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ORIGINAL ARTICLE – OPEN ACCESS

Is the Examination of a Single Night Polysomnography Sufficient for a Diagnosis of OSAS in Adolescent Patients?

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ABSTRACT

Objective: The objective of the study was to evaluate the first night effect (FNE) on sleep architecture and respiratory parameters of adolescent patients with suspected obstructive sleep apnea syndrome (OSAS).

Materials and Methods: A retrospective investigation was made of a total of 88 patients (51 males and 37 females, mean age 15.52±1.30 years, range 13–17 years) applied with polysomnography (PSG) because of suspected OSAS between March 1, 2016, and August 31, 2019. PSG was applied on two consecutive nights. The presence of OSAS was evaluated separately on the two consecutive nights and diagnostic accuracy was compared.

Results: When the patients were investigated in respect of sleep architecture, there was seen to be a significant difference between the two nights in the values of total sleep time (min) (p=0.001), time in bed (min) (p=0.001), sleep latency (min) (p=0.001), and rapid eye movement (REM) latency (min) (p<0.001), and the FNE was seen to have an effect on the REM percentage (p=0.001). No statistically significant difference was determined in the non-REM sleep parameters between the two nights. In the patient-based examination, two patients with borderline apnea/hypopnea index values and evaluated as normal on the first night were diagnosed as mild OSAS on the second night, and one patient diagnosed with moderate OSAS on the first night was diagnosed with severe OSAS on the second night.

Conclusion: There was seen to be a significant FNE on the sleep parameters of the adolescent age group, and in the evaluations made in respect of the respiratory parameters, the second night PSG examination can be considered useful, especially in patients with borderline values.

Keywords: Adolescent, obstructive sleep apnea syndrome, polysomnography

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INTRODUCTION

The most commonly seen sleep disorder in childhood and adolescence is obstructive sleep apnea syndrome (OSAS), for which the gold standard method in diagnosis is polysomnography (PSG) examination (1–4). However, the procedure is usually applied in a sleep laboratory, and it is known that this environment can alter the sleep structure (5–7). The first night effect (FNE) on an individual of the strange environment of a sleep laboratory was first defined in 1964 by Rechtschaffen et al. (8), and this well-known phenomenon is thought to be due to reasons such as non-adaptation to the technical hardware used for PSG. The main characteristics of this phenomenon are a reduction in rapid eye movement (REM) and total sleep time (TST), an increased delay in REM sleep, and a lower sleep efficiency (SE) index (9). For many years, clinicians with a professional interest in sleep have focused on the relationship between the first night spent in the sleep laboratory by adult and adolescent patients and the organization and architecture of sleep. However, studies conducted on the presence of respiratory disorders related to sleep in adolescent patients with the application of a single night PSG and to define the effect on the severity and on respiratory parameters are both old and limited in number (2, 10).

The aim of this study was to investigate the effects of the first night in a sleep laboratory of adolescent patients with suspected OSAS on sleep architecture, PSG results, the presence and severity of respiratory disorders, and respiratory parameters.

MATERIALS and METHODS

Setting and Patients

The study was approved by the local ethics committee of apnea/hypopnea index (AHI) Evran University Faculty of Medicine (decision no: 2020-07/49, dated: May 29, 2020). The study was carried out retrospectively on a total of 88 patients, aged 13–17 years, who were applied with PSG because of suspected OSAS between March 1, 2016, and August 31, 2019. All procedures were applied in compliance with the 1975 Helsinki Declaration.

Written consent was obtained from patients and parents. Patient records, hospital computerized system records, and patient anamneses were examined and the patients included were those with no medical, psychiatric, or neurological disorders, who had not taken a transmeridian flight in the previous 4 weeks, and who were applied with PSG examination on two consecutive nights.

Exclusion criteria were the presence of medical, psychiatric, or neurological disorders or having taken a transmeridian flight in the previous 4 weeks. Evaluation of the presence of OSAS was made separately for the two consecutive nights by a clinician not involved in the study and diagnostic accuracy was compared.

PSG Recording

The participants in the study went to sleep in a room specifically prepared for PSG, then the sleep status throughout the night was evaluated objectively with recordings on a PSG device (Philips Respironics Alice 5, 2016, USA) within the laboratory according to the 2007 criteria of the American Academy of Sleep Medicine (AASM). The patients were monitored throughout the night by a trained technician, through the following channels: Electroencephalogram (C3, C4, CZ, 02) (50 µv/cm sensitivity, 0.3–35 Hz low-high-frequency filters were used), jaw electromyogram (EMG) (50 µv/cm sensitivity, 10–70 Hz low-high-frequency filters were used), electromogram (Fpl, Fp2) (50 µv/cm sensitivity, 0.3–35 Hz low-high-frequency filters were used), respiration (nasal/oral thermistor), electron activity, and leg EMG.

The parameters evaluated were age, gender, body mass index (BMI: kg/m^2), nasal and oral airflow (using both an oral-nasal thermocouple and a nasal pressure cannula), snoring sounds, thoracic-abdominal movements, mean O_2 saturation (SaO_2), mean heart rate, leg movements, and body position. Using the computer software, the AHI and oxygen desaturation index were automatically scored then checked manually by the technician.

The following sleep parameters were recorded: The time from the patient lying down in bed to the time of getting out of bed (time in bed [TIB] in min), the total time throughout the night spent asleep (TST in min), the adequacy of sleep (SE [TST/sleep period time (%)]), the time from falling asleep to the first REM stage was determined (REM latency [REML] in min), and the time from turning off the lights to the first minute of Stage 2 sleep (sleep latency [SL] in min).

Apnea was accepted as the stopping of at least 90% of the air flow for at least 10 s. Hypopnea was accepted as ≥50% reduction in air flow for at least 10 s related to a stimulus or ≥3% oxygen desaturation. Stimuli were defined as sudden shifts in electroencephalographic frequency lasting at least 3 s. AHI was accepted as the number of apnea and hypopnea events during sleep. The severity of OSAS was graded according to the AHI and categorized as normal (<5), mild (5–14.9), moderate (15–29.9), or severe (≥30).

Statistical Method

Data were analyzed using SPSS 17.0 software (IBM Statistics for Windows version 17, IBM Corporation, Armonk, NY, USA). The conformity of continuous variables to normal distribution was tested with the Kolmogorov–Smirnov test. Quantitative variables were indicated in the tables as median (minimum–maximum) and mean±standard deviation values, and categorical variables as number (n) and percentage (%). Consecutive measurements with normal distribution were compared using the paired samples t-test and for the comparison of non-parametric variables, the Wilcoxon signed-rank test was applied. P<0.05 was considered statistically significant.

Table 1. Demographic data of the patients

Characteristic	n=88
Age (years)	15.52±1.30
Sex (male)	57.9%
BMI (kg m^2)	28.51±4.99
OSAS severity	
Normal (AHI<5)	27 (30.7%)
Mild (AHI 5–14.9)	20 (22.7%)
Moderate (AHI 15–29.9)	34 (38.7%)
Severe (AHI ≥30)	7 (7.9%)

AHI: Apnea/hypopnea index h-1; BMI: Body mass index; OSAS: Obstructive sleep apnea syndrome

RESULTS

Evaluation was made of a total of 88 adolescent patients with suspected OSAS who were applied with PSG. According to the PSG results, 30.7% of the patients were evaluated as normal and 7.9% as severe OSAS. The demographic data of the patients are shown in Table 1.

When the patients were examined in terms of sleep parameters, there was seen to be a significant difference between the two nights in the values of TST (min) (p=0.001), TIB (min) (p=0.001), SL (min) (p=0.001), and REML (min) (p<0.001), and the FNE was seen to have an effect on the REM percentage (p=0.001).

No statistically significant difference was determined in the non-REM sleep parameters between the two nights. The PSG variables are shown in Table 2. When the results were evaluated in terms of the respiratory parameters, there was no difference between the two nights in respect of the saturation and respiratory parameters (p>0.05) (Table 3). In the patient-based examination, two patients with borderline AHI values and evaluated as normal on the first night were diagnosed as mild OSAS on the second night, and one patient diagnosed with moderate OSAS on the first night was diagnosed with severe OSAS on the second night.

DISCUSSION

PSG is used routinely in specialized centers to evaluate sleep disorders in adolescent patients (1–3). Although single night PSG examination is a practice with clinical use in diagnosing sleep problems, because the first night spent in a sleep laboratory can itself cause sleep disruption, many researchers have advocated the need for a minimum of two nights recordings to provide patient adaptation to the environment (11–15).

This is known as the FNE, and although it is seen in all age groups, there are few studies in literature on this subject in the

Table 2. Sleep variables of the group for two consecutive nights

Variables	13–17 years (n=88)			
	Night 1	Night 2	Variation (%)	p
TST (min)	347.0 (124.0–524.0)	401.0 (292.5–511.2)	20.5	0.001
TIB (min)	395.0 (130.5–524.0)	435.0 (259.0–547.0)	10.9	0.001
Stage 1 (%TST)	5.1 (4.6–5.9)	4.2 (3.6–4.8)	1.2	0.910
Stage 2 (%TST)	43.7 (32.3–54.1)	43.3 (32.2–52.7)	1.6	0.847
Stage 3 (%TST)	10.3 (7.4–13.1)	11.7 (8.1–14.8)	1.1	0.934
Stage 4 (%TST)	21.4 (12.6–29.8)	19.8 (12.8–24.8)	2.7	0.773
REM (%TST)	17.4 (5.0–35.5)	26.7 (11.0–41.0)	9.3	0.001
SL (min)	40.0 (6.5–79)	36.0 (10–71)	29.5	0.001
REML (min)	137.5 (52.0–253.5)	94.5 (15.0–190.0)	24.6	<0.001
SE (TST/SPT; %)	84.5 (65.0–94.6)	90.5 (76.0–96.5)	6.6	<0.001

REM: Rapid eye movement; REML: REM sleep latency; SL: Sleep latency; SPT: Sleep period time; TIB: Time in bed; TST: Total sleep time; NS: Non-significant; SE: Sleep efficiency

Table 3. Respiratory variables of the group for two consecutive nights

Variables	13–17 years (n=88)			
	Night 1	Night 2	Variation (%)	p
AHI (events/h TST)	14.7 (1.3–82.8)	15.2 (1.3–82.7)	3.4	0.587
AI (events/h TST)	8.1 (0.2–40.8)	8.2 (0.3–40.6)	1.2	0.612
Average SaO_2	96.9 (93.2–98.9)	96.7 (93.4–99.1)	0.3	0.715
Minimal SaO_2	84.10 (76.8–89.6)	82.4 (74.1–90.4)	2.1	0.723
O_2 desaturation index (ODI)	9.1 (1.0–18.4)	8.9 (1.3–19.5)	1.1	0.681

AHI: Apnea/hypopnea index h-1; AI: Arousal index; EEG: Electroencephalogram; TST: Total sleep time; ODI: Oxygen desaturation index

adolescent period in particular (1–3, 10). The effects of FNE on respiratory parameters are an even less studied subject (2, 10). Therefore, when the sleep laboratory was first established in our clinic, adolescent patients underwent two nights of PSG tests. Subsequently, as the efficacy of the first night test was seen to be high, the tests started to be applied for a single night. The aim of this study was to investigate FNE on the respiratory parameters and sleep architecture of adolescent patients with suspected OSAS.

The results of this study are discussed by focusing on the two main subjects: First, the FNE on sleep architecture and second, the effect of the potential results on respiratory variables in the PSG examination of adolescent patients.

First, the effect of the sleep laboratory on the sleep architecture of the adolescent patients was evaluated. Scholle et al. (3) evaluated 105 children and adolescents and in all the age groups of studies including a total of 24 adolescents aged 14–17 years, it was reported that between the nights an increase was observed in TST, REM sleep, and SE, a decrease in REML and no difference in NREM sleep. Verhulst et al. (2) reported that there was no difference between the nights in SE and SL values, and FNE was seen on the REM sleep and REML parameters. Both of those studies evaluated both children and adolescents and it was emphasized that FNE was more prominent in the adolescent patients. Therefore, in the current study, adolescent patients were evaluated. On the first night of the current study, a significant decrease was seen in the TST, TIB, and REM sleep values, and on the second night, a significant increase was seen in the SE values. When evaluated in respect of sleep architecture, the results of the current study were seen to be consistent with literature.

In studies in literature that have investigated the relationship between respiratory variables and FNE, contradictory results have been reported (2, 3, 10). Scholle et al. (3) evaluated the FNE on respiratory variables in 131 children and adolescents with suspected sleep disorders and reported that there was no difference in respiratory parameters between the two nights. In another study of 70 patients aged 2–17 years where this situation was examined, there was reported to be no FNE on respiratory and saturation parameters (2). However, in another study, there was a non-significant increase in AHI values on the second night. The reason for this improvement was due to the increase in the slow wave sleep percentage on the second night (10). In the current study, no difference was detected between the two nights in either respiratory parameters or saturation values. These results were seen to be consistent with the findings in literature. Nev-

ertheless, it was seen in the current study that there could be problems diagnosing OSAS, especially in patients with borderline values. The PSG examinations of both nights were evaluated by an observer not involved in the study and blinded to the patients. It was determined that two patients evaluated as normal on the first night were evaluated as mild OSAS on the second night, and one patient diagnosed as moderate OSAS on the first night was diagnosed as severe OSAS on the second night.

Similarly, in the study by Verhulst et al. (2), patients in the 2–6 years age group and three patients in the 7–12 years age group were diagnosed with OSAS on the second night despite normal results on the first night, and all the patients in the 13–17 years age group were diagnosed from the first night examination. In the same study, when the age groups were evaluated separately, the accuracy of diagnosis from the first night PSG examination was reported to be 86%, 91%, and 100%, respectively (2). In another study, it was reported that 15–25% of patients with borderline AHI values evaluated as normal on the first night were diagnosed as OSAS on the second night (15). In the current study, which only evaluated patients in the 13–17 years age group, the results of the first night PSG examinations of three patients were different from those of the second night. When the PSG values of the patients were examined, in three patients, there was observed to be a significant reduction in the number of respiratory effort-related arousals (RERA) despite no significant change in total apnea and an increase in AHI following an increase in the number of hypopnea events together with desaturation. It is thought that the increase in AHI values in these patients may be related to the increase in REM value in the second night, and respiratory events that do not meet the definition of hypopnea due to the absence of oxygen desaturation after the RERA in the first night's sleep are considered to be hypopnea, as a result of which desaturation is considered to cause an increase in AHI value. Unlike the study by Verhulst et al. (2) of an adolescent group, 96.6% diagnostic accuracy was determined and this difference was thought to be due to the difference in patient numbers. The current study included 88 patients aged 13–17 years, whereas there were only 16 patients in the Verhulst study. The results of the current study were generally compatible with the results of Scholle and Verhulst, and it was, therefore, concluded that OSAS assessment can be safely performed in adolescent patients based on the measurements of a single night, but a second night of PSG examination would be beneficial for patients with borderline values.

The most important limitation of the current study was the retrospective design, meaning that it was dependent on the quality of the documentation. However, patient records in our clinic have been computerized and kept in great detail, especially for the past 10 years. Therefore, data loss was considered to be at a minimum level. Another limitation was that other younger patients were not included, but as the previous studies have already evaluated this age group, the current study only included adolescent patients and was thus the first study with a large number of patients in the adolescent age group. The decision to examine this age group only was made as an important point in the studies by Scholle and Verhulst was the emphasis that FNE was more evident in adolescent patients.

CONCLUSION

The results of this study demonstrated that FNE was evident in the adolescent age group, especially in the sleep parameters, and in evaluations made of the respiratory parameters, and the second night PSG examination could be useful, especially in patients with borderline values. There is a need for further studies to be conducted on adolescent patients taking into consideration the staging diagnostic criteria of OSAS.

Ethics Committee Approval: The Ahi Evran University Clinical Research Ethics Committee granted approval for this study (date: 29.05.2020, number: 2020-07/49).

Informed Consent: Written informed consent was obtained from patients who participated in this study.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept – MM, MA; Design – MM, MA; Supervision – MM, MA; Resource – MM, MA; Materials – MM, MA; Data Collection and/or Processing – MM, MA; Analysis and/or Interpretation – MM, MA; Literature Search – MM, MA; Writing – MM, MA; Critical Reviews – MM, MA.

Conflict of Interest: The authors have no conflict of interest to declare.

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