

Comparison of Polysomnographic Features in Geriatric and Adult Patients

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Research

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Abstract

Objectives: In our study, it was aimed to compare polysomnography features in geriatric and adult patients.

Materials and Methods: Our study was conducted as a retrospective case-control study. Sleep Patients who were hospitalized in the polysomnography laboratory with a pre-diagnosis of the disorder were divided into 2 groups according to their age as younger than 65 years old and over. Alice 6 computerized system (Respironics; Philips, Illinois, USA) polysomnography was applied to detect sleep disorders.

Results: A total of 500 people, including 180 (36%) women, 320 (64%) men, were included in our study. The mean age was 52.36 ± 13.69 . Positive Airway Pressure (Pap) treatment rates were significantly higher in the geriatric age group compared to adults. Sleep efficiency, mean sleep time, and total sleep time were higher in adults compared to geriatric patients. In the geriatric patient group, the most common diagnosis as a result of PSG was the diagnosis of Severe OSAS with 84 (%) people. When the lower extremity mobility measurements during sleep were evaluated, the values were found to be significantly higher in geriatric patients with severe OSAS. Stage 3 and Rem stage were significantly higher in adults in terms of NREM3 (%) and REM (%) measurements.

Conclusion: Sleep times are reduced in geriatric patients, restless leg movements during sleep are more common than adult patients, and sleep-disordered breathing is generally more severe in geriatric patients.

Introduction

Sleep, which is one of the basic needs of the body, is a form of rest of the body, and it is a rhythmic process where the sleeping person (individual) can be woken up easily by stimulants. Sleep is a necessary physiological process that is beneficial to the human body as well as balancing the person's rest and energy consumption during this time. Sleep-related respiratory disorders, in general, are common conditions in society. Although it negatively affects people's social life, it can also occur with comorbid diseases when sleep disorders happen together with comorbid diseases (respiratory, cardiac, disrupting the conscious state, etc.), the mortality coefficient increases as well.

Obstructive sleep apnea syndrome (OSAS) is a situation characterized by a collapse or obstruction of the airway due to a change in muscle tone in the pharynx during sleep, a feeling of drowning in sleep, snoring, waking up tired and napping during the day. This happens as a result of a decrease in the airflow by more than 90% with a period of at least 10 seconds. It also leads to the development of hypertension, severe cardiac problems, and neurological disorders (1). Oxidative stress, which causes these chronic pathologies, has been shown to play essential roles in OSAS pathogenesis (2).

According to international definitions, people aged 65 and above are defined as elderly (geriatric) persons(3). The prevalence of OSAS in the general population is ~ 5%. Its frequency increases with age. When the apnea-hypopnea index (AHI) is 15 or more per hour, the disease is estimated to happen in

~15% of individuals over the age of 65 (4). Despite this high prevalence, OSA is underdiagnosed, possibly due to the unknown geriatric features of the condition, thus complicating the management of OSAS in geriatric patients (5).

Age is not a contraindication for polysomnography. Age-related sleep changes, sleep-being awake rhythm disturbance, and the biological rhythm changes can also be seen. In geriatric patients, the most striking change in sleep rhythm is phase progression, such as falling asleep earlier, inability to resume sleep, decreased sleep depth disorders. With the increase in wakefulness periods, a decrease in deep sleep stages, there is a worsening of OSA symptoms and co-morbid diseases. There is no study comparing sleep characteristics and polysomnographic sleep values of geriatric and adult patients. However, by determining the sleep characteristics and the differences of geriatric patients, a separate group approach should be carried out for the geriatric patients, and their sleep disorders should be treated. We tried to compare sleep characteristics and polysomnographic values of geriatric and adult patients under the age of 65 to determine the differences between them.

Material Method

The study was planned as a retrospective study. Patients who were diagnosed with OSAS through polysomnography (PSG) and treated with positive airway pressure (PAP) between January 2014 and January 2019 were included in the study. Polysomnography records of patients were retrospectively evaluated. The patients were divided into two groups: over 65 years of age(geriatric patients) and under 65 years of age (adult patients). All demographic and medical stories of each participant, such as age, body mass index (BMI), smoking, presence of comorbid disease, were questioned and recorded (Table 1).

At least 4 hours of PSG recorded data of all the patients included in the study were obtained through using the standard PSG(Somnostar Alpha, Sensormedics-USA) device. PSG consists of electroencephalogram (EEG) (4 channels: C4A1, C3A2, O1A2, O2A1), electrooculography (EOG) (2 channels), submental and tibial electromyography(EMG), electrocardiogram (ECG), oronasal airflow sensor, chest and abdominal movement sensor, body position sensor and a pulse oximeter. In the PSG data, sleep staging was performed according to the criteria of Rechtschaffen and Kales. Respiratory parameters were evaluated according to the requirements of the American Academy of Sleep Medicine (AASM) (6). Patients who needed PAP treatment were admitted to the hospital for a second time and underwent PAP titration. Daytime sleepiness was assessed on the Epworth Sleepiness Scale. In addition to the clinical features of all patients such as simple snoring, chest pain, day sleepiness, apnea, dry mouth, psychological causes, symptoms of insomnia and sleepwalking, following parameters of average desaturation index, minimum oxygen saturation, average oxygen saturation, sleep latency, sleep efficiency, total sleep time(REM, NREM 1, 2, 3), the average apnea duration, and arousal index, the PAP average values were recorded. Demographic, clinical, and polysomnographic variables of patients and polysomnographic values of adults and geriatric patients were compared (Table 2).

2.1. Statistical Analysis

The SPSS Windows 20 program was used for statistical analysis. Descriptive statistical methods (mean, standard deviation, median, frequency, ratio, minimum, maximum) were used to evaluate the study data. The suitability of quantitative data to normal distribution was tested with Kolmogorov-Smirnov, Shapiro – Wilk test, and graphical evaluations. Student - *t*-test was used to compare two groups of quantitative data with normal distribution, and the Mann-Whitney *U* test was used to compare two groups of data with the abnormal distribution. Pearson Chi-Square test and Fisher's Exact test were used for the comparison of qualitative data. Significance was determined as $p < 0.05$.

2.2 Ethics statement

The present study protocol was reviewed and approved by the Institutional Review Board of Afyonkarahisar Health Sciences University Faculty of Medicine (approval No. 2020/144). Informed consent was submitted by all subjects when they were enrolled.

Results

A total of 500 patients [180 (36%) women and 320 (64%) men] who were evaluated by polysomnography in the sleep laboratory of our hospital between January 2015 and June 2019 were included in the study. The ages of the patients ranged between 18-81, and the mean age was 52.36 ± 13.69 . The participants were divided into two groups: over 65 years of age (geriatric) and under 65 years of age.

Height, weight, smoking, and smoking duration rates, comorbid disease rates, except non-cardiovascular disease, did not show significant differences according to age groups ($p > 0.05$).

The rates of body mass index (BMI), diagnosis of OSAS, and use of CPAP were higher in geriatric age groups than in adult patients ($p < 0.01$). While rates of diabetes, asthma, and chronic obstructive pulmonary disease (COPD) did not show significant differences between the age groups ($p > 0.05$), rates of comorbid conditions such as coronary artery disease (CAD) and hypertension showed significant differences in geriatric patients than adults ($P=0,012$). When the stages of OSAS were evaluated, simple snoring, mild OSAS, and moderate OSAS were more common in adults, while the diagnosis of severe OSAS was significantly higher in geriatric patients ($p < 0.01$) (Table 1).

When the rates of Positive Airway Pressure (Pap) treatment were evaluated, Continue Positive Airway Pressure (CPAP), bilevel Positive Airway Pressure (BiPAP), and BiPAP ST were significantly higher in the geriatric age group than adults ($p < 0.01$). Figure 1

When the symptoms were evaluated, snoring, chest pain, insomnia, sleepwalking, dry mouth, and psychological complaints were higher in adults, whereas daytime sleepiness and apnea witnessed by others were significantly higher in the geriatric patient group. ($p < 0.01$).

Apnea incidence, apnea-hypopnea index, hypopnea, total sleep duration, central apnea index were higher in geriatric patients ($p < 0.01$).

Sleep efficiency, average sleep duration, and total sleep duration were higher in adults than in geriatric patients ($p < 0.01$).

When sleep stage times were evaluated according to age groups, stage 3 and Rem stage were significantly higher in adults in terms of nrem3 (%) and REM (%) measurements ($p < 0.01$). While there was no statistical difference between the two groups in terms of mean pulse and minimum oxygen values, a significant difference was present in terms of saturation values ($p < 0.01$) (Table 2).

When the comparison was made on sleep stages of all the age groups, an increase in the severity of OSAS detected when the weight and BMI (body mass index) increased (respectively $p = 0.03$, $p = 0.014$).

When the serious OSAS cases were evaluated, mean saturation values were decreased compared to other OSAS patterns, while there was a significant increase in the pulse values ($p < 0.01$) (Table 3). The diagnostic classification of OSAS for all the age groups is given in Figure 2.

The mean age of geriatric patients was 69.38 ± 3.810 , of which 48 (% 37.5) were female, and 80 (% 62.5) were male. Severe OSAS was the most common diagnosis with 84 (% 65.6) in the geriatric patient group through PSG results ($p < 0.01$). When the lower limb mobility measurements during sleep were evaluated, the values were significantly higher in geriatric patients with severe OSAS ($p = 0.046$).

Discussion

There is an average sleep period, which varies between 6-10 hours per day. Sleep duration is genetically determined and may vary with age, health, and emotional status (7). Typically, people at geriatric age groups fall asleep late, and their total sleep time decreases compared to the adults. This might be explained by the changes happening to the organ functions with aging and its impact on sleep neurophysiology [8]. OSAS usually is twice as common in males, while in the geriatric age group, female to male ratios are similar as time progresses [9]. The lower frequency of OSAS in women of the premenopausal stage than men has been linked to the different distribution of fat due to sex hormones [10]. According to some studies, overweight is not typical in geriatric OSAS patients, unlike adults [11]. In our study, while there was a significant difference between geriatric and adult groups in terms of body mass index (BMI), there was no significant difference in terms of height and weight. In terms of gender distribution, there was no difference between the two groups. Based on literature information, OSAS is more common in men, and the population of our study is consistent with the literature.

OSAS has consequences that concern many systems, especially the cardiovascular system (CVS). The primary outcomes of OSAS on CVS are hypertension, cardiac arrhythmias, ischemic heart diseases, and myocardial infarction (12,13). It is also an inducing and aggravating factor for metabolic diseases such as diabetes [14]. The relationship between chronic respiratory diseases (COPD, Asthma, CRF) and OSAS

is slightly different. But Sanders et al. has reported in their study that this relationship is coincidental and that there is no specific physiological mechanism supporting the formation of OSAS in patients with chronic respiratory diseases [15]. Besides, patients with this combination have a higher risk of developing chronic respiratory failure than patients with only OSAS [16]. Similarly, in this study, we observed a significant difference in the geriatric age group in terms of coronary artery disease (CAD) and hypertension. In contrast, in terms of diabetes, COPD, and asthma rates, there was no significant difference between the geriatric age group and the adult group. In our study, the incidence of CRF diseases was similar in both groups.

Factors that reduce muscle tones such as fatigue, overweight, substance use, chronic nasal congestion, and sleeping position on its back are the leading causes of snoring as they increase the muscle resistance in the upper respiratory tract and pharynx [17]. Most of the snoring patients are not aware of this, and usually, their partner informs the doctor about it because snoring does not wake the patient up unless it is powerful. In geriatric age groups, it was observed that snoring reporting decreased compared to the middle age group which could be possibly explained with the suggestions that their partners who could witness snoring of geriatric patients would be less due to higher passing away rate than adults and increased central apnea frequency in geriatric age groups [21]. In our study, the rate of admission with the snoring complaints was higher in the adult group than geriatric patients. There was no statistical difference between the geriatric and adult groups in terms of smoking and weight.

Many symptoms (such as headache and chest pain, lack of concentration, forgetfulness, psychiatric disorders, sweating, cough, enuresis, libido, and impotence) have been identified in the literature associated with OSAS affecting daily life [18-20]. Among these, it was determined that the common headache and chest pain in the adult group might be related to increased carbon dioxide and decreased oxygen saturation when it was crosschecked with the literature(21). However, the psychological complaints of sleepwalking, insomnia, and dry mouth complaints are more common in adults. In contrast, the complaint of witnessed apnea and excessive daytime sleepiness complaints were more frequently observed in the geriatric patient group.

Minimum O₂ saturation and mean O₂ saturation measurements of geriatric patients show significantly lower values than adult cases. Light sleep increases in geriatric age groups, and with the increase in the number of wakefulness, the continuity of sleep may worsen, which leads to decreased effectiveness in sleep, daytime sleepiness, and daytime lethargy [22]. In our study, mean desaturation measurements were higher in geriatric patients and were statistically significant when the two groups were compared.

In a study that compared two groups with age above 65 and under and aimed to determine the underlying factors related to the severity of OSAS, it was determined that male sex, BMI, and aging were independent risk factors for severe OSAS in the geriatric group [23]. Similarly, in our study, there was a statistical difference in aging and BMI of geriatric patients compared to adults.

It is estimated that the incidence of sleep apnea and hypopnea increases during the geriatric period [24]. Sanders, in his study, detected that the prevalence of apnea was higher in the geriatric group than in

adults [25]. However, the relationship between age and the frequency of apnea is not as simple as thought. In comparison to AHI, geriatric age groups have more frequent disorders, but its relationship with morbidity and mortality that happens due to daytime sleepiness is not clear. [26]. The increase of the disease with age was not found as pronounced in the age group above 65 as under the age of 65. But, it is not entirely clear whether age alone increases the risk of apnea and AHI. [27]. In the study of Kripke et al., 427 geriatric patients were monitored in 5 years, and it was shown that AHI increased with age (28). In the study conducted by Hock et al. With 105 geriatric patients, a significant increase was found in AHI, mean apnea count, and OSAS (obstructive sleep apnea syndrome) prevalence from 60 to 90 years of age. (29). In our study, apnea, AHI, and aurosol were statistically higher in the geriatric OSAS group, and mean oxygen saturation was lower in geriatric patients. All of these show us that geriatric age groups have more sleep apnea-hypopnea complaints and are consistent with literature records.

Recent reports have shown that the worsening of upper respiratory muscles may be partly responsible for the further deterioration of OSAS in geriatric age groups and that decreased skeletal muscle function is an essential physical disease associated with aging [30]. In another study, PAP levels were strongly correlated with BMI, AHI, upper respiratory tract, and critical pharyngeal pressure [31]. In this study, high levels of AHI in geriatric age groups, changes in the upper respiratory tract with age, and high rates of apnea increased the need for PAP use in treatment, and the rates of PAP usage were statistically higher in geriatric patients compared to adults.

It is important to note that sleep condition should not be interpreted as a pathological phenomenon in geriatric age groups less than an hour and just afternoon. The reduction was statistically significant in geriatric patients with nrem2 (%) and nrem3 (%), as well as with nrem3 and REM measurements compared to adult patients. Studies have shown that the architecture of Geriatric sleep changes due to decreased deep, slow sleep [22]. Similar results were obtained in our study. This study has some limitations that need to be stated. Recently, seasonal changes associated with the humidity of the air during sleep have been reported. We have not analyzed the seasons in which PSG have been conducted.

Conclusion

In conclusion, the effects of many comorbid medical conditions and age-related physiological changes in sleep architecture and circadian rhythm should be taken into account in the polysomnographic and clinical evaluation of adult and geriatric patients. Comprehensive assessment and management of insomnia, along with the treatment of comorbid medical conditions in patients with geriatric OSAS, may improve the patient's sleep quality and daytime life, and it can contribute to the comfortable life of the patient.

List Of Abbreviations

Posittive Airvey Pressure (Pap)

Obstructive sleep apnea syndrome (OSAS)

Apnea-hypopnea index (AHI)

Polysomnography (PSG)

Body mass index (BMI)

Electroencephalogram (EEG)

Electrooculography (EOG)

Electromyography(EMG),

Electrocardiogram (ECG),

American Academy of Sleep Medicine (AASM)

Continue Positive Airway Pressure (CPAP),

Bilevel Positive Airway Pressure (BiPAP),

Chronic respiratory diseases (COPD)

Especially the cardiovascular system (CVS).

Coronary artery disease (CAD)

Declarations

Funding

No financial support has been received from any person or organization for this study.

Ethics statement

The present study protocol was reviewed and approved by the Institutional Review Board of Afyonkarahisar Health Sciences University Faculty of Medicine (approval No. 2020/144). Informed consent was submitted by all subjects when they were enrolled. Consent was not obtained from participants because the study was retrospectively conducted **7.3.Consent to publication** All kinds of publication and work permits were obtained from the institution where our work was carried out.

Availability of data and material

The data of our study are available in the Afyonkarahisar Health Sciences Sleep Diseases Department archive. If desired, all files and files attached to Excel or Spss will be shared.

Disclosure and conflict of interest

He made no influence on this work in relation with the company or its products. Other authors have no potential conflicts of interest to disclose.

Author Contributions (Use CRediT terms)

Conceptualization: Balcı A. Methodology: Balcı A. Formal analysis: Çilekar Ş. ; Data curation: Çilekar Ş; Writing - original draft preparation: Balcı A Approval of final manuscript: all authors.

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Tables

Table 1. Evaluation of demographic features.

		Total (n=500)	Young (n=372)	Elderly (n=128)	p	
		n (%)	n (%)	n (%)		
Age (years)		52,36±13,69	46,45±10,639	69,38±3,810	p<0.01	
BMI (kg/m ²)		17,30- 51,8(32,9)	17,30- 51,8(32,7)	23,5- 51,6(33,65)	0,03	
Size(cm)		70-187(167)	70-187(167)	150- 182(165)	0,041	
Weight(Kg)		23-181(93)	23-181(92)	35-177(94)	0,526	
Neck circumference (cm)		61,36±47,89	55,14±43,22	79,02±55,98	p<0.01	
Cigarette Smoking (Persons)		314(%62,8)	236(%63,4)	78(%60,9)	0,672	
Cigarette Smoking (pocket-years)		21,39±20,00	17,99 ±16,39	31,25±25,55	p<0.01	
Gender	Female	180(%36)	132(%35,5)	48(%37,5)	0,749	
	Male	320(%64)	240(%64,5)	80(%62,5)		
Smoking	Never Smoked	186	136	50	0,343	
	Still Smoking	314	236	78	0,672	
Comorbid diseases (n=122)	Hypertension and CAD	45	26	19	0,012	
	Diabetes	82	51	31	0,08	
	COPD	35	24	11	0,424	
	CRF	28	18	10	0,263	
	Astma	13	9	4	0,748	
Diagnosis	OSAS	450	330	120	0,005	
	Mixed Apnea	2	0	2	0,005	
	Normal findings	48	42	6	0,068	
Osas phase	Simple snoring	52	45	7	p<0.01	
	mild Osas	93	77	16		
	Moderate Osas	109	88	21		
	Severe Osas	246	162	84		
		Cıpap	311	216	95	p<0.01
		Bıpap	58	43	15	p<0.01

treatment	Bipap St	2	0	2	p<0.01
	Suggestions	129	113	16	p<0.01
	Total	500	372	128	p<0.01

BMI: Body mass index; CAD: Coronary artery disease; COPD: Chronic obstructive pulmonary disease.
OSAS: obstruktif sleep apne syndrome CRF: Chronic respiratory failure

Table 2. Evaluation of the disease characteristics.

		Total (n=500) n (%)	Young (n=372) n (%)	Elderly (n=128) n (%)	p
Symptoms	Simple snoring	107(%21,4)	90	17	p<0.01
	Chest pain	107(%21,4)	83	24	p<0.01
	sleepiness	97 (%19,4)	68	29	p<0.01
	apnea	86(%17,2)	42	44	p<0.01
	Dry mouth	39(%7,8)	34	5	p<0.01
	Psychological reasons	37(%7,4)	29	8	p<0.01
	insomnia	17(%3,4)	17	0	p<0.01
	sleepwalker	10(%2)	9	1	
OSAS classification	Snoring(horlama)	52(%10,4)	45	7	p<0.01
	Mild	93(%18,6)	77	16	p<0.01
	Moderate	109(%21,8)	88	21	p<0.01
	Severe	246(%49,2)	162	84	p<0.01
Sleep stages	Stage 1(NREM1)	22,91±18,61 dk	22,06±15,85	25,24±24,90	0,095
	Stage 2(NREM2)	31-2829(181)	31-2829(158,5)	33-313(166)	0,09
	Stage 3 (NREM3)	83,35±49,27	89,03±46,25	67,70±54,92	p<0.01
	REM	0-159(44)	0-137,5(47,5)	0-159(33)	p<0.01
Sleep stages %	Stage 1 %	0-41(6)	0,6-34,2(5,6)	0-41(7,4)	0,02
	Stage 2 %	55,18±13,19	53,67±12,27	59,36±14,96	p<0.01
	Stage 3 %	25,11±16,17	26,69±16,52	20,78±14,45	p<0.01
	Rem %	0-43,8(13,8)	0-35,6(13,9)	0-43,8(13,25)	0,544
AHI(apne hipopne indexi)	37,33±31,26	34,74±44,59	44,59±28,34	0,023	
hipopne	0,0-131,6(22,6)	0,20-131,60(20,7)	0-108,6(29,75)	0,001	
Hourly use (night/min)	12,8-99,6(89,8)	30,7-99,6(91,9)	12,8-99,1(79,9)	p<0.01	

Uyku etkinliđi				
Recording time	35-990(91)	61-990(92)	35-95(89)	p<0.01
Total sleep time	51-461,5(338,5)	113-461(345,5)	51-416,5(306)	p<0.01
Minimum oxygen saturation	18-97(76)	18-97(76)	58-97(74,5)	0,07
Average oxygen saturation	28-97(91)	61-97(92)	28-97(90)	p<0.01
Avarage pulse rate	45-102(74)	60-102(75)	45-96(74)	0,69
Mean apnea indexi(sec)	7,9±14,30	7,02±13,96	10,40±14,97	0,026
ARI (Aeresol index)	50,33±48,38	52,31±49,82	44,25±43,50	0,104
central apne indexi	00-29(0,20)	0-29,1(0,2)	0-21,7(0,3)	0,03

OSAS: obstrüktif sleep apne syndrome

Table 3. Change in total sleep stages for all ages

	Simple snoring (n=52)	Mild osas=92	Moderate osas n=109	Severe osas n=246	p
Age (years)	18-69(41)	18-76(47)	18-75(52)	27-81(56)	0,237
Cigarette pack year	15,26±19,04	17,73±17,34	18,89±17,92	25,16±21,29	
BMI (kg/m ²)	18-48((31,35)	19,10- 45,30(32,70)	17,30-39(32)	19,4-48(34,6)	0,03
Neck circumference (cm)	5-285(53)	0-221(40)	0-285(47)	0,284(58,50)	0,046
Minimum oxygen saturation	35-96(78)	35-94(76,50)	18-92(76)	60-97(75)	0,427
Average oxygen saturation	61-95(91)	61-95(929)	74-97(92)	28-97(91)	p<0.01
Average pulse rate	62-96(76)	60-97(74)	62-95(72)	45-102(76)	p<0.01
Size(cm)	150-187(166,5)	150-186(166)	70,182(166)	70-185(167)	0,608
Weight(Kg)	23-177(88,5)	43-140(90)	43-180(90)	35-181(95)	0,014
aurosol	1-181(39)	1-181(41)	1-213(20)	0-411(41,5)	p<0.01
Total sleep time	89,5- 461,5(348,75)	170,5- 435,5(340)	103-456(339)	51- 446(336,25)	0,186
Stage 1	2-66,5(13,5)	0-112(14,5)	0-78(19,5)	0,5- 213,5(20,25)	0,037
Stage 2	39,5- 262,5(179,25)	68- 310(175,25)	38-270,5(175)	31- 2829(182,75)	0,065
Stage 3	4,5-221(90,75)	4-227,5(76)	1,5-190(76)	0-299(71,5)	0,385
REM	0-106(47)	0-133(53,5)	0-145(46,5)	0-159(36,5)	0,500
Stage 1 %	1,1-21,4(5,2)	0-41(4,65)	1-25,9(6,1)	0,2-34,2(7,4)	0,157
Stage 2 %	52,97±11,89	52,99±12,90	20,2-76,8(54,5)	8,9-93,6(58)	0,023
Stage 3 %	6-61(26,75)	1,6-208(24,3)	5-71,2(22,3)	1-86,3(20,15)	0,630
REM %	0,6-26,5(14,5)	0-30,9(16,05)	0-40,6(15)	0- 43,8(12,150)	0,386
Uykuortalama	89-97(95)	86-96(93)	85-95(92)	35-990(88)	p<0.01
Hipopne	0-4,8(2,1)	2,4-14,7(9,25)	8-29(18,3)	4,7- 131,6(41,8)	p<0.01
Apnea hipopne index	2,64±1,37	10,04±3,09	20,86±3,90	62,15±26,50	p<0.01

Sleep activity	85,30±17,79	85,40±12,251	84,54±14,70	84,21±15,08	0,905
Apnea index	0-1,6(0,2)	0-6,1(0,6)	0-50(1,4)	0-96,2(7,5)	p<0.01
Central apnea index	0-1,4(0)	0-2,2(0,2)	0-12,2(0,2)	0-29,1(0,4)	p<0.01

BMI: Body mass index

Figures

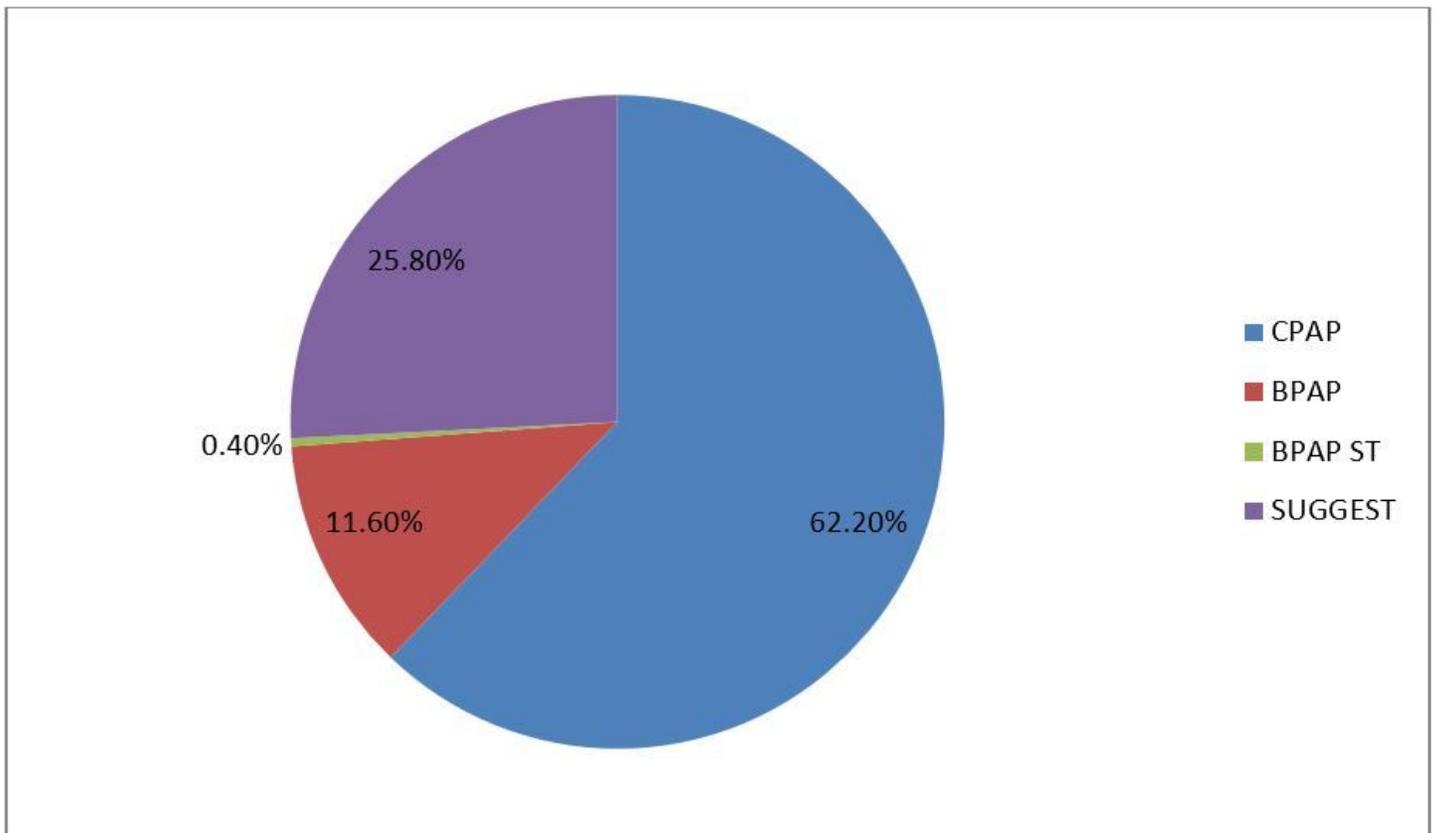


Figure 1

Treatments given to OSAS patients

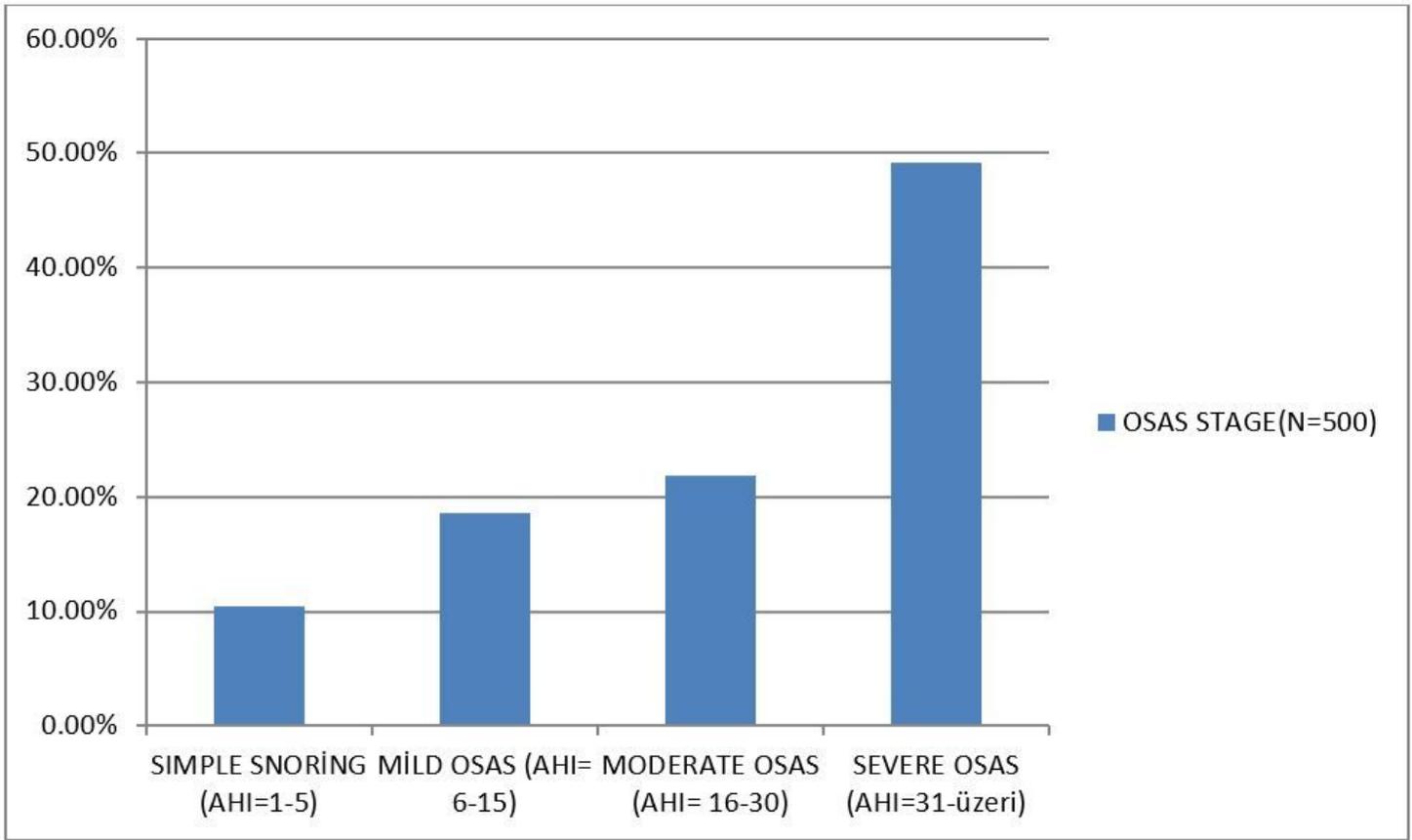


Figure 2

OSAS STAGES