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Comparison of vitamin D3 levels in normal, overweight and obese individuals.

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Abstract:

Context:

Obesity is considered as a global epidemic. It is associated with risk of multiple health problems. Vitamin D deficiency is prevalent in India. Vitamin D deficiency is increasingly associated with insulin resistance, type 2 DM and CVD, conditions also commonly linked with overweight and obesity.

Aims:

Comparison of vitamin D3 levels in normal, overweight and obese individuals without comorbidities.

Settings and Design:

Cross sectional observation study

Methods and Material:

189 eligible individuals were enrolled, divided into 3 groups based on BMI- normal, overweight, obese according to guideline for Asian population. Excluding secondary obesity. Blood samples for vitamin D measurement and anthropometric measurements were taken.

Statistical analysis used:

Comparison among different BMI categories will be done using ANOVA (Analysis of variants) followed by post hoc comparison.

Results:

Our study revealed that Hypovitaminosis D was most common in the obese and subjects with central obesity. Overall 64.6% had Vitamin D deficiency, 22.2% had insufficiency, only 13.2% had normal vitamin D. Hypovitaminosis D was observed in 68% of subjects with central obesity as compared to 32% without central obesity.

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Conclusions:
In our study there was hypovitaminosis D in all 3 groups, but the mean level of 25(OH) D was very low in obese and overweight individuals without comorbidities and hypovitaminosis D directly proportional to the central obesity. Overall vitamin D deficiency is present in even normal individuals.
Key-words: Vitamin D, Obesity, central obesity.

Introduction:
Obesity is considered as a global epidemic, obesity is increasing rapidly.
In the last 10 years, the count of obese people has doubled in the country, 21% are obese/overweight in woman, and 19% are obese/overweight in men, according to NFHS-4[1].
Obesity is associated with increased risk of multiple health problems. Vitamin D deficiency is increasingly associated with unfavourable metabolic phenotypes including insulin resistance, type 2 DM and CVD, conditions also commonly linked with overweight and obesity. since there is a negative relation between levels of Vitamin D, the degree of obesity and central adiposity, it is difficult to determine the independent effects of 25(OH) D level, and obesity on metabolic syndrome.

Subjects and Methods:

- This is a Cross sectional study.
- **Study Place**: JSS medical college and Hospital, Mysore.
- **Study duration:** This study was conducted over 18 months.

Study population:

- The study population would include the patients of either sex visiting General medicine OPD or admitted in the General medicine wards of JSS Hospital, Mysore.

Sample size and its estimation including sampling procedure:

- Assuming at least an estimated difference between the means of vitamin D3 levels as 6.2 ng/ml at 95% confidence interval, power of 80% a sample size of 63 in each group will be required and purposive sampling technique is adopted to enrol the subjects into the study.

Sample selection criteria:
Inclusion criteria:

- Patients who are above 18yrs and below 60 yrs of age.
- Patients who are categorised into

Normal group - 18.5 to 22.9 kg/m^2
Overweight group - 23.0 to 24.9 kg/m^2
Obese group - > 24.9 kg/m^2 according to Indian consensus guideline.

Exclusion criteria:

- Secondary obesity
- Chronic renal disease
- Chronic liver disease
- Post bariatric surgery

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- Hypertension
- Diabetes Mellitus

Study setting and Data collection procedure:

- Patients will be examined using a structured proforma, detailed case history and clinical evaluation will be done, sample collection will be done by primary investigator.
- General and health information.
- Clinical and anthropometric assessment :
  Weight, Height, BMI, Hip circumference, Waist circumference, SBP, DBP
- Biochemical assessment- after obtaining the valid consent blood samples are collected for estimation of Vitamin D.
- Vitamin D level was estimated with ECLIA (electro-chemiluminescence binding assay) method using cobas 6000 analyser.

Data Analysis:

- The collected data entered into MS Excel followed by the analysis using SPSS version -23
- The demographic characters would be represented using analytical means with standard deviation and percentages. Bar diagram, pie diagram will be used where ever necessary.
- Comparison among different BMI categories will be done using ANOVA (Analysis of variants) followed by post hoc comparison, the test will be fixed only after finding out the normality of data.
- All the possible association between the demographic characteristics and the outcome will be found out using Chi square test, a p value < 0.05 will be considered as statistically significant

Results:

Mean Age in Normal was 38.92 ± 14.38, In over Weight group was 39.41 ± 12.52 and in obese group was 43.76 ± 11.06. In Normal Group, 87 (49.21%) were Female and 102 (50.79%) were male. In the study among females, 72.4% had deficiency, 19.5% had insufficiency and 8% had normal vitamin D levels and among males, 57.8% had deficiency, 24.5% had insufficiency and 17.6% had normal vitamin D levels. No significant relation between sex and vitamin D.
Mean BMI in Normal was 20.96 ± 1.23, In over Weight group was 23.95 ± 0.45 and in obese group was 28.58 ± 3.2.

From the study it can be observed that with increase in age, vitamin d deficiency was increasing, however there is no statistical significant association between age and levels of Vitamin D, ($P = 0.342$)

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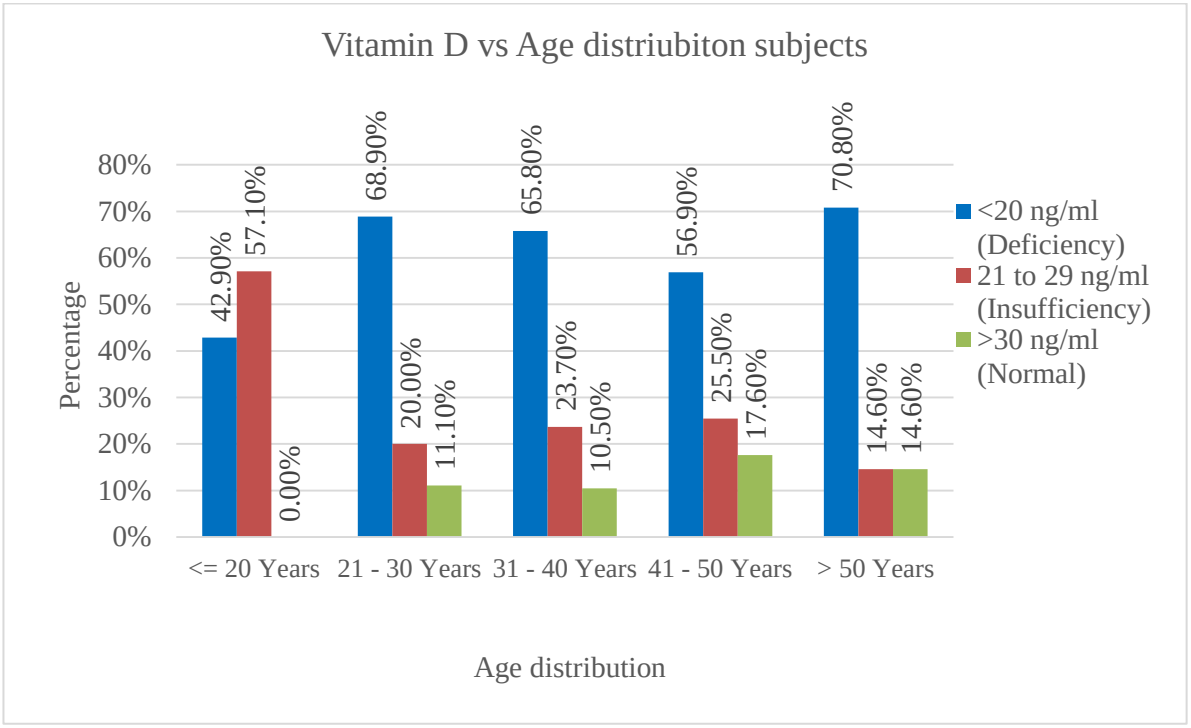

Figure 8: Bar diagram showing Association between Age distribution and Vitamin D levels

Overall in the study 122(64.6%) had Vitamin D deficiency, 42(22.2%) had insufficiency and 25(13.2%) had normal vitamin D levels. There is statistical significant association (*P* <0.001) between Vitamin D level and three groups. With increase in BMI there was increase in deficiency.

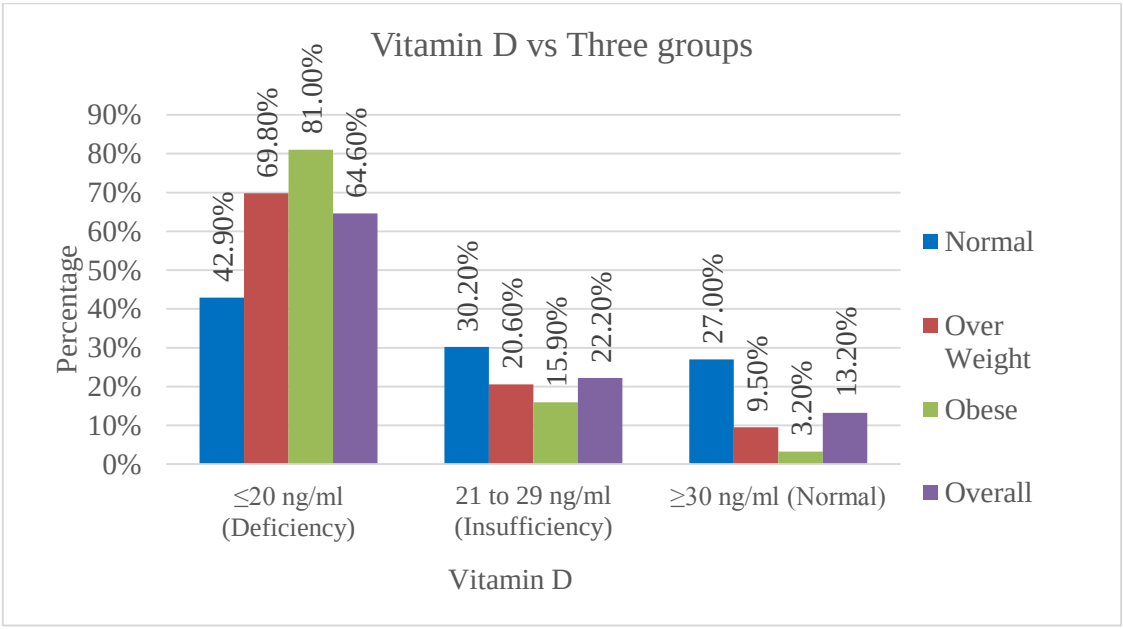

Figure 12: Bar diagram showing Vitamin D levels classification comparison between three groups and over all levels

In the study 114 (60.3%) had central obesity, 75(30.9%) did not have central obesity. Among subjects with Vitamin D deficiency, 68% had Central obesity, among subjects with

insufficiency, 52.4% had central obesity and among subjects with normal Vitamin D levels, 36% had central obesity. There was significant association between waist circumference and vitamin D levels

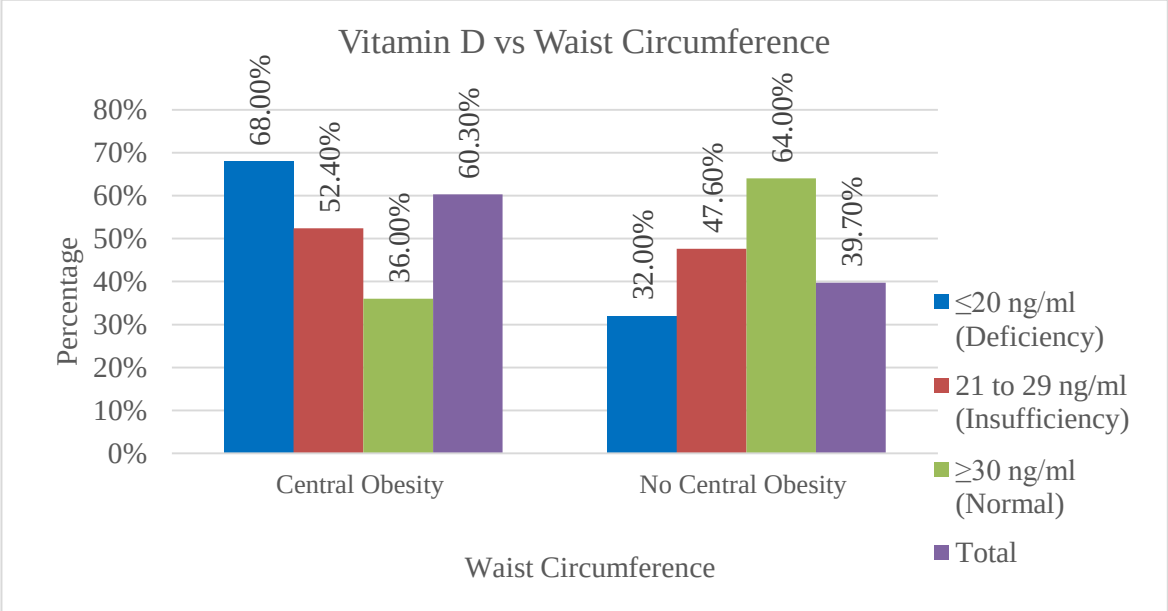

Figure 14: Bar diagram showing Association between Vitamin D levels and Waist Circumference

Discussion:

Vitamin D deficiency is present all over the world, still it is the most under diagnosed and under-treated nutritional deficiency in the world.

In the study we undertook, Majority of the subjects were in the 5th decade. 70.8% of the subjects of > 50yr of age were vitamin D deficient. From the study it can be observed that with increase in age, vitamin d deficiency was increasing, however we did not find statistically significant relation between age and Vitamin D levels**.** This is similar to a study of Alam MS et al ., 2018 [68, 2] in Bangladesh, statistical significance was not found between level of 25(OH)D and age groups less than 40yrs and more than 40yrs. On the contrary a study carried out by Daly et al., 2012 [69,3] and Song et al., 2014[70,4] in Australia and Korea respectively, there was significant association between hypovitaminosis D with increase in age.

In our study, there was no significant differences in the prevalence of Vitamin D deficiency between males and females. Vitamin D deficiency was present among 63 female subjects (72.4%) and 59 male subjects (57.8%). This is in agreement with the observations of Alam et al. and Palazhy et al [71,5]. Study done by Yan X et al. 2019 in a cross sectional study in china revealed that women are more prone to have inadequate vitamin D levels [72,6]. Women on average have more subcutaneous fat than men, greater subcutaneous fat in women takes up more vitamin D molecules produced from skin, leading to reduced vitamin D molecules entering the blood circulation in women than in men. Gallagher D et al, 2000 showed women had hypovitaminosis D than did men. [73,7]

Obesity, it is one of the major lifestyle disorders and is significantly associated with the prevalence of hypovitaminosis D. These findings were similar with our present study. This

could be attributed to lower concentration of circulating and reduced bioavailability of the vitamin D among obese subjects.

In this study we observed that low level of Vitamin D (<20ng/mL) was most predominantly present in the obese subjects (81%), while Vitamin D insufficiency(21-29ng/ml) was more often seen in the overweight individuals (20.6%) thereby proving a significant relationship with BMI and Vitamin D deficiency. Overall in the study 64.6% had Vitamin D deficiency, 22.2% had insufficiency and 13.2% had normal vitamin D levels, with increase in BMI there was increase in vitamin deficiency.

Obese subjects have low serum vitamin D than normal BMI people, and serum vitamin D is inversely corresponds with increase in Body mass index. This has been shown in many clinical and epidemiological studies conducted in different countries of the world. The vitamin D deficiency is more prevalent in obese people, accounted at between 40% and 80% in a study done by Paul AK et al., 2020.[74,8] Liu S et al., 2005 also have found an inverse association between 25(OH) D levels and BMI[75,9]. A Cross sectional study on vit D and BMI with total of 10,229 subjects done by Rolf Jorde et al., 2010, [76,10] which revealed a statistically significant negative relation between the vitamin D level and Body mass index.

Study by Gonza´lez-Molero et al. [77,11] a 12-year, population-based, prospective study, regarding the association between serum vitamin D level and obesity in southern Spain, Suggested hypovitaminosis D in obese people may not be secondary to obesity, but it may leads to obesity, vitamin D status of the people may decide the incidence of obesity in people. But the causative association between obesity and serum vitamin D level still remains uncertain. It may have a multiple etiological factors, these are the few factors like insufficient exposure to sun, inadequate supplement of vitamin D, more storage in fat tissue, less physical activity in obese subjects because of reduced mobility, enhanced activity of the 24(OH) enzyme in fat tissue that aids vitamin D catabolism or hepatic steatosis leads to a reduced production of vitamin D in the liver. [78,12]

Vitamin D deficiency was more profound in subjects with central obesity which is described as waist circumference of >90 cm males and >80cm in females. In the study among subjects with normal BMI, 47.6% had central obesity, among subjects with overweight, 57.1% had Central Obesity, and among subjects with obesity, 76.2% had central obesity. Vitamin D deficiency was observed in 83 subjects (68%) with central obesity as compared to 39 subjects (32%) without central obesity, implying that as the waist circumference increases, there is increased chances of developing Vitamin D deficiency. Ford ES et al., 2005, study also has showed negative association between vitamin D levels and central adiposity. [79,13]

Moy and Bulgiba [80,14] have found that low levels of serum vitamin D level was independently associated with marked central obesity in Malaysian subjects. Botella-Carretero et al. [81,15] found that extremely obese subjects with metabolic syndrome had a higher prevalence of hypovitaminosis D than patients without metabolic syndrome (60.9 versus 33.3%, resp.) in spite of having similar BMIs.

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RECOMMENDATIONS

Needs future randomised controlled long-term studies that measure BMI and body composition i.e. fat mass, including adequate control for time of year (seasonality), community, sun exposure and dietary intakes.

Needs long term interventional study to assess effect of vitamin D supplementation in healthy population on general and central obesity.

Food fortification needs to be initiated with an aim to improve distribution through organised sector with proper surveillance. Increasing efforts to mobilise available resources that would improve knowledge and education about the benefits of sun exposure without sunscreen along with enhancing the dietary calcium intake would go a long way much before the food fortification programme become a reality. In the absence of sun exposure, adequate quantity of Vitamin D from dietary sources and supplementation is a must to meet the body's requirement.

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