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SCIENTIFIC INVESTIGATIONS

Sleeping Together: A Pilot Study of the Effects of Shared Sleeping on Adherence to CPAP Treatment in Obstructive Sleep Apnea

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Objectives: To examine the sleep of married couples, recorded together in the laboratory before and after the husband is treated with continuous positive airway pressure (CPAP) to control his obstructive sleep apnea (OSA). The purpose was to investigate how these data relate to shared sleeping when he is on CPAP and his adherence to this treatment.

Methods: Following a split-night diagnosis of OSA with CPAP titration, 10 married men slept for 2 additional nights with their non-apneic wife while both were recorded. The first night included a standard baseline 12-channel clinical polysomnogram without treatment. Following 2 weeks of home CPAP, the couple returned for a second polysomnography night with the husband on CPAP. Both partners completed Epworth Sleepiness Scales and Sleep Apnea Quality of Life Interviews each lab night. During the intervening 2 weeks, sleep logs were completed daily noting if CPAP was used, the presence of snoring, and where and how well they slept. Adherence data from machine downloads were obtained after an average of 4.6 months.

Results: The husbands' baseline sleep differed significantly from their wives on 6 of 7 sleep variables related to OSA and on Epworth Sleepiness Scale scores. Their sleep did not differ the second night, except for his lower percentage of slow wave sleep. Adherence to CPAP was unrelated to OSA severity but positively related to the number of nights the couple slept together during the 2 weeks of home CPAP. The frequency of sleeping together was negatively related to the wives' arousal frequency on laboratory nights.

Conclusion: Although CPAP controls a husband's sleep-related OSA symptoms, his treatment adherence is strongly related to his wife sharing the bed. Addressing the wife's sensitivity to arousals when bed sharing may improve the husband's treatment adherence.

Keywords: OSA, CPAP adherence, SAQLI; partner, sleep

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Perhaps the most common reason for referral to a sleep center is to rule out suspected obstructive sleep apnea (OSA) in a middle-aged man. This is typically triggered by a complaint of his bedpartner, whose own sleep is disturbed by the movement arousals, snoring, and respiratory gasping of the husband. Often the partner attempts to control these by changing the patient's sleep position or by removing herself or him, to sleep separately.

That this is a common problem is documented in a recent "Sleep in America"[1] telephone poll of more than 1000 adults. Sixty-seven percent of the sample who were married or live with someone reported that their bedpartner snores, and more than half of those who snore say this disturbs the sleep of others. Thirty-one percent who live with someone respond that, because of a sleep problem they, or their partner, sleep in a separate bedroom or use earplugs.

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Recent research has begun to investigate OSA as a shared problem affecting both marital partners with disturbed sleep at night, excessive sleepiness during the day, reduced quality of life, and strained marital relationships.[2-4] Pankhurst and Horne[5] studied the effect one partner's movements has on the sleep of the other among couples without sleep disorders. They found that men have more movements than women and that women report that their sleep is affected by their partners sleep more than did men. In addition, men are also more often loud snorers,[6] and the sound of snoring is a major disturber of the sleep of a bedpartner. In a questionnaire study of 1032 women,[7] those who slept with a heavy snorer reported symptoms of insomnia, morning headache, daytime sleepiness, and fatigue at a higher rate than did women who slept with non-snorers. Given these findings, it was predicted that the wives of men with OSA would be motivated to encourage their partner's adherence to treatment regimens that control snoring and excessive movements.

Nasal continuous positive airway pressure (CPAP) is currently the most effective and most commonly prescribed treatment for breathing disorders of sleep associated with frequent arousals and loud snoring. However, acceptance and long-term adherence to this treatment, for enough hours of the night to be effective, has been a problem.[8] Many attempts to improve adherence have had minimal success.[9-11] One approach that has not received much attention but has proved helpful in other medical problems is a couple-focused intervention.[12]

At this time, there is only one published study[13] in which married couples were recorded simultaneously in the laboratory during the husband's diagnostic test for OSA in a split-night protocol. Because this was a 1-night study, the data analysis involved a comparison of the untreated first half night and the CPAP treated second half. The main findings were that the wives' sleep efficiency increased from 74% to 87% and their Arousal Index dropped from 21 to 12 when the husband's OSA was controlled with CPAP. There was no follow-up of home use or whether the couple continued to sleep together.

The present study tested the sleep of married partners when sharing a queen-size bed in the laboratory before treatment was initiated and again while the husband's sleep-disordered breathing was controlled by CPAP. It was predicted that, before treatment, there would be significant differences in the sleep of the partners and that these would no longer be present following the initiation of CPAP. It was further predicted that daytime sleepiness and quality of life of both partners in relation to his sleep disorder would also improve. It was predicted that once his OSA was treated, shared sleeping would be better tolerated and have a positive effect on the husbands' adherence to this treatment.

METHODS

Subjects

Subjects were selected sequentially from those referred to an outpatient sleep disorder service to rule out OSA. Because this was a small pilot study, the sample was restricted to men because OSA is most common in middle-aged men.[14] Those married men, currently living with their wife, who met OSA criteria (apnea-hypopnea index > 10) on their standard diagnostic split-night polysomnogram and controlled on CPAP that night were contacted to determine if they met the further inclusion criteria for the study. These criteria included their acceptance of CPAP as their treatment, willingness of both partners to return for 2 additional nights of monitored sleep, separated by 2 weeks, and their ability to read and write English. Exclusion criteria included failure on previous CPAP trials, presence of an additional sleep disorder, use of medications such as antidepressants that would affect normal sleep architecture, excessive use of caffeine (more than six 8-ounce cups of coffee or caffeinated sodas per day), and more than 2 drinks of alcohol per night or use of street drugs. Also excluded were those patients with severe lung disease, congestive heart failure, or a neuromuscular disease. A diagnosis of hypertension did not exclude participation if blood pressure was controlled on medication. Regular bed sharing varied. Six couples reported that they slept together regularly and 4 did not. The principal investigator met each couple to explain the protocol. Ten couples accepted and both members signed informed consent forms approved by the Institutional Review Board of this institution. The wives were interviewed to rule out indications of OSA or other sleep disorder. Three couples who met criteria could not participate due to having young children at home. No couple needed to be dropped following the baseline Night 1 for insufficient sleep or the presence of an unanticipated sleep disorder. None of the wives met OSA criteria, although some did snore. One couple was lost to follow-up when they moved out of state. The characteristics of the sample are described in Table 1. They are in general representative of the men with OSA who are seen on this service. The CPAP ma-

Table 1—Description of the 20 People Comprising the Sample

Demographic	Husband	Wife
Age, y	47.4 ± 9.7	42.2 ± 10.7
BMI, kg/m2	38.4 ± 8.2	29.6 ± 4.1
Education, y	15.4 ± 2.9	15.4 ± 3.5
Ethnicity, no. of couples		
Caucasian	8	
Hispanic	1	
African American	1	
Co-sleeping frequency, no.		
Always	6	
Sometimes or Never	4	

Data are expressed as mean ± SD or number.

Table 2—One-Way Analysis of Variance Between Husband's and Wife's Sleep Variables and Test Scores

	Night 1 Baseline				Night 2 Treatment			
	Husband	Wife	F	p	Husband	Wife	F	p
AHI, no./h	46.63 (27.32)	1.89 (3.34)	26.40	0.00	1.87 (1.54)	1.41 (2.23)	2.86	NS
AI	39.52 (26.89)	12.57 (9.28)	8.98	0.00	10.46 (5.46)	14.28 (13.52)	0.69	NS
SI	350.53 (227.15)	8.66 (14.79)	15.11	0.00	42.89 (91.73)	12.52 (17.73)	1.05	NS
SE	81.00 (11.84)	81.81 (10.64)	0.26	NS	85.95 (10.12)	85.90 (8.64)	0.00	NS
Sleep stage, % of TST								
SWS	5.43 (3.24)	12.47 (5.81))	9.91	0.00	7.85 (6.06)	13.44 (5.45)	4.69	0.04
REM	15.48 (6.19)	21.63 (5.06)	5.91	0.03	20.54 (7.05)	19.81 (7.83)	0.05	NS
Min SaO_2, %	72.20 (17.55)	92.20 (4.49)	12.18	0.00	91.40 (4.03)	93.30 (3.80)	1.17	NS
ESS score	15.20 (4.77)	8.10 (3.85)	13.40	0.00	5.60 (3.81)	6.30 (2.94)	0.21	NS
SAQLI	3.82 (0.89)	4.27 (0.65)	1.48	NS	5.50 (0.58)	4.61 (0.90)	8.20	0.01

Data are expressed as mean (SD), with df 1,11. Night 1 is without treatment and Night 2 is with the husband on continuous positive airway pressure. AHI refers to Apnea-Hypopnea Index, the number of apneas + hypopneas per hour of sleep; AI, Arousal Index, the number of arousals per hour of sleep (arousals were visually scored if the electroencephalogram frequency increased abruptly > 16 Hz for at least 3 seconds following at least 10 seconds of continuous sleep); SI, Snoring Index, the number of snores per hour of sleep (snores were visually scored from the snoring channel as bursts of increased tone verified by the auditory recording); SE, sleep efficiency; TST, total sleep time; SWS, slow-wave sleep, Stage 3+4; REM, rapid eye movement sleep; Min SaO_2, lowest level of oxygen saturation; ESS, Epworth Sleepiness Scale score; SAQLI, Sleep Apnea Quality of Life score.

Table 3—Correlations between Shared Sleep, CPAP Adherence, and Other Variables

	CPAP %	CPAP mean/h	CPAP > 4 h	Husband's age	Husband's AHI Night 1	Wife's AI Night 1	Wife's AI Night 2	Wife's SAQLI Night 2
1 Shared sleep nights	0.651*	0.747*	0.751[a]	0.373	-0.031	-0.624[a]	-0.682*	0.405
2 CPAP %	X	0.539	0.798[b]	0.667*	-0.211	-0.458	-0.505	0.788[a]
3 CPAP mean, h		X	0.899[b]	0.554	-0.220	-0.662*	-0.581	0.590
4 CPAP > 4 h			X	0.603[a]	-0.306	0.670[a]	-0.672[a]	0.795[b]
5 Husband's age				X	0.008	-0.282	-0.250	0.717[a]
6 Husband's AHI Night 1					X	0.662[a]	0.662[a]	-0.493
7 Wife's AI Night 1						X	0.938[b]	-0.572
8 Wife's AI Night 2							X	-0.730[a]
9 Wife's SAQL1 Night 2								X

[a]p value < 0.05
[b]p value < 0.01
CPAP% refers to the percentage of nights continuous positive airway pressure (CPAP) was used; CPAP mean h, average number of hours CPAP was used on the nights used; CPAP > 4 h, percentage of nights CPAP used for 4 or more hours; AHI, apnea-hypopnea index; AI, Arousal Index; SAQLI, Sleep Apnea Quality of Life score.

chine was delivered to the home following Night 1. The equipment had the capacity to record use on a nightly basis on a removable card. The husband and wife were each given a 2-week log on which to report where they slept the previous night and whether CPAP was worn. (See Appendix A and B.) Both patient and wife completed Epworth Sleepiness Scales[15] and Sleep Apnea Quality of Life interviews [16] administered by the research assistant before each lab night. The sleep studies were standard, attended, 12-channel polysomnography studies for OSA lasting 420 minutes using Sandman equipment (Nellcor Puritan Bennett, Pleasanton, CA). The sleep stages and respiratory events were scored by the head technician, a registered polysomnography technologist of many years experience. Each record was reviewed and signed off by the principal investigator, who is board certified in sleep medicine. The research assistant and the principal investigator were blinded for names and dates of the participants and the studies, which were presented in random order intermixed with those of current clinical patients to avoid scoring bias. The other tests were scored by the research assistant and reviewed for accuracy by the principal investigator before being entered into the computer. Adherence to treatment was measured by a download of the card in the CPAP machine at an average of 4.6 months.

All numerical data were analyzed using SPSS 12. program (SPSS Inc, Chicago, IL) for differences between groups Night 1 and Night 2 on sleep variables and test scores by 1-way analyses of variance with the significance level set at $p < 0.05$. Table 2 reports these data. The relationship of the number of nights of shared sleep with follow-up adherence, as recorded on the CPAP machine, was tested by Pearson correlations. (See Table 3.) Lastly, the correlation matrix was examined to note other variables related to the amount of shared sleeping and to CPAP adherence that might be explored in a study that included a larger number of subjects.

RESULTS

On Night 1, 6 of 7 variables were significantly different between the groups. Only sleep efficiency failed to differ between the husbands and wives. On Night 2, only the percentage of slow-wave sleep was significantly different between the groups, with the husbands' percentage of slow-wave sleep lower than that of the wives, a normal finding in this age group. The Epworth Sleepiness Scale scores were significantly different between groups before treatment and no longer different once the husband's OSA was treated. The Sleep Apnea Quality of Life had an opposite pattern of results. Both husband and wife had low scores at baseline, indicating their poor adjustment to the disorder. Following 2 weeks of CPAP, his score on the Sleep Apnea Quality of Life improved and was then significantly higher than the wife's score, indicating that he was now better adjusted to his diagnosis and treatment than she was.

The home logs kept by each partner showed that the husband was not always aware when his wife left to sleep elsewhere for part of the night. For this reason, the number of nights of shared sleep was based on the wife's logs. The correlations between the number of shared nights during the first 2 weeks on CPAP and his continued use of this equipment are significant (Table 3).

In addition, the 2 outcome variables—number of nights of shared sleep and the husband's adherence to CPAP treatment—were unrelated to the severity of his apnea-hypopnea index, his rate of snoring per hour of sleep, or his number of arousals per hour of sleep. Bed-sharing frequency was negatively correlated to the wives' Arousal Index on both lab nights. This suggests that wives who have disrupted sleep when sharing the bed in the laboratory are less likely to share the bed at home, whether or not her husband's sleep-disordered breathing is under control. Several unpredicted correlations of interest were noted between CPAP-adherence measures and the husbands' age ($r = .67$), his Epworth Sleepiness Scale score on Night 2 ($r = .72$), and his wife's Night 2 Sleep Apnea Quality of Life score ($r = .78$). Again, these results suggest that older men are more tolerant of this equipment, as are those who are still experiencing some daytime sleepiness after 2 weeks on CPAP and whose wives are more accepting of the husband's condition and treatment.

Due to the small number of cases, stratifying the sample by their history of shared sleep prior to the study, to examine the relationship with later treatment adherence, was explored informally. Four of the 10 couples stated that they did not share the bed for sleeping (3 answered "not at all" and one "only rarely"). The other 6 reported that they slept together nightly. This history was strongly supported by the data from the current report

on their daily 2-week logs. Logs of the 4 who, by history, were not sleeping together averaged only 6 of the 14 nights (43%) together, whereas the logs of the 6 regular sharers averaged twice as many: 12 of the 14 (86%) nights were shared. This history also affected the husbands' adherence. The downloads from their machines showed that the husbands who slept separately used their CPAP machine 4 or more hours per night on only 43% of the nights recorded, whereas the regular bed sharers met this target on 74% of the nights. Further, the sleep of the non-sharing wives was negatively impacted by their partners' CPAP use in the laboratory. Their Night 1 Arousal Index, of 16.5 increased to 21.0 per hour on Night 2, whereas the wives who regularly shared the bed had fewer arousals (Night 1 Arousal Index = 10.0) and had no change (Night 2 Arousal Index = 9.9).

DISCUSSION

The results of this small study are important to the extent that the predicted finding can be replicated: that is, that treatment adherence to CPAP in married men is strongly related to the frequency with which his partner sleeps with him during his initial home treatment. The finding that the wife plays a big part in the husband's adherence to CPAP treatment not only needs replication, but also further understanding of what leads some wives to separate for sleep and not return to share the bed when the husband's sleep-disordered breathing is brought under control. It is possible that some wives who choose to sleep separately are light sleepers or have learned a conditioned response to arouse more often when sleeping with their partner, a response that developed while the husband was symptomatic. This may take time to extinguish. The fact that some wives do not change their quality-of-life scores when their husband's sleep disorder is controlled, and may even have more arousals when he is on CPAP, suggests that 2 weeks is too short a time for the wives to adapt to their husbands' improved condition.

Future studies should include more subjects and a longer follow-up period to investigate whether directly engaging the wife as an aid in the husband's CPAP treatment, and encouraging her to stay in the shared bed, will benefit both partners. Her continued exposure to the husband's quiet sleep and regular respiration is predicted to have a positive effect on the wife's ability to sleep well with him and so support his continued treatment.

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Appendix A—Sleep Log

Patient #_____

Example	Date	Check CPAP		N. of Hours On	Bedtime (lights out)	N. of Wake ups	Morning Wake Up Time	Quality of Sleep			Wife in Bed		
	9/20/05	On/Off		4	10:30 PM	2	7:30 AM	Good	Fair	Poor	All Night	Partly	Not in Same Bed
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													
13													
14													

Appendix B—Sleep Log

Wife of Patient #_____

	Date	He wore CPAP		N. of Hours CPAP On	Your Bed-time	N. of Awak-en-ings	Morn-ing Wake Up	Check Quality of Your Sleep			Did He Snore?			Did You Stay Sleeping Together?		
		Yes	No					Good	Fair	Poor	A Lot	Some	None	All Night	Partly	No
1																
2																
3																
4																
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