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Motivational Enhancement to Improve Adherence to Positive Airway Pressure in Patients with Obstructive Sleep Apnea: A Randomized Controlled Trial

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Background: Obstructive sleep apnea (OSA) is associated with a variety of medical conditions. Positive airway pressure (PAP) is an effective treatment for improving sleep, yet adherence rates are low. The aim of the current study is to test two treatments versus standard care in improving adherence to PAP.

Method: Two hundred twenty-seven patients with OSA were randomized to standard care (SC), education (ED) and motivational enhancement therapy (MET). Adherence was measured objectively and the first week of adherence (prior to the intervention) was used as an *a priori* moderator of the effect of the various interventions. Mediators of treatment response were also examined using theory-based measures of decisional balance and self-efficacy.

Results: Adherence declined over time for all three groups. There was a significant interaction between level of adherence during the first week of treatment and treatment group. Those who had moderate levels of adherence during their first week of PAP were more likely to adhere to treatment at follow-up if they had MET; those who had high levels of adherence during their first week of PAP were more likely to adhere to treatment at follow-up if they had ED. MET treatment increased the perception of the positive aspects of PAP, but ED did not.

Conclusions: Initial adherence to positive airway pressure could help guide subsequent treatment plans. The results also support social cognitive theory in that educational approaches might be best suited for those who are ready for change whereas more motivational approaches might be best for those who are ambivalent about change.

Keywords: OSA, behavioral sleep medicine, psychology, adherence

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INTRODUCTION

Obstructive sleep apnea (OSA) is estimated to affect 2% of women and 4% of men in the middle-aged work force in the United States,[1] with higher prevalence rates among the elderly and African Americans.[2,3] Untreated OSA is associated with impaired cognition and mood, hypertension and vascular disease, and increased motor vehicle accident risk.[4-8] Despite the availability of effective and minimally invasive treatments, OSA continues to be an underrecognized health condition.[9]

Positive airway pressure (PAP) is considered the standard of care for moderate to severe OSA.[10] Several randomized controlled trials demonstrate that PAP improves nighttime respiratory disturbances, common daytime sequelae (e.g., sleepiness, cognitive functioning, mood) and medical morbidities associated with OSA[11,12]; however, treatment benefits may depend on the amount of nightly PAP use.[13-15] Many studies suggest that only a minority of patients use PAP as recommended,[16] and as many as 25% abandon PAP within the first year.[17] Patterns of PAP use develop as early as the first week of treatment.[18,19] Recently, the Center for Medicare and Medicaid Services (CMS) stipulated that continued coverage for PAP beyond the first 3 mo of therapy is contingent upon documentation of "clinical benefit by…improvement of the beneficiary's symptoms and objective evidence of adherence" (NCD for Continuous Positive Airway Pressure Therapy for Obstructive Sleep Apnea (240.4)). Thus, the available scientific evidence and current health insurance guidelines emphasize the need for interventions to improve PAP adherence.

Baseline daytime sleepiness, disease severity, and PAP pressure predict PAP adherence.[16,17,20] Improved sleep during the titration night and improved daytime symptoms predict early adherence to PAP.[20,21] Side effects, such as mask discomfort, mouth dryness, skin irritation, and air leaks, are common early in treatment, but interventions targeting these symptoms do not reliably produce improvements in adherence or OSA-related symptoms.[22-25] Recent work suggests that environmental factors, such as quality of partner support and involvement, are also linked to adherence.[26,27] The most robust predictors of adherence to PAP treatment stem from psychological theories of health behavior change. Constructs such as decisional balance (e.g., the relative weight of the 'pros' vs. the 'cons' of change) and self-efficacy, from the Transtheoretical Model (TTM)[28] and Social Cognitive Theory (SCT),[29] respectively, have been found to be strongly associated with objective PAP adherence early in treatment[30,31] and after 1 and 6 months of use.[31-33] These studies suggest that targeting these psychological constructs within a theoretical framework may be critical to improving PAP adherence.

Recent efforts have focused on applying theory-driven psychological interventions to the problem of PAP adherence. One study, for example, found that a group intervention that used a cognitive behavioral approach improved PAP use by

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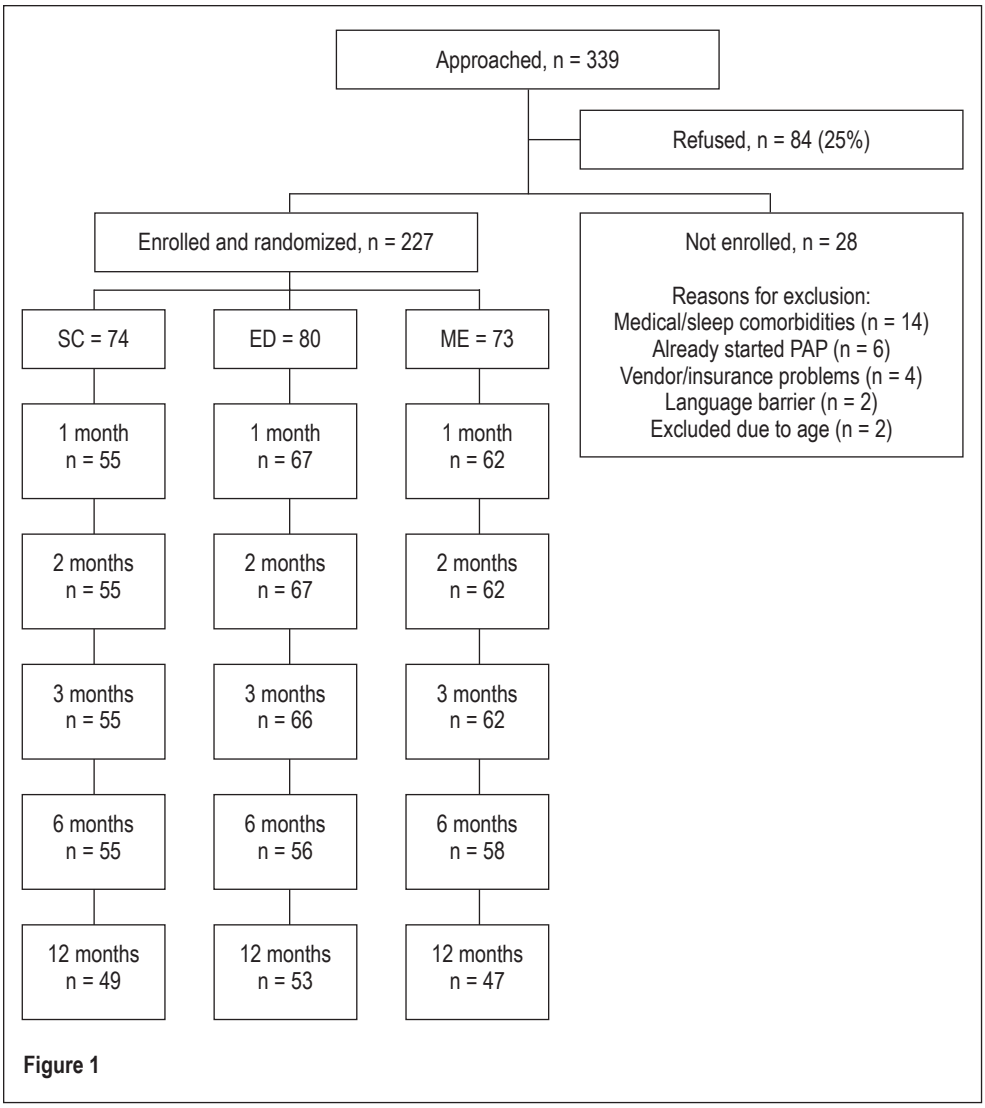

Figure 1

2.9 h compared to standard care. The Cognitive Behavioral Treatment (CBT) group also demonstrated higher scores of both self-efficacy and social support, but not on outcomes expectancies.[34] However, the intervention involved multiple cognitive and behavioral components, such as role modeling, relaxation, educational videos, and group CBT, thus the active ingredients of the intervention are unclear. Our research group developed a Motivational Enhancement Therapy (MET)[35,36] based on motivational interviewing (MI) for PAP adherence. MET is like MI but the intervention is briefer, delivered in a medical setting, and relies heavily on the provision of feedback. MET is a patient-centered intervention that helps patients to activate their own motivation to change by targeting key constructs of behavior change: readiness to change, perceived importance of changing versus not changing (decisional balance), and confidence in one's ability to change (self-efficacy).[36] MET has been used in other settings to modify maladaptive behaviors such as excessive alcohol use[37] and smoking[38,39] to promote positive health behaviors such as regular exercise.[40] Initial pilot studies in adults with OSA found that brief MET delivered in an individual format improved 12-week adherence compared to attention control groups.[41]

The current randomized controlled trial compared PAP adherence in a large sample of newly diagnosed PAP-naïve patients with OSA assigned to one of three interventions: MET (a tailored intervention providing personalized feedback using patient-centered counseling), education (ED; an information control providing didactic information about OSA and the benefits of PAP similar to ED provided at the best sleep disorders centers), or standard care (SC; a complete medical care model allowing continued interaction with physicians and other healthcare professionals, but not including additional individual counseling time). Our primary outcome was daily PAP adherence over the course of 1 y after treatment initiation. We also examined whether PAP use by group was related to changes in TTM and SCT constructs (decisional balance and self-efficacy). We hypothesized that: (1) MET participants would demonstrate higher nightly use of PAP compared to ED and SC participants and (2) MET participants would demonstrate greater improvements in hypothesized mediators of PAP use over time. A secondary aim of the study was to explore whether efficacy of the interventions was moderated by PAP use during the first week of treatment (baseline), given previous research that indicated that early use of PAP predicts greater longer-term adherence.[18,19] We hypothesized that MET would be most effective for those with intermittent use in the first week, as this would reflect high levels of ambivalence.

METHODS

Participants

Three hundred thirty-nine participants between the ages of 25 and 85 y with OSA were approached for the study, and 227 participants (67%) were recruited and randomized. All participants were recruited from the Sleep Disorders Center of Lifespan Hospitals (a Brown University affiliated hospital in Providence, RI). Inclusion criteria included diagnosis of moderate to severe OSA by full in-laboratory overnight polysomnography (apnea-hypopnea index > 15) and naïve to PAP therapy. Exclusion criteria included diagnosis by split-night polysomnography, evidence of a severe neurological condition or unstable psychiatric illness, a sleep disorder other than OSA (including primary central sleep apnea), congestive heart failure, and end-stage renal disease. Of those approached for involvement in the study, 84 participants (25%) refused to take part and 28 participants (8%) did not meet the study criteria (see Figure 1 for details).

All participants provided informed consent prior to participating in the study. Both the Rhode Island Hospital and the Brown University Institutional Review Boards approved the study. Participants were paid $15 for attending each follow-up assessment session (3, 6, and 12 mo) for a total of $45.

Procedures

Participants were enrolled in the study after their PAP titration night but before initiating PAP treatment. Participants were urn randomized[42] in a 1:1:1 ratio into one of three groups (MET, ED, or SC) balancing for age, sex, education, apnea severity, and Epworth Sleepiness Scale score. Individuals in the MET and ED groups each received two, 45-min, face-to-face individual counseling sessions by a trained nurse 1 week (7 ± 2 days) and 2 weeks (14 ± 2 days) after initiating PAP treatment. Intervention sessions were delivered after 1 week of PAP use to draw upon this experience in the MET counseling sessions. One additional booster phone call was made to each participant in the MET and ED groups at week 3 of PAP use. Participants' objective adherence to PAP was measured continuously over the course of the study. All participants were referred to the same home healthcare company for PAP set-up and clinical management. Physicians and other healthcare providers were blinded to whether or not their patients were enrolled in this study.

Interventions

The MET counseling is described in detail elsewhere.[43] Briefly, our manualized MET intervention was based on previous work by a coauthor (BB) and focused on helping patients resolve their ambivalence regarding consistent use of PAP. The nurse counselor strived to maintain an atmosphere of collaboration and partnership, rather than education. The counseling sessions were tailored to the individual's readiness to change; less directive approaches were used for those who were ambivalent about using PAP (e.g., asking permission from the patient to discuss aspects of their life that were important to them and how they might be related to sleep), whereas direct problem solving was used for those who were more ready to use and maintain use of the device. Key components of the intervention included: (1) assessing readiness and confidence to change, each on a scale of 1 to 10, and exploring the reasons for choosing that value; (2) discussing what the patient already knows about the effects of sleep apnea and PAP on health, eliciting permission to provide feedback about such health effects, providing the information, and eliciting the patient's interpretation of the information ("elicit-provide-elicit" process); (3) perceived benefits of PAP in order to enhance outcome expectations; (4) goal setting, consistent with both MI style and with social cognitive theory (setting specific, attainable, and realistic goals for use, if motivated); (5) identification of rewards for hard work on adherence to PAP; and (6) discussion of important values and goals and the ways in which PAP adherence facilitates and hinders these goals.

ED participants were provided with education developed by two of the authors (MA, TA) regarding the pathophysiology of apnea, its medical and behavioral consequences, and the benefits of treatment. Charts and diagrams were used as educational tools. The sessions and material presented were standardized and in no way tailored to the participants' readiness to change. This comparison intervention was designed to represent the education patients might receive in many sleep disorders centers, and served as a contact control condition. MET and ED were matched on contact time.

SC was provided to all participants, regardless of randomization, but those randomized to SC received only SC. SC consisted of standard clinical care that is provided within our accredited, academic Sleep Disorders Center. SC involved the physician discussing the benefits of treatment prior to and after diagnosis to prepare for PAP treatment. Participants completed a "morning after" questionnaire about their experience with PAP therapy after their titration night with PAP. Participants maintained regular follow-up visits with their physicians, usually 8 to 10 weeks after PAP initiation. All participants were able to contact their physicians and/or the home healthcare provider at any time without restriction.

Counselor Training and Treatment Fidelity

A registered nurse with 30 y of nursing experience and 20 y of experience with sleep apnea was trained to deliver both interventions. The MET and ED training were each 1.5 days. The MET training was conducted by one of the authors (BB), who is a member of the Motivational Interviewers Network of Trainers. The nurse counselor reached training criterion after successful role-plays with staff and successful completion of four pilot patients ("successful completion" was defined as adherence to MI process and to the treatment protocol as it was conceived). All patient counseling sessions were audio-taped, and the nurse counselor followed one treatment manual for the ED condition and one for the MET condition. Skills drift was prevented by weekly supervision with the initial trainer (BB), in which MET sessions were listened to and the nurse counselor was given feedback on adherence to MI principles and to the intervention protocol. ED training was conducted by two authors (MA and TA). Skill drift in ED was prevented by regular meetings with the nurse-clinician and review of cases. Though both interventions were delivered by the same counselor, several precautions were taken to reduce the possibility of contamination: (1) the ED treatment was very didactic, using charts and graphs; (2) both interventions were delivered with a treatment manual; and (3) all ED and MET sessions were audiotaped and 20% of tapes were randomly selected on an ongoing basis to assess for treatment contamination.

Dependent Measures

Adherence measurements were taken daily throughout the course of the study and downloaded at the follow-up assessments of 3, 6, and 12 mo. Measurements from 1, 2, 3, 6, and 12 mo were used in the analyses. All other dependent measures were taken at baseline, 3, 6, and 12 mo.

Adherence

The primary outcome was average nightly use of PAP, at the proper prescribed pressure. PAP devices were equipped with objective monitors using the Smart Card™ technology provided with the Respironics REMstar® Pro and C-Flex™ machines (Murrysville, PA) so that use could be measured objectively. Consistent with previous studies,[44-46] PAP

Table 1—Demographics for treatment groups (for randomized subjects)

Variable	SC	ED	MET	P value for group comparison[b]
Sample size[a]	74	80	73	
Sex, number (%) male	57 (77)	48 (60)	45 (62)	0.05
Age, y	52.4 (11.8)	47.0 (11.4)	51.7 (10.0)	0.005
Education	14.9 (2.8)	14.5 (3.1)	15.1 (3.8)	0.49
AHI	48.2 (26.2)	46.1 (23.2)	45.7 (23.8)	0.80
ESS	11.9 (5.1)	12.6 (4.9)	11.6 (5.2)	0.45
BMI, kg/m^2	35.8 (8.4)	35.0 (7.3)	35.1 (7.3)	0.76
Verbal IQ	113.6 (9.5)	112.9 (9.1)	114.2 (9.9)	0.69
RXPRESS, cm H_2O	10.6 (2.7)	11.0 (2.9)	10.8 (2.7)	0.62
PERSA90	27.1 (28.5)	25.8 (28.5)	24.0 (26.2)	0.80

Entries are mean (standard deviation) unless otherwise noted. [a]These are baseline sample sizes; sample sizes at other time points are given in Table 2. [b]Chi-square test used for sex, analysis of variance for all others. AHI, apnea-hypopnea index; BMI, body mass index; SC, standard care; ED, education; ESS, Epworth Sleepiness Scale; MET, motivational enhancement therapy; PERSA90, percent time spent below 90% oxygen during the diagnostic sleep study.

adherence was measured covertly. Participants were informed that the PAP machine would be accessed periodically to determine how the device was working at night. Research staff, who downloaded adherence data at the follow-up sessions, were blinded to group membership. Adherence was measured nightly during the course of the year-long study. Participant average adherence from the beginning of the experiment up to 1, 2, 3, 6 and 12 mo were used in analyses, i.e., cumulative mean responses were used.

Decisional Balance

The decisional balance measure was modeled after measures designed for assessing decision-making processes in smoking cessation[47] and in exercise.[48,49] It consists of both pro items, which assess the benefits of engaging in a particular behavior, and con items, which assess the costs to the patient of engaging in PAP adherence. A five-point Likert scale was used to rate each item, with 1 being "not important at all" and 5 being "extremely important." An index is calculated by subtracting the sum of the con scale from the sum of the pro scale. Internal consistencies were 0.70 for the pro items and 0.43 for the con items.[46] Measurements were taken concurrent with the 3-, 6-, and 12-mo PAP adherence measurements.

Self-Efficacy

The self-efficacy scale was constructed using statements[50] to assess the extent to which patients believed that they could do the required tasks. For example, "I am confident I can (perform something), even if (barrier)." Support for wording the items that includes the phrase "even if (barrier)" comes from research on smoking cessation, which has found that self-efficacy perceptions of not smoking in smoking conducive environments is a strong predictor of smoking cessation.[51] Internal consistency for the PAP self-efficacy scale was 0.87.[46] Measurements were taken concurrent with the 3-, 6-, and 12-mo PAP adherence measurements.

Statistical Methods

Data analyses were conducted with SAS statistical software, version 9.1 (SAS Institute, Cary, NC). The primary study aim was addressed with a linear mixed-model fit for the dependent variable of adherence to PAP, as a function of intervention group (MET, ED, SC), time (1, 2, 3, 6, and 12 mo), and the interaction between group and time (group*time). A spatial exponential covariance structure was used to fit unequally repeated measures over time. Random intercept and time terms were also included in the model for participants. To address our secondary aim of whether the first week of PAP (the time before the behavioral interventions were delivered) moderated effects of group on adherence, we used another linear mixed model, but included interactions of average nightly use at week 1 with each of the group, time, and group*time terms. Highly nonsignificant terms ($P > 0.3$) were dropped from the final model to simplify the model and improve the precision of the estimators. For both of the models described previously, specific contrasts of interest were made only when related main or interaction effects were significant. Similar procedures were used for self-efficacy and decisional balance measures as outcome variables in place of adherence, with two exceptions: there were slight differences in model selection procedures, as noted in the Results section, and the transformation $y' = ln(c - y)$ was applied to the outcome variables because they had left-skewed distributions, where c is a suitable upper bound of the data and ln is the natural log. Statistics were inverted back to the original scale for presentation.

RESULTS

Demographics and Sample Sizes

A total of 227 participants were enrolled and randomized to one of the three treatment groups (SC, MET, ED) and 184 of these participants (81%) had outcome data at the 1-mo time point (44 participants dropped out prior to 1 mo). Overall, the study achieved 66% retention from randomization to 12 mo, with 81% being retained from the end of the counseling (1 mo) through 12 mo. Table 1 shows the demographic information for all randomized participants. We compared dropouts and completers on each demographic and severity variable and found no differences between the groups. In addition, there were no significant differences in dropout rate among groups.

The three treatment groups were significantly different in age ($P = 0.005$), with the ED group being the youngest, and in sex composition ($P = 0.05$), with marginally more men in SC. Consequently, age was entered into all models as a covariate. Sex was not significant in any outcome model, nor did it improve the goodness-of-fit statistics, so it was not included as a covariate in the models.

Intervention Effects on PAP Adherence

Sample mean PAP adherence estimates and sample sizes by time are presented in Table 2. The linear trends over time among groups were not significantly different ($P = 0.71$ for the

group*time interaction). Averaging across groups, the mean decrease in average adherence per mo was 0.052 h, translated for noncumulative data (P = 0.05).

Table 2—Sample statistics for study outcomes, by group and time

Group	Outcome	Baseline	1 mo	2 mo	3 mo	6 mo	12 mo
SC	Adherence		3.82 (2.27) n = 54	3.68 (2.37) n = 55	3.65 (2.36) n = 55	3.65 (2.46) n = 55	3.73 (2.50) n = 49
	Decisional balance	47.11 (6.02) n = 61			45.51 (7.67) n = 51	45.51 (7.90) n = 47	45.08 (10.55) n = 48
	Self-efficacy	20.96 (2.88) n = 72			20.61 (4.49) n = 51	21.00 (5.06) n = 47	19.83 (6.29) n = 48
ED	Adherence		4.43 (2.51) n = 67	4.48 (2.48) n = 67	4.48 (2.50) n = 66	4.34 (2.41) n = 56	4.34 (2.45) n = 53
	Decisional balance	46.32 (5.70) n = 73			46.33 (7.69) n = 60	44.66 (9.14) n = 50	45.76 (8.38) n = 50
	Self-efficacy	21.11 (3.21) n = 79			21.05 (4.50) n = 60	21.04 (5.03) n = 50	20.98 (5.19) n = 50
MET	Adherence		4.26 (2.27) n = 62	4.37 (2.34) n = 62	4.34 (2.35) n = 62	4.14 (2.34) n = 58	3.86 (2.61) n = 47
	Decisional balance	45.28 (6.94) n = 67			46.13 (6.23) n = 60	45.91 (6.95) n = 56	46.61 (7.47) n = 44
	Self-efficacy	20.63 (3.26) n = 71			22.48 (3.08) n = 60	20.96 (4.23) n = 56	21.25 (4.84) n = 44

Values are given as mean (standard deviation). SC, standard care; ED, education; MET, motivational enhancement therapy.

Moderating Effects of Week 1 PAP Adherence

We stratified participants on adherence to PAP during the first week to examine whether initial use moderated intervention effects. Specifically, we categorized PAP use during the first week (W_1_use) into three levels, as described in previous studies[18,19]: low users (< 2 h/night); moderate users (≥ 2 but < 6 h/night), and high users (≥ 6 h/night). The group*time and group*time*W_1_use effects were not significant (P > 0.6) and dropped from further models. W_1_use, however, moderated the effects of group on adherence (P = 0.008 for Group*W_1_use interaction) as well as time effects (P = 0.0003 for Time*W_1_use).

Figure 2 demonstrates estimates by group and W_1_use at the 12-mo time point. Figure 2 shows that among moderate users in the first week, average adherence at 12 mo in the MET group was significantly higher (mean = 4.12 h/night, standard error (SE) = 0.42) than the average adherence in the other two groups (SC: mean = 2.46 h/night, SE = 0.40; ED: mean = 3.21 h/night, SE = 0.40; P = 0.002). The figure also illustrates that among high users in the first week, average adherence at 12 mo in the ED group was significantly higher (mean = 5.91 h/night, SE = 0.35) than the average adherence of the other two groups (SC: mean = 4.81 h/night, SE = 0.39; MET: mean = 4.81 h/night, SE = 0.35; P = 0.002). Similar patterns were observed at other time points. Low users appeared to derive no particular benefit from either the MET or the ED treatment over SC.

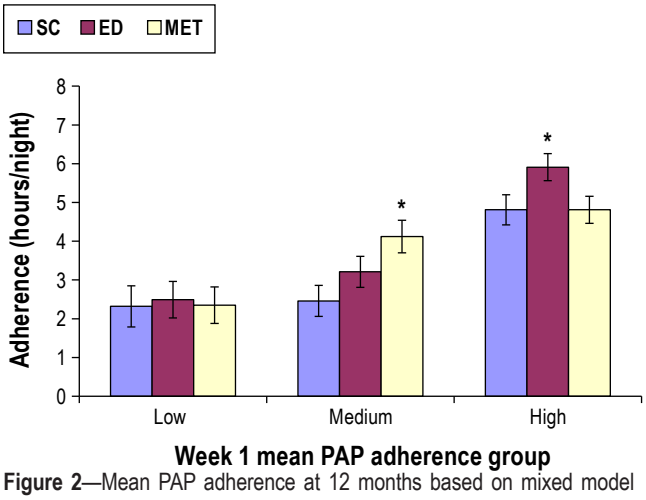

Figure 2—Mean PAP adherence at 12 months based on mixed model fit, by treatment group and week 1 adherence average (low: less than 2 h/night, medium: at least 2 but less than 6 h/night, high: at least 6 h/night). Error bars extend 1 SE above and below means. See methods for description of variables in the mixed model. *P < 0.01 for comparison of this group versus average of other groups within the week 1 user group. SC, standard care; ED, education; MET, motivational enhancement therapy.

Intervention Effects on Decisional Balance

Analyses for decisional balance yielded a similar pattern as those seen for adherence (Figure 3), although most results were not significant. There was one advantage for MET in the total score on the decisional balance scale. The moderate user group demonstrated a higher index score at 12 mo when compared to the average of other two groups for moderate users (P = 0.04). The group*time*W_1_use interaction was not significant (P = 0.9) and thus was dropped from the final model. Decisional balance results need to be interpreted with caution as the reliability of the cons subscale was low.

Intervention Effects on Self-Efficacy

At 12 mo, MET had the highest mean confidence score for moderate PAP users and ED had the highest mean confidence score for high users, but there were no significant group differences, group-by-time interactions, or interactions when week 1 use was entered into the model. The final model did not include terms for group*time or group*time*W_1_use because they were insignificant (P > 0.2).

DISCUSSION

The primary goal of this study was to determine the relative benefit of two brief, behavioral approaches, over and above

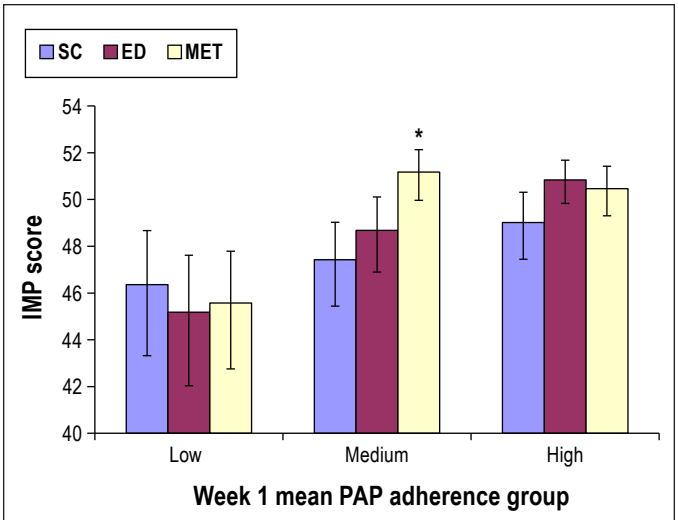

Figure 3—Mean decisional balance at 12 months based on mixed model fit, by treatment group and week 1 adherence average (low: less than 2 h/night, medium: at least 2 but less than 6 h/night, high: at least 6 h/night). Error bars extend 1 SE above and below means. (Endpoints for error bars were determined on the transformed scale then inverted back for presentation, yielding shorter upper bars than lower bars, reflecting the left skewed nature of the data.) *P < 0.05 for comparison of this group versus average of other groups within the week 1 user group. SC, standard care; ED, education; MET, motivational enhancement therapy; IMP, importance rating score on decisional balance assessment.

the provision of SC, on PAP adherence among a large sample of patients with OSA seeking treatment at a metropolitan sleep disorders center. This is the first study to apply a motivational counseling approach to the problem of adherence to PAP and to follow participants over the course of 1 y. We did not find significant effects of either MET or ED on adherence over time. All three groups of participants decreased PAP use over the course of the 1-y follow-up. Thus, our primary hypothesis was not supported.

We also hypothesized that, by the end of treatment, MET would be associated with patient perception of greater "pros" of change (versus cons) and higher self-efficacy and motivation to use PAP. Our study did not demonstrate change in self-efficacy over time or among groups, but we did demonstrate advantages for MET among the moderate users in improving the decisional balance associated with PAP treatment. Change on this construct is expected with efficacious MET counseling. It is important to note that the measurement of these psychological constructs can be influenced by experience. For these reasons, we should use these constructs with the understanding that experience with PAP therapy changes over time and that outcomes associated with them will be dependent, in part, on when the constructs are measured. Sawyer et al. has demonstrated this effect in a previous study.[31] Although some practitioners may be concerned that MET counseling can take time, in our study, MET counseling was delivered in only two face-to-face sessions and one brief phone call. This is clearly a relative cost-effective counseling strategy. It may be even more cost effective in practice if it is only applied to those with moderate initial use of PAP.

We also found that initial use of PAP within the first week of treatment moderated the effects of the two behavioral interventions. In moderator analyses each behavioral intervention demonstrated benefit for some of the participants, depending on their initial use of PAP prior to any behavioral intervention being delivered in the study. Moderate users of PAP (> 2 and < 6 h/night), who may have a mixed experience with their use in the first week of treatment, benefited most from the motivational intervention. This finding is consistent with the intention of MET, which is designed to address ambivalence among individuals who are trying to change their health-related behaviors. Alternatively, those PAP users who were good users in the first week of treatment (> 6 h/night) benefited most from the educational intervention. These individuals may be already convinced of the benefits of treatment and less ambivalent than the moderate users. Simple, directed educational approaches may work for these patients. Poor PAP users, who could also be seen as less ambivalent and also less invested in treatment, did not benefit from either behavioral intervention. These participants could have also required longer, more intense counseling sessions in order to better appreciate the risks of poor adherence.

Our results suggest that different approaches should be used contingent on PAP use patterns identified within the first week of treatment. For example, moderate use in the first week of treatment could be a sign of ambivalence. In this case, more intensive motivational counseling may be needed that focuses on helping the patient weigh the pros and cons of treatment and on building his/her self-efficacy and motivation for use. However, consistent users of PAP could be targeted with simpler, more cost effective educational approaches that can be delivered by individuals who would not need the specialized types of training involved in the MET counseling. Our ED intervention was time intensive compared to that provided in many clinical settings. It remains to be seen, however, whether or not less intensive ED interventions would yield similar results for the high user group. Additional studies could address these specific questions of moderation by targeting certain groups with specific interventions based, in part, on the results of this study. Although some believe that moderator analyses have significant limitations in the context of randomized controlled trials, others[52] argue that moderator analyses are critical to the guidance of future research and to clinicians who need to target treatments to individuals. Given arguments on both sides, we believe that our planned moderator analyses, if upheld by replication, could have important implications for how patients are approached in the clinical setting.

Ambivalent users of PAP are more likely to struggle with both the barriers and facilitators to treatment and, therefore, the motivational intervention may be a better fit for this group of patients. The motivational intervention uses a specific set of intervention skills to help patients resolve their ambivalence about using PAP. Patients are not confronted about their nonadherence. The counselor is trained to ask strategic questions that help patients reflect on their level of adherence and how that level is connected to important values and goals in their lives. Personalized feedback on health and health outcomes related to OSA are provided to patients in a collaborative, nonconfrontational manner so that patients can interpret the implications of their choice to use or not use them in a nondefensive manner. Counselors are instructed to "roll" with resistance to maximize the person's involvement in his/her own health behavior change.

Consistent users of PAP are less likely to need a discussion about the pros and cons of using PAP or their confidence that they can use PAP effectively and consistently. These individuals may be convinced that PAP is beneficial and that they are capable of adhering to this treatment. In our study, their use was more than 5 h per night. The average use in most studies is 4 h per night. These patients appear to benefit most from an intervention that highlights the consequences of OSA and the benefits of PAP treatment in a didactic format. The provision of simple information may be enough to reinforce current use patterns and to motivate additional PAP use. This intervention most closely mirrors the approach in sleep clinics and primary care offices when PAP adherence is a target. Many physicians could be led to believe that their educational approaches are working for most of their patients because well-adhering patients may be more likely to follow up with their physicians. The results of this study, however, suggest that these educational efforts might only be working for a subset of the patients seen for treatment of OSA. It is also possible that the age difference between this group and the other two groups could have contributed to their ability to retain the information provided by the didactic approach, making them better "learners" of the information and therefore better adherers as a response to the intervention.

Low users in our study (< 2 h/night in week 1) seemed not to respond to either MET or ED over traditional SC. This finding suggests that there may need to be a different approach for these individuals. This group of patients may not suffer from ambivalence about treatment, but rather, may believe that they do not need this treatment at all. There are many potential reasons for nonadherence in this group that the two interventions in this study did not address. For example, low users may have little social support for their behavior change, they may feel in poor control of their health, they may have an anxiety reaction to the treatment, or they may have low perceptions of the risks of untreated sleep apnea. Conversely, they may simply have needed more counseling time to benefit from either type of counseling, MET or ED. Among this low user group, any counseling could be perceived as confrontational, because their initial experience with treatment may have been negative. If this hypothesis were true, it would be important for there to be more follow-up and time to develop a rapport with the patient before delivering a behavioral intervention designed to improve adherence or provide more information on PAP treatment to increase the sense of importance. Involvement of partners and social support networks may be especially important for this group. One might also suspect that earlier intervention, either at the time of the sleep study or at least prior to the initiation of PAP, could result in improved adherence outcomes. More research is needed on the contributors to nonadherence among low users and on interventions targeting this population.

The current study is one of the first randomized clinical trials of a behavioral intervention to improve adherence to PAP among naïve PAP users. There are, however, limitations to this study. The interventions were initiated 1 week after initial use of PAP. Although this allowed us to examine initial use as a moderator of treatment effect, and demonstrated individual differences in treatment response, we might have also missed the most critical point in treatment, the first week. It remains possible that either of MET or ED may have demonstrated different efficacy if it were provided prior to the initiation of PAP. Another limitation is that the interventions were not delivered in response to poor adherence. Thus, we were not able to target the "teachable moment" when participants are most likely to respond to a behavioral intervention. Future studies should attempt to provide treatment to individuals at times when they are finding PAP particularly troublesome and may therefore be more receptive to interventions at that time. This study only provided one counseling contact after two face-to-face sessions. It is possible that a more comprehensive intervention, or higher dosing of either ED or MET, would result in greater changes to adherence over SC. In addition, such interventions may be too time-consuming to be practically integrated into a clinical sleep disorders center setting. Our attempts to deliver the treatment briefly, and by a trained nurse-clinician, were in keeping with the intention of developing interventions with clinical applicability in mind. Although we believe that additional counseling sessions may be needed, we would caution investigators in this area to keep in mind the intention of building an intervention that is transferable into the standard clinical care setting. We were also limited by using a single therapist to deliver both interventions. We took careful steps to ensure that the therapies maintained their integrity, but using a single nurse to deliver the therapies has the potential to limit the external validity of the study. However, our design limits nurse × treatment effects, which can only be avoided with a large sample of nurses, something that was not feasible in the current study. Finally, our *post hoc* analyses, although interesting, limit the sample size in the analyses and the findings from these analyses may not be reproducible. Larger samples within each subgroup may have revealed different effects due to increased power. Despite these limitations, we believe that this study serves as initial evidence that MET and ED counseling have their place in the care of these patients. MET seems to be best targeted to patients who meet minimal use requirements (2 h/night) but whose use is not consistent (less than 6 h/night) in the first week of treatment. ED, on the other hand, effectively bolsters use among already strong users of treatment. These relative benefits of each therapy fit well within the theoretical models upon which we built this study.

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