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Research Article

TATA STEEL EXECUTIVES HAVE A LOWER PREVALENCE OF VITAMIN D DEFICIENCY AND COMPARABLE PREVALENCE OF VITAMIN B_{12} DEFICIENCY IN RELATION TO REPORTED RATES IN THE INDIAN POPULATION

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ABSTRACT
Introduction: Literature highlights the prevalence of Vitamin D deficiency in areas of adequate sunlight too. Vegetarianism is a contributing factor to Vitamin B_{12} deficiency. The present study aimed to study the prevalence of Vitamin D and B_{12} deficiency in corporate executives of Tata Steel. *Method:* It was a prospective cross sectional study with executives of Tata Steel as the study group and footballers of Tata Football Academy as the comparison group. All subjects were administered a pre-designed questionnaire on their lifestyle and a serum vitamin D and vitamin B12 estimation was done. Based on reference value of the assay kit, Vitamin D values less than 10.0 ng/ml and Vitamin B_{12} less than 200pg/ml indicated deficiency. *Result:* 26.6 percent of Tata Steel executives had a vitamin D <10ng/ml whereas this was only 2.1 percent in footballers. The prevalence rate of vitamin B_{12} deficiency in Tata Steel executives was 67.7 percent, significantly higher than that in footballers (16.7 percent). The prevalence of vitamin B_{12} deficiency was 82.5 percent in vegetarians compared to 58.3 percent in non-vegetarians. *Conclusion:* Though the study group (Tata Steel executives) had a significantly higher rate of vitamin D deficiency than the comparison group (football players of Tata Football Academy), this was lower than that reported in other Indian studies. Similarly, the prevalence rate of vitamin B_{12} deficiency in the study group was significantly higher than that in the control group and this was comparable to that reported in Indian studies.

Key Words: Vitamin D, Vitamin B_{12}, Deficiency and Tata Steel

INTRODUCTION
Vitamin D is known as "Sunshine Vitamin" as 90 percent of vitamin D is manufactured from ultraviolet ray exposure to skin, which initiates the conversion of cholesterol in the skin to vitamin D3. It is required mainly for calcium and phosphorus absorption. Vitamin D deficiency results in osteomalacia in adults and rickets in children. Other musculoskeletal symptoms (non-specific backache, generalized body ache and joint pain) may also be seen. With the easy availability of 25-hydroxyvitamin D assay, it is possible to diagnose hypovitaminosis D in absence of overt signs of vitamin D deficiency (Plotnikoff and Quigley, 2003; Holick, 2003). Vitamin D deficiency is not uncommon in India. Recent literature highlights its high prevalence in the Indian sub-continent (Kanekar et al., 2010; Pingle and Gulvady, 2007).
A study at Hinduja hospital found an 80 percent prevalence rate of vitamin D deficiency in patients with non-specific aches and pain. Another study showed a prevalence of 28 percent vitamin D deficiency amongst corporate executives (Pingle and Gulvady, 2007**)**.
The possible reasons contributing to vitamin D deficiency in a sunlight sufficient country like India are dark skin pigmentation that interferes with ultraviolet ray transmission, insufficient exposure to sun due to social factors or workplace environment and high phytate content in diet that binds with calcium and interferes with its intestinal absorption (Pingle and Gulvady, 2007**).** Vitamin B_{12} is an essential nutrient required in the conversion of homocysteine to Methionine, which in turn activates Folate required for DNA synthesis. B_{12} is also required in synthesis of myelin, in erythropoeisis and in energy production in mitochondria. B_{12} deficiency results in neurological and hematological manifestations. The source of vitamin B12 is largely food of animal origin, some plant origin food with soil contaminants, milk solids or fortified food. Vitamin B_{12} deficiency is common in vegetarians including sub-groups like the elderly, pregnant women, infants & children and industrial workers (Pawlok et al., 2013). The study by Pingle and Gulvady carried out among corporate executives in India identified 65 percent of executives as deficient in vitamin B_{12} (Pingle and Gulvady, 2007**).**
Considering the high prevalence of vitamin D and vitamin B12 deficiency in Indians, its long term deleterious effect and the reversibility of the condition through replacement therapy and lifestyle modification, Tata Steel decided to carry out a study to establish the prevalence of vitamin D and B_{12} deficiency for executives of Tata Steel at Jamshedpur under "Sunshine Vitamin Project".

MATERIALS AND METHODS

The study was carried out at Tata Steel jointly by the Departments of Occupational Health Services and Nuclear Medicine, Tata Main Hospital in the period January to December 2012. It was a cross sectional study with executives of Tata Steel, Jamshedpur forming the study group and footballers of Tata Football Academy (TFA) forming the comparison group. Footballers of TFA reside in a company run hostel and have supervised hours of exercise and a common diet. The advantage of using them as a comparison group was that hours of outdoor activity, exposure to sunlight and diet was consistent in the entire group. With the background of a 30 percent reported prevalence rate of vitamin D deficiency in corporate executives (Gulvady and Pingle, 2007), the sample size required for the study was calculated as 292 for a 95 percent confidence interval and 80 percent power. There were 441 executives in the study group and 48 footballers in the comparison group. The footballers in the control group were cadets of Tata Football Academy who were exposed to a minimum period of 4 hours of sunlight daily during the daily physical exercise and the foot ball practice. The exclusion criteria were diagnosed cases of vitamin D or B_{12} deficiency already on replacement therapy, pregnant women and a history of hospitalization in the past one month. The executives and footballers were scheduled for blood sampling over a period of 6 weeks. A pre-designed questionnaire was administered that included demographic details and questions on type of work (sedentary/outdoor), lifestyle, dietary habits, concomitant illness and medication. Fasting samples were drawn in plain vials and serum separated.

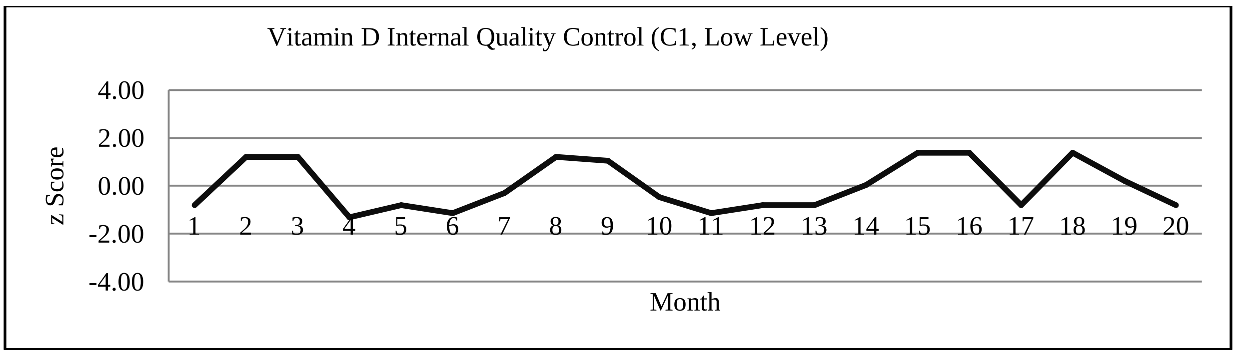

Figure 1: Results of internal QC for Vitamin D assay for low level control

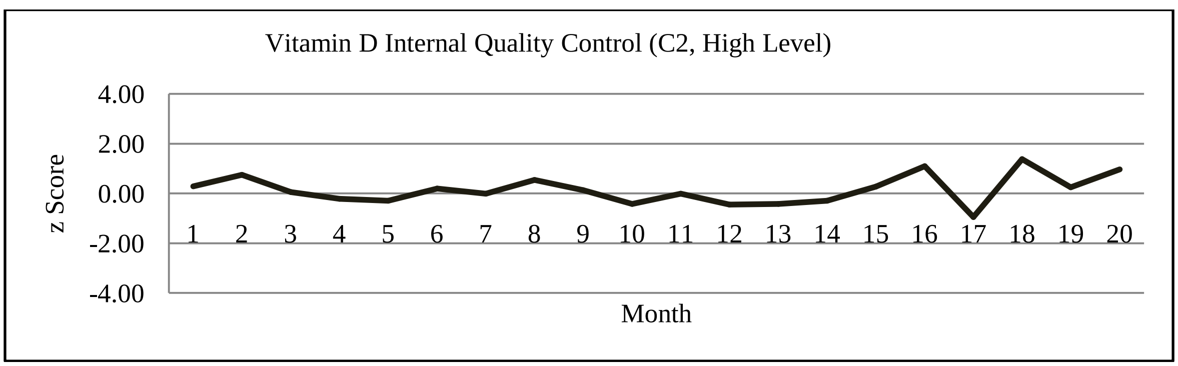

Figure 2: Results of internal QC for Vitamin D assay for high level control

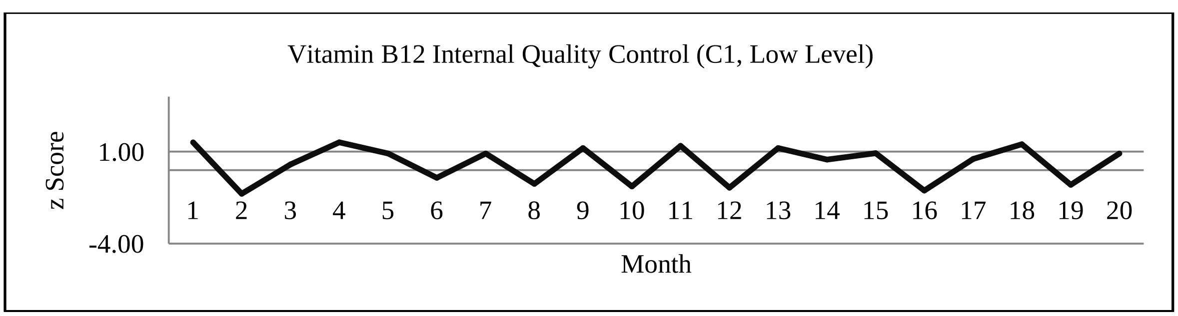

Figure 3: Results of internal QC for Vitamin B_{12} assay - low level control

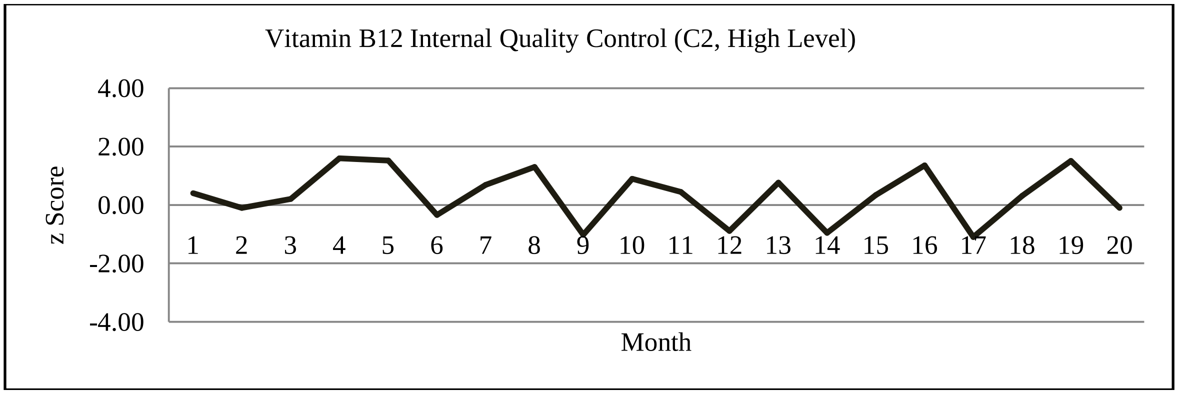

Figure 4: Results of internal QC for Vitamin B_{12} assay – high level control

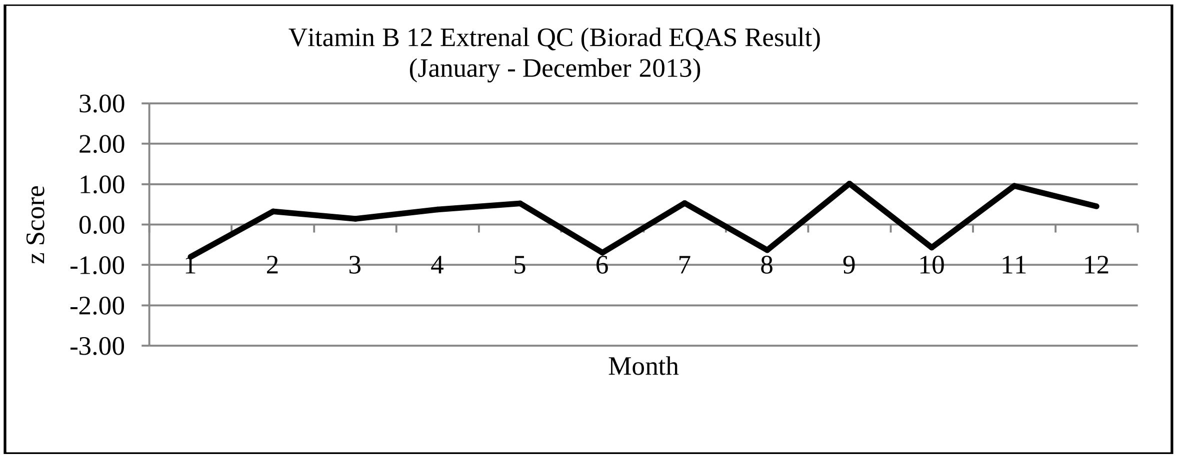

Figure 5: External QC (EQAS) for Vitamin B_{12}

25 hydroxy Vitamin D was assayed by Radioimmunoassay (RIA) method using Diasorin kit. Vitamin D assay was validated during the study period only if the z-score was within 2.0 for the low and high level internal controls (Figs. 1 & 2). Vitamin B_{12} assay was carried out on Beckman Coulter Access 2 Chemiluminescence Immuno Assay (CLIA) automated processor. Vitamin B_{12} assay was validated during the study period with both internal quality control sera of Biorad (Figs. 3 & 4). External quality assurance of Vitamin B_{12} assays was validated through the EQAS program of Biorad (Fig. 5). Considering the reference values indicated by Diasorin test kit for 25 hydroxy Vitamin D, values less than 10ng/ml was considered as vitamin D deficiency. The normal range of vitamin B_{12} as per the test kit was 200-900 pg/ml**.** Persons with deficient vitamin D and B_{12} levels were referred to a physician for clinical assessment and treatment, including counselling on lifestyle modification. Calcirol sachet once weekly for one month and then fortnightly for the next month was prescribed for Vitamin D deficient patients. For patients with vitamin B12 deficiency, Capsule B Complex once daily was prescribed for 2 months. Follow up vitamin D and B_{12} tests were done after 2 months.

Data entry and analysis and statistical tools: Data was entered in MS-Excel and STATISTICA and analysed. The tests of significance used were correlation co-efficient, chi-square and student's t test. Frequency distribution curves and the correlation maps were generated in the STATISTICA software.

RESULTS

There were 67 percent males and 37 percent females in the study group. The mean age of the study group was 45.21±7.66 years (Fig. 6). Institutional hierarchy in Tata Steel is by Impact Level (IL) with the top management being in IL1 and the most junior executive in IL6. 85 percent of the study group were from IL3 and IL4 and 15 percent were from IL2 (Fig. 7). All persons of the control group were between 18-30 years of age. The control group consisted of males only. The control group did not have an assigned impact level.

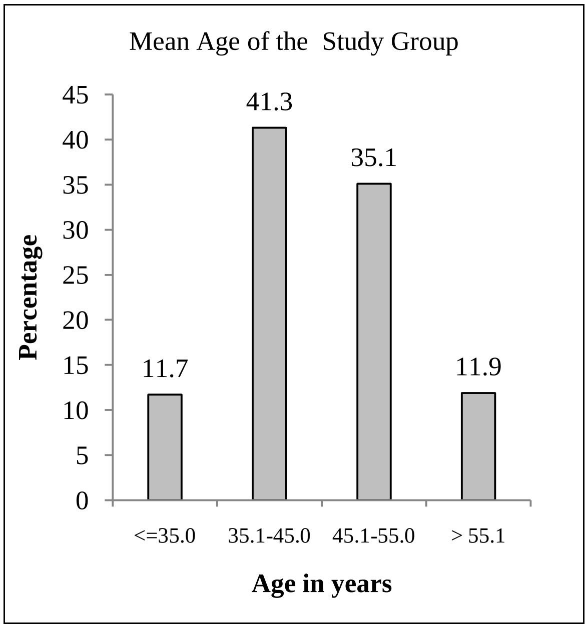

Figure 6: Mean Age of Study Group

Figure 7: Job Positions in the study group

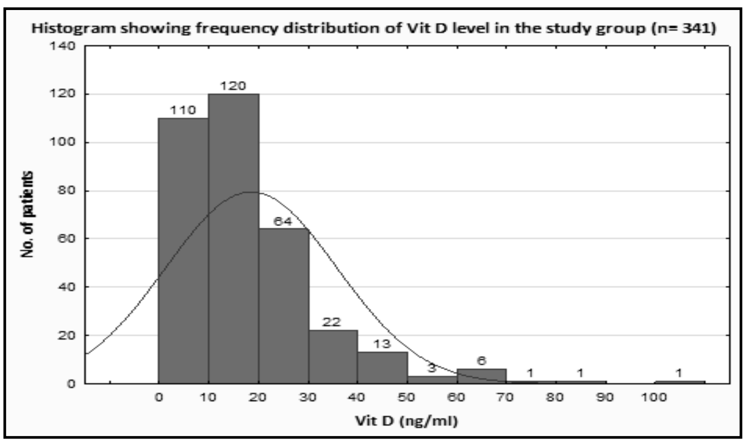

Figure 8: Vitamin D in Study Group

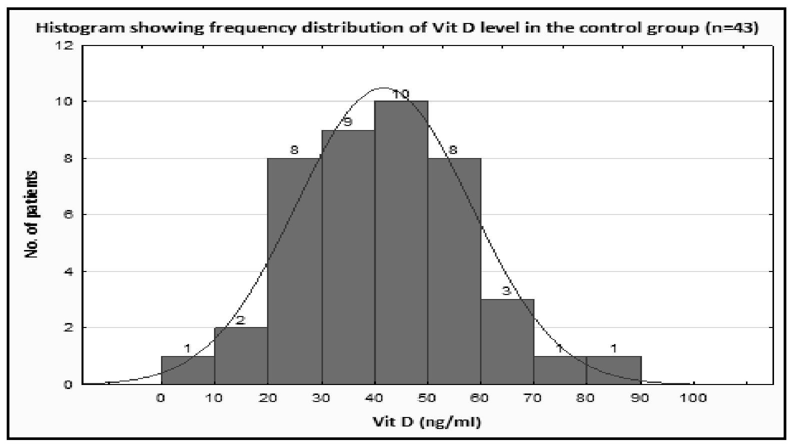

Figure 9: Vitamin D in Control Group

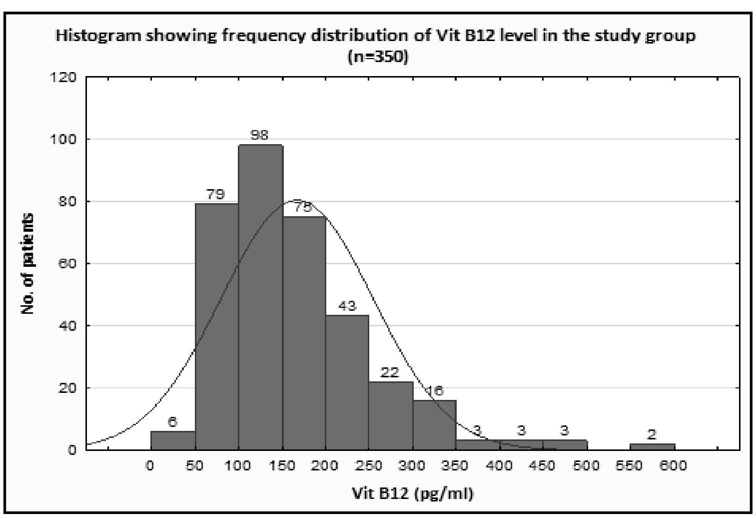

Figure 10: Vitamin B_{12} in Study Group

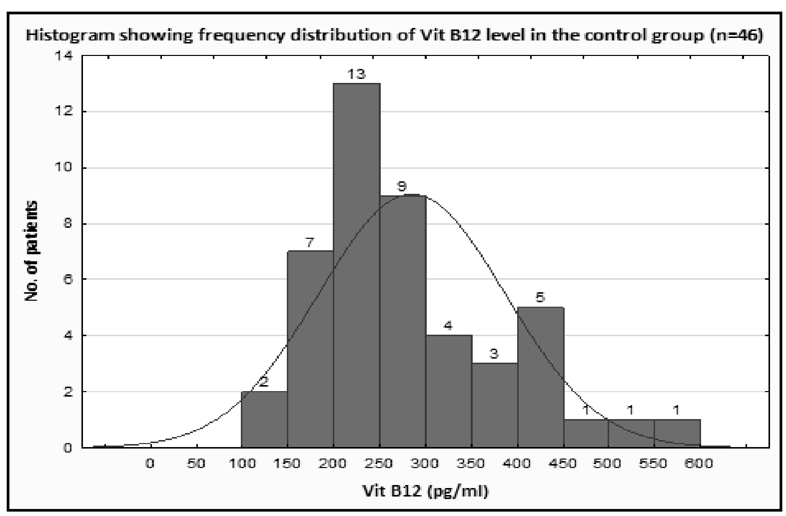

Figure 11: Vitamin B_{12} in Control Group

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The vitamin D level in ng/ml was 19.84±17.6 in the study group and was 48.8±16.2 in the control group (Figs. 8 & 9). 26.6 percent of Tata Steel executives had a vitamin D level less than 10 ng/ml whereas this was only 2.1 percent in the control group. The vitamin B_{12} level was 179.26 ±107.8 in the study group and 267.3±101.4 in the comparison group (Fig. 10). 67.7 percent of Tata Steel executives had vitamin B_{12} level less than 200 pg/ml whereas this was 16.7 percent in the control group (Fig. 11).

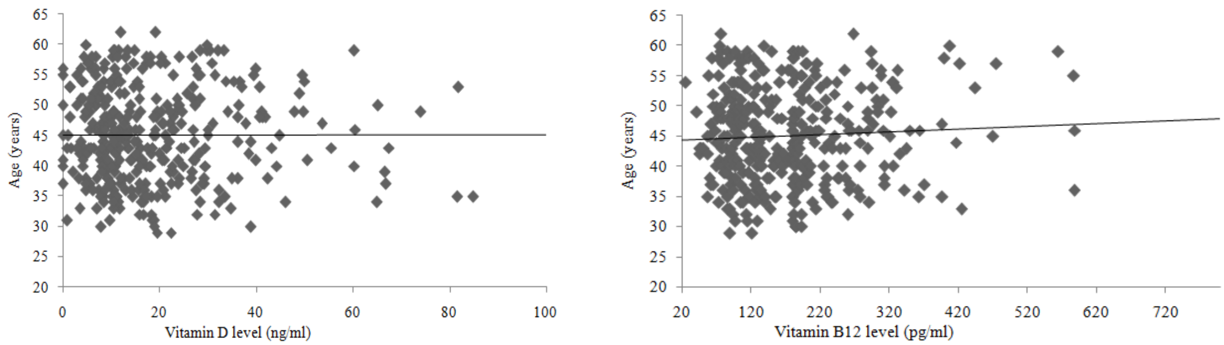

Figure 12 and 13: Correlation of age with Vitamin D and B_{12} levels (Study Group)

No correlation with age was seen for either vitamin D (r = (-0.13), p = 0.807) or vitamin B12 deficiency(r=0.07, p= 0.137) (Figs. 12 and 13). 26.5 percent males had a vitamin D level less than 10.0 ng/ml; 34.5 percent females had vitamin D less than 10.0 ng/ml. 68.8 percent males had a vitamin B12 level less than 200 pg/ml whereas this was 58.8 percent in females. The difference in percentage of males and females with vitamin D and vitamin B12 deficiency was statistically not significant (p > 0.05).

In IL2 executives (hierarchy wise, the senior most in the study group), the prevalence of vitamin D deficiency (vitamin D< 10.0 ng/ml) was 34.8 percent; in the IL3 (middle level executives) this was 33.8 percent whereas in the IL4 (junior executives) this was 18.6 percent (Fig. 14). The prevalence of vitamin B12 deficiency (vitamin B12< 200 pg/ml) was 76.8 percent in IL1, 74.9 percent in IL3 and 60.2 percent in IL4 (Fig.14). The prevalence of vitamin B12 deficiency was 82.5 percent in vegetarians compared to 58.3 percent in non-vegetarians. Executives spending more than 4 hours in outdoor activity had a prevalence of vitamin D deficiency of 21.2 percent; this was 33.3 percent in executives with less than 4 hours of outdoor activity.

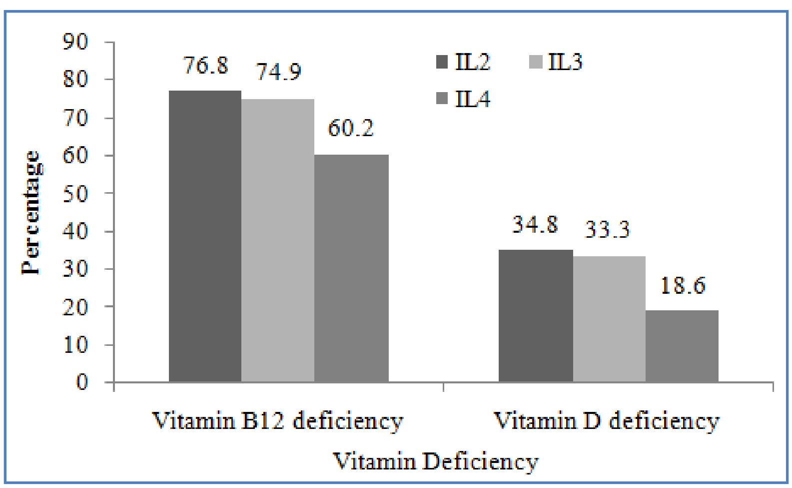

Figure 14: Prevalence of Vitamin B12 and Vitamin D deficiency in job levels

117 patients in the study group and 1 in the comparison group with vitamin D level < 10.0 ng/ml were started on vitamin D supplementation. 62 patients did not turn up for the follow up test 2 months later. In the 55 patients with post therapy follow up, the average increase in vitamin D was18.4 ng/ml (range: 0.7-83). An increase from baseline level of vitamin D by 10.1-50 ng/ml was seen in 49 percent of patients, 1 percent (3 patients) showed a rise from

baseline level of > 50.1 ng/ml, 21 percent showed an increase between 5.1-10.0 ng/ml and in 23 percent it remained less than 5.0 ng/ml (Fig. 15).

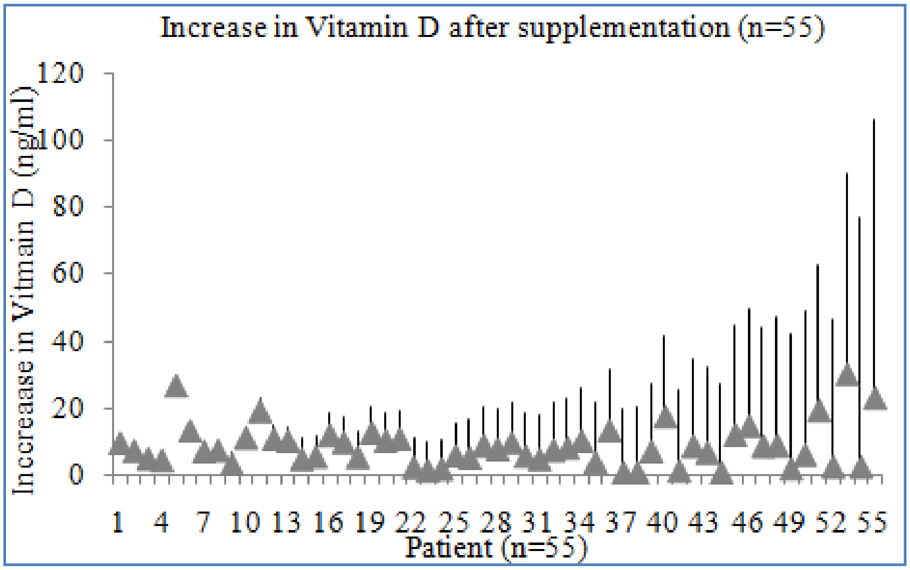

Figure 15: Increase in Vitamin D levels post supplementation

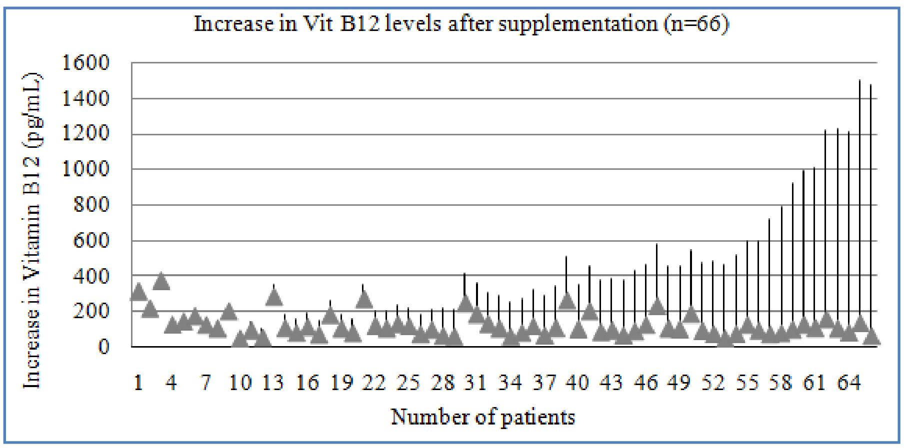

Figure 13: Increase in Vitamin B_{12} post supplementation

300 patients in the study group and 8 patients in the comparison group were put on vitamin B12 supplementation. Follow up test after 2 months was done in only 84 patients, the rest did not turn up for the follow up test. 18 patients showed no change in vitamin B12 levels in the follow up test- 40 percent showed an increase in vitamin B12 <200 pg/ml whereas the rise was between 201-1400 pg/ml in 60 percent of patients (Fig. 16). The average increase was 304.4pg/ml (range: 4.0-1416.0).

DISCUSSION

The prevalence of Vitamin D deficiency in Tata Steel executives was 26.6 percent, significantly higher than the prevalence in the comparison group of footballers (2.1 percent). It was significantly lower than the prevalence of vitamin D deficiency reported in other Indian studies. Arya et al., (2004) has reported that 67 percent of young healthy individuals have a vitamin D level < 15 ng/ml whereas Harinarayan et al (2004) has reported a prevalence of 62 percent in urban adults in their population based study in Andhra Pradesh. In another study, the mean vitamin D level reported by Harinarayan et al (2004) was 13.5 ±0.59 whereas this was 19.84 in our study group. However, it was comparable to the study on corporate executives of Pingle.S who reported a prevalence of 28 percent in a Mumbai-based study (Pingle et.al, 2007). The football players as control showed a low prevalence of Vitamin D deficiency (2.1 percent) in our study. It was significantly lower than that reported by Marwaha et al (2009) in a study that included 473 healthy young jawans (21-40 years); 29.4 percent of his study group had a vitamin D< 10.0 ng/ml. No gender difference in prevalence rate of vitamin D deficiency was noted in our study (26.5 percent in males, 34.5 percent in females, p>0.05). However, Harinarayan et al (2008) reported a significant difference in prevalence rate of 62 percent in urban males versus 75 percent in urban females. The prevalence rate of vitamin B12 deficiency in Tata Steel executives was 67.7 percent, significantly higher than that in footballers (16.7 percent). It was comparable to the study of Pingle et al (2007), who reported a prevalence rate of 65 percent in executives. It was also comparable to other Indian studies. Pawlok et al (2013) in their review article have reported definite rates for specific population-62 percent in pregnant women, 25 percent to 86 percent in children, 21 to 41 percent in adolescents and 11 to 90 percent in adults. Yajnik et al., (2006) reported a median plasma level of B12 less than 150 pmol/L in 67 percent of his study group. The prevalence of vitamin B12 deficiency in our study was significantly higher in vegetarians (82 percent versus 58.3 percent in non-vegetarians), comparable to the prevalence reported in a review article (Pawlok et al., 2013).

The prevalence rate of both vitamin D and vitamin B12 was linked to hierarchy, with senior executives showing a significantly higher rate. A significantly higher rate of vitamin D deficiency was seen in executives who spent less than four hours a day on outdoor activity. The vitamin D and vitamin B12 assays were done under strict quality control (figures 1, 2, 3, 4 and 5). Vitamin D assay is a technically challenging procedure. In absence of established laboratory QC methods across the country, a lower value of vitamin D may be due to inconsistent laboratory performance and this may be a factor contributing to the high figures of vitamin D deficiency reported in Indian studies.

CONCLUSION

The prevalence rate of vitamin D and vitamin B12 deficiency in Tata Steel executives was significantly higher compared to the control group of football players. Outdoor activity of less than 4 hours a day, seniority (with a greater probability of desk bound job) in the organizational hierarchy and a vegetarian diet was linked to higher prevalence. The prevalence rate of vitamin B12 deficiency was comparable to that reported in Indian studies. Intervention through counseling and replacement resulted in improvement in the vitamin D and vitamin B12 levels.

However, the prevalence of vitamin D deficiency in Tata Steel executives was significantly less than that reported in other Indian studies. Besides lifestyle and socio-economic factors, this may be linked to assay methods and laboratory performance and there is need to standardize these to determine the actual extent of vitamin D deficiency in the country.

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REFERENCES

Arya V, Bhambhri R, Godbole MM & Mithal A (2004). Vitamin D status and its relationship with bone mineral density in healthy Asian Indians. *Osteoporosis International*, **15** (1)56-61.

Gulvady C, Pingle S & Shanbhag S (2007). Incidence of Vitamin B12/Vitamin D3 deficiency among company executives. *Indian Journal of Occupational and Environmental Medicine*, **11**(2) 83-85.

Harinarayan CV, Ramalaxmi T & Venkataprasad U (2004). High prevalence of low dietary calcium and low vitamin D status in healthy south Indians. *Asia Pacific Journal of Clinical Nutrition*, **13**(4) 359-365.

Harinarayan CV, Ramalaxmi T, Prasad UV & Sudhakar D (2008). Vitamin D status in Andhra Pradesh: a population based study. Indian Journal Medical Research, **127** 211-218.

Holick MF (2003). Vitamin D deficiency: what a pain it is. *Mayo Clinic Proceedings*, **78** 1457-1459.

Kanekar A, Sharma M & Joshi VR (2010). Vitamin D Deficiency-A Clinical Spectrum: Is There a Symptomatic Nonosteomalacic State? *International Journal of Endocrinology*.

Marwaha RK, Tandon N, Shivaprasad C, Kanwar R, Mani K, Aggarwal R, Bhadra K, Singh S, Sharma B & Tripathi RP (2009). Peak bone mineral density of physically active healthy men with adequate nutrition and no known current constraints to bone mineralization. *Journal of Clinical Densitometry*, **12**(3) 314-321.

Pawlok R, Parott SJ & Sudha R (2013). How prevalent is Vitamin B12 deficiency among vegetarians. *Nutrition Reviews*, **71**(2) 110-117.

Plotnikoff GA & Quigley JM (2003). Prevalence of severe hypovitaminosis D in patients with persistent, nonspecific musculoskeletal pain. *Mayo Clinic Proceedings*, **78**(12) 1463-1470.

Wills MR, Day RC, Phillips JB & Bateman EC (1972). Phytic acid and nutritional rickets in immigrants. *The Lancet*, **7754**(1) 771-773.
Yajnik CS & Deshpande S (2006). Vitamin B_{12} deficiency and hyperhomocytenemia in rural and urban Indians. *Journal of the Association of Physicians of India,* **54** 775-782.