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Article

Indoor Employment as a Factor Associated with Serum Vitamin D Levels in Obstructive Sleep Apnoea Syndrome

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Abstract

Background/Objectives: Variations in Vitamin D (Vit D) levels have been described among individuals working in different settings. Moreover, published evidence suggests an association between obstructive sleep apnea-syndrome (OSAS) and Vit D insufficiency. The aim of this study was to assess the association between certain exposures at the occupational environment and Vit D levels, in relation to OSAS severity. **Methods:** For a period of 12 months, Vit D serum levels were assessed in subjects consecutively investigated for OSAS. These were divided into group A (control subjects working indoors), group B (control subjects working outdoors), group C (OSAS patients working indoors) and group D (OSAS patients working outdoors). **Results:** A total of 189 subjects were included (155 males and 34 females), comprising 129 OSAS patients and 60 non-apneic controls. Serum 25(OH)D levels were significantly higher in group B compared to the other groups (32.2 ± 13 vs 22.9 ± 6.7 ng/ml for group A, $p = 0.001$ vs 15.2 ± 7.6 ng/ml for group C, $p < 0.001$ vs 22.9 ± 9.3 ng/ml for group D, $p < 0.001$). Additionally, serum 25(OH)D levels were increased in group A compared with group C (22.9 ± 6.7 vs 15.2 ± 7.6 ng/ml respectively, $p = 0.001$) and were similar between groups A and D (22.9 ± 6.7 vs 22.9 ± 9.3 respectively, $p > 0.05$). Regression analysis revealed that AHI ($\beta = 0.023$, OR: 1.023, 95% CI: 1.003 – 1.043, $p = 0.022$) and indoor occupation ($\beta = 1.030$, OR: 2.802, 95% CI: 1.172 – 6.699, $p = 0.021$) were associated with Vit D insufficiency. **Conclusions:** Serum Vit D levels are decreased in OSAS patients working indoors. Thus, the working environment should also be considered in the overall assessment of Vit D status in OSAS patients.

Keywords: environment; obstructive sleep apnoea syndrome; occupation; vitamin D

1. Introduction

Obstructive sleep apnoea syndrome (OSAS) is a sleep-related breathing disorder, characterized by recurrent episodes of partial or complete upper airway obstruction that leads to nocturnal hypoxia, sleep fragmentation and excessive daytime sleepiness, with an increasing prevalence - driven by rising obesity rates - thereby posing a major public health burden [1,2]. OSAS has been linked to adverse cardiovascular events and increased risk of metabolic disorders [3,4]. Moreover, untreated OSAS is associated with an elevated risk of traffic accidents and adverse effects on quality of life and work productivity [5,6].

Vitamin D (Vit D) is a fat-soluble vitamin primarily synthesized in the skin following sunlight exposure or acquired through diet, and plays an essential role in calcium homeostasis [7]. In view of

its relatively prolonged half-life and stable hepatic production, serum 25-hydroxy-vitamin D [25(OH)D] is the recommended indicator of overall Vit D status; serum concentrations <20 ng/ml are considered detrimental to bone health [8]. With prevalence rates of up to 40.4% recorded throughout European populations, vitamin D deficiency is a major global health concern. [9]. Insufficient sunlight exposure, inadequate dietary intake, and malabsorption are among the principal contributors to this deficiency [10]. Moreover, evening or night shift work, as well as indoor occupations, have been linked to an increased risk of vitamin D deficiency [11,12].

A growing body of evidence suggests an association between OSAS and Vit D insufficiency, which appears to worsen with increasing sleep apnoea severity [13]. Although this was partially explained by shared, overlapping risk factors that predispose to both OSAS and hypovitaminosis D (e.g. obesity, older age), results from a meta-analysis challenged this assumption, indicating that additional pathogenic mechanisms, such as chronic low-grade inflammation or excessive daytime sleepiness, may also play a role [14,15]. However, a causal relationship between the two conditions cannot be excluded [16].

Accordingly, this study aimed to compare Vit D serum levels between OSAS patients and non-apneic controls across different occupational groups, and to investigate the association between working environment and Vit D insufficiency in this population.

2. Materials and Methods

2.1. Patients

Subjects referred to the Sleep Unit of our institution for symptoms suggestive of sleep disordered breathing, and who were actively employed in various occupations and provided written informed consent, were consecutively recruited over a 12-month period. The study was conducted in accordance with the Helsinki Declaration of Human Rights [17]. The study protocol was approved by the Institutional ethics committee.

Exclusion criteria were: inability or unwillingness to participate; central sleep apnoea syndrome; conditions affecting calcium, phosphorus and Vit D metabolism and/or absorption; severe heart failure; inflammatory diseases; cancer; chronic liver or renal disease; osteoporosis; sleep disorders other than OSAS; Vit D supplementation and/or corticosteroid therapy.

Detailed information on medical history, current medication use, with emphasis on Vit D supplements, and smoking status were recorded. Information on typical occupational activities and work schedule, dress habits and use of sunscreens or other protective measures was also obtained.

All participants underwent a comprehensive physical examination, during which height, weight, neck circumference, hip, and waist circumference were measured according to a standardized protocol. Body-mass index (BMI) was calculated using the following formula: $BMI = \text{weight (kg)} / \text{height}^2 \text{ (m}^2\text{)}$.

Daytime sleepiness was evaluated using the validated Greek version of the Epworth Sleepiness Scale (ESS) [18]. The scale comprises eight items describing common daily situations. Respondents rate their likelihood of falling asleep on a scale of 0–3 for each item. The maximum total score is 24, and scores >10 indicate excessive daytime sleepiness.

Pulmonary function tests, arterial blood gases analysis and a 12-lead electrocardiogram were also performed to exclude underlying pulmonary and cardiovascular disease.

2.2. Polysomnography (PSG)

Overnight polysomnography (PSG) was performed using a standard clinical montage. All PSG studies were acquired using validated clinical systems and manually scored by trained sleep technologists, following AASM criteria for sleep staging and respiratory event scoring [19,20].

2.3. Blood Samples and Measurements

Venous blood samples were collected from all participants shortly after completion of the PSG. Blood was drawn after at least 8h of fasting, immediately centrifuged (3000 rpm for 10 min), and the serum was separated and stored at -80o C until analysis. Biochemical analyses were performed using an automated analyzer and included measurements of serum glucose, total cholesterol, triglycerides, high-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C), creatinine, alanine aminotransferase (ALT), aspartate aminotransferase (AST), and C-reactive protein (CRP). Serum 25(OH)D concentrations were measured using a commercially available radioimmunoassay kit in accordance with the manufacturer’s instructions (DiaSorin, Stillwater, MN). Serum 25(OH)D levels <20 ng/ml were considered indicative of Vit D insufficiency [21].

2.4. Statistical Analysis

Analysis was performed using Statistical Package for Social Sciences version 23 (IBM SPSS, Armonk NY, USA)). Normality of distribution was assessed using the Kolmogorov-Smirnov test. Categorical variables were expressed as frequencies, continuous variables with normal distribution as mean ± standard deviation, and skewed variables as median (25th–75th percentile). Differences in categorical variables were evaluated using the chi-squared test. Correlations were examined using Pearson’s correlation coefficient. Group comparisons were conducted using one-way ANOVA or the Kruskal–Wallis test, as appropriate, based on data distribution. Post-hoc comparisons for parametric data were performed using Tukey’s test, whereas Dunn’s multiple comparison test was applied for non-parametric variables. A binary logistic regression model was used to assess the possible association between Vit D insufficiency and occupation after adjusting for anthropometric, demographic and sleep parameters. Statistical significance was defined as a two-tailed p<0.05.

3. Results

In total 189 subjects (155 males and 34 females; mean age 47.5 ± 9.7 years) participated in the study, including 129 OSAS patients (12 with mild, 17 with moderate and 100 with severe OSAS) and 60 non-apneic controls. Their characteristics are displayed in Table 1.

Table 1. Demographic and clinical characteristics of the study population.

	Overall sample (n = 189)	OSAS patients (n = 129)	Non-apneic controls (n = 60)	p value (OSAS vs controls)
Sex (males/females)	155 / 34	110/19	45/15	0.087
Age (years)	47.5 ± 9.7	48.2 ± 9.2	46 ± 10.7	0.138
OSAS severity (n)	–	Mild: 12 Moderate: 17 Severe: 100	–	–
Serum 25(OH)D (ng/ml)	21.8 ± 10.7	19.1 ± 9.3	27.5 ± 11.3	< 0.001

3.1. Correlations Between 25(OH)D Levels and Sleep Characteristics

Serum levels of 25(OH)D were positively correlated with REM sleep stage duration (r = 0.152, p = 0.037), average (r = 0.336, p < 0.001) and minimum (r = 0.310, p < 0.001) oxyhaemoglobin saturation during sleep. Negative correlations were observed with ESS score (r = -0.176, p = 0.016), sleep stage 1 duration (r = -0.154, p = 0.035), time spent with oxyhaemoglobin saturation <90% during sleep (r = -

0.291, $p < 0.001$)) and arousal index ($r = -0.331$, $p < 0.001$). Moreover, a negative correlation was observed with BMI ($r = -0.168$, $p = 0.022$), and AHI ($r = -0.451$, $p = < 0.001$).

OSAS patients and non-apneic controls were divided according to their occupation into the following smaller groups: group A (subjects working indoors with no OSAS, $n = 30$: 21 males and 9 females), group B (subjects working outdoors with no OSAS, $n = 30$: 24 males and 6 females), group C (OSAS patients working indoors, $n = 64$: 55 males and 9 females) and group D (OSAS patients working outdoors, $n = 65$: 55 males and 10 females). The characteristics of each group are displayed in Tables 2 (anthropometric/demographic) and 3 (sleep characteristics).

Table 2. Demographic and clinical characteristics of the study population.

	Group A (Non-OSAS subjects working indoors) (n = 30)	Group B (Non-OSAS subjects working outdoors) (n = 30)	Group C (OSAS patients working indoors) (n = 64)	Group D (OSAS patients working outdoors) (n = 65)	p
Gender (male/female)	21/9	24/6	55/9	55/10	0.263
Age (years)	48.3 ± 11.3	43.6 ± 9.7	47.5 ± 9.4	48.9 ± 9.1	0.091
BMI (kg/m²)	32.3 ± 7	31.9 ± 6.6	35.6 ± 7.6	37.8 ± 7.4*, #	0.001
Neck circumference (cm)	41.9 ± 3.9	39.2 ± 4.6	44.1 ± 3.8##	45.7 ± 3.6**, ##	<0.001
Waist circumference (cm)	108.3 ± 18.9	107.3 ± 15.4	121.3 ± 15.3*, #	125.4 ± 14**, ##	<0.001
Hip circumference (cm)	111.1 ± 19.7	112.8 ± 13	119.6 ± 14.8	120.8 ± 17.7	0.052
WHR	0.98 ± 0.09	0.95 ± 0.07	1.02 ± 0.07	1.05 ± 0.13*, ##	0.001
Married (%)	80%	83.3%	78.1%	78.5%	0.943
More than elementary education (%)	100%	93.3%	100%	89.2%*, ^	0.018
Smoking (%)	40%	40%	35.9%	36.9%	0.972

Abbreviations: BMI: Body mass index, WHR: Waist to hip ratio. *: $p < 0.05$ compared with non-OSAS subjects working indoors; **: $p < 0.001$ compared with non-OSAS subjects working indoors; #: $p < 0.05$ compared with non-OSAS subjects working outdoors; ##: $p < 0.001$ compared with non-OSAS subjects working outdoors; ^: $p < 0.05$ compared with OSAS patients working outdoors; ^^: $p < 0.001$ compared with OSAS patients working outdoors.

Table 3. Comparison of sleep parameters between groups.

Group A	Group B (Non-OSAS subjects	Group C (OSAS patients working indoors)	Group D	p
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	(Non-OSAS subjects working indoors) (n = 30)	working outdoors) (n = 30)	(n = 64)	(OSAS patients working outdoors) (n = 65)	
TST (min)	302.1 ± 67	317.6 ± 52.5	327 ± 64.9	316.9 ± 51.1	0.297
N1 (% TST)	9.7 (5.2 – 16)	7.4 (4 – 16.5)	8.8 (4.4 – 15.8)	10 (4.1 – 18.5)	0.646
N2 (% TST)	63.9 ± 12.5	66 ± 9.9	70 ± 15.8	70.3 ± 16.2	0.132
N3 (% TST)	12.9 (5.6 – 24.1)	13.1 (5 – 21.9)	5.1 (0.4 – 15)*, #	4.7 (0.1 – 13.8)*, #	<0.001
REM (% TST)	9.9 (3.9 – 14)	9.6 (3.1 – 14.5)	6.5 (0.5 – 11)	5.4 (2 – 10.8)	0.106
AHI (events/h)	3.4 (1.7 – 4.5)	3.3 (1 – 4.4)	59.9 (33.5 – 72.9)**, ##	55.2 (25.9 – 73)**, ##	<0.001
Aver SaO ₂ (%)	94.2 (92.8 – 94.7)	94.7 (93 – 96.1)	92 (89 – 93) **, ##	91(88.4 – 92.9) **, ##	<0.001
Min SaO ₂ (%)	85.7 ± 5	84.1 ± 16.4	70.1 ± 11.3**, #	70.3 ± 10.1**, #	<0.001
T < 90% (%)	0 (0 – 1.8)	0.2 (0 – 2.6)	24.6 (8.7 – 51.8) **, ##	33.8 (10.2 – 59.8) **, ##	<0.001
Arousal index	15.2 ± 8.8	15.9 ± 6.3	33.5 ± 20.2**, ##	35.2 ± 22.9**, ##	<0.001
Sleep efficiency (%)	83.4 (72.7 – 89.8)	85.5 (75 – 93.4)	89.8 (82.3 – 93.3)*	87.1 (80.3 – 92.7)*	0.023
ESS score	6.4 ± 4.2	9.2 ± 4.6	11.8 ± 5.1**	12 ± 5.5**	<0.001

Abbreviations: AHI: Apnoea hypopnoea index, Aver SaO₂: Average oxyhaemoglobin saturation, ESS: Epworth sleepiness scale, Min SaO₂: Minimum oxyhaemoglobin saturation, N1: sleep stage 1, N2: sleep stage 2, N3: sleep stage 3, REM: Rapid eye movement, TST: Total sleep time, T<90%: Time with oxyhaemoglobin saturation <90%. *: p<0.05 compared with non-OSAS subjects working indoors; **: p<0.001 compared with non-OSAS subjects working indoors; #: p<0.05 compared with non-OSAS subjects working outdoors; ##: p<0.001 compared with non-OSAS subjects working outdoors; ^: p<0.05 compared with OSAS patients working outdoors; ^^: p<0.001 compared with OSAS patients working outdoors.

No significant differences were observed between these 4 groups in terms of indices of renal and liver function or lipid profile. Patients in group D exhibited worse respiratory function compared to those in group A. All laboratory results are presented in Table 4.

Table 4. Comparison of different laboratory results between groups.

Group A	Group B	Group C	Group D	p
(Non-OSAS subjects working indoors) (n = 30)	(Non-OSAS subjects working outdoors) (n = 30)	(OSAS patients working indoors) (n = 64)	(OSAS patients working outdoors) (n = 65)	

FEV ₁ (% predicted)	102.9 ± 15.4	101.4 ± 23.4	93.2 ± 16	91.9 ± 17*	0.026
FVC (% predicted)	99.3 ± 11.7	99.2 ± 21.1	88.8 ± 15.6*	89.2 ± 18.6*	0.013
pO ₂ (mmHg)	85.1 ± 9.6	90.4 ± 19.6	80.3 ± 8.7	79.4 ± 8.8*,#	<0.001
pCO ₂ (mmHg)	40.9 ± 2.4	40 ± 4.8	41.4 ± 4.2	42.6 ± 5.3	0.055
Glucose (mg/dL)	97 (81 – 113.5)	90 (80 – 112.5)	96.5 (91.5 – 110)	108 (84 – 137)	0.079
Creatinine (mg/dL)	0.93 ± 0.16	0.92 ± 0.28	0.93 ± 0.16	0.91 ± 0.18	0.960
SGOT (mg/dL)	25 ± 7.2	24.7 ± 6.9	22.9 ± 6.9	22.3 ± 5.8	0.369
SGPT (mg/dL)	27 (18.5 – 41)	24 (18 – 32.5)	26.5 (21 – 35.3)	29 (18 – 48)	0.810
Cholesterol (mg/dL)	209.5 ± 43.9	189.6 ± 39	209.3 ± 47	214.2 ± 41.3	0.275
Triglycerides (mg/dL)	154.5 (99.3 – 204.8)	123.5 (75.8 – 167.3)	159 (106 – 198)	163.5 (111 – 220.3)	0.373
LDL-C (mg/dL)	132.4 ± 33.2	112.6 ± 35.6	126.4 ± 36.6	124.3 ± 33.4	0.362
HDL-C (mg/dL)	47.4 ± 14.9	50.8 ± 13.3	47.2 ± 12.4	48.8 ± 13	0.776
25(OH)D (ng/ml)	22.9 ± 6.7	32.2 ± 13*	15.2 ± 7.6**,##	22.9 ± 9.3*,^^	<0.001

Abbreviations: ALT: alanine aminotransferase, AST: aspartate aminotransferase, FEV₁: Forced expiratory volume in 1st sec, FVC: Forced vital capacity, HDL-C: High density lipoprotein-cholesterol, LDL-C: Low density lipoprotein-cholesterol, pCO₂: Carbon dioxide partial pressure, pO₂: Oxygen partial pressure, 25(OH)D: 25-hydroxyvitamin D. *: p<0.05 compared with non-OSAS subjects working indoors; **: p<0.001 compared with non-OSAS subjects working indoors; #: p<0.05 compared with non-OSAS subjects working outdoors; ##: p<0.001 compared with non-OSAS subjects working outdoors; ^: p<0.05 compared with OSAS patients working outdoors; ^^: p<0.001 compared with OSAS patients working outdoors.

As seen in Table 5, serum 25(OH)D levels were highest in group B compared with all other groups (32.2 ± 13 vs 22.9 ± 6.7 ng/ml for group A, p = 0.001, vs 15.2 ± 7.6 ng/ml for group C, p < 0,001 vs 22.9 ± 9.3 ng/ml for group D, p < 0.001). Additionally, serum 25(OH)D levels were increased in group A compared with group C (22.9 ± 6.7 vs 15.2 ± 7.6 ng/ml respectively, p = 0.001) and were similar between groups A and D.

Table 5. Serum 25(OH)D levels according to occupation and OSAS status.

Groups	n	Serum 25(OH)D (ng/ml)
Group A: Non-OSAS subjects working indoors	30	22.9 ± 6.7 ^{##}
Group B: Non-OSAS subjects working outdoors	30	32.2 ± 13 ^{*,##,^^}

Group C: OSAS patients working indoors	64	15.2 ± 7.6
Group D: OSAS patients working outdoors	65	22.9 ± 9.3

*: p<0.05 compared with non-OSAS subjects working indoors; **: p<0.001 compared with non-OSAS subjects working indoors; #: p<0.05 compared with OSAS subjects working indoors; ##: p<0.001 compared with OSAS subjects working indoors; ^: p<0.05 compared with OSAS patients working outdoors; ^^: p<0.001 compared with OSAS patients working outdoors.

3.2. Predictive Factors for Vitamin D Results - Binary Logistic Regression Analysis

Binary logistic regression analysis revealed that AHI ($\beta = 0.023$, OR: 1.023, 95% CI: 1.003 – 1.043, $p = 0.022$) and indoor occupation ($\beta = 1.030$, OR: 2.802, 95% CI: 1.172 – 6.699, $p = 0.021$) were associated with Vit D insufficiency, [defined as 25(OH)D serum levels <20 ng/ml], independently of age, sex, BMI, WHR, hypoxia indices during sleep, arousal index and ESS.

4. Discussion

We identified AHI and working indoors as independent predictors for Vit D insufficiency. The relationship between Vit D insufficiency and OSAS has been previously explored, but findings have been inconsistent [14,22,23]. In the present study, serum 25(OH)D concentrations were significantly predicted by AHI, consistent with the findings of a recent systematic review and meta-analysis that indicated an inverse association between serum 25(OH)D levels and OSAS severity in patients without comorbid conditions [23].

Similarly, according to another meta-analysis, patients with OSAS have lower circulating serum 25(OH)D levels and a higher prevalence of Vit D deficiency compared with patients without OSAS, with the largest discrepancies observed among patients with moderate-to-severe disease. Notably, these variations were not significantly influenced by age, BMI, or geographical latitude, and CPAP therapy did not increase serum 25(OH)D concentrations [14].

In the current study, Vit D levels indicated a negative correlation with indoor occupational activity. The results of the 5th Korea National Health and Nutrition Examination Survey (KNHANES 2010-2012), with 5409 participants, revealed that working conditions and Vit D deficiency were significantly associated among male shift workers, office workers, and permanent workers, while no such association was observed among female participants [24]. According to a meta-analysis of 71 studies, shift workers (80%) and indoor workers (78%) had higher rates of Vit D deficiency than outdoor workers (48%). Furthermore, compared to outdoor workers, indoor workers had considerably lower 25(OH)D levels ($p < 0.0001$) [11]. Overall, Vit D concentrations reported in that meta-analysis were higher than those in our population, likely reflecting the added impact of OSAS as an additional risk factor. These findings are supported by another systematic review showing that shift workers and workers in indoor environments are the occupational groups most susceptible to Vit D insufficiency [12].

As expected, subjects working indoors are less exposed to sunlight. Of note, glass used in buildings absorbs all UVB radiation, preventing cutaneous Vit D synthesis [25]. Furthermore, indoor workers with traditional working hours are typically exposed to sunlight only during early morning or late afternoon hours, when UVB intensity is insufficient for optimal Vit D production [25]. This restriction may be affected by shift work that involves evening or nocturnal shifts. Overall, the available evidence remains inconclusive with respect to the impact of occupational characteristics (e.g. shiftwork, indoor work, work activities) on Vit D status, suggesting that sunlight exposure alone does not fully explain Vit D deficiency in working populations. Nevertheless, there are studies that supported this, by reporting comparable serum vitamin D concentrations between indoor and outdoor workers [26,27].

From the opposite perspective, several cardinal features of OSAS may also adversely affect Vit D levels, e.g. obesity. It has been demonstrated that in healthy individuals, circulating 25(OH)D

concentrations are inversely correlated with higher body fat percentages [28]. Another study reported that obese individuals tend to spend less time in outdoor activities, including sun exposure, a behaviour that has been associated with higher body fat percentage and BMI [29]. Vitamin D is stored in adipose tissue [26,27]. The capacity of adipose tissue to locally metabolise Vit D is shifted towards decreased synthesis and increased catabolism in obese individuals [30]. As a result of sequestration within adipose tissue and reduced systemic bioavailability, oral Vit D supplementation results in smaller increases in serum 25(OH)D levels in obese compared to non-obese individuals [31,32]. Moreover, the volumetric dilution of vitamin D within an expanded adipose tissue mass, regardless of whether it is derived from dietary intake or cutaneous synthesis, may contribute to hypovitaminosis in obese individuals [33]. Excessive daytime sleepiness, another feature of OSAS as a result of sleep fragmentation, may also indirectly lower serum 25(OH)D levels by limiting outdoor activities and sun exposure [15]. However, in the current study neither excessive daytime sleepiness nor increased BMI were predictors of Vit D insufficiency.

The following limitations of this study should be acknowledged: First, the relatively small sample size. Larger studies are necessary as to better evaluate the effect of occupational setting on Vit D levels in OSAS populations. Second, important information, such as skin pigmentation and dietary habits of the participants were not evaluated. Still, the study was carried out over a restricted 12-month time-frame in a homogeneous cohort of Caucasian participants residing in the same geographic area, with broadly similar dietary and clothing behaviours, which likely minimized interindividual variability. Third, the study primarily included middle-aged participants; therefore, caution should be exercised when extrapolating these findings to older OSAS patients, as both OSAS prevalence and Vit D insufficiency increase with age [34,35]. Finally, detailed cardiovascular assessments were not performed, which may be relevant given the established associations between Vit D status and vascular morbidity [32,33].

In conclusion, indoor working is associated with lower serum Vit D levels in patients with OSAS. Therefore, the occupational setting should be taken into account when evaluating Vit D status in individuals with OSAS.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Data available on request due to restrictions.

Conflicts of Interest: The authors declare no conflicts of interest.

Abbreviations

The following abbreviations are used in this manuscript:

25(OH)D	25-hydroxy-vitamin D
AHI	Apnea-Hypopnea Index
ALT	Alanine Aminotransferase
AST	Aspartate Aminotransferase
Aver SaO ₂	Average Oxyhaemoglobin Saturation
BMI	Body-Mass Index
CRP	C-Reactive Protein

ESS	Epworth Sleepiness Scale
FEV ₁	Forced Expiratory Volume in 1st sec
FVC	Forced Vital Capacity
HDL-C	High-Density Lipoprotein Cholesterol
LDL-C	Low-Density Lipoprotein Cholesterol
Min SaO ₂	Minimum Oxyhaemoglobin Saturation
N1	Sleep Stage 1
N2	Sleep Stage 2
N3	Sleep Stage 3
OSAS	Obstructive Sleep Apnea Syndrome
pCO ₂	Carbon dioxide Partial Pressure
pO ₂	Oxygen Partial Pressure
PSG	Polysomnography
REM	Rapid Eye Movement
T<90%	Time with oxyhaemoglobin saturation <90%
TST	Total Sleep Time
Vit D	Vitamin D

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