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STUDY OF VITAMIN B12 AND VITAMIN D3 IN FACTORY EMPLOYEES IN THE DISTRICT OF CHHATRAPATI SAMBHAJI NAGAR

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Abstract

Background: Nutritional deficiencies are the most common cause of anemia in the tropical countries. Deficiencies of vitamin B12 and folate can cause severe anemia and cytopenias due to ineffective hematopoiesis and can sometimes minor hemolytic anemia. Vitamin D deficiency is likely to play an important role in the very high prevalence of rickets, osteoporosis, cardiovascular diseases, diabetes, cancer and infections such as tuberculosis in India. Aim is to study Vitamin B12 and Vitamin D levels in factory employees. Objective is to evaluate Vitamin D and Vitamin B12 levels in factory employees and identify groups vulnerable for these deficiencies. **Materials and Methods:** Present cross-sectional study was performed in 714 factory employees from Chhatrapati Sambhaji Nagar district of Maharashtra for a period of 2 months. Vitamin D3 and vitamin B12 levels were estimated on Vitross 5600 dry chemistry with immunochemistry by Chemiluminescent Immunoassay

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platform from plain vacutainer samples. Statical analysis done by using Unpaired t Test. All the patients were in the fasting state. **Results:** 714 employees were examined for vitamin D and B12. Out of which 676 were males and 38 were females. Age range of employees were from 20 to 60 years. Out of which 18% males had deficiency, 73% males had insufficiency and only 9% males had sufficient levels of Vitamin D in males. For Vitamin B12 67.45% males had deficiency and 33% males had sufficient levels. For females: 37% females had deficiency, 53% had insufficiency and 11% had sufficient levels of Vitamin D3.42.1% females had deficiency and 58% females had sufficient levels of Vitamin B12.
Keywords: Hematopoiesis, Hemolytic anemia, osteoporosis, vitross5600, Chemiluminescent

Introduction

Apart from dietary intake and supplementation, Vitamin D is synthesized in vivo when solar ultraviolet B (UVB) radiation interacts with the precursor molecule, 7-dehydrocholesterol, in the skin(1,2,3) These endogenous production account for 90 % of total vitamin D in healthy individuals and any activity that reduces sunlight exposure will tend to reduce vitamin D levels(4) . Vitamin D deficiency is likely to play an important role in the very high prevalence of rickets, osteoporosis, cardiovascular diseases, diabetes, cancer and infections such as tuberculosis in India. An inadequate level of vitamin D has been linked to a number of diseases including metabolic disorders, autoimmune conditions, psychiatric, respiratory and cardiovascular disorders, and cancers as well as osteoporosis and osteomalacia(5) . The widespread systemic effects of vitamin D have been attributed to the ubiquitous expression of vitamin D receptors in various organ systems (6). As vitamin D synthesis is highly dependent on sunlight, factors and conditions associated with decreased time spent outdoors can be expected to adversely impact vitamin D status. Factory employees represents work that occurs indoor with traditional 9 a.m. to 5 p.m. Monday through Friday schedule, sometimes evening or night shift work, with or without rotating shifts. Shift work has been epidemiologically associated with a number of health conditions, including sleep disturbances, cardiovascular disorders, gastrointestinal and digestive problems, and increased cancer risk, among others(7,8,9)

Majority factory employees are from low-income rural households. Many of them have a poor school education, which limits their options for working outside of factory labor(10,11) . Additional finances made while working are often sent back to support family members, which has a substantial anti-poverty effect(12,13) . Beside the minimum salary, workers heavily rely on bonuses and overtime work(11,13) . Malnutrition among workers is not uncommon and has been linked to the mass fainting's that are regularly reported from the factories11 . It has been concluded that a decent diet, an adequate living standard and savings might be out of reach for this population(11,12,13) The expense on food is under extreme budgeting, achieved through eating and living in groups and minimizing costs by bringing food from their hometowns which also sometimes involve workers skipping meals(11,12)

Anaemia of nutritional origin is caused by diets that lack sufficient amounts of essential hematopoietic nutrients, such as iron, vitamin A, vitamin B12 or folic acid, to meet the need for hemoglobin (Hb) and red blood cell synthesis(14,15) . Malnutrition among women in reproductive age, with respect to underweight, anemia and micronutrient deficiencies, is associated with numerous poor health related outcomes, such as impaired

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cognition, reduced work capacity and impaired immune responses, leading to lowered resistance to infections(16,17) . Nutritional deficiencies are the most common cause of anemia in the tropical countries. Deficiencies of vitamin B12 and folate can cause severe anemia and cytopenias due to ineffective hematopoiesis and can sometimes minor hemolytic anemia.

Keeping both situations in mind present study was designed to study Vitamin B12 and Vitamin D levels in factory employees with respect to adverse health outcomes related to shift work and identify groups vulnerable for these deficiencies.

Material and Method

Present cross-sectional study was performed in 714 factory employees for a period of 2 months. Factory management, superintendents and union representatives were informed in detail about the objectives and procedure of the study. Study was announced during a meeting to all factory employees. Written informed consents, including a study description in lay language, were obtained (signature or fingerprint) at lunch breaks and after end of work, prior to any data collection. Workers who signed the informed consent were invited in a separate room during working hours for clinical screening and blood investigations. Inclusion criteria Employees between age 20 to 60 years of both gender (female: nulliparous and non-pregnant)

Exclusion criteria Workers who refused to give consent

Vitamin D3 and Vitamin B12 estimation: 210 Venous blood samples were collected in a plain bulb during the day time between 11:00 AM and 05:00 PM. Samples collected were taken to the central lab for the estimation of Vitamin D3 and Vitamin B12. All the patients were in the fasting state. Vitamin D3 and Vitamin B12 were estimated using the VITROSS 5600.

Operational Definition

1. Normal Vit D3: The standard or biological references used were less than 10 ng/ml as deficient, 10 to 30 ng/ml as insufficient and between 31 and 100 ng/ml as adequate
2. Normal VitB12: Standard or biological references used were less than 180 pg/ml as deficient and ≥ 180 pg/ml as adequate

Statistical Analysis

Statistical analysis was performed using Medcalc software. Data are expressed as mean ± SD, frequency and percentage N (%). 'Unpaired t-test' were used for comparing the two groups, $\chi 2$- test was used to evaluate correlation between two variables. Statistical significance was assumed if P value less than 0.05.

Results

In Table 1 showing demographic distribution, maximum subjects were male i.e. 676 (95 %) 227 whereas females were only 38 (5 %). Subjects in age group 20 to 30 years were 310 (43 %), in 31 to 40 were 311 (44 %) and in > 40 years were 93 (13 %).

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In Table 2 showing Vit D3 distribution, maximum males i.e. 493 (69 %) were having insufficient Vit D3 values (between 10 to 30 ng/ml). Amongst total females also majority i.e. 20 (53%) were having insufficient Vit D3 values (between 10 to 30 ng/ml).

In Table 3 showing Vit B12 distribution, maximum males i.e. 456 (64 %) were having deficient Vit B12 values whereas among total females majority i.e. 22 (58%) were having adequate Vit B12 values (≥ 180 pg/ml).

In Table 4 showing comparison of Vit D3 & Vit B12 values amongst deficient & non deficient, statistically significant difference was found for both Vit D3 & Vit B12 values between deficient & adequate group. (P<0.0001)

Table 1: Demographic distribution

Sr No.	**Age range (years)**	**Male N (%)**	**Female N (%)**	**Total N (%)**
1	20 to 30	280(40%)	30(4%)	310(43%)
2	31 to 40	303(42%)	8 (1%)	311(44%)
3	>40	93(13%)	0(0%)	93 (13%)
Total N (%)		676(95%)	38(5%)	714(100%)

Table 2: VitaminD3 values distribution

Sr No.	**Age range(years)**	**Vitamin D3 (ng/mL)**			**Total N (%)**	**Chi Square**	**P value**
		<10	**10 to30**	**31to 100**			
1	20 to 30	64(9%)	228(31%)	18(3%)	310(43%)	10.09	0.038
2	31 to 40	53(7)	225(32%)	33(5%)	311(44%)		
3	>40	19(3%)	60(8%)	14(2%)	93(13%)		
4	Male	122(18%)	493(73%)	61(9%)	676(94%)	8.82	0.012
5	Female	14(37%)	20(53%)	4(11%)	38(6%)		
Total N(%)		136(19%)	513(71%)	65(10%)	714(100%)	-	-

Table 3: Vitamin B12 value distribution

Sr No.	**Age range(years)**	**Vitamin B12 (pg/ml)**		**Total N (%)**	**Chi Square**	**P value**
		<180	**≥ 180**		**39.20**	**<0.0001**
1	20 to 30	215(30%)	95(13%)	310(43%)		
2	31 to 40	196(27%)	115(17%)	311(44%)		
3	>40	61(9%)	32(4%)	93%(13%)		
4	Male	456(67.45%)	220(33%)	676(95%)	10.31	0.0013
5	Female	16(42.1%)	22(58%)	38(5%)		
Total N(%)		472(66%)	242(34%)	714(100%)	-	-

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Table 4: Comparison of VitD3 & Vit B12 values amongst deficient & non deficient

Sr no.	Vitamin	Adequate Mean±SD	Deficient Mean ±SD	Total N(%)	t Value	P Value
1	vitD3(ng/ml)	268.66±124.59	170.32±10.46	714(100%)	-19.55	<0.0001
Total N(%)		65(9%)	649(91%)			
2	Vit B12(pg/ml)	40.78±20.68	16.76±5.23	714(100%)	-23.80	<0.0001
Total N (%)		242(34%)	472(66%)			

Discussion

In present cross-sectional study 714 factory employees were enrolled and blood investigations as Vit D3 and Vit B12 was performed in all. Vitamin D3 was detected by radioimmunoassay (Vitross 5600 dry chemistry platform) and serum Vit B12 by chemiluminescent enzyme immunoassay (CLIA) (Vitross 5600 dry chemistry platform). Vit D3 less than 10 ng/ml were taken as deficient, 10 to 30 ng/ml as insufficient and between 31 and 100 ng/ml as adequate. VitB12 less than 180 pg/ml were taken as deficient and ≥ 180 pg/ml as adequate. Results obtained consist of maximum subjects were male i.e. 676 (95 %) whereas females were only 38 (5 %). Subjects in age group 20 to 30 years were 310 (43 %), in 31 to 40 were 311 (44 %) and in > 40 years were 93 (13 %). Maximum males i.e. 493 (69 %) were having insufficient Vit D3 values (between 10 to 30 ng/ml). Amongst total females also majority i.e. 20 (3 %) were having insufficient Vit D3 values (between 10 to 30 ng/ml). Maximum males i.e. 456 (64 %) were having deficient Vit B12 values (<180 pg/ml) whereas amongst total females' majority i.e. 22 (3 %) were having adequate Vit B12 values (≥ 180 pg/ml). Statistically significant difference was found for both Vit D3 & Vit B12 values between deficient & adequate group. (P<0.0001). In similar study by Luca Coppeta *et al.* (2018)18 they found overall 90 papers, 23 articles through PubMed, 30 through Scopus, and 37 through ISI Web of Knowledge. According to the research' findings, some professions either experience this vitamin shortage or are more likely than others to. It is routinely observed that shift workers and indoor workers are the occupational category most prone to experience a vitamin D3 deficit. Investigating the possibility of offering nutritional education to employees in addition to implementing preventative measures in the workplace would seem appropriate. Jan Makurat *et al.* (2016)19 conducted a cross-sectional survey among 223 female workers (nulliparous, non-pregnant) at a garment factory in Phnom Penh. Anthropometric measurements were performed and blood samples were taken to obtain results on hemoglobin, iron, vitamin A, vitamin B12. In total, the workforce had an iron deficit of 22.1%, anaemia in 26.9%, underweight in 31.4%, and marginal iron storage in 46.5%. There was no indication of a vitamin A or vitamin B12 deficiency. Although not significantly, serum ferritin and retinol-binding protein concentrations were negatively and positively correlated with body mass index, respectively. Iron deficiency and iron deficiency anaemia were differentiated between underweight and non-underweight workers, with the latter having a higher prevalence.

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Conclusions

Low iron status, anaemia, and underweight were all common. Young, nulliparous female garment workers in Cambodia may be at a higher risk of nutritional inadequacies than other groups. To improve their nutritional, micronutrient, and health status, strategies must be established. The general prevalence of anaemia seems to be influenced by the low iron status. Both those who were underweight and those who were not were affected by low haemoglobin and iron deficiency. Although body mass index was inversely correlated with iron reserves, genuine differences in iron status between participants who were underweight and those who were not cannot be substantiated. Chaitanya Gulvady *et al.* (2007)20 surveyed total of 75 senior executives were and analysed blood levels of vitamin D (25 Hydroxy Cholecalciferol) by RIA method and vitamin B12 by CLIA method. The findings showed that 28% of CEOs had vitamin D deficiencies and that 65% of executives had vitamin B12 deficiencies (less than 193 pg/ml). People who have a history of frequent exercise had a lower prevalence of low levels of vitamin B12 (58%) than other people. In people who report a history of regular exercise, the prevalence of vitamin D deficiency is lower (25%) than it is in the general population (46.2%). People whose workdays began earlier had a higher prevalence of vitamin D deficiency (47%) than people whose workdays began later (12%). In the second part of the study, vitamin B12/D3 oral supplements and lifestyle counselling were given to 58 executives with low B12/D3 values for a duration of three months. After that, the respondents' B12/D3 values were examined after a redesigned questionnaire had been distributed. Following oral medication, sun exposure, and dietary changes, there were noticeable increases in serum B12 and D3 values. Daniel Sowah *et al.* (2017)21 conducted an electronic search in Medline, Embase, the Cochrane Central Register Controlled Trials, and CINAHL Plus with Full Text generated 2505 hits; 71 peer-reviewed articles fulfilled the inclusion criteria. Investigations focused on shift workers, indoor and outdoor workers, lead/smelter labourers, coalminers, and medical professionals. The pooled average metabolite level was calculated as mean SD, and the deficiency/insufficiency status was expressed as a percentage of the total number of subjects in each category. Indoor workers had lower 25-hydroxyvitamin D (25-(OH)D) levels than outdoor workers (40. 6 13.3 vs. 66.7 16.7 nmol/L; p 0.0001). Shift workers, lead/smelter workers, and coalminers had mean 25-(OH)D levels (in nmol/L) that were 33.8 10.0, 77.8 5.4, and 56.6 28.4, respectively. Shift workers (80%) and indoor workers (78%) had higher levels of vitamin D deficiency (25-(OH) D 50 nmol/L) than did outdoor employees (48%). The greater incidence of vitamin D insufficiency among shift workers and indoor employees may be related to important lifestyle variations (e.g. sunlight exposure). The urban Indian population suffers from vitamin D3 inadequacy as a corporate lifestyle disorder, while living in tropical regions with plenty of sunlight. Due to modern workplace conditions, extended workdays, and changing lifestyles, office leaders in particular are not exposed to sunlight22. Incidence of vitamin B12 deficiency is observed to be high, may be due to predominantly vegetarian diets and insufficient consumption of dairy products, poultry and meat. Present study results may help target health promotion and preventive efforts.

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Limitations

Conclusion Understanding the deficiency prevalence of vitamin D3 and Vitamin B12 in various occupational categories can inform public health attempts to reduce their deficiency and ensure improved population health outcomes.

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