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ORIGINAL ARTICLE

An evaluation of the effects of video modelling on the first-night effect in polysomonography examination of patients with obstructive sleep apnea

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Abstract
The aim of this study was to evaluate the effect on patient anxiety and first-night effect (FNE) of a video modelling application, which has an important place in behavioural information practices. A total of 232 adolescent and adult patients with suspected obstructive sleep apnea were randomly separated into groups within two age ranges using the sealed envelope method. Group 1 (14–18 years, *n*: 40) and group 3 (19–65 years, *n*: 76) were verbally informed about the polysomnography (PSG) procedure. The patients in group 2 (14–18 years, *n*: 37) and group 4 (19–65 years, *n*: 79) were shown a training video of PSG procedure. Anxiety levels of the patients in groups 2 and 4 were seen to have significantly reduced, and when these groups were compared, the decrease was seen to be more significant in the adolescent patients ($p < 0.001$, $p = 0.001$). No significant difference was determined between the values of total sleep time, REM sleep, and sleep efficiency in the video modelling groups on the 2 days ($p > 0.05$ for all). There was a difference between the REM latency and sleep latency values on the 2 days, and this was at a low level of significance in the video modelling group. Video modelling was seen to be effective in reducing patient anxiety and it was concluded that it could be used to reduce FNE.

Keywords Video modelling · Obstructive sleep apnea · Anxiety · First-night effect · Polysomnography

Introduction

Sleep disorders are a serious health problem affecting approximately 10% of the general population and causing performance loss of approximately 60 billion USD per year. Previous studies have shown the effects on sleep disorders of various factors such as age and gender [1–3] and anxiety [4]. Polysomnography (PSG) examination is the gold standard method in the diagnosis of sleep disorders and is generally performed in a special laboratory [5]. However, it is known that the sleep structure can be changed in a sleep laboratory.

First-night effect (FNE) is a well-known phenomenon that was first described in 1964 [6] and was reported in detail 2 years later [7], which is thought to arise from poor adaptation of the subject to the strange environment of the sleep laboratory and the technical equipment used for PSG. The basic characteristics of this effect are a short total sleep time (TST), short REM sleep, a lower sleep efficiency index, and delayed REM sleep [3, 8, 9]. Previous studies have reported that personal characteristics, such as trait anxiety, are a potential reason for FNE [10, 11]. There are a few studies in the literature related to the reduction of FNE [3, 11, 12].

Informing the patient about a procedure that is to be applied is known to be one of the important stages of diagnosis and treatment in providing the understanding of the importance and the content of the procedure, and reduces the anxiety that develops associated with lack of information about the procedure [13, 14]. Patients are generally informed verbally and in writing before PSG examination, and the procedure is applied after delivering this information. Behavioural information practices include video modelling (VM), video games or modelling techniques with music, and distraction procedures [13–15]. VM is widely used for anxious subjects in areas such as medicine, sport, and dentistry, and is a technique based on psychology fundamentals

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that provides the learning of positive coping behaviours by watching the behaviour of those close to them or others, live or on video recordings [13–16]. To the best of our knowledge, there are no reports in the literature of the effect of VM on FNE and PSG results.

The aim of this study was to evaluate the effects of VM on PSG results and first-night sleep in patients of different age groups with obstructive sleep apnea.

Methods

Setting and patients

Approval for this prospective study was granted by the Local Ethics Committee and all procedures were applied in conformity with the principles of the 1975 Helsinki Declaration. Informed consent was obtained from all the study participants, and from parents or legal guardians in the case of minors.

The study included 232 patients aged 14–65 years who presented with complaints of daytime sleepiness and/or snoring between 01.03.2018 and 31.08.2019. The patients included were those who had never previously undergone PSG for any reason, had no medical, psychiatric, or sleep disorder other than obstructive sleep apnea syndrome (OSAS), had no DSM-IV axis I disorder that could have a potential effect on REM latency, drank < 5 g units of alcohol and did not use illegal drugs, had not previously used psychotropic drugs, and, in the 4 weeks before the study, had not taken a transmeridian flight or undertaken shift work.

Criteria for exclusion from the study were (1) other sleep disorders such as central sleep apnea syndrome, narcolepsy, or upper airway resistance syndrome or restless legs syndrome, (2) a history of hypertension, thyroid replacement therapy, diabetes mellitus, hyperlipidemia, or medical treatment for any active infection or inflammatory disease, (3) any hepatic, pulmonary, renal, or cardiac failure, (4) consumption of > 5 g units of alcohol, (5) illegal drug use, (6) the use of psychotropic drugs before the study, (7) having taken a transmeridian flight or undertaken shift work in the 4 weeks before the study, (8) panic disorder, obsessive compulsive disorder, major depression, dysthymia, bipolar disorder, psychosis, or substance dependence determined in the psychiatric examination, and (9) unwillingness to participate in the study.

All the study participants were instructed not to drink alcohol for 24 h before the procedure and not to drink caffeinated drinks on the day of the procedure. A detailed psychiatric evaluation was applied to all the patients before PSG, and before the procedure, all the patients completed the State-Trait Anxiety Inventory (STAI).

A total of 232 adolescent and adult patients were randomly separated into groups within two age ranges using the sealed envelope method. Group 1 (14–18 years, *n*: 40) and group 3 (19–65 years, *n*: 76) were verbally informed about sleep apnea, sleep disorders, and the PSG procedure. The patients in group 2 (14–18 years, *n*: 37) and group 4 (19–65 years, *n*: 79) were shown a training video of approximately 1 h which gave detailed explanations of sleep apnea and respiratory disorders in sleep in addition to the verbal information. After receiving the information, the STAI was used to evaluate the level of anxiety of the patients. The PSG procedure was then applied to all patients on two consecutive nights.

Polysomnography recordings

All the patients went to sleep in a room specifically designed for PSG and were observed throughout the night by a trained technician. The nocturnal sleep status of each patient was evaluated objectively using a laboratory PSG device (Philips Respironics Alice 5, 2016, USA), which applied evaluations according to the American Academic Sleep Medicine (AASM) 2007 criteria.

The patients were monitored through the following channels: electroencephalogram (EEG) using C3, C4, CZ, 02 at 50 µv/cm sensitivity and 10–70 Hz low–high-frequency filters, chin electromyogram (EMG) at 50 µv/cm sensitivity, and 10–70 Hz low–high-frequency filters, electromogram (EOG) at Fpl, Fp2 at 50 µv/cm sensitivity and 0.3–35 Hz low–high-frequency filters, respiratory monitoring (nasal/oral thermstor), electron activity, and leg EMG.

The following sleep variables were defined and recorded: time in bed (TIB-mins) = the duration from the time the patient lay down in bed to the time of rising, total sleep time (TST-mins), the total time spent sleeping throughout the night, sleep efficiency (SE) = TST/TIB, sleep latency (SL-mins) = the time from switching off the lights to the first minute of grade 2 sleep, and REM latency (RL-mins) = the time from falling asleep to the stage determined as the REM stage. Apnea is defined as the stopping of at least 90% of the air flow for at least 10 s. Hypopnea is defined as ≥ 3% oxygen desaturation or ≥ 50% reduction in air flow for at least 10 s related to a stimulus.

In addition to the sleep variables, the variables of apnea/hypopnea index (AHI), STAI, body mass index (BMI-kg/m^2), age, and gender were also recorded. Patients with severe OSAS were excluded from the study: five patients in group 3 who developed central apnea lasting longer than 20 s or desaturation (< 90%) after central apnea, and seven in group 4 in the consideration that patient homogeneity would be affected.

Statistical analysis

Data obtained in the study were analysed statistically using SPSS 17.0 software (IBM Statistics for Windows version 17, IBM Corporation, Armonk, NY, USA). Conformity of continuous variables to normal distribution was assessed using the Kolmogorov–Smirnov test. Quantitative data were stated as mean ± standard deviation and median, range (minimum–maximum) values. Categorical data were stated as number (n) and percentage (%). Variables showing normal distribution and consecutive measurements were compared using the paired t test, and for the comparisons of non-parametric variables, the Wilcoxon Signed-Rank test was used. The data of differences between diagnosis and age groups showing normal distribution were analysed with one-way ANOVA, and for non-parametric variables, the Kruskal–Wallis test was applied. The Tukey test was used for post hoc analysis. In the evaluation of the PSG factors associated with anxiety levels, Pearson and Spearman correlation analyses were used. A value of $p < 0.05$ was accepted as statistically significant.

Results

A total of 232 patients were included in the study. The demographic characteristics of the patients grouped according to age and the information given are shown in Table 1. Before and after receiving the information, all the patients completed the STAI anxiety questionnaire. After receiving information and watching the video, the anxiety levels of the patients in groups 2 and 4 were seen to have significantly reduced ($p = 0.001$ for both). In groups 1 and 3, no difference was seen in the levels of anxiety before and after receiving the information ($p > 0.05$ for both). When the sleep parameters were evaluated, no difference was observed between the days in respect of the percentage of REM sleep of the patients in groups 2 and 4 ($p > 0.05$ for both). FNE was determined in the patients in groups 1 and 3.

The 2nd night REML values were found to be significantly lower than the 1st night values in both age groups, and this difference was seen to be at a higher level of statistical significance in the patients who only received verbal information ($p < 0.001$, $p = 0.019$, $p = 0.003$, $p = 0.012$). The PSG variables are shown in Table 2. Although the primary aim of the study was to evaluate whether or not respiratory parameters were affected by FNE, there was seen to be no difference between the days in respect of respiratory and saturation parameters (Table 3).

The patients completed the STAI anxiety scale before and after receiving information about PSG. When the relationships were evaluated between the anxiety levels measured after the procedure and the first-night sleep parameters, a negative correlation was determined between increasing anxiety levels and TIB (r: −0.139, $p = 0.035$), and sleep efficiency (r: −0.407, $p < 0.001$), and a positive correlation with SL (r: 0.203, $p = 0.002$). No correlations were determined with the other parameters.

Discussion

The results of this study showed that there was no difference in the anxiety levels of all the groups before the patients were informed about PSG, and after receiving information, the anxiety levels of the patients who received VM were seen to have significantly decreased. When the PSG results were evaluated, no difference was determined between the first and second day TST, TIB, REM duration, and SE values of the VM group. The FNE was seen in the SL and REML values of all the groups, but the difference was of lower statistical significance in the VM groups (group 2 and group 4).

Anxiety can be defined as the multi-system response of an organism to a threat or danger, and just as it may emerge without reason, it may be based on a real situation that leads to a greater than normally expected reaction [17, 18]. In a recent study, [13], the effect on children's anxiety about dentists was evaluated following the application of video film modelling, and there was reported to be a positive effect in reducing the anxiety of the children about the dentist and in acceptance of how the mask was applied for sedation. That study demonstrated tht VM significantly reduced anxiety levels before the procedure and increased compliance with treatment.

Clinicians dealing professionally with sleep disorders have focussed on the relationship between anxiety and sleep structure, and have reported that a high level of anxiety impairs sleep architecture [9]. Fuller et al. evaluated anxiety

Table 1 Demographic data of the patients

	14–18 years		19–65 years	
	Group 1 ($n = 40$)	Group 2 ($n = 37$)	Group 3 ($n = 76$)	Group 4 ($n = 79$)
Age (years)	16.67 ± 1.71	16.86 ± 0.82	50.97 ± 10.31	50.87 ± 11.67
Sex (Male)	57.50%	54.10%	59.20%	56.90%
BMI (kg m^2)	25.56 ± 3.97	25.68 ± 3.71	28.47 ± 5.55	28.26 ± 5.59

BMI Body mass index

Table 2 The change over the 2 days in the sleep parameters of the patients grouped according to age and the information received

	14–18 years						19–65 years					
	Group 1 ($n=40$)			Group 2 ($n=37$)			Group 3 ($n=76$)			Group 4 ($n=79$)		
	Night 1	Night 2	p Wilcoxon	Night 1	Night 2	p Wilcoxon	Night 1	Night 2	p Wilcoxon	Night 1	Night 2	p Wilcoxon
STAI-Trait	47.47 ± 13.69	45.89 ± 12.76	NS	46.60 ± 8.96	34.24 ± 6.59	< 0.001	44.20 ± 9.96	43.40 ± 8.60	NS	43.18 ± 7.36	37.27 ± 9.80	0.001
TST (min)	323.79 ± 115.84	396.68 ± 64.06	0.001	372.92 ± 111.64	398.26 ± 45.49	NS	311.54 ± 101.78	373.78 ± 54.12	0.001	355.48 ± 105.68	364.11 ± 52.88	NS
TIB	388.11 ± 98.18	434.22 ± 62.75	0.001	409.15 ± 94.64	427.78 ± 48.79	NS	372.11 ± 92.47	419.66 ± 87.96	0.001	402.06 ± 88.69	404.56 ± 95.14	NS
Stage 1 (%TST)	4.52 ± 0.85	3.56 ± 0.74	NS	3.15 ± 0.69	2.50 ± 0.58	NS	3.87 ± 0.91	3.54 ± 0.61	NS	2.81 ± 0.78	3.08 ± 0.70	NS
Stage 2 (%TST)	45.18 ± 13.5	42.45 ± 11.68	NS	44.14 ± 14.66	39.18 ± 12.44	NS	43.52 ± 14.10	44.54 ± 13.27	NS	44.48 ± 12.89	43.19 ± 13.52	NS
Stage 3 (%TST)	10.48 ± 2.45	11.48 ± 3.41	NS	9.89 ± 2.78	10.31 ± 2.17	NS	11.14 ± 2.84	10.74 ± 2.63	NS	10.21 ± 2.75	11.47 ± 2.98	NS
Stage 4 (%TST)	20.56 ± 7.25	16.74 ± 5.28	NS	17.87 ± 9.38	23.78 ± 4.66	NS	21.04 ± 8.04	19.79 ± 7.64	NS	20.59 ± 7.52	17.11 ± 5.79	NS
REM (%TST)	17.87 ± 9.38	25.59 ± 7.91	0.001	23.91 ± 5.58	25.28 ± 7.19	NS	19.36 ± 7.71	23.78 ± 4.66	0.008	24.07 ± 5.69	25.66 ± 6.55	NS
SL (min)	42.63 ± 15.98	31.86 ± 16.43	0.001	34.43 ± 10.28	27.21 ± 10.27	0.011	43.75 ± 17.47	32.50 ± 13.50	0.001	39.22 ± 19.11	34.26 ± 17.84	0.007
REML (min)	133.73 ± 48.87	95.86 ± 30.44	< 0.001	119.44 ± 36.07	99.58 ± 38.27	0.019	125.63 ± 38.73	97.80 ± 29.45	0.003	118.55 ± 34.54	98.36 ± 30.62	0.012
Sleep efficiency (TST/TIB)	83.60 ± 9.20	91.72 ± 4.24	0.001	90.71 ± 7.73	92.42 ± 6.25	NS	83.86 ± 9.26	89.31 ± 5.03	0.546	88.55 ± 6.94	90.36 ± 5.17	NS

REM rapid eye movement, *REML* REM sleep latency, *STAI* state-trait anxiety inventory, *SL* sleep latency, *SPT* sleep period time, *TIB* time in bed, *TST* total sleep time, NS nonsignificant

Table 3 Respiratory variables of the groups on two consecutive nights

	14–18 years						19–65 years					
	Group 1 ($n=40$)			Group 2 ($n=37$)			Group 3 ($n=76$)			Group 4 ($n=79$)		
	Night 1	Night 2	*p* Wilcoxon	Night 1	Night 2	*p* Wilcoxon	Night 1	Night 2	*p* Wilcoxon	Night 1	Night 2	*p* Wilcoxon
AHI (events/hr TST)	18.24 ± 19.44	18.91 ± 19.40	NS	21.52 ± 22.61	22.62 ± 20.03	NS	40.66 ± 30.20	41.59 ± 30.35	NS	38.06 ± 30.45	37.98 ± 30.35	NS
AI (events/hr TST)	15.01 ± 10.88	17.55 ± 9.00	NS	13.28 ± 8.13	16.36 ± 10.45	NS	24.04 ± 13.72	26.53 ± 15.90	NS	24.41 ± 11.93	24.36 ± 12.90	NS
Average SaO2	97.47 ± 11.29	96.97 ± 8.77	NS	97.61 ± 10.62	97.66 ± 9.18	NS	95.36 ± 9.64	96.35 ± 9.46	NS	95.81 ± 9.55	95.42 ± 8.89	NS
Minimal SaO2	82.44 ± 9.57	84.70 ± 8.40	NS	84.28 ± 9.45	84.40 ± 9.15	NS	80.71 ± 10.36	82.56 ± 7.41	NS	83.88 ± 7.95	79.61 ± 8.73	NS

AHI apnea/hypopnea index h^{-1}, *NS* nonsignificant

levels of patients before sleep studies and a high level was reported to have a negative effect on first-night sleep [9]. In another study, Kajimura et al. [10] grouped patients as low and high-anxiety groups according to the STAI-trait score, and patients with a high-anxiety level showed lower environment adaptation, and there were also reported to be more evident FNE characteristics in the PSG results.

Both of those studies differed from the current study in that the basic aim was to determine the relationship between anxiety levels and FNE. The relationship between anxiety level and FNE was evaluated, and in a recent study, the application of placebo and nitrazepam was compared in 8 voluntary patients, and it was seen that because of the hypnotic/anxiolytic effect of the placebo application, the FNE results could be improved without causing a decrease in REM sleep [3]. In the current study, the VM method was used for the purpose of reducing patient anxiety, and the STAI-trait scores before receiving information were similar in all the groups. After receiving the information, the scores in the VM group were significantly different both in comparsion to the verbal information groups and to the pre-information scores, and the level of significance of the difference was seen to be extremely high in the adolescent group in particular ($p<0.001$) (Table 2). This was thought to be because adolescents adapt better to technology.

After receiving the information, when the relationship was evaluated between anxiety levels and the first-night sleep parameters, a negative correlation was determined between increasing anxiety levels and TIB (r: −0.139, $p=0.035$), and sleep efficiency (r: −0.407, $p<0.001$), a positive relationship was observed with SL (r: 0.203, $p=0.002$), and no correlation was determined with the other parameters. There is evidence in the literature supporting the role of video modelling (VM) in decreasing stress and increasing the capability to deal with stress for patients to be applied with surgical or invasive procedures. As seen in the studies focused on, watching training videos before treatment resulted in a significant reduction in anxiety and associated behaviours. It has also been emphasised that the application of VM is effective in developing coping strategies to manage stressful situations and provides the initial support in reducing the anxiety of expectation. The basic reason for this is that patients who have had stressful clinical experiences can obtain information about the experience from the VM application and may, therefore, have a lower level of psychogenic and physiological stimulation. However, this effect has been seen to be more limited in the application of verbal information, which could be related to reasons such as the ability of the person giving the information, the psychological status at that time or restricted time, and many other factors such as the educational level of the patient and stress levels. The results of the current study were consistent with those of previous studies in that VM application showed a significant

reduction in anxiety in all age groups, with a more significant effect seen in adolescent patients.

Lorenzo and Barbanoj reported that the factors most affecting the process of adaptation to the laboratory were the variables associated with REM sleep [18]. It was stated by Vgontzas et al. that when the hypothalamo–hypophyseal–adrenal axis and sympathetic nerve system were active in individuals under stress, there was a negative effect on variables associated with REM sleep [19]. Suetsugi et al. showed that the use of placebo and the use of benzodiazepine had a similar positive effect on first-night REM sleep, but it was emphasised that there was no effect on non-REM sleep parameters [3]. In the current study, the FNE was seen on REM sleep in the patients who received verbal information only, in both the adolescent and adult age groups, whereas in the VM groups, the first-night REM sleep values were seen to be no different from the second night values. The FNE was seen in the REML values in all the groups, but the difference in the VM groups (groups 2 and 4) was determined to be at a lower level of significance ($p=0.019$, $p=0.012$, respectively). When the study results were evaluated in respect of the REM sleep values, there was determined to be no difference between the 2 days in all the groups, which was consistent with the previous findings in the literature.

The relationship between anxiety and sleeplessness is well known, and the previous studies have shown that the elimination of anxiety can reduce FNE, increase sleep efficiency and TST, and reduce SL [9, 10]. Kitaoka et al. reported that with a possible anxiolytic effect, fermented ginseng increased TST and sleep efficiency and reduced SL [12]. Suetsugi et al. evaluated the application of placebo, 5-mg nitrazepam, or no medication on 4-day PSG results in 8 volunteers, and reported that placebo created similar FNE results as nitrazepam, and while TST and sleep efficiency increased significantly compared to the control group values, there was a decreasing effect on SL [3].

In the current study, no difference was determined between the first and second night sleep efficiency and TST results in the VM group, and the difference between the days in the SL values was significant in all the groups, with a higher level of significance seen in the verbal information group. In studies in the literature that have evaluated FNE in adolescent patients, the SL values have been seen to be longer compared to those of adult patients. The main reason for this could be that the emotional status is not fully established in this age group of patients. In the current study, the SL values were seen to be relatively longer compared to findings in the literature. This was thought to be related to the education level in the region where the study was conducted.

When the current study results were evaluated in respect of sleep duration and sleep efficiency, the first-day results of both VM groups were seen to be significantly higher than those of the patients who received verbal information only. When comparisons were made of the first and second day values of the VM group, the first-day values were seen to be lower, but the difference was not statistically significant.

In studies that have evaluated the relationship between FNE and respiratory variables, conflicting results have been reported. In two different studies by Scholle et al. [20] and Verhulst et al. [21], no difference was reported between the respiratory parameters on two nights, whereas Li et al. [22] reported that there was a non-statistically significant improvement in the 2nd night AHI values and this improvement was associated with an increase in the slow-wave sleep percentage. The results of the current study that there was no difference between the first and second nights in respect of both the respiratory parameters and saturation values in all the groups, were consistent with the findings of Scholle and Verhulst, showing that OSAS screening could be applied safely based on a single night measurement.

The primary limitation of this study was that the effect of gender on FNE was not evaluated. However, as there are studies in the literature related to the effects of gender on FNE, it was not felt to be necessary to group the patients in the current study according to gender.

In conclusion, the results of the current study showed that by watching the video about the procedure to be applied, the use of VM for the purpose of reducing FNE was useful, particularly for adolescent patients, in respect of patient compliance and the acquisition of positive coping strategies, and VM was effective in reducing patient anxiety and can, therefore, be used to reduce FNE.

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Compliance with ethical standards

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

Ethics Committee approval The study was conducted in accordance with the ethical principles stated in the "Declaration of Helsinki".

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