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CHARACTERIZATION OF SLEEP QUALITY IN VITAMIN D DEFICIENT ELDERLY OF BANGALORE CITY

Physiology

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ABSTRACT

The older population is at a high risk of Vitamin-D deficiency due to decreased cutaneous synthesis and dietary intake of Vitamin-D. Although recent studies have investigated the influence of Vitamin-D on sleep patterns, there is a lack of research on the relationship between Vitamin-D and sleep patterns in elderly population. Hence there is a need to evaluate whether Vitamin-D deficiency affects sleep quality in the elderly.

OBJECTIVES: A.To assess Serum 25(OH) Vitamin-D in the elderly. B.To assess Sleep Quality in the elderly with different levels of Vitamin-D.

MATERIAL & METHODS: This study involved 80 healthy elderly subjects with consideration of inclusion and exclusion criteria. Written informed consent was taken. For each subject, fasting blood sample of 4ml was collected for Serum 25(OH) Vitamin-D assessment. Anthropometric measurements were taken. 24-hour dietary recall, General History Questionnaire using the Pittsburgh Sleep Quality Index were administered and quality of sleep was evaluated. Results were compiled and statistically analyzed.

RESULTS: A comparison of Serum Vitamin-D levels and PSQI components showed that the mean scores for subjective sleep duration, sleep latency, and sleep quality were significantly higher in the Vitamin-D deficient participants, indicating that the Vitamin-D deficient participants had poorer sleep quality.

CONCLUSION: A significant correlation was found between Serum Vitamin-D deficiency and poor sleep quality. Based on the results of this study, sleep disorder management for elderly can be improved by providing regular examinations checking their Serum Vitamin-D levels and supplementing Vitamin-D to the elderly to enhance their quality of sleep.

KEYWORDS

Vitamin-d, Sleep Quality

1. INTRODUCTION

Ageing is defined as gradual, insidious, and progressive decline in structure and function (involving molecules, cells, tissues, organs) that begin to unfold after the achievement of sexual maturity (Caruso LB,Silliman RA. 2008). Between 2000 and 2030, the number of older adults worldwide is expected to increase from 420 to 974 million (Jeyalakshmi S et al, 2012) India has around 100 million elderly at present and expected to increase to 323 million, constituting 20% of the total population by the year 2050.(United Nations Population Fund, 2012).

Adequate nutrition is fundamental to healthy ageing. Energy requirements decrease with age due to decline in lean body mass and decreased physical activity and slowed rates of protein turnover. Despite this decrease, older adults are at risk of under nutrition due to medication side effects, functional, visual, or cognitive impairment, oral disease, swallowing disorders, or loss of smell/taste, depression and social isolation, and chronic illnesses1. Although vitamin requirements do not change with age, older adults are particularly prone to inadequate intake of Vitamin D, Vitamin B12 and Calcium and are also associated with reduced Calcium and Vitamin D absorption (Caruso LB,Silliman RA. 2008).

Sleep disturbance is a common complaint among the senior citizens. The deteriorating quality of sleep and chronic illness, in fact, forms a vicious cycle. (Hirschowitz M. 2004)

Recent studies have focused on the less commonly known roles of vitamin D, such as its influence on sleep. The mechanism of vitamin D and its effect on sleep is likely to play a major role in the brainstem, which controls sleep. This hypothesis is supported by evidence of vitamin D receptors in parts of the brainstem (Gominak SC, Stumpf WE., 2012)

Previous studies on the correlations of serum vitamin D levels and sleep duration by (Lee H J et al, 2012) & (Lee J et al 2016) concluded that lower serum vitamin D levels were associated with a significantly higher risk of short sleep duration.

Hence this study was undertaken to find the characteristics of sleep quality in the Vitamin D deficient elderly of Bangalore city, a population which is genetically different from those referred in previous studies or in the reference mentioned below.

2. OBJECTIVES

A. To assess Serum 25(OH) Vitamin-D in the elderly.
B. To assess Sleep Quality in the elderly with different levels of Vitamin-D.

3. MATERIAL & METHODS

In this descriptive correlational study after obtaining the ethical clearance ,80 elderly aged more than 60 years were recruited from an enrichment center in Bangalore. To be included in this study the subjects were 1) to have no history of Alzheimer's, hepatic disorders, renal disorders, Bone related Disorders, intake of vitamin D or Calcium supplements or drugs known to influence Vitamin D metabolism and sleep, 2) Possessing Verbal communication skills necessary to understand and respond to questions, 3) to be able to care for themselves independently (Informed consent was taken from all subjects or their families if the subject was unable to read or write), 4) to be non-alcoholic and non-smokers, 5) more than High school level education. The study was done during the period of June to August 2019 which is neither winter nor summer in Bangalore city. After explaining the entire procedure, Written Informed consent was obtained. General Physical examination and systemic examination was done. Demographic characteristics, past medical history and use of medications were collected via structured questionnaire. Height and weight were measured, and BMI calculated using Quetlet's Index (wt in kg/ Height in m2)

MEASUREMENT OF SERUM VITAMIN D LEVELS

This study measured serum 25-hydroxyvitamin D, which is the best indicator of vitamin D conditions in the body [Norman AW]. Specimens were kept frozen until they were analyzed by fully automated chemiluminescence immunoassay method. This study used 30 ng/mL as the cut-point for serum vitamin D deficiency. Less Than 30ng/dl were categorised as Cases and more than 30ng/dl as controls.

SLEEP QUALITY

The participants' quality of sleep was evaluated using the Pittsburgh Sleep Quality Index (PSQI)]. This tool evaluates sleep quality during a 1-month period and contains 7 components: subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbance, use of sleeping medication, and daytime dysfunction. The scores for each component range from 0 to 3, with higher values indicating poorer sleep quality. The final sleep quality index is obtained by adding the component scores together. The total score ranges from a minimum score of 0 to a maximum of 21, and a higher total score indicates poorer sleep quality. This study as in Buysee's study interpreted a total score of 5 or lower as indicating normal sleep quality, while a score of 6 or higher indicated poor sleep quality.

STATISTICALANALYSIS

Using the independent-samples t-test, the participants' serum vitamin D levels and mean scores for each PSQI component were measured. The chi-square test was used to analyze differences in the distribution of serum vitamin D deficiency and sleep quality. Simple logistic regression analysis was used to identify variables that showed a significant effect on sleep quality. Variables that were found to be significant were adjusted for in the multiple logistic regression analysis. SPSS version 21 was used for the statistical analysis; the confidence level was set at 95% and significance level at $P < 0.05$.

4. RESULTS

After procuring the results of serum analysis, all the parameters were tabulated and statistical treatment was given to the data and represented in appropriate charts, graphs, and tables. Serum 25(OH) D levels of all the subjects were measured.

The baseline characteristic of the participants is shown in Table 1, Table 2 and Table 3

Age distribution of participants is shown in Table 1. The Mean ± SD age of subjects ranged from 65 to 91 years with a mean age (±SD) of 69.31 (±8.13) years. The subjects consisted of 47 females (59%) and 33 males (41%).

Table 1: Average Age of Subjects and Gender Distribution

	Count	*Average Age (Years)*
Female	47	69.72 ± 9.25
Male	33	68.72 ± 6.29
Overall	**80**	**69.31 ± 8.13**

Table 2: Average BMI of Subjects

Average BMI	
Female	26.78 ± 6.87
Male	23.90 ± 5.48
Overall	**25.59 ± 6.46**

The BMI of subjects ranged from 14.46 to 52.36. Both males and females had BMI within WHO said limits of Normal to Overweight category. None of them were obese.

Table 3: Dietary habits of Subjects

Diet	
Vegetarian	43
Non-Vegetarian	37

The subjects consisted of 43 Vegetarians (54%) and 37 Non-Vegetarians (46%). All the subjects consumed the same diet every day. The dietary calcium intake was 978 mg per day. The energy intake from 24hr diet was 1810 kcal per day. Vitamin D intake was negligible through food., even in the non-vegetarian group of subjects, as they hardly consumed non vegetarian food.

Table 4: Comparison of 25(OH)D levels of male and female study groups with normal values

	Normal Range (ng/ml)	*Sample Range (ng/ml)*	*M ± SD*	*Median*	*P-Value*
Males	30 - 100	8.45 - 28.13	14.63 ± 5.16	14.2	**0.0478 ***
Females	30 - 100	4.1 - 21.95	12.72 ± 4.68	11.83	

Table 5: Differences in the overall PSQI score and the scores for each item according to serum vitamin D level

	Overall Score Mean ± SD	*Cases (25 OH D < 30 ng/ml) Mean ± SD*	*Controls (25OH D ≧ 30 ng/ml) Mean ± SD*	*P Value*
PSQI Total Score	3.71 ± 2.1	3.98 ± 2.37	3.64 ± 1.95	0.001 *
Subjective Sleep Score	0.95 ± 0.75	0.99 ± 0.4	0.89 ± 0.8	0.025 *
Sleep Latency	0.7 ± 0.8	0.95 ± 0.5	0.6 ± 0.5	0.001 *
Sleep Duration	1.05 ± 0.7	1.2 ± 0.6	0.99 ± 0.9	0.005 *
Habitual sleep Efficiency	0.03 ± 0.05	0.06 ± 0.05	0.03 ± 0.2	0.723
Sleep Disturbances	0.63 ± 0.6	0.64 ± 0.8	0.58 ± 0.5	0.089
Use of Sleep Medication	0.01 ± 0.1	0.04 ± 0.1	0.05 ± 0.09	0.402
Daytime Dysfunction	0.77 ± 0.6	0.85 ± 0.7	0.73 ± 0.4	0.684

Comparison made using the Student t-test

5. DISCUSSION

In this Case Control study, 80 elderly citizens of age more than 60 years who met the inclusion and exclusion criteria were recruited for the study after obtaining the ethical committee clearance. Serum 25(OH) D were estimated and all the results were tabulated, statistically treated and expressed in appropriate graphs and tables.

Table 1 shows the age distribution of the study group. The average age of subjects was 69.31 (±8.13) years. The average age of male study group was 68.72 (±6.29) years and average age of female study group was 69.72 (±9.25) years.

Wortsman et al in their study have proven that vitamin D bioavailability is affected by obesity. Table 2 shows average BMI of the subjects which was 25.59 (±6.46) kg/m2. The average BMI of female subjects was 26.78 (±6.78) kg/m2 whereas the average BMI of male subjects was 23.90 (±5.48) kg/m2. Both the groups were not obese, thus nullifying one of the confounding factors that would have affected this study.

Table 3 shows the dietary habits of the subjects. There were 46% non-vegetarians and 54% vegetarians in the study. All subjects consumed the same diet every day. Vitamin D intake was almost negligible through vegetarian food. Moreover, the non-vegetarians in the group hardly consumed any non-vegetarian food.

SERUM VITAMIN D LEVELS:

Table 5 shows comparison of serum 25(OH)D levels of male and female study groups with that of normal serum levels. The male study group had lesser than the lower limit of normal serum 25(OH)D range of (30-100ng/ml). The female study group also had lesser than the lower limit of normal serum 25(OH)D levels. However, female study group had significantly lesser mean serum 25(OH)D levels than that of male study group.

Several previous studies like Fradinger et al and Holick MF et al have reported low serum 25(OH)D levels in the older population. Older adults are at a risk of lower vitamin D due to decreased cutaneous synthesis, decreased dietary intake, and decreased intestinal absorption. In this study the dietary intake of vitamin D was negligible. This was in accordance with study done by Omdahl et al. With advancing age, a gradual vitamin D deficiency becomes evident. This is due to a reduction of the concentration of 7-dehydrocholesterol in the epidermis, typical during aging, and to a consequent decrease of synthesis under UV irradiation. On the other hand, a decreased exposition to UV light is frequent in the elderly people. In addition, a low nutritional intake of vitamin D is present.

In this study, significant difference between male group and female group was seen in 25(OH)D levels. This is in accordance with the study done by Fleet.J.C et al. which states that postmenopausal women have severe estrogen loss which in turn disrupts the vitamin D endocrine system. Several groups have suggested that the loss of intestinal vitamin D responsiveness in absence of estrogen is due to reduction in vitamin D receptors in the body.

PSQI SCORE

The mean PSQI score of all subjects in this study was 3.71 ± 2.1. A study done by Jennifer et al on men above the age of 65 measured objective sleep duration and sleep effective- ness using wrist actigraphy and found that lower serum vitamin D levels were associated with shorter sleep duration and poorer sleep effectiveness, consistent with the findings of this study.

The precise mechanism of vitamin D and its effect on sleep is still unclear, except that vitamin D is likely to play a major role in the brainstem, which controls sleep

[Gominack sc et al]. This hypothesis is supported by evidence of

vitamin D receptors in parts of the brainstem such as the anterior and posterior hypothalamus, substantia nigra, mid- brain central grey matter, raphe nuclei, and in the nucleus reticularis pontisoralis and caudalis. These regions are known to use pacemaker cells to execute important roles in the first stages of sleep and in maintaining sleep. Specifically, the hypothalamus and nucleus reticularis pontis suppress muscles that affect sleep, such as the bulbar and somatic musculature.

Other effects of vitamin D on sleep were reported in Stumpf and Jennes' 1984 study. In that study, vitamin D was found to be a broad-range steroid hormone. Like all steroid hormones, it is involved with the endocrine and autonomic nervous systems, and as such is closely associated with brainstem regions such as the medulla oblongata, pontine nuclei, and midbrain nuclei. The role of vitamin D in the endocrine and autonomic nervous systems could lead to wide-ranging effects on the cardiovascular system, digestive system, immune system, and sleep-wake cycle.

Serum vitamin D levels were associated with significant differences in the total PSQI score, subjective sleep quality, sleep latency, and sleep duration. A study done by Huang W et al on the effects of vitamin D supplementation on pain and sleep found that those with vitamin D deficiency had higher total PSQI scores than the normal group, as well as longer sleep latency and shorter sleep duration.

6. CONCLUSION

A significant correlation was found between Serum Vitamin-D deficiency and poor sleep quality. Based on the results of this study, sleep disorder management for elderly can be improved by making them aware of the importance of nutrition and providing regular examinations checking their Serum Vitamin-D levels and supplementing Vitamin-D to the elderly to enhance their quality of sleep.

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