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Treatment of Chronic Insomnia with Yoga: A Preliminary Study with Sleep–Wake Diaries

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There is good evidence for cognitive and physiological arousal in chronic insomnia. Accordingly, clinical trial studies of insomnia treatments aimed at reducing arousal, including relaxation and meditation, have reported positive results. Yoga is a multicomponent practice that is also known to be effective in reducing arousal, although it has not been well evaluated as a treatment for insomnia. In this preliminary study, a simple daily yoga treatment was evaluated in a chronic insomnia population consisting of sleep-onset and/or sleep-maintenance insomnia and primary or secondary insomnia. Participants maintained sleep–wake diaries during a pretreatment 2-week baseline and a subsequent 8-week intervention, in which they practiced the treatment on their own following a single in-person training session with subsequent brief in-person and telephone follow-ups. Sleep efficiency (SE), total sleep time (TST), total wake time (TWT), sleep onset latency (SOL), wake time after sleep onset (WASO), number of awakenings, and sleep quality measures were derived from sleep–wake diary entries and were averaged in 2-week intervals. For 20 participants completing the protocol, statistically significant improvements were observed in SE, TST, TWT, SOL, and WASO at end-treatment as compared with pretreatment values.

KEY WORDS: sleep; relaxation; yoga; insomnia.

INTRODUCTION

A number of contributory factors have been implicated in chronic insomnia, including psychological conditioning, constitutional predisposing factors, dysfunctional beliefs and attitudes, and cognitive and physiological arousal (Morin et al., 1999). The observed elevated physiological arousal may be related to activation of the stress system in these patients (Vgontzas et al., 1998) and is the basis for a hyperarousal hypothesis of insomnia (Bonnet & Arand, 1997). It has been suggested that "insomnia is a disorder of inappropriate arousal," rather than a disorder of sleep, and that "treatment strategies should be directed toward normalizing the level of arousal" (Bonnet & Arand, 1995). In support of this hypothesis, cognitive and somatic relaxation techniques have been reported to be effective

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treatments (Bootzin & Rider, 1997; Morin et al., 1999; Morin, Culbert, & Schwartz, 1994; Murtagh & Greenwood, 1995).

Yoga is a comprehensive system whose aim is the achievement of physical, psychological, and spiritual health and well-being, and incorporates a wide variety of postural/exercise, breathing, and meditation techniques (Goyeche, 1979). Yoga has also been used as a therapeutic treatment ("yoga therapy"; Khalsa, 2004; Sharma & Singh, 1989) as it is believed that different techniques can produce unique psychophysiological effects and that this specificity can be used to target specific disorders. Basic research on yoga has suggested that it is effective in influencing psychophysiological, neuroendocrine, and autonomic parameters, and therefore, has mostly been used to treat disorders that have a strong psychosomatic or psychological component (Arpita, 1990; Funderburk, 1977; Goyeche, 1979; Khalsa, 2004; Murphy & Donovan, 1999; Sharma & Singh, 1989). Research on the efficacy of yoga has been reported on its component techniques independently, as well as on its practice as a comprehensive multicomponent discipline (Funderburk, 1977; Goyeche, 1979; Khalsa, 2004; Patel, 1993; Raub, 2002; Sharma & Singh, 1989).

Despite the current popularity of yoga (Saper, Eisenberg, Davis, Culpepper, & Phillips, 2004), there is little evidence of its clinical use in insomnia (Estivill-Sancho & Jaraba, 1991). A few peer-reviewed studies have reported on the effectiveness of meditation as an insomnia treatment either alone (Carr-Kaffashan & Woolfolk, 1979; Schoicket, Bertelson, & Lacks, 1988; Woolfolk, Carr-Kaffashan, & McNulty, 1976), or as part of a multicomponent treatment (Jacobs et al., 1993; Jacobs, Benson, & Friedman, 1993, 1996); one study has reported on the effectiveness of a breathing technique (Choliz, 1995). Only two uncontrolled studies have evaluated the effectiveness of a yoga treatment for insomnia. One of these revealed significant improvement in objective and subjective sleep measures but has been published only in abstract form (Koch, Volk, Heidenreich, & Pflug, 1998). The other brief report used an undefined insomnia population with a relatively coarse measure of nocturnal wakefulness (Joshi, 1992). As in many yoga-intervention studies, both studies required attendance at multiple practice sessions and involved significant input on the part of the investigators delivering the treatment.

The reported ability of yoga to reduce arousal suggests that it could be an effective insomnia treatment. This suggestion is reinforced if the contention that yoga techniques can be used as tailored treatments for specific disorders is true (Anand, 1991). The purpose of this preliminary pilot study was to evaluate the potential suitability and effectiveness of a simple set of yoga exercises requiring minimal training that can be practiced individually on a daily basis by patients with chronic insomnia.

METHODS

Participants Recruitment

Participants with a complaint of difficulty initiating sleep (sleep onset insomnia) and/or maintaining sleep (sleep maintenance insomnia, early morning awakenings) were recruited from referrals by physicians and sleep specialists, and institution-wide e-mail advertisements. The insomnia criteria for inclusion in this analysis were consistent with the criteria for *DSM-IV* Primary Insomnia and Insomnia Related to Another Mental Disorder and typical of criteria used in insomnia research (Lichstein, Durrence, Taylor, Bush, &

Riedel, 2003; Martin & Ancoli-Israel, 2002). The insomnia complaint had to be chronic and persistent in nature with a prior history of at least 6 months duration. Typical or average sleep onset latency had to be at least 30 min and/or the amount of wakefulness between sleep onset and time out of bed had to total at least 30 min. To preclude any potential expected sleep disruptions during the study protocol, all participants had to affirm that they did not anticipate any planned life stressors (moving, divorce, etc.), shift work, or transcontinental travel during the protocol, and would not undergo any other concurrent nonpharmacological treatment for insomnia during the course of the protocol. Participants had to be physically and medically capable of practicing the techniques safely. Participants with prior experience with meditation or yoga were not excluded. Participants were not remunerated for their participation.

Experimental Protocol

Following informed consent, participants who had not previously been evaluated with a sleep history interview by a sleep specialist and diagnosed with chronic insomnia underwent a sleep history interview by the investigator to determine the presence of chronic insomnia. This was then reviewed with the participant and a board-certified sleep specialist to verify the insomnia diagnosis and the appropriateness of the subject's participation in the study. The sleep history interview determined the prior duration of the insomnia, the potential relationship of its onset to prior life events, its severity over time, a history of prior attempts to treat the insomnia either pharmacologically or behaviorally, the subject's habitual daily sleep–wake schedule, the typical/average sleep onset latency, the typical/average number and duration of mid-sleep awakenings, the nature of cognitive activity during the sleep onset period and during mid-sleep awakenings, the timing, frequency, and duration of any daytime naps, the use of caffeine and other substances and medications, the presence and severity of daytime fatigue or sleepiness, any symptoms consistent with other sleep disorders (i.e., sleep apnea, narcolepsy, parasomnias, restless legs syndrome, periodic leg movements, etc.), and a brief medical and psychiatric history.

Participants began the study protocol with a pretreatment 2-week baseline evaluation during which time they maintained their habitual daily schedule and completed daily sleep–wake diaries. This was followed by a 1-hr yoga treatment training session, which described and demonstrated the exercises to be performed. Participants were not instructed in or informed about any other behavioral treatment recommendations for insomnia (e.g., stimulus control, sleep hygiene, sleep restriction, etc.). Participants then began daily practice of the yoga treatment and returned approximately 1 week later for a brief in-person evaluation of their practice of the exercises, at which time small adjustments were made and any questions or difficulties addressed. Subsequent follow-ups by telephone, usually less than 15 min in duration, occurred every 2 weeks, or more frequently if needed. During these follow-up telephone contacts, the subject's compliance with the treatment was reviewed from the practice time entries in previously submitted sleep diaries (see below) and from their verbal report of practice over the previous week. Both daily regularity and the duration of the daily practice sessions were reviewed. Problems or difficulties with the exercises or compliance were discussed and potential solutions and strategies to encourage and improve compliance were proposed, implemented, and followed up on subsequent interactions.

Yoga Treatment

The yoga exercises used were from the Kundalini Yoga style (as taught by Yogi Bhajan) that emphasizes meditation and breathing techniques in addition to postures, which is easy to perform and is practiced widely. The exercises chosen were selected because they were specifically recommended for improving sleep and were easy to learn and perform with minimal instruction. The same set of exercises was performed every day during the intervention. All exercises were done in the seated posture, with instructions to maintain the spine erect but relaxed, with all breathing through the nose, and with eyes closed unless otherwise specified. Special attention in the initial training session was devoted to specific instructions on the practice of long, slow abdominal breathing to insure that participants understood this breathing pattern. Participants were instructed to breathe as slowly as was comfortable. The basic cognitive process of meditation was also described in detail. Participants were instructed to maintain a relaxed mental focus either on their breathing or a mantra, returning their attention to this focus in a relaxed manner when they found their thoughts wandering.

The full set of exercises included the following: (1) long, slow, abdominal breathing with meditation on long, slow abdominal breathing for 1–3 min; (2) arms extended upwards at a 60° degree angle with the palms flat and facing upwards with meditation on the breath for 1–3 min; (3) arms extended horizontally to the sides with the wrists bent upwards and the palms facing away with meditation on the breath for 1–3 min; (4) hands clasped together at the sternum with the arms pushing the palms together with meditation on the breath for 1–3 min; (5) a breathing meditation called "Shabad Kriya." Palms are resting in the lap facing upward with right over left and the thumbs touching. Eyes are 1/10 open and gaze is downwards past the tip of the nose. The inhale is in 4 segments or "sniffs," followed by breath retention for 16 counts, and an exhale in 2 segments, so that the ratio of inhale:hold:exhale is 4:16:2. During the inhale, the mantra "Sa, Ta, Na, Ma" is mentally recited with each segment. During the breath retention, this mantra is mentally repeated four times. During the exhale the mantra "Wahe Guru" is mentally recited concurrently with each exhale segment. Participants are encouraged to maintain the overall breathing frequency as slow as is comfortable, while maintaining the specified ratio of inhale:hold:exhale for up to 11 min.

After the first 10 participants had successfully completed the experimental protocol using this 30-min set of exercises, it was decided to increase the treatment duration to a 45-min session for subsequent participants in order to evaluate whether such an increase would yield greater improvements in sleep. This 45-min intervention used the same exercises as the 30-min intervention, except that only Exercises 2–5 above were performed, and exercise 5 was extended in duration to up to 31 min. Participants were instructed to perform the treatment in the evening, preferably just before bedtime. If, on occasion, the subject's evening schedule made it difficult to incorporate the treatment, participants were to practice the treatment at another time of day.

Outcome Measures

Participants completed daily sleep–wake diaries throughout the 2-week baseline and the 8-week treatment phase. They were instructed to complete the diaries shortly after

awakening on a regular basis and to avoid completing them during the night. Participants recorded the time in and out of bed, sleep onset latency, the number and duration of all nocturnal awakenings, the timing of any daytime naps on the previous day, the timing of the yoga treatment practice (during the 8-week treatment phase), hypnotic medications taken, and the quality of nocturnal sleep and restedness at wake time on a scale of 1–5. Completed diaries were brought in by the participants following the baseline, and the first week of the treatment, and then mailed in on a weekly basis for the remainder of the treatment phase.

For the 2-week interval of the baseline and for each of the four consecutive 2-week intervals in the treatment phase, average values were calculated for the daily sleep diary entries for total wake time (TWT), total sleep time (TST), sleep efficiency (SE), sleep quality (scale of 1–5), sleep onset latency (SOL), number of awakenings, wake time after sleep onset (WASO; calculated as the total duration of all awakenings from sleep onset to the final terminal awakening), and quality of restedness at wake time (scale of 1–5). To assess treatment compliance and duration of practice, the sleep diaries also had an entry for the times they began and finished each daily treatment session (except for the first subject in the study who completed an earlier version of the sleep diary without this entry). A two-way repeated measures analysis of variance (ANOVA) was conducted on each of the following outcome measures: TWT, TST, SE, sleep quality, SOL, number of awakenings, WASO, and quality of restedness at wake time.

RESULTS

A total of 40 participants (34 females) meeting the criteria of chronic insomnia described above signed informed consent and were enrolled into the study. Of these, 6 participants withdrew prior to initiating the treatment phase. Of the 34 participants who completed the 2-week baseline evaluation and underwent the treatment training session, all of them found the treatment to be acceptable and agreed to implement it. A total of 13 participants withdrew during the treatment phase. Reasons for withdrawal included change in life circumstances precluding continued time for and/or commitment to the protocol (e.g., illness, family emergency, moving, etc.; 7 participants), unknown/lost to follow-up (4 participants), did not wish to continue committing time to the treatment (1 subject), and dislike of the treatment (1 subject). Of the 21 participants who successfully completed the treatment, 1 subject had insufficient evaluable sleep–wake diary data, and 20 participants completed the 8-week treatment protocol with evaluable data.

The 20 participants completing the protocol with evaluable data consisted of 2 men and 18 women with an average age of 48.1 years ($\pm$10.0 *SD*) and an age range of 30–64 years. They reported durations of chronic insomnia from 0.6 to 43.6 years (average = 12.2 years, $SD = 12.6$ years). Two participants reported concurrent depression at the time of study and were on antidepressant medication during the study. Two participants had symptoms consistent with restless legs syndrome, and three participants reported suffering from mild to moderate anxiety at the time of study. Thirteen participants had previously seen a sleep specialist and six of these had previously undergone at least one overnight sleep study performed in the course of the diagnosis and management of their insomnia. Ten participants had undergone previous trials with one or more prescription hypnotic medications to treat their insomnia, and one of these continued regular hypnotic medication during the study.

On the basis of averages derived from the 2-week baseline sleep–wake diaries, 6 participants had a WASO >30 min with a SOL <30 min (i.e., pure sleep maintenance insomnia), 1 subject had a SOL >30 min with WASO <30 min (i.e., pure sleep onset insomnia), 12 participants had a WASO >30 min with a SOL >30 min, and 1 participant had a WASO and a SOL both <30 min.

A two-way repeated measures analysis of variance (ANOVA) was conducted on each of the following outcome measures: TWT, TST, SE, sleep quality, SOL, number of awakenings, WASO, and quality of restedness at wake time. For each outcome variable, the ANOVA compared the first 10 participants with the 30-min treatment and the last 10 participants with the 45-min treatment for averages determined during the 2-week baseline, and each of the four subsequent 2-week averages during the 8-week treatment phase. For all outcome variables, there was no significant main effect for group $F(1,18)$ all <2.4, all $p > .14$, or for Group × Time interaction, $F(4,72)$ all <1.6, all $p > .18$, and therefore, all of the data below are presented for all 20 participants combined.

Significant main effects for time were observed for TWT, $F(4, 76) = 9.14$; $p < .001$; TST, $F(4, 76) = 6.02$; $p < .001$; SE, $F(4, 76) = 8.86$; $p < .001$; SOL, $F(4, 76) = 4.42$; $p < .003$; and WASO, $F(4, 76) = 6.42$; $p < .001$, with all $p < .05$ after Bonferroni corrections for the eight comparisons. Main effects for time for sleep quality, $F(4, 76) = 3.14$; $p = .02$, the number of awakenings, $F(4, 76) = 2.94$; $p = .03$, and quality of restedness at wake time, $F(4, 76) = 2.30$; $p = .07$, were not statistically significant at the $p = .05$ level after Bonferroni correction. The group averages with standard errors for all time points are shown in the graph in Fig. 1 for TWT, TST, SE, and sleep quality, and reveal progressive

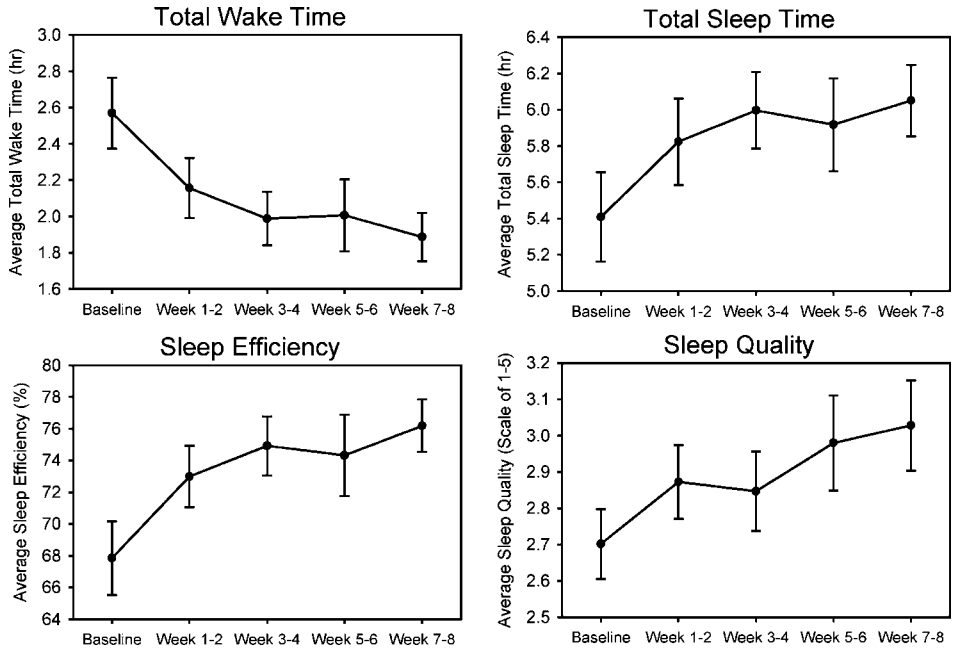

Fig. 1. Averaged data over 2-week intervals for the pretreatment baseline and the 8-week treatment are plotted for total wake time (TWT), total sleep time (TST), sleep efficiency (SE), and sleep quality. Error bars represent standard errors of the mean.

improvements in each measure over time. TWT decreased by 0.7 hr (26.6%), TST increased by 0.6 hr (12.2%), SE increased by 8.3%, and sleep quality increased by 0.3 units. Overall, SOL decreased by 15.2 min (30.1%) and WASO decreased by 22.4 min (34.5%). Duncan's post hoc tests comparing the baseline values with all subsequent values during treatment revealed significant ($p < .05$) improvements at end-treatment (Weeks 7–8) for TWT, TST, SE, SOL, and WASO.

To assess clinical effectiveness in terms of SOL and WASO, the proportion of participants achieving reductions of 50% and posttreatment values less than 30 min was evaluated (Morin et al., 1999). Of the 13 participants with a SOL >30 min at baseline, 4 (31%) had at least a 50% reduction in SOL and 5 (38%) had a SOL <30 min at end-treatment, with a total of 5 participants meeting either criterion and 4 participants meeting both criteria. Of the 18 participants with a WASO >30 min at baseline, 5 (28%) had at least a 50% reduction in WASO, 3 (17%) had a WASO <30 min at end-treatment with a total of 6 participants (33.3%) meeting either criterion and 2 participants meeting both criteria. Using 80 and 85% as clinical markers of improved sleep efficiency (Morin et al., 1999), three participants (15%) and six participants (30%) had sleep efficiencies greater than 85 and 80%, respectively; average total sleep times at end-treatment for these two groups of participants were 6.8 hr (± 1.1 *SD*) and 6.7 hr (± 1.2 *SD*), respectively.

For the nine participants undergoing the 30-min treatment and recording treatment practice times, the overall average daily treatment duration during the 8-week intervention was 24.4 min. For the 10 participants undergoing the 45-min treatment the average was 28.7 min. A two-way repeated measures ANOVA comparing the two groups over the four 2-week intervals over the treatment phase revealed no significant main effect of group, $F(1, 17) = 1.34$; $p = .26$. A repeated measures ANOVA on all 19 participants showed a significant main effect for time, $F(3, 54) = 3.06$; $p < .04$, with the overall average of all 19 participants decreasing from 28.6 to 27.4 to 24.8 to 25.8 min in the 2-week intervals during the treatment. The slope of a linear regression analysis correlating average daily treatment time with the improvement in sleep efficiency from pre- to end-treatment did not reach statistical significance ($r = .37$, slope $= .35$, $p = .12$).

DISCUSSION

The results of this preliminary study indicate that the yoga treatment generated statistically significant improvements in most of the important subjective sleep measures. However, it would be premature to express high confidence about the effectiveness of this treatment on the basis of the preliminary nature of this study. As an uncontrolled study, there are a number of significant limitations to the interpretation of the results and their comparison with those of previous randomized controlled trials reported in the literature. The potential confounding contributions due to any self-selection of participants with high allegiance, positive attitudes toward and/or expectations for the yoga treatment, the disproportionate number of female participants, any potential influence of the investigator, any effects of regression to the mean or temporary resolution of insomnia symptoms due to its natural episodic occurrence were not controlled for in this study. Furthermore, the results have not taken into account the drop-out rate from the study; therefore, from an intention-to-treat perspective the improvements observed may be relatively inflated.

A comparison of the relative degree of sleep improvement in this study to previous insomnia studies is problematic given that most studies have recruited participants from the general population with primary insomnia and exclude insomnia secondary to other medical/psychological conditions. The population in this study consisted of a mix of both primary and secondary insomnia, the majority of whom were referrals from other sleep specialists, 6 of which had previous sleep studies performed, and 10 had previous unsuccessful trials with hypnotic medications. A disproportionate share of the population in this study consists of participants who may be considered previous treatment failures.

With this caution in mind, a comparison with two previous meta-analyses of controlled behavioral treatment studies of primary insomnia reveal that the 12.2% increase in TST in this study is comparable to the improvements in both meta-analyses, whereas the 30.1% decrease in SOL and the 34.5% decrease in WASO are smaller. However, the improvements in WASO in this study appear to be slightly better than for either somatic or cognitive relaxation techniques alone in the meta-analyses. A more appropriate comparison can be made with another uncontrolled study in a clinical population with mixed primary and secondary insomnia that used a multicomponent nonpharmacological intervention (Verbeek, Schreuder, & Declerck, 1999). The improvement in TST in this study was greater than reported in that study (4%), whereas the improvements in SOL, WASO and pre–post difference in SE were less than in that study (43%, 46%, 15.1%, respectively). The percentage of participants meeting the $<$30-min clinically significant improvement criteria for SOL and WASO in this study (38 and 17%, respectively), is similar to the overall 19% reported in that study.

In general, most all participants found the yoga intervention easy-to-learn and tolerable to perform. The participants instructed in the 45-min treatment did not show greater benefit than those instructed in the 30-min treatment. However, this may be due to the fact that the actual amount of average daily practice time was very similar between the participants in each treatment (28.7 min vs. 24.4 min, respectively) and also that the sample size was too small to detect a difference.

A key advantage of the yoga intervention used in this study is that it is simple and easy for participants to learn in a single 1-hr training session. Generally, only minor adjustments needed to be made during the brief single in-person follow-up, and few participants required much interaction on the subsequent telephone follow-ups. If the yoga intervention in this study is superior in effectiveness to previously studied relaxation techniques, then incorporation of this treatment into current cognitive behavioral treatment programs may yield a more highly effective treatment requiring less therapist intervention. The current popularity of yoga, and its recognition as a health maintenance practice, should also add to the attractiveness of such a treatment for insomnia patients. Further evaluation of this intervention with a more homogenous insomnia population in a randomized controlled trial is needed.

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