

Vitamin D Deficiency and Treatment Plan

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ABSTRACT

Vitamin D is obtained from the consumption of few foods and helps in absorption of calcium from the gut of a human being and maintains phosphate and calcium level of blood to maintain bone mineral density. In case of deficiency of vitamin D supplements are provided to the patient in the form of tablets. The tablets of vitamin D3 and vitamin D2 are prescribed to the patients. Since, vitamin D plays a vital role in human body functioning and with the increasing rate of vitamin D deficient population across the globe, current study suggest a change in meal plan and to incorporate some habits to reduce vitamin D deficiency which is spreading rapidly. Thus, study opens a future prospects to conduct more research in finding a remedy for highly prevailing diseases.

Keywords:

Cholecalciferol, Deficiency, Vitamin D, Vitamin D3

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INTRODUCTION

Vitamin D is basically a prohormone, it describes that the vitamin D is transferred into a hormone inside the human body. Vitamin D is not only one substance, vitamin D is a combination of five substances which includes ergocalciferol which is also termed as vitamin D2 and cholecalciferol also known as vitamin D3 are the most significant substances out of five substances which are included amongst the five substances of vitamin D. Vitamin D plays vital role in human body which includes maintaining adequate level of calcium in blood, balancing concentration of phosphate in blood, allowing bone mineralisation to be in the normal range in order to prevent involuntary contraction of muscle which results in spasms and cramps in the muscles. D Vitamin also play an important role in the growth of bone by means of remodelling of osteoclasts and osteoblasts, controlling inflammation in body along with modulating these

processes like neuromuscular function, immune function, cell growth, and glucose metabolism. Vitamin D also regulate many gene encoding proteins that regulate differentiation, proliferation and apoptosis. Thus as a result of performing many significant functions inside human body, insufficient supply of vitamin D makes the bone brittle, thin and deformed and in adults causes osteomalacia whereas in children results in rickets[1]. A combination of vitamin D and calcium prevents osteoporosis in older adults. The two significant forms of vitamin D are ergocalciferol which is vitamin D2.

All vitamins are organic in nature and thus called as organic compounds that are required by the body in a small quantity. Most of the vitamins are consumed through diet as they are not produced inside the body or if produced inside the body, the quantity is very less. Basically there are two categories of vitamins: vitamins that are soluble in fat which includes A, D, E, K vitamin. Figure 1 shows vitamins that are fat soluble that includes A, D, E and K- Vit. (Vitamin) Figure 2 shows structure of Vit. D in D2 form ergocalciferol and cholecalciferol which is vitamin D3 the basic difference between the two forms is the difference in the side chain in both the forms. Figure 2 and 3 shows the chemical structure of the ergocalciferol i.e. Vit. D 2 and cholecalciferol Vit. D3 [2], [3].

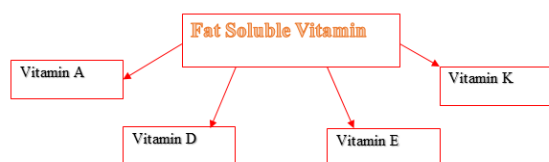


Figure 1: Shows Vitamins that are soluble in fat and includes Vitamin A, D, E and K.

Vit. A,D,E, and K are stored in fatty tissue inside the liver and are reserved in body for a long duration of time including days and sometimes months. Fats present in diet helps in absorption of fat-soluble vitamins through the intestinal tract of the human being. Whereas, Vit. that are soluble in water do not stay in human body for a long duration of time as water soluble vit. cannot be stored inside the body of a human being. The water soluble vitamins are excreted by means of urine in human beings. Thus, a regular and a good quantity of supply of water soluble vitamins that too in a sufficient quantity is required [4].

Synthesis of D-Vit.

D Vit. is synthesized in outermost skin layer of human being usually called as epidermal layer. When epidermal layer get exposed to sunrays, the Ultraviolet radiations coming from the sun converts a cholesterol derivative 7-dehydrocholesterol present in the skin into cholecalciferol (Vitamin D3) Figure 3 shows the structure of vitamin D3 Cholecalciferol. The cholecalciferol is then transferred into calcidiol inside the liver. The calcidiol is then transferred into active vit. D, calcitriol. the conversion of calcidiol to calcitriol is accomplished in kidney. Vitamin D is required for the usual absorption of phosphorus and calcium and are needed to keep the bone healthy[5]. A lack of exposure to sun rays results in deficiency of vit. D inside body and thus result in rickets in children, which includes pain in bones and deformation of bones as a result of lack of calcium and phosphorus. In senior citizens softness of bones, osteomalacia, is seen. Figure 4 shows the synthesis of Vit D's active form from 7-dehydrocholesterol inside human body from sunlight.

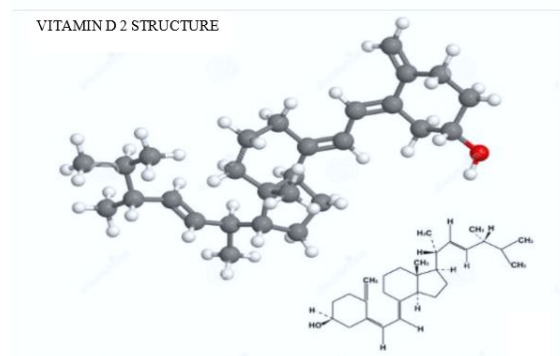


Figure 2: Shows the structure of vitamin D in D2 form ergocalciferol [3].

Benefits of Vitamin D3

- Strength to bones by providing calcium absorption and maintaining bone mineral density.
- Provides muscle strength by helping in fat loss.
- Triglycerides and Cholesterol
- Depression is controlled by controlling serotonin, a mood altering hormone
- Heart disease rate is reduced by improving cardiovascular health
- Regulating glucose level in diabetes
- Weight loss is achieved, thus helps in maintaining healthy body weight
- Chances of getting ill by influenza are reduced to nearly 50%
- Autoimmune disorders
- Health of skin is maintained

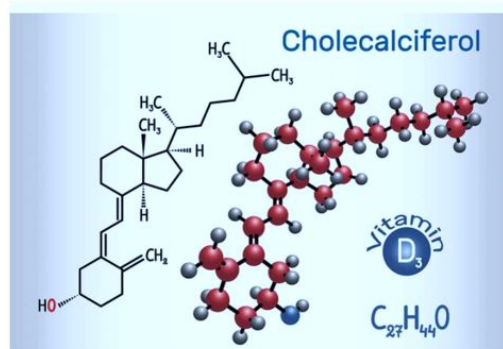


Figure 3: Shows the structure of vitamin D in D3 form Cholecalciferol [2].

Vitamin D3 (cholecalciferol) supplements

- Cereals that are fortified: using cereals that are fortified to make breakfast is a good choice to overcome the deficiency of vitamin D, using fortified cereals works great on health especially multigrain cereals that are rich in vitamin D.
- Milk which is fortified: now a day's fortified milk is available in market along with soya milk. Consuming fortified milk, fortified soya milk, fortified rice milk also provides vitamin D to the person.
- Tuna fish packed in can: people living in coastal area consume fish on a regular basis. But, people who live far from coastal area do not have access to fish opt for canned tuna fish as a supplement of vitamin D.
- Orange juice which is fortified: people who do not prefer animal food including fortified milk, fish and eggs opt for fortified juices to increase the level of vitamin D in body.
- Fatty fish: few varieties of fatty fish includes salmon, tuna, trout are consumed by people to get a good source of omega-3 fatty acids and thus prevents deficiency of vitamin D along with getting protection from cardiovascular diseases.
- Eggs: eggs are a good source of vitamin D, since eggs are used as an ingredient in many recipes, eggs are

consumed by many people but to use the whole egg while preparing any dish from egg is required [6].

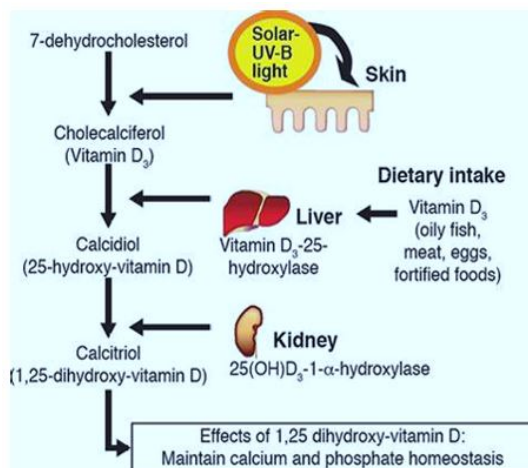


Figure 4: Shows the production of Vit D's active form from 7-dehydrocholesterol inside human body by using sunlight [7].

REVIEW OF LITERATURE

Carpagnano GE et al. conducted a study on the relation of vitamin D deficiency with severe failure of respiratory system caused due to COVID-19, Vit D deficiency is increasing highly and is related to high rate of infections of respiratory tract. Today, world is facing the pandemic of SARS-CoV-2 disease (COVID 19). Patients of coronavirus disease face severity of disease due to storm of cytokine. Looking at the working of D vit in immune system, the study analyses the level of D vit in patients of covid having severe respiratory failure caused as a result of COVID-19 and analyses the correlation of deficiency of vit D with extreme respiratory failure. The study suggested that high percentage of vit D deficiency was seen in COVID-19 patients with severe failure of respiratory function and are provided treatment in respiratory intensive care unit (RICU). Patients having extreme deficiency of vitamin D were at high risk of mortality. Severe deficiency of vitamin D might be related to poor judgement by the patients and thus suggests that the add-on therapy might help the patient to recover faster [8].

Karin A et al. conducted a study on the deficiency of vitamin D prevailing across the globe, the usage of vitamin D supplements is increased highly in last few years. Now a days, consumption of supplements of vitamin D in a defined quantity of dose is a matter of debate since many interventional researches failed to

clearly describe the clear advantages of vitamin D. this could be related to the limitations of the trial which could not analyse the basic nutritional requirement of vitamin D in the study, involving replete population of vitamin D, sample size which is very small, and metabolites and dosage having inconsistent intervention methods. Vitamin D deficiency is related to weak skeleton involving bone loss, fractures. A severe low vit D level is observed to raise the danger of infections, mortality rate, and many other diseases. Vitamin D is not observed to treat all ailments but, is efficient in handling ailments arising from deficiency. Vitamin D has rare side effects and thus, a significant, less costly and safe add-on treatment for many ailments. Systematically prescribing supplements of vitamin D is suggested to avoid vitamin D deficiency [9].

Michael FH conducted a study on the deficiency of vitamin D as a pandemic, the insufficiency and deficiency of vitamin D has been an issue worldwide that affects children population globally, nearly one billion children are affected by D vit deficiency and result of D vit deficiency cannot be judged. A link of chronic and acute illness involving childhood dental caries, preeclampsia, infectious disease, cancers, immune disorders, type 2 disease, periodontitis. The study provides a treatment plan to treat vitamin D deficiency in children. It is suggested that fortification of food with supplements of vitamin D provided good source to the children along with increased sun exposure. But, it was observed that individuals having malabsorption of fat and had undergone gastric bypass surgery require screening and regular monitoring of vitamin D levels [10].

METHODOLOGY

A questionnaire form is distributed in ten general physician's clinic and the form was given to all those people who were facing symptoms similar to vitamin D deficiency and to those who have a family history of vitamin D deficiency, thyroid, cardiovascular disease, and fibroids. All the people having the history of any of the disease and symptoms similar to that of vitamin D deficiency. All the patients who filled the questionnaire form were seen for the higher number of symptoms of vitamin D deficiency and out of 150 candidates who filled the questionnaire form 90 candidates were selected for the survey. Table 1 Shows the questionnaire form distributed to conduct the study regarding vitamin D deficiency and changes in diet and lifestyle choice.

Table 1: Shows the questionnaire form distributed to conduct the study regarding vitamin D deficiency and changes in diet and lifestyle choice.

		Name:
		Age:
		Sex:
		Occupation:
Do you have Vitamin D deficiency?	Yes:	
	No:	
Do you get sick very often?	Yes:	
	No:	
Do you feel fatigue and tiredness?	Yes:	
	No:	
Do you have feel pain in back and bone?	Yes:	
	No:	
Do you have depression?	Yes:	
	No:	
Do you have issue with wound healing?	Yes:	
	No:	
Do you have low bone mineral density?	Yes:	
	No:	
Do you face excess hair loss?	Yes:	
	No:	
Do you feel muscle pain?	Yes:	
	No:	

Since, deficiency of Vitamin D has been a pandemic and the number of people suffering from the deficiency of vitamin D is increasing every year. Especially in countries of Asia where the exposure of Sun is very high throughout the day and especially during summer season, the prevalence of deficiency of vitamin D is very high. The primary reason behind the increasing rate of the deficiency of vitamin D is the lifestyle choice and disturbed eating habits. Eating junk food and less nutritious food along with sleeping late at night and less exposure to sun rays has resulted in increasing vitamin D deficiency across the globe.

RESULT AND DISCUSSION

To conduct the survey regarding the effect of dietary changes and lifestyle habits on the patients suffering from the deficiency of vitamin D, a survey form is distributed in a total 150 candidates and out of these 150 candidates around 90 candidates were selected for the survey based on the number of symptoms of vitamin D deficiency shown by the candidates. All the 90 candidates were randomly divided into three groups and were asked to eat rooted vegetables including sweet potato, colocasia, yam, beet root, turnip, potato, radish, carrot, include home-made clarified butter (GHEE) in their diet and follow an exercise routine for 40-45 mins every day by getting up early and sleeping before 11pm in night for a period of 3 months in order to see changes in the levels of D vit deficiency. Table 2 show the results of study conducted regarding D vit deficiency and effect of changes in diet and lifestyle choice performed on the vitamin D deficiency. The results obtained shows that on following a regular exercise routine, sun exposure, eating

healthy diet and incorporating ghee in diet reduced vitamin D deficiency in most of the candidates participated in the survey. The results were obtained by testing the vitamin D level of all candidates who followed the suggested routine to recover from D vit deficiency.

The test of all the candidates of group A, group B, and group C was conducted and the vitamin D level of all the candidates was checked. A total of 16 candidates in group A showed increased vitamin D level i.e. more than 30 nano gram/millilitre (ng/mL). As per the guidelines of ICMR (Indian Council of Medical Research) the blood level of vitamin D more than 30 nanogram/millilitre is considered as normal D vit level of blood [11]. In group B, a total of 16 candidates showed more than 30 nano gram/millilitre of D vit, whereas, in group C, a total of 15 candidates showed more than 30 nano gram/millilitre of D vit. On further analysing the increased level of vitamin D in group A, group B, and group C, it was observed that all the candidates who followed plan 1 i.e. exposure to Sun by doing exercise, plan 2 i.e. sleeping early and getting up early, plan 3 i.e. eating rooted vegetables, and plan 4 i.e. including clarified butter in diet showed increased level of vitamin D level in blood. Thus, it is clear that on following all the suggested plans i.e. plan 1, plan 2, plan 3, and plan 4 for a period of 3 months showed increased level of vitamin D in candidates of group A, B group, and C group.

Table 2: Show the results of the study conducted regarding deficiency of vit D deficiency and the effect of changes in diet and lifestyle choice performed on the vitamin D deficiency.

Survey group A, B, C	Number of candidates followed exposure to Sun by doing exercise (plan 1)	Number of candidates followed sleeping early	Number of candidates followed eating rooted vegetables (plan 3)	Number of candidates followed including	Number of candidates who followed plan 1/ plan 2/ plan 3/plan 4 and showed

		and getting up early (plan 2)		clarified butter in diet (plan 4)	increased level of vitamin D
Group A (30 candidates)	17	18	17	16	16
Group B (30 candidates)	18	17	16	17	16
Group C (30 candidates)	16	15	18	15	15

CONCLUSION

The present study is based on a survey conducted to determine the effect of dietary changes and lifestyle habits in the patients suffering from the deficiency of vitamin D, a survey form was distributed in a total 150 candidates visiting general physicians clinic and out of these 150 candidates around 90 candidates were selected for the survey based on the higher number of symptoms of vitamin D deficiency shown by the candidates. All the 90 candidates were randomly categorized into three groups A, B, and C and all were asked to eat rooted vegetables (plan 3) including sweet potato, colocasia, yam, beet root, turnip, potato, radish, carrot, include home-made clarified butter (GHEE) in their diet (plan 4) and follow an exercise routine for 40-45 minutes every day with increasing difficulty level every second day by getting up early (plan 1) and sleeping before 11pm in night for a period of 3 months (plan 2) to see the changes in the levels of deficiency of vit D.

All the candidates who followed the suggested treatment plan i.e. plan 1, plan 2, plan 3, and plan 4 to see the change in vitamin D level of blood were tested to analyse the effectiveness of the treatment plan. Out of all candidates belonging to group A, a total of 16 candidates showed raised level of D vit and the level of D vit in all 16 candidates was calculated as more than 30 ng/mL. In group B, a total of 15 candidates showed raised level of vitamin D and the level of D vit in all 15 candidates of group B was calculated as more than 30 ng/mL. In group C, a total of 15 candidates showed raised vit D level and D vit level in all 16 candidates was calculated as more than 30 ng/mL. On further analysing the results obtained it was observed that all the candidates who followed plan 1, plan 2, plan 3, and plan 4 showed recovery from vitamin D deficiency. So, it can be concluded that a combined result of following all the four suggested plans showed raised level of vitamin D in the survey candidates. Thus, following a healthy traditional meal plan, following a fixed routine and proper exposure to sunlight showed recovery from vitamin D deficiency. The candidates who

followed few plans and not followed all the four mentioned plans showed raised level of vitamin D but did not recover from vitamin D deficiency. Thus, current survey opens future prospects for conducting survey on treating other vitamin deficiency by making healthy lifestyle choices.

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