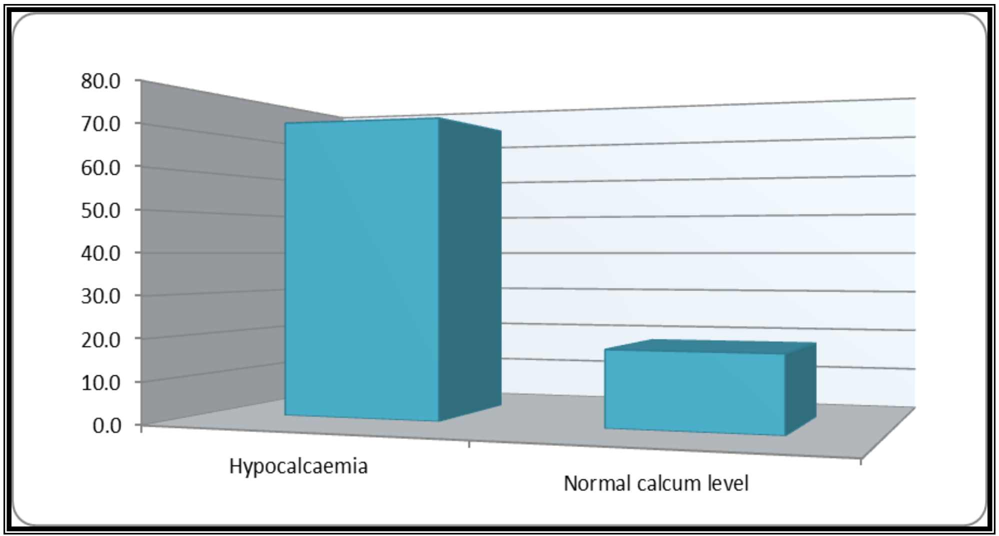

Fig. (2): Calcium levels in our study group.

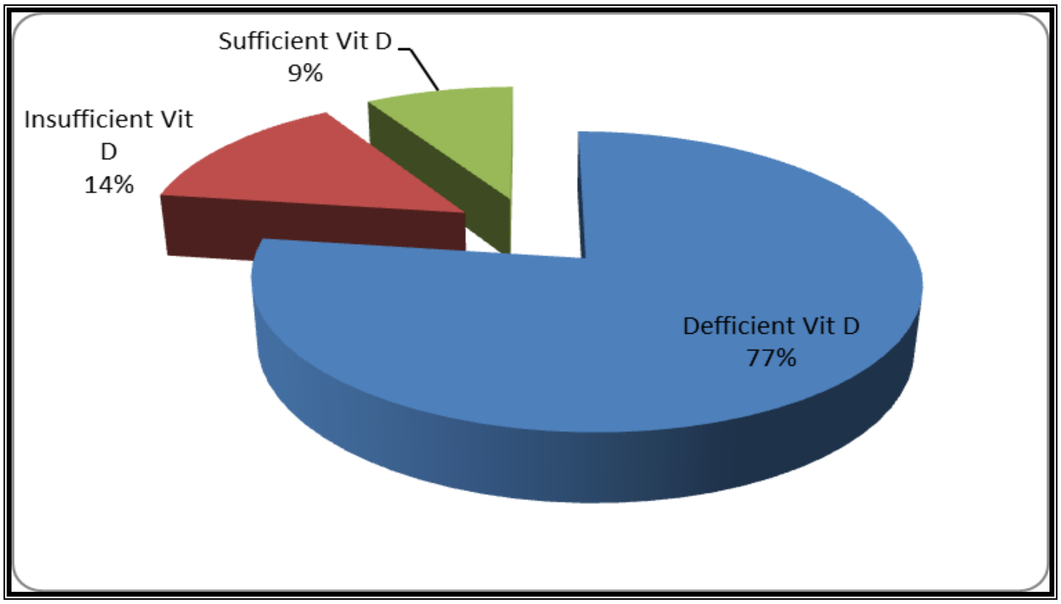

Fig. (3): Vitamin D level in our study group, divided into 3 groups.

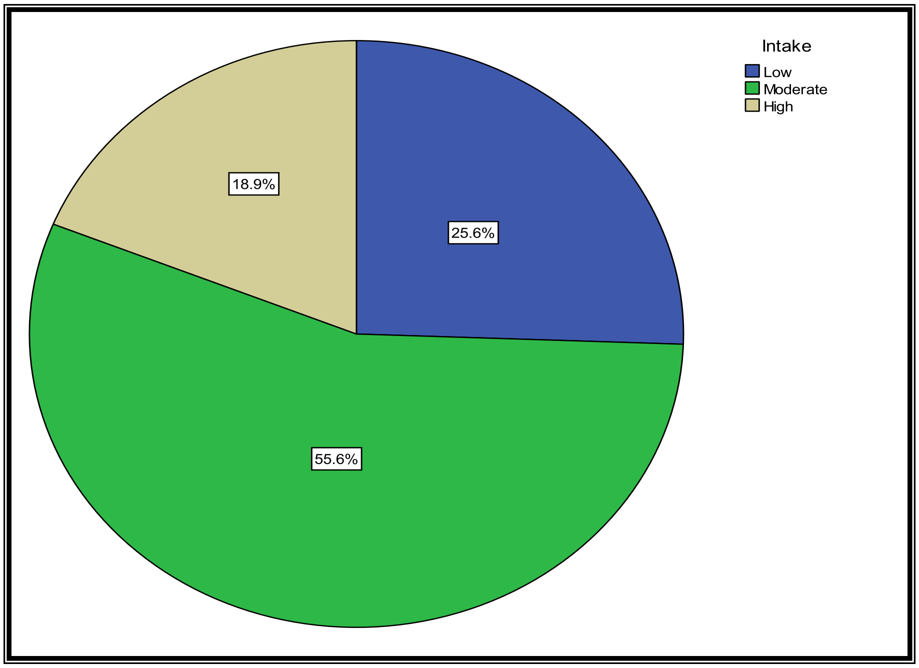

Fig. (4): Intake of vitamin D rich foods

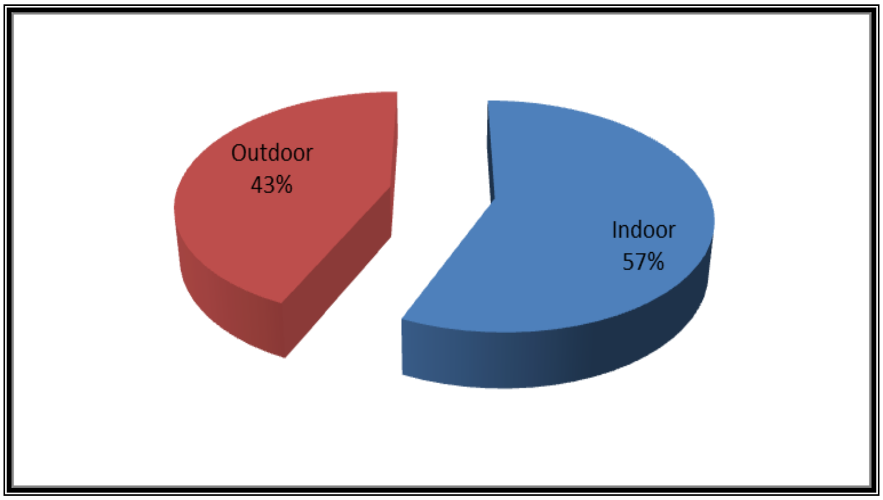

Fig. (5): Indoor vs outdoor occupations

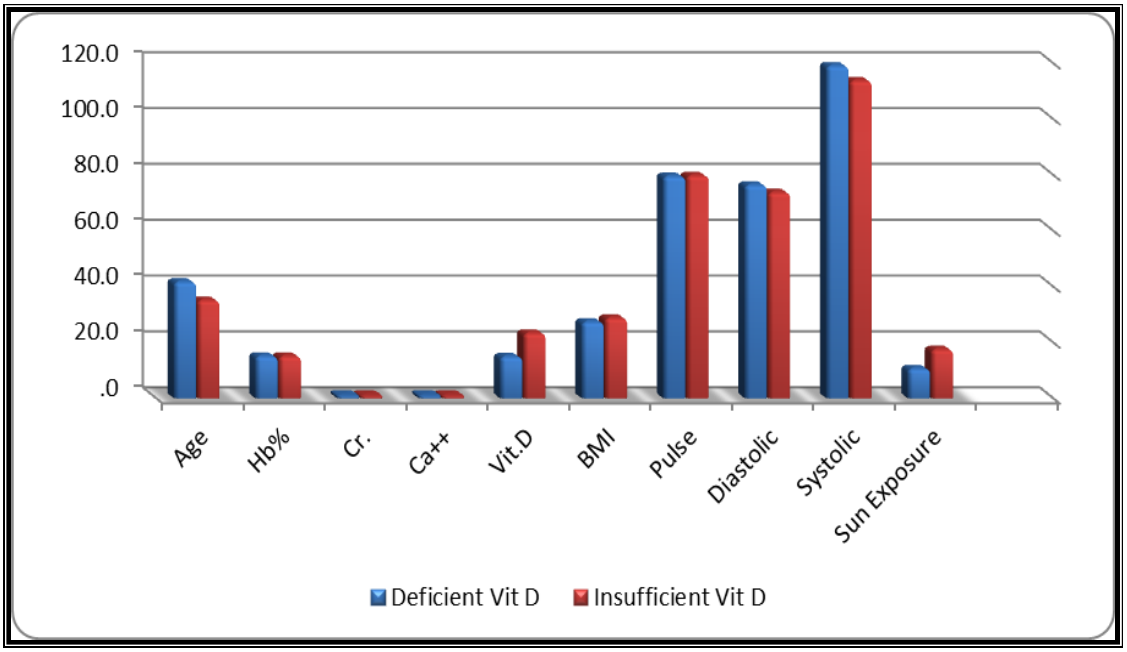

Fig. (6): Comparison between deficient and insufficient vitamin D groups

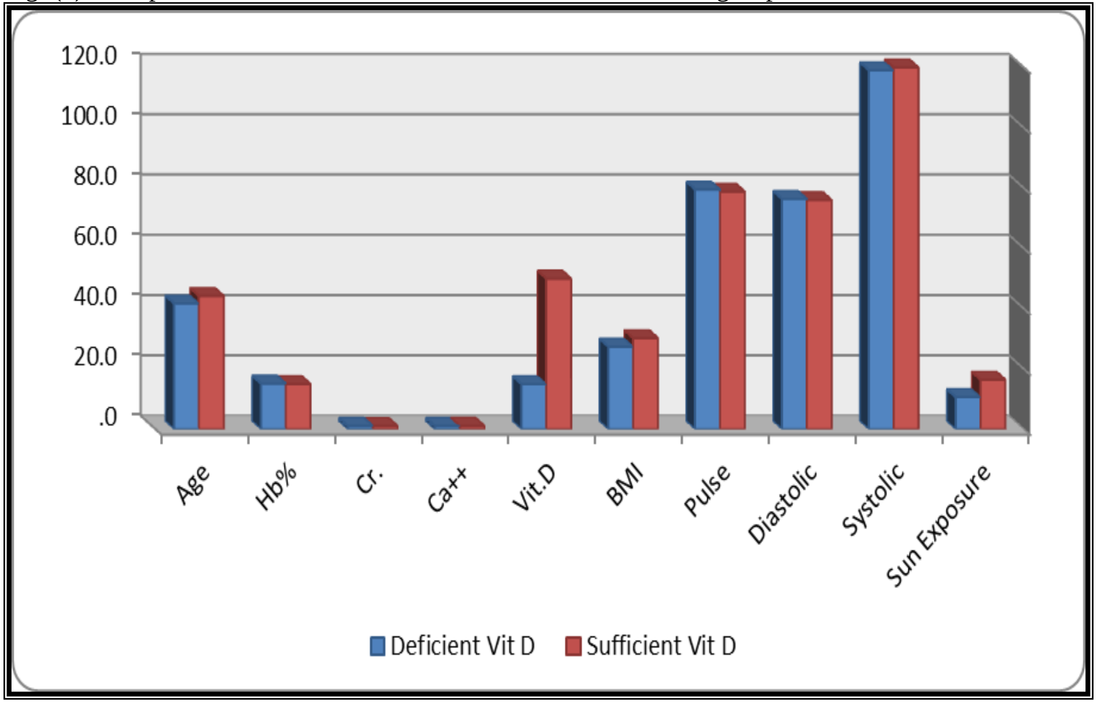

Fig. (7): Comparison between deficient and sufficient vitamin D groups.

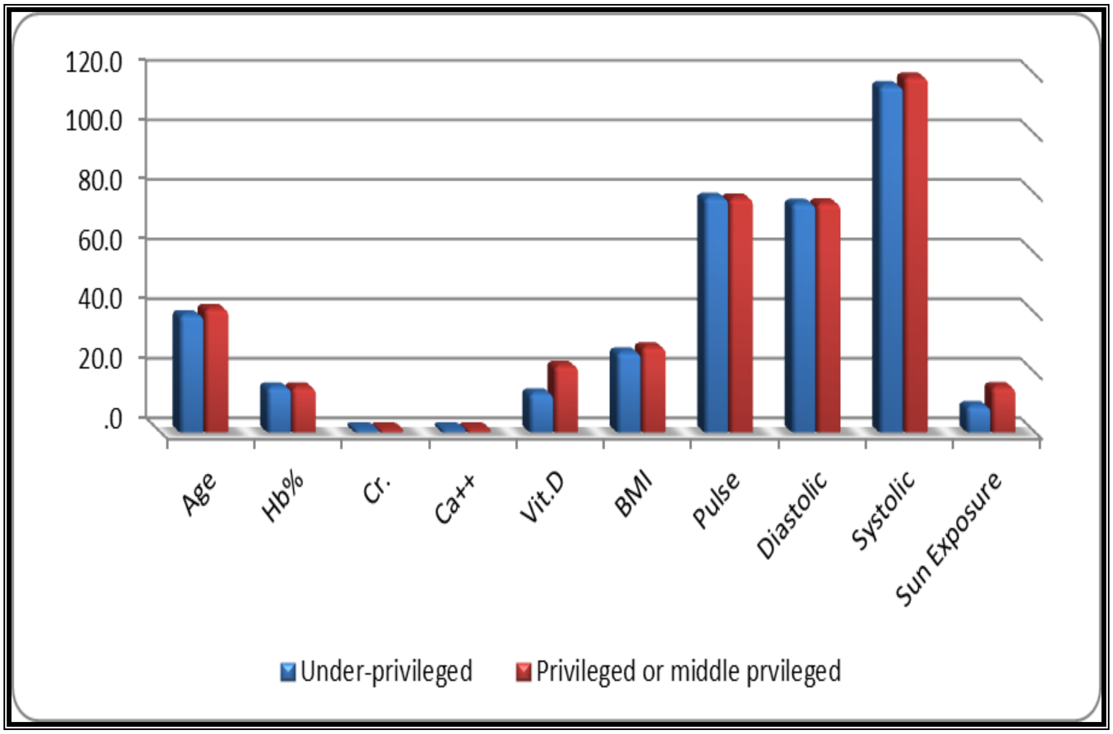

Fig. (8): Comparison between under-privileged vs privileged or middle privileged groups.

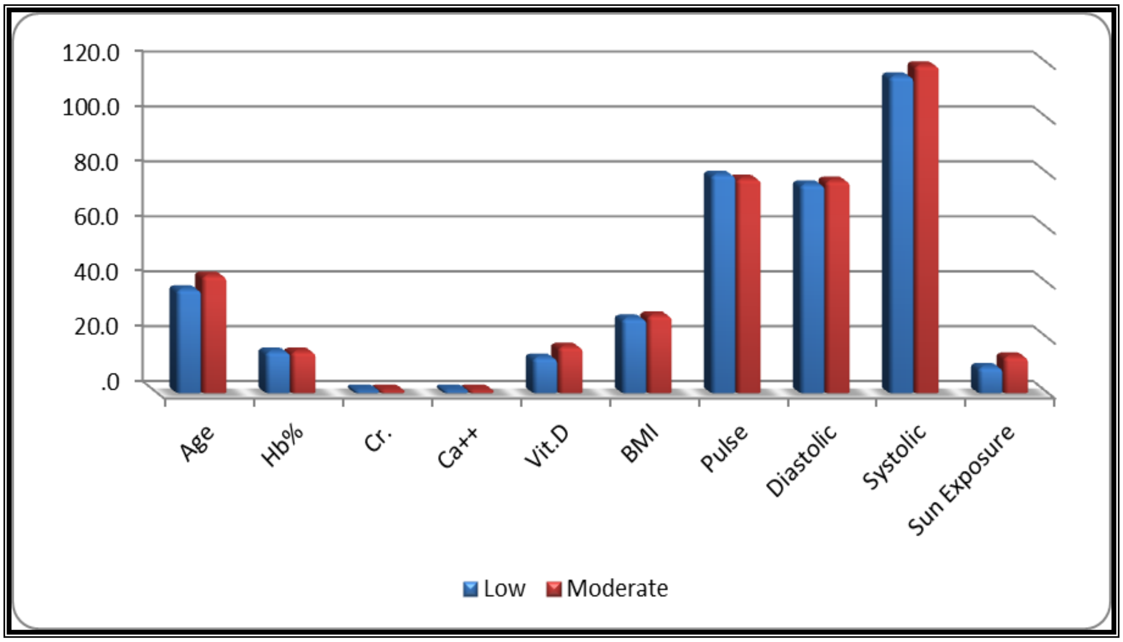

Fig. (9): Comparison between low and moderate intake of vitamin D rich foods.

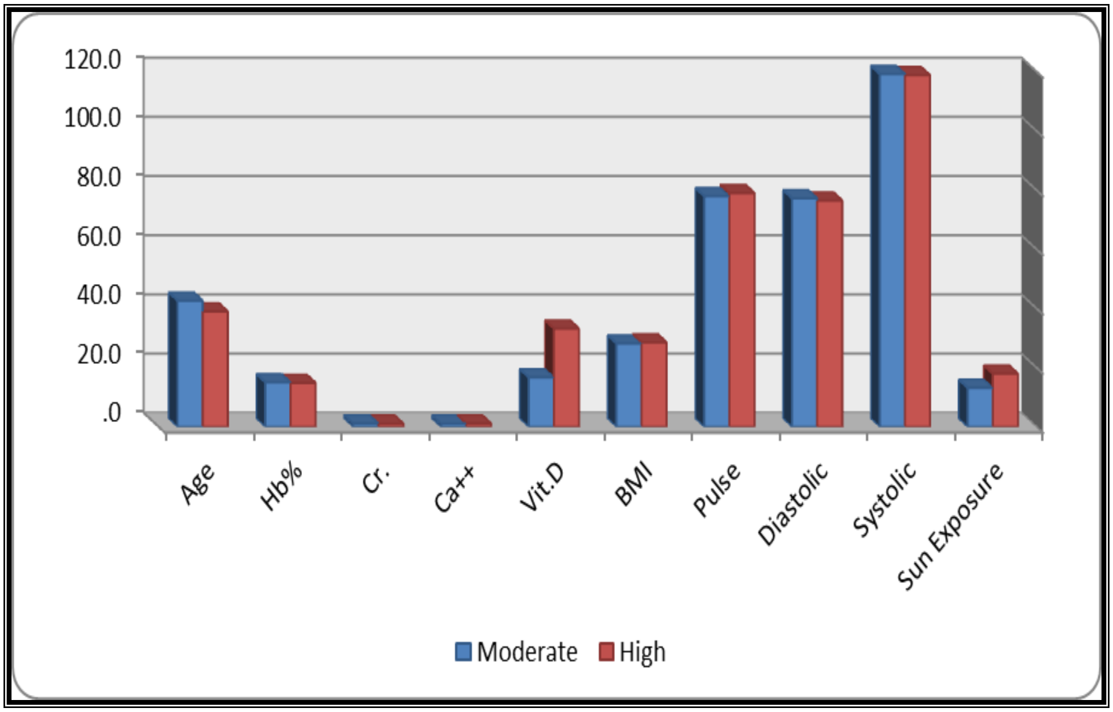

Fig. (10): Comparison between moderate and high intake of vitamin D rich foods

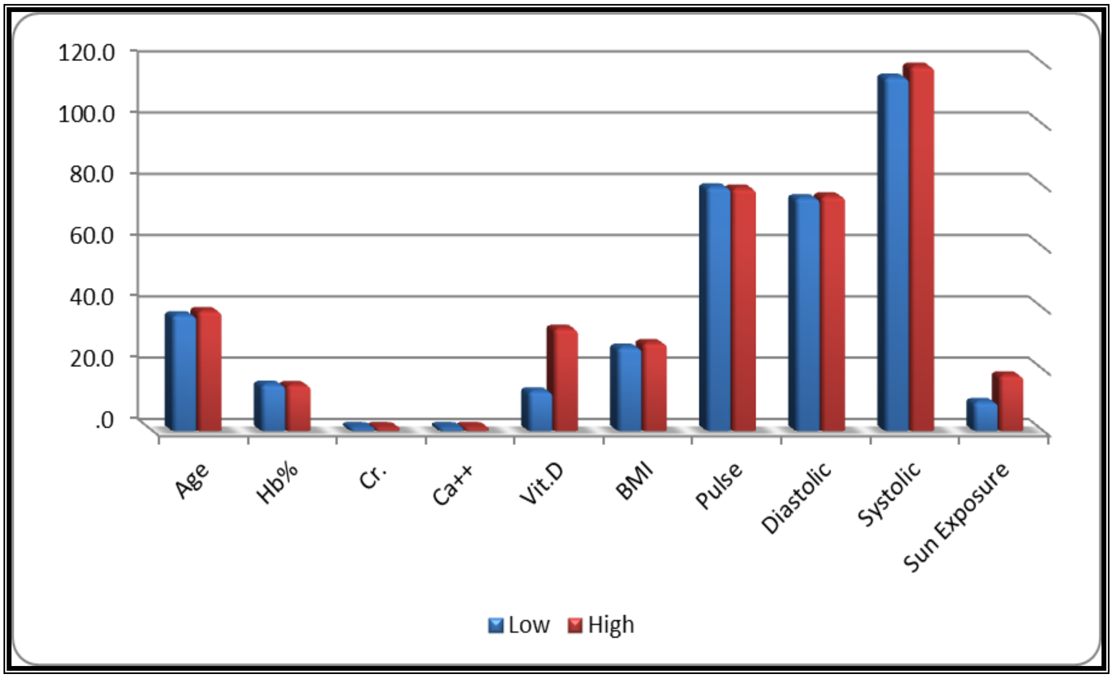

Fig. (11): Comparison between low and high intake of vitamin D rich foods

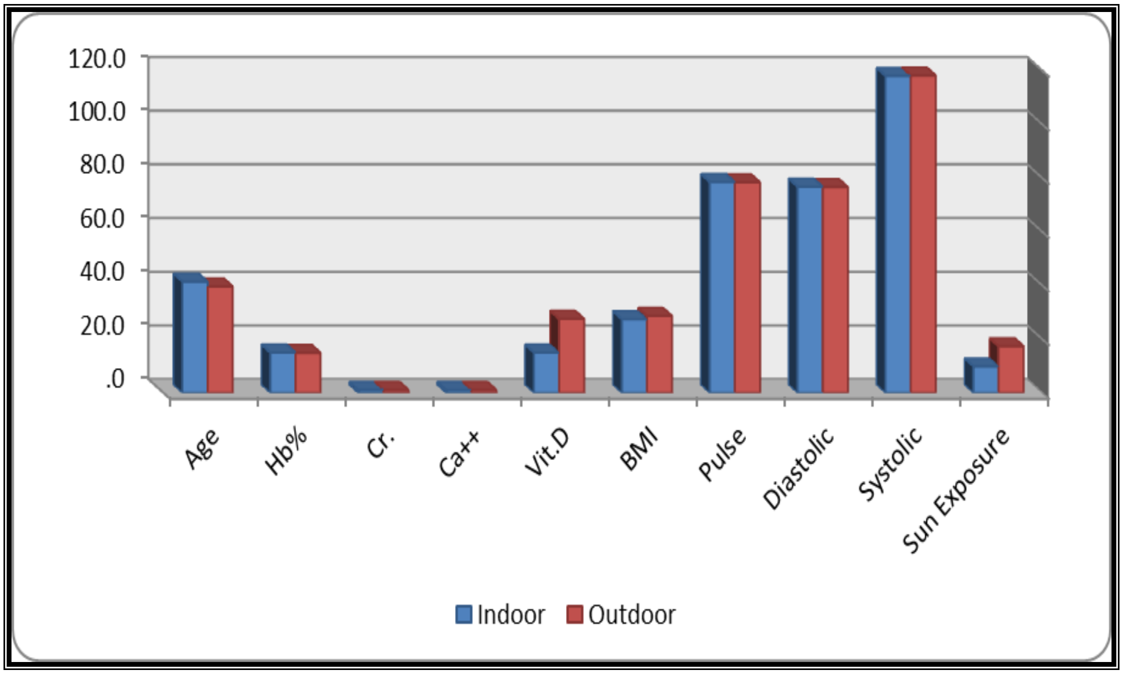

Fig. (12): Comparison between indoor and outdoor occupations

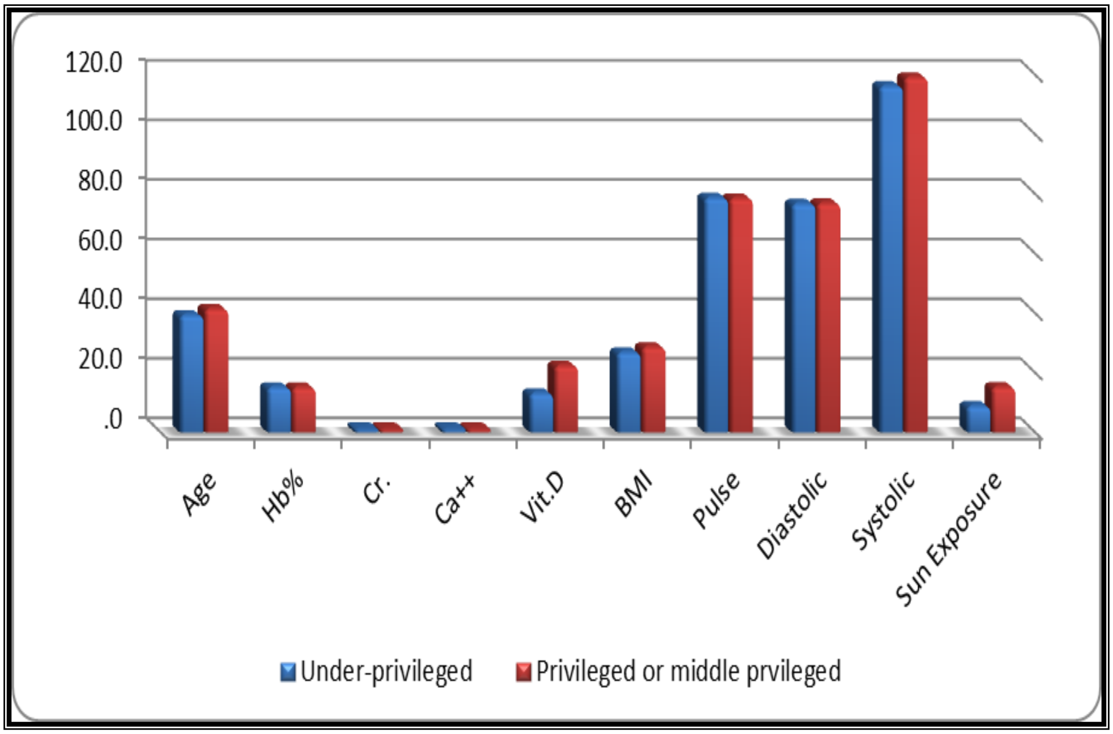

Fig. (13): Comparison between under-privileged vs privileged or middle privileged groups.

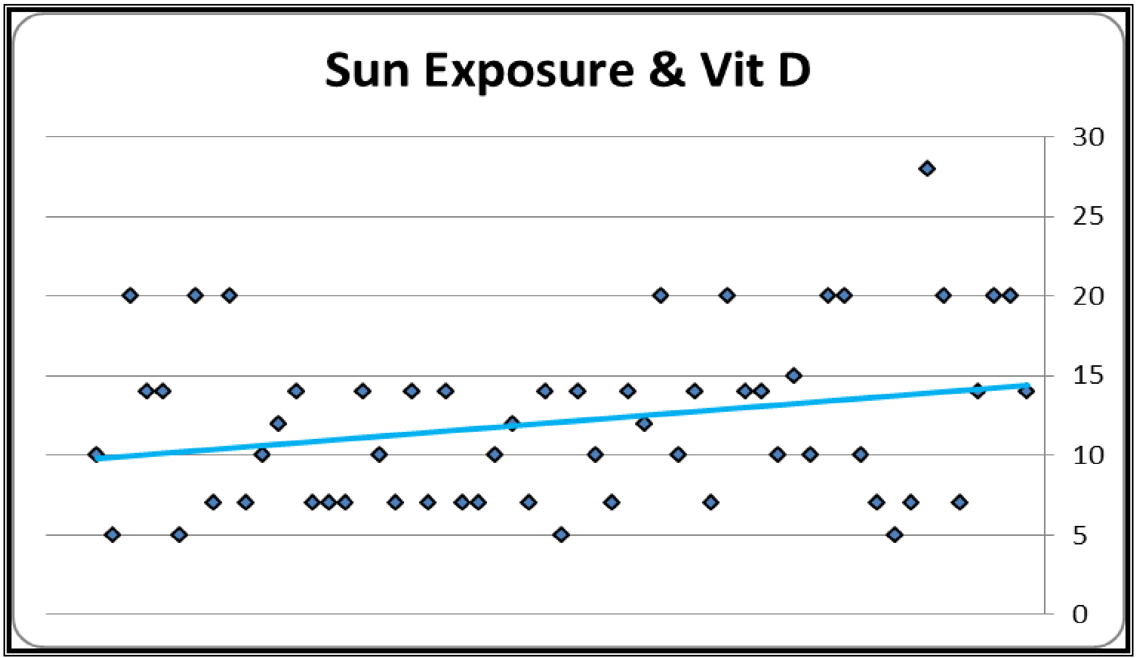

Fig. (14): correlation between Sun exposure & vitamin D

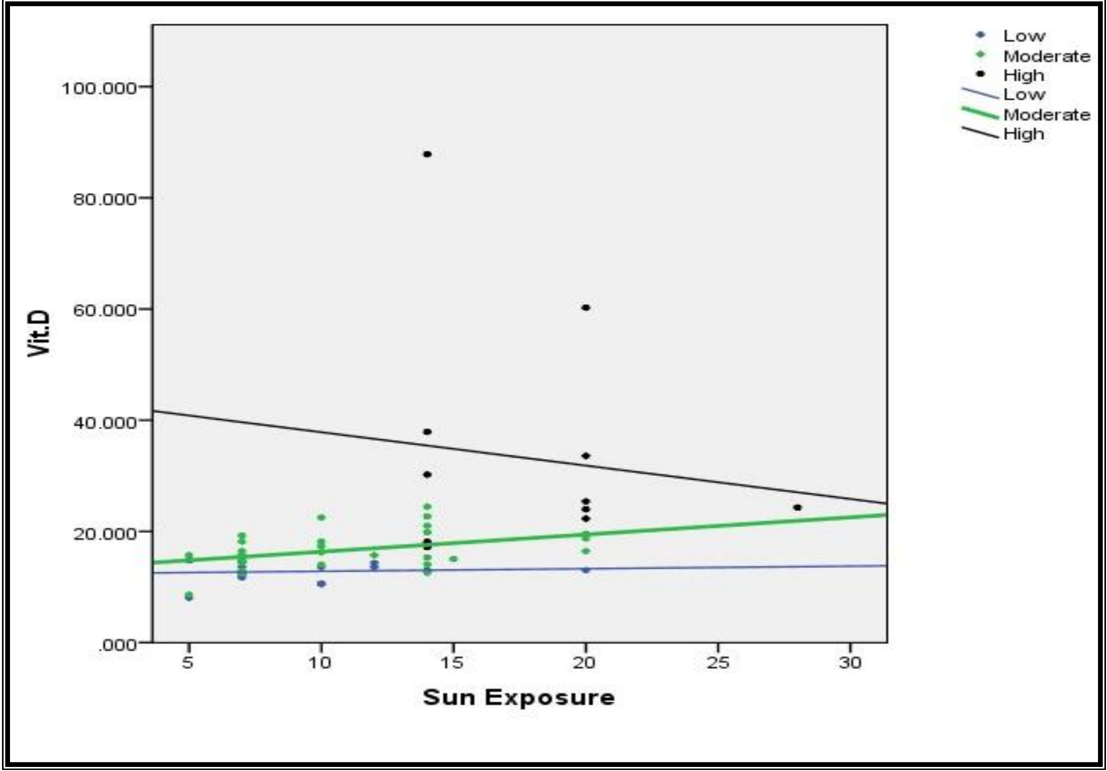

Fig. (15): correlation between Sun exposure & vitamin D among different intake patterns

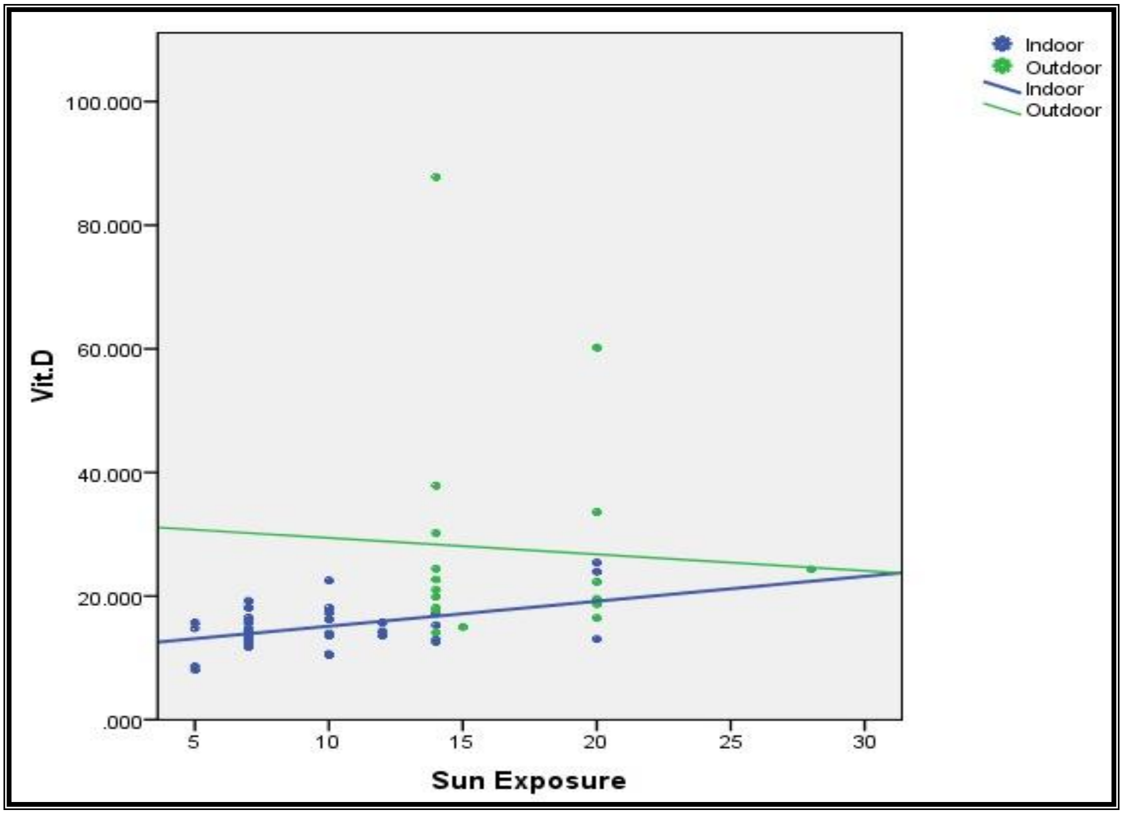

Fig. (16): correlation between Sun exposure & vitamin D in indoor vs outdoor activities

## Discussion

This study was conducted on ninety male subjects in Dakhalia governorate aged 40.7±12.5 years old. Vitamin D level was assessed in 57 subjects. Forty four subjects had deficient vitamin D as defined by vitamin D level of less than 20 ng/ml (77%), eight subjects with insufficient vitamin D as defined by vitamin D level ranging 20-30 ng/ml (14%), and five patients with sufficient vitamin D as defined by vitamin D level above 30 ng/ml (9%). These results are comparable to different studies in previous literature, where it was reported that, the prevalence of serum 25OHD deficiency reportedly varies between 30% and 93% in different studies **(Masud, 2007) (Malabanan et al., 1998) .** Typically, the prevalence of low 25OHD levels (<20 ng/ml) has been reported in approximately 36%, otherwise healthy, young adults, aged 18–29 years **(Tangpricha et al., 2002) ;** 41% in outpatients aged 49–83 years **(Malabanan et al., 1998) ;** while up to 57% in general medicine inpatients in the US **(Thomas et al., 1998).** The picture is more pronounced in Europe, where 28%–100% of healthy adults and 70%–100% of all hospitalized adults have such 25OHD values **(Isaia et al., 2003) (Passeri et al., 2003).**

In addition, **Mansoor et al., 2010** reported that, about 90% of the healthy volunteers in their study were suffering from low vitamin D levels (insufficiency and deficiency), compared to 86% in the present study. Furthermore, the prevalence of low vitamin D levels are slightly higher than what was reported by **Zargar et al., 2007**, **Atli et al., 2005** and **O'Sullivan et al., 2008,** who found vitamin D deficiency in 83% of the people in the Kashmir valley in India, 15.3% of elderly males in Turkey, and 54% in healthy Turkish youth, respectively.

Hypovitaminosis D is very common in this Middle East and does not spare the pediatric age **(Kimball et al 2008),(El-Hajj Fuleihan 2009).** A large proportion of adolescent girls, up to 70% in Iran **(Moussavi et al., 2005)** and 80% in Saudi Arabia **(Siddiqui and Kamfar 2007),** had 25(OH)D levels below 25 nmol/L. The reported proportions were 32% in Lebanese girls and between 9% and 12% in Lebanese adolescent boys**( El-Hajj Fuleihan et al., 2006).** The mean 25(OH)D level was near 25 nmol/L in Lebanese, Saudi, Emirati, and Iranian women **(Saadi et al.,2006) (Gannage-Yared et al., 2000).** A similar mean was recorded in elderly Lebanese **(Arabi et al.,2006).**

In our study, twenty five subjects were classified normal BMI, twenty eight were classified overweight and thirty seven were classified as obese subjects. Subsequent analysis showed no association between BMI and other variables such as vitamin D levels, sun exposure and there was no difference of BMI between deficient or insufficient vitamin D groups. The inconsistent relationship between BMI and serum 25OHD levels in our study may be because of fact that most of the subjects in our study were in the healthy BMI range and only 37% were actually obese (BMI≥30 kg/m$^2$).

Adiposity has been reported to be strongly related inversely to serum 25OHD and directly to PTH concentrations, independent of age, sex, season, or smoking. The association has been found to be weaker if anthropometric measures only, rather than precisely measured total body fat percentage, are used, implying a specific role for adipose tissue **(Snijder et al.,2005).** This may explain the insignificant relation between BMI and 25OHD levels in the present study because we measure BMI only by anthropometric means.

In the present study, sun exposure was correlated with vitamin D levels, (r value 0.37, P value 0.005), and these results are well confirmed in previous literature. However, it had been reported that, despite the significant role of sunlight in vitamin D synthesis, the studies carried out in the last two decades have shown a high prevalence of 25OHD deficiency in tropical countries, such as China, Turkey, India, Iran, and Saudi Arabia **(Du et al.,2001),(Alagol et al.,2000),(Azizi et al.,2000),(Gowami et al.,2000) .** Pakistan is one of the sun-rich countries of the world and its inhabitants are supposed to have ample sunlight exposure, enough to maintain the adequate vitamin D status. However, vitamin D deficiency is also frequent among Pakistanis, which was first noted in the Pakistani immigrants in the UK in the early 1970s. The detection of vitamin D deficiency after immigration to the UK was assumed to be an environmental characteristic and it was thought that Pakistanis may not be getting enough sun exposure after migration**(Goel et al.,1976).**

Environmental and cultural factors that could have contributed to such high prevalence were included in subsequent analysis which showed that sun exposure is among the top predictors while veiling was the least predictor also sub grouping according to sun exposure showed that group with fair and poor sun exposure were vitamin D deficient compared to the vitamin D sufficiency in the good sun exposure group. Although in a sunny country only minority of all subgroups claimed to have good sun exposure which could argue for the high prevalence. Factors as air pollution could additionally influence the percentage of UVB reaching the earth which have influential effect in determining the amount of ground level UVB. It has been demonstrated that level of air pollution is inversely proportion to the amount of UVB reaching the earth **(Hosseinpanah et al.,2010) .** Some studies investigated the effect of air pollution on vitamin D level among healthy population , one study conducted in India found that atmospheric pollution rendered children in this area more prone to vitamin D deficiency and in another study conducted in Belgium supported a positive correlation between hypovitaminosis D and air pollution and lastly the study conducted in Tehran among healthy females where the odds for living in Tehran for having 25OH vitamin D level < 20 ng/dl was 5.22 (CI 95% 2.2-12.2).

In further analysis, vitamin D was correlated to sun exposure in case of moderate intake of vitamin D rich foods only, (r 0.419, P value 0.021). Also vitamin D was correlated to sun exposure for indoor activities, (r 0.451, P value 0.005). Through analyzing patterns of sun exposure, intake of vitamin D rich foods and occupation patterns, it was found that only intake pattern had a significant impact on vitamin D level, (P value 0.004). These results are in agreement with **(Qiao et al.,2013)** who reported that, the possible reasons were as follows: (1) most of the youth were working indoor. As a result, they have less time spent in the outside hence less sun exposure. In addition, they did not have the habit of drinking milk; (2) the ability of synthesizing and absorbing vitamin D was decreased in the seniors.

In addition, it was reported that, when environmental, social, or physiological circumstances prevent adequate exposure to sunlight, dietary compensation must occur to maintain serum 25(OH)D levels. For those countries in which high levels of fatty fish are not consumed, the richest natural source of vitamin D, the only alternative to increasing their exposure to natural or artificial UVB light is to fortify their food or to use vitamin supplements **(Calvo et al.,2005).**

In conclusion, the results of the present study revealed higher rate of hypo-vitaminosis D in adult Egyptian men. Sun exposure was found to be the most dependent risk factor for this hypovitaminosis D.

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