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A Closer Look at Yoga Nidra- Early Randomized Sleep Lab Investigations

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Abstract

Objectives: We aimed to examine trial feasibility plus physiological and psychological effects of a guided meditation practice, Yoga Nidra, in adults with self-reported insomnia.

Methods: Twenty-two adults with self-reported insomnia were recruited to attend two visits at our research center. At Visit 1 (V1), participants were asked to lie quietly for ninety minutes. The primary outcome was change in electroencephalography (EEG). Heart rate variability (HRV), respiratory rate and self-reported mood and anxiety were also measured. At Visit 2 (V2), the same protocol was followed, except half of participants were randomized to practice Yoga Nidra for the first 30-minutes.

Results: There were no between-group changes (V1-V2) in alpha EEG power at O1 (Intervention: 13 ± 70%; Control: −20 ± 40%), HRV or sleep onset latency in response to Yoga Nidra. Respiratory rate, however, showed statistically significant difference between groups (Yoga

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Authors Contributions: Each author reviewed and approved this manuscript, and contributed to the design, execution, data analysis, and/or writing for this trial.

Disclaimer: By completing this study, we do not aim to promote any school of yoga over another. This work aimed to investigate the effects of Yoga Nidra on sleep, and thus the script chosen was representative of a general Yoga Nidra practice used for sleep.

Conflict of Interest: The authors declare no conflicts of interest.

Ethics approval: This study was approved by the IRB at NUNM.

Consent to Participate: All participants signed an approved consent form before participation.

Availability of data and material: our data is available.

Code availability: upon request.

Nidra −1.4 breaths per minute (bpm) change during and −2.1 bpm afterwards vs. Control +0.2 bpm during and +0.4 bpm after; p=.03 for both during and after). The intervention displayed good acceptability (well-tolerated) and credibility (perceived benefit ratings) with implementation success (target sample size reached; 5% dropout rate).

Conclusions: This preliminary clinical trial provides early evidence that Yoga Nidra is a well-tolerated, feasible intervention for adults reporting insomnia. Decreased respiratory rate in response to Yoga Nidra needs to be confirmed in more definitive studies.

Trial Registration Information: This trial was registered on ClinicalTrials.gov as "A Closer Look at Yoga Nidra: Sleep Lab Analyses" (NCT#03685227).

Keywords

Insomnia; Yoga Nidra; Mind-Body Medicine; Audio Recording; Respiration Rate; Electroencephalogram

Introduction

Up to 50% of adults in the US are affected by at least short-term symptoms of insomnia. [1] While the effectiveness of Cognitive Behavioral Therapy in treating insomnia is proven, issues of availability, acceptability and adherence limit its benefit. Moreover, there is a considerable latency of response. [2] There are several well-documented adverse effects with the use of benzodiazepine and non-benzodiazepines sedative hypnotic agents. [2-4] Given the paucity of options in treating insomnia, Yoga Nidra has attracted our interest as a potential treatment. It is low-cost and highly accessible, making it particularly appealing as a standalone treatment; as opening act in a stepped care approach [5] with CBTI or as a "rescue" intervention.

Yoga Nidra is a guided meditation technique which involves listening to vocal recitation. [6, 7] It is a traditional East Indian approach to addressing insomnia and promoting subjective well-being. [6] The essence of Yoga Nidra is similar to other acceptance based therapies [8] that have been identified as potential enhancements to CBT-I. [9, 10] Yoga Nidra has been shown to reduce subjective stress and anxiety in different clinical conditions [11, 12] and improve perceived sleep quality, [13, 14] amongst other outcomes including modification to brainwave power in alpha, theta, and delta frequency ranges, [13, 15-19] hormones, [20] and neurotransmitters such as dopamine. [21] Yoga Nidra, however, has not been studied in a clinical trial specifically designed to assess its ability to combat insomnia.

In accordance with our published protocol, [22] the randomized controlled trial reported here was designed as a feasibility study and preliminary mechanistic investigation of Yoga Nidra and was implemented in 18 adults with self-reported symptoms of insomnia. The goals were to assess whether the practice is an acceptable and tolerable intervention for our population of interest, and if it facilitates relaxation and sleep compared to lying quietly as a time-matched control condition.

Aims of the Study

In this study our aims were to: (1) measure brainwave patterns using EEG before, during, and after Yoga Nidra (vs. lying quietly) in order to compare EEG power in various frequency ranges and brain locations, as well as sleep latency between intervention and control groups (primary outcome); (2) compare changes in respiratory rate and heart rate variability (HRV) before, during, and after Yoga Nidra to a lying quietly control intervention (secondary outcomes); and (3) assess feasibility/acceptability of our intervention using accepted measures [23] [24] (secondary outcome). We hypothesized that mean alpha EEG power in the occipital lobe (primary outcome measure) and HRV parameters would increase, and respiratory rate and sleep onset latency would decrease in response to Yoga Nidra (as compared to the control condition of lying quietly). We further hypothesized that the intervention would be feasible and acceptable (as demonstrated by participant reaction to the intervention, as well as recruitment and retention rates).

Methods

The clinical trial was conducted from September 2018 to March 2019, according to our published protocol, [22] which was approved by the Institutional Review Board (IRB) at the National University of Natural Medicine (IRB # ES62018) and registered on ClinicalTrials.gov (NCT# 03685227, “A Closer Look at Yoga Nidra: Sleep Lab Analyses”). The trial was ended when the targeted number of participants (N=18) completed the intervention.

Participants

In order to recruit 9 participants into each study arm, and leave room for a 20% dropout rate, our target sample size was 22 participants. These participants were recruited beginning in September 2018, and ending in February 2019, using flyers, newspaper, and digital ads, as well as by calling a list of individuals who consented to be contacted for mind-body research at our institution. Potential participants were screened by telephone for eligibility. Inclusion criteria for the participation was predetermined as: age 18-45 years; mild to moderate insomnia, indicated using as a score of 8-21 on the Insomnia Severity Index (ISI); being able to lie down on a standard massage table for 90-minutes; absence of any hearing impairment based on self-report; and a stated ability to comprehend conversational English. Participants were excluded if they had participated in any mind-body practice (yoga, tai chi, meditation, or other) regularly (once per week or more) within the last 6-months and if they used sleeping medications (e.g. benzodiazepines, melatonin, antihistamines) or other recreational drugs (e.g. cigarettes, marijuana, more than seven alcoholic drinks per week, stimulants) that could interfere with sleep. Eligible participants attended a screening visit where they reviewed and signed an approved informed consent form prior to being assessed for depression. Candidates were excluded and referred to medical management if they scored 10 or more the Patient Health Questionnaire (PHQ-9); or 3 or more on the STOP-BANG survey, indicating risk for sleep apnea. [25]

Study Design

All individuals attended two afternoon visits (with measurements taking place roughly between 1:30 and 3 o'clock PM) at our research center, the Helfgott Research Institute, that involved 90-minutes of EEG, respiratory rate, and HRV measurements and completion of pre/post surveys that assessed mood (via the Positive Negative Affect Schedule, or PANAS), anxiousness (via the State Trait Anxiety Index or STAI) and acceptability/tolerability of the experience (in-house pre/post intervention rating survey). Visit 1 oriented participants to the research facility and measurement equipment and provided a baseline assessment. During Visit 1, all participants were connected to the measurement equipment and asked to lie quietly for 90 minutes on a soft massage table with an optional blanket, while respiratory rate, heart rate variability, and EEG were measured. At the start of Visit 2, participants were randomized to Control or Intervention Groups. Those randomized to the Control group were told they were in the control group and would be doing a repeat of Visit 1. Those in the Intervention group were told they would be doing Yoga Nidra for the first 30 minutes of the visit. The study utilized allocation concealment for the randomization process included having a staff member not involved with the trial fill envelopes with allocation assignments (i.e., "intervention" or "control"), seal and sign each envelop *a priori*. The study coordinator then opened a sealed envelope at Visit 2, in front of each participant, to reveal group assignment. Those randomized to practice Yoga Nidra listened to a recorded practice for the first 30-minutes of the session, then continued to lie quietly for the remaining 60-minutes. Those randomized to the control arm repeated the procedures from Visit 1 (lying quietly for 90-minutes), thus providing a time-matched control, with components similar to Yoga Nidra (lying down in the same room as before, with continuous rest for an hour following this period) but without the voice recording playing for them. Participants were not told to "try" and fall asleep. They were told they could sleep if they felt like sleeping. However, during the Yoga Nidra recording, they were instructed to follow the voice's directions.

To assess feasibility/acceptability of our intervention, pre/post-intervention treatment rating surveys were administered (these included: post-intervention comfort and tolerability questionnaires, and pre/post-intervention questionnaires on physical, mental, and emotional relaxation) and reasons for dropout were evaluated. Recruitment/retention rates, adverse events, and participant feedback were monitored and reported in terms of other Bowen feasibility outcomes including implementation, adaptation, practicality, integration, expansion, and limited-efficacy testing [23], [24].

Yoga Nidra Intervention

The Yoga Nidra intervention used in this study (an audio-recording of a 30-minute Yoga Nidra practice) was designed based on the published work by Swami Satyananda Saraswati [6] that has been widely used in research; and interviews with other expert practitioners and teachers [19]. The authors followed instructions in Saraswati's book for use in insomnia and took portions from several scripts in the book to create a script specific for insomnia. We consulted Vishwas Mandlik (a direct student of Satyananda Saraswati, teacher of author E.S., and renown yoga teacher at Yoga Vidya Gurukul in Nasik, India) on any modifications needed, including an appropriate ending that would allow a participant to fall asleep, rather than wake them up as per the usual script. Importantly, the existing

protocolized script is available upon request, and makes it possible to easily reproduce this practice for future studies, or for creation of widely available Yoga Nidra recordings via podcast, streaming services, etc. Yoga Nidra has been described in different ways by various schools of yoga. The practice that we used in the present study included several short activities that commonly appear in Yoga Nidra, including rotating awareness of body parts, a breath practice, mental/recollected experiences of opposite emotions and sensations, and visualizations. The practice is described in detail in our published protocol, [22] and is similar to what has been successfully implemented to address a variety of conditions [11, 12, 18, 20, 21, 26-31] . The script follows the Bihar School of Yoga style of Yoga Nidra, which is popular, has been used in research, and is the only widely-available published scripted version we could find.

Assessment of Outcome Measures

Measurement methods and devices used are described here and are detailed in our protocol paper. [22].

Feasibility measures reported for this study are based on previously published definitions [23], [24]. The primary feasibility outcome of “acceptability” was measured in terms of participant reaction to the intervention (vs. control) in terms of (1) comfort and tolerability (0-100 slider scale ratings, where 0 corresponded to “not at all”, 50 to “somewhat” and 100 to “very”); (2) credibility/perceived benefit ratings (participants were asked to what extent they felt Yoga Nidra could help them fall asleep in the future, using a 0-100 slider scale to respond, where 0 corresponded to “no”, 50 to “maybe” and 100 to “yes”); (3) pre-intervention expectation of benefits vs. post-intervention perceived benefit ratings (using a 0-100 slider scale to indicate physical, mental, and emotional relaxation); (4) reasons for dropout.

Further exploratory feasibility criteria were assessed in post hoc analysis of our post-visit survey data, as well as using adverse event reporting and recruitment/retention data. These feasibility characteristics Bowen, [23] include: demand (measured as interest in future use of the intervention, using a yes/no response after Visit 2), implementation (measured by evaluating by our ability to implement the intervention as planned during this study, considering recruitment success, dropout rate and visit completion), practicality (measured here using adverse events and participant-reported challenges/distractions that occurred during this study to evaluate the extent to which the intervention has potential to be delivered within real-world constraints,), adaptation (measured by evaluating the possibilities for modifying intervention protocols to suit different individuals and environments), integration (measured by considering the level of systemic change needed before the intervention could be implemented into an existing infrastructure or program of care), expansion (measured by evaluating the potential to use the intervention in new settings or populations, based on requirements of the practice and needs of each situation), and limited-efficacy testing (measured as whether or not the intended effects on outcomes of interest were demonstrated in this study).

Physiological measures include brainwave patterns, HRV, and respiratory rate. Brainwaves were monitored using the ProComp Infiniti Electroenchephalography (EEG) device with

BioGraph Infiniti software, from Thought Technologies. [32, 33] Data were quantified in terms of EEG power (uV^2/Hz), and output results were converted to European Data Format (EDF) using a MatLab program before sleep scoring by Registered Polysomnographic Technicians at Sleep Strategies® in Ottawa, Canada. Sleep scoring included sleep onset latency, sleep efficiency, and other exploratory parameters. Respiratory rate was measured using the portable and wireless Spire® device that clips to a waistband and collects real-time data. [34] Specific HRV parameters obtained include (1) root mean square of successive differences between R-R intervals (RMSSD) and (2) high frequency HRV parameters (HF), which are generally associated with activity in the parasympathetic nervous system (PNS). [35] To measure HRV, we used the portable BodyGuard2® device, which measures HRV in real-time, attaches to the chest via adhesive, and is wireless with an R-R sampling frequency of 1000 *Hz.* [36]

Self-reported outcomes include eligibility screeners for depression (Patient Health Questionnaire, PHQ2/PHQ9), [37, 38] sleep apnea (STOP-BANG survey), [39] and insomnia (Insomnia Severity Index, ISI) [40, 41]; as well as baseline surveys to describe anxiety (Generalized Anxiety Disorder, GAD-7), [42] and subjective sleep quality (Pittsburgh Sleep Quality Index, PSQI), [43] as well as the and the PROMIS-29 survey [44] for various aspects of wellness, including sleep. Pre/post intervention mood and anxiety were quantified using the Positive and Negative Affect Schedule (PANAS), [45] and the 6 question State Trait Anxiety Index (STAI Y-6). [46]

Sample Size Estimation

The sample size of 18 adults was based on our primary outcome, change in alpha power generated from the occipital lobe (EEG location, O1, or Occipital 1). The estimated change in alpha power for our study was based on observations made in another similar research study, examining how meditation impacted brainwave activity, [47] and which agrees with other studies on Yoga Nidra and meditation. [6, 47, 48] Assuming our intervention could produce a 10% increase in alpha power at O1 (approximately 29 uV^2/Hz: corresponding to an increase from 300.37 in the control group to 329.13 in the intervention group), [47] and allowing for a pooled standard deviation of 19 uV^2/Hz as previously observed), [47] and applying an alpha threshold of 0.05, our sample size calculation determined a minimum sample size of 9 individuals per study arm as necessary to provide 90% power. Allowing for a 20% dropout rate, we recruited 11 individuals into each of two study arms, totaling 22 participants.

We also explored whether our sample size provided enough power to detect change in our other secondary outcomes (respiratory rate, sleep onset latency (SOL), heart rate variability (HRV), and acceptability, and credibility). **Respiratory rate:** our study was well powered to detect change in respiration rate, with 95% power to detect a change of 1.6 breaths per minute, based on a study that described in detail, the chemical and neural regulation of breathing, and a decrease from 14.0 ± .7 bpm to 12.4 ± 0.6 bpm during transcendental meditaion [49]. **SOL:** we have less than 80% power with our sample size of 18, to observe a between-group SOL difference of five minutes (using an SD of 7 min). We would need 52 people in our study to reach 80% power. **HRV:** clinically significant change in heart rate

variability parameters are not very clearly defined in terms of clinically significant change [50], however, considering a study on a mind-body technique (pranayama) for hypertension, which showed a clinically significant change in blood pressure alongside a change in RMSSD of 12 ± 13 milliseconds, we would need a sample size of 31 for 80% power, leaving us underpowered at n=18, to expect a similar change in this HRV outcome. **Acceptability/ Credibility:** Feasibility pilot trials generally determine sample size differently than efficacy or effectiveness trials, instead basing sample size on a need for at least minimum precision in measurements, and a portion of the population ultimately needed for an effectiveness trial, considering whether the effect size for that future trial is hypothesized to be small, medium, or large [51]. Considering this guidance, our sample size of 9 per arm would prepare us for a larger trial with an expected large (>0.8) effect size. This effect size is appropriate for measuring, for example, a change in SOL of 6 min (SD 7), or a change of 5 points (SD 6) on the Insomnia Severity Index often used in efficacy trials or interventions aimed at reducing insomnia, and where a shift in category (each containing 8 points) is clinically significant.

Statistical Analysis

Feasibility outcomes were assessed using self-report survey data, recruitment, and retention data, as well as adverse events and challenges reported during the study.

Primary between-group comparisons for each outcome assessed differences in magnitude of change from Visit 1 to Visit 2. The primary physiological endpoint was alpha EEG power. The secondary endpoints included respiratory rate, HRV (RMSSD and HF), EEG power at six frequency ranges and three locations, sleep onset latency, and sleep efficiency. Mean (standard deviation, or SD) of all outcomes, by group and visit, were calculated as averages over the first 30-minutes (during which Yoga Nidra took place at V2 for the Intervention Group) and over the last 60-minutes (or the napping period); as well as for each activity of the Yoga Nidra practice (which generally includes several relaxation exercises and guided visualizations, detailed in our protocol paper for this study) [52] and each 5-minute increment of the nap period. Changes in average levels over intervention and post-intervention periods, from Visit 1 to Visit 2, were compared between groups using independent sample t-tests. Within-participant changes in the treatment group (Visit 1 to Visit 2; and pre/post visit) were assessed using paired t-tests. Finally, mean time courses of outcomes (respiratory rate, HRV, and EEG power) as well as stages of sleep (N1, N2, N3, and REM) across all activities and recording periods are visualized to explore temporal patterns, and notable differences were tested for exploratory significance.

All outcomes were assessed for normality, and appropriate transformations were applied prior to analysis. Sleep onset latency is presented as mean. We also present proportions of participants in each group who experience any sleep.

Recruitment was assessed as the rate of enrollment over three months of recruitment. Retention was assessed as the proportion of participants completing assessments at the end of Visit 1, beginning Visit 2, and completing assessments at the end of Visit 2. Measures of acceptability (perceived benefit in terms of comfort, tolerability, perception that it could help with sleep production, and physical/mental/emotional relaxation) will be presented as mean (SD) for 0-100 point slider scale responses, as well as what percentage of

participants reported greater than 50% on perceived benefit slider scales (indicating “more than somewhat beneficial”; our benchmark for success).

The study team and biostatistician were blinded to group assignment until data analysis was complete.

Results

Sixty-four individuals screened by phone and 22 enrolled in the study (Figure 1). Reasons for exclusion within those individuals who completed a telephone screen included: no insomnia (ISI score below 8), elevated age (above 45), existing regular mind-body practice (in the past 6-months), current use of sleeping medications, existing diagnosis of depression or sleep apnea, current smoking, more than 14 alcoholic drinks per week, or use of other drugs. All 22 enrolled individuals attended the baseline Visit 1 and consented to the study. Upon intake, 3 were excluded due to PHQ9 scores of 10 or more (indicating likelihood of depression). 19 participants were officially enrolled and completed Visit 1 baseline measurements. 18 participants attended Visit 2 and were randomized, with 9 participants in each group (Yoga Nidra or Control); all of whom completed measurements and were included in our final analysis.

Table 1 presents baseline characteristics including: demographics, insomnia severity, anxiety, and overall health at intake, as well as familiarity with mind-body practices. There was no significant difference between groups with respect to age, insomnia (ISI), subjective sleep quality (PSQI), general anxiety (GAD7), or PROMIS-29 scores (that indicate various aspects of wellness). Mean GAD7 scores for both groups indicate minimal to mild anxiety in our sample on average (GAD7 scores <10), and mean ISI scores indicate subthreshold to moderate insomnia (ISI score 8-21) while mean PSQI scores indicate poor subjective sleep quality (mean PSQI score > 5). Mean PROMIS-29 T-scores for both groups were within one standard deviation of “average” (where a T-score of 50 indicates average for this instrument). Thus, participants in this trial were not overly anxious, but did have poor sleep quality on average. They also described themselves as somewhat rested and somewhat sleepy, with no differences between groups.

Electroencephalography Changes

Alpha and Theta Power (Indicators of Drowsiness and Meditative States)— There was no between-group difference in change in alpha power at O1 from Visit 1 to Visit 2 (our primary outcome, indicated using an asterisk in Figure 2A) during Yoga Nidra vs. lying quietly (P=.57 in a two sample t-test assuming unequal variances, where change was +0.3 ± 2.1 $\mu V^2/Hz$ [Intervention] and −0.6 ± 4.1 $\mu V^2/Hz$ [Control]; equating to a 13 ± 70% increase during the practice of Yoga Nidra at V2 vs. lying quietly at V1 in the Intervention group, and a 20 ± 40% decrease in the Control group, during lying quietly at V2 vs. V1). Within-group changes were also not significant (P=.67 in a paired t-test for both groups, with V1 and V2 values of 2.7 ± 1.7 and 3.0 ±2.7 $\mu V^2/Hz$ [Intervention], and 5.7 ± 4.7 and 5.1 ± 6.3 $\mu V^2/Hz$ [Control]).

Secondly, during the allowed napping period following Yoga Nidra, average power for alpha and theta frequency ranges at O1 decreased less in the intervention group than in the control group, (Figure 2B), where change in alpha was −0.26 $\mu V^2/Hz$ in the Intervention group vs. −2.8 $\mu V^2/Hz$ in the Control, and change in theta was–0.010 $\mu V^2/Hz$ (Intervention) vs. −1.1 $\mu V^2/Hz$ (Control), however these changes were not statistically significant (P=.06 for alpha and P=.09 for theta).

Delta Power (Indicator of Sleep Drive)—There was a 32% decrease in average delta power at O1 (V1 to V2) in the Control group, while the Intervention group displayed a 17% decrease during Yoga Nidra (Figure 2A). However the interaction between group and time was not statistically significant.

Figure 3S details changes in EEG power (V1 to V2 for Intervention and Control groups) in each frequency band, by brain location, during each activity of Yoga Nidra, and during 5-minute increments of the hour-long nap. Measurements at the central lobe (C3) for the intervention group showed changes similar to those observed in alpha and theta frequency bands, while changes in the remaining frequency ranges and locations are not easily distinguishable between intervention and control groups througout the time course shown in Figure 3S in the Supplementary Information.

Sleep and Rest

Pre/Post Change in Self-Reported Sleepiness and Restedness—There was no self-reported difference in “sleepiness” or “restedness” on a 0-100 slider scale between groups before Visit 1 (Sleepiness: 44 ± 22, Intervention vs. 50 ± 23, Control; Restedness: 51± 20, Intervention vs. 43 ± 11, Control, as shown in Table 1) or Visit 2 (Sleepiness: 41 ± 27, Intervention vs. 40 ± 21, Control; Restedness: 59 ± 24, Intervention vs. 50 ± 14, Control), and no between-group difference in the change in “sleepiness” or “restedness” from before to after either visit (P>.05 for all comparisons), with pre/post V1 shifts in “sleepiness” of 0.4 ± 31 (Intervention) vs. −12 ± 21 (Control), and “restedness” of 16 ± 16 (Intervention) vs. 19 ± 16 (Control), and pre/post V2 shifts in “sleepiness” of 3 ± 33 (Intervention) vs. −2 ± 22 (Control), and “restedness” of 9 ± 23 (Intervention) vs. 3 ± 17 (Control). Within-group “sleepiness” also did not change significantly (P>.05) for either group pre/post either visit (V1: 44 ± 24 vs. 44 ± 22, Intervention; and 50 ± 23 vs. 38 ± 20, Control). Within-group “restedness” increased for both groups (P=.02, intervention [from 51 ± 20 to 67 ± 19]; P=.009, control [from 43 ± 11 to 61 ± 15]) after Visit 1, but not Visit 2 (P=.61, control [50 ± 14 to 53 ± 20]; P=.28, intervention [59 ± 24 to 67 ± 29]).

Perceived Sleep—84% of our sample said they believed they fell asleep during V1. At V2, 67% of the control group believed they fell asleep, while 78% of the Yoga Nidra group believed they fell asleep (Table 3).

Polysomnographic (EEG) Detection of Sleep

Detection of Sleep.: Analyses were performed by a registered polysomnographic technician (RPSGT) as per American Academy of Sleep Medicine sleep scoring criteria in order to objectively detect sleep. [53] At V1, 83% of our sample fell asleep. At V2, 78% of the

control group slept, while 89% of our intervention group slept. When comparing sleep efficiency during the hour following Yoga Nidra (Intervention) vs. the hour immediately upon lying down (Control), there was no between-group difference (P=.73), with sleep efficiency changes (V1 to V2) of −7 ± 25% in the Intervention group and −2 ± 35% in the Control. There were also no within-group differences between visits (P=.46, Intervention [V1 (upon lying down): 32 ± 26% vs. V2 (post Yoga Nidra: 26 ± 31%]; and P=.90, Control [V1 (upon lying down]: 43 ± 28% vs. V2 (upon lying down a second time): 42 ± 43%).

Of note, however, when looking at sleep during and after the practice of Yoga Nidra, 78% of participants (7/9) fell asleep *during* the Yoga Nidra practice (average SOL, 9 min), even though they were instructed by the recording to stay awake and focus on the meditation; and two more participants fell asleep within 15 minutes after the practice ended. Average sleep efficiency during Yoga Nidra was 39 ± 33%. Furthermore, 43% of participants (3/7) who fell asleep during Yoga Nidra did not wake up when the practice ended, and all but one participant that woke up, fell back asleep within 10 minutes, and continued sleeping into the hour-long napping period which followed.

Sleep Onset Latency (SOL).: When comparing SOL immediately following Yoga Nidra vs. upon lying down (Control), there was no statistical difference between groups (P=.23 in a two-sample t-test assuming unequal variance, where average V1-V2 change in SOL for individuals who slept at both visits was −5.4 ± 10 minutes (Intervention) and +0.17 ± 5 minutes (Control). A “normal” time to sleep onset is between 10-20 minutes [54]. At Visit 1, 22% of the Control group took longer than 20 minutes to fall asleep (they did not sleep at all) and at Visit 2 this number doubled, with 45% taking more than 20 minutes to fall asleep (two individuals did not sleep at all, one took 22 minutes, and one took 55 minutes). In the Yoga Nidra group, at Visit 1, 45% of the Intervention group took longer than 20 minutes to fall asleep (with one person not sleeping, and an average SOL for the three who slept, of 31 ± 12 minutes). At Visit 2, following Yoga Nidra practice, the number of participants with extended SOL times at V1 was halved (22% did not sleep at all), and notably, 33% were already sleeping when the recording ended, and the remaining 45% fell asleep in less than 10 minutes after Yoga Nidra ended (average SOL, 7 ± 2 minutes).

Sleep Staging.: Sleep staging analysis of our EEG measurements is overlaid chronologically with activities of Yoga Nidra and the napping period which followed in Table 1S (Supplementary Information). While we detected no obvious changes in sleep staging associated with any particular Yoga Nidra activity, this figure shows a unique overview of how each participant’s sleep/wake stages responded to the practice vs. control of lying quietly. Caution is warranted in interpretation of these results due to the small sample size and thus possibility of this result being type 2 error.

Respiratory Rate

There was a significant time*group interaction, i.e. there was a decrease in response to Yoga Nidra compared to the control condition, both *during* the practice period (P=.03, using a non-equal variance t-test) and the hour *after* (P-value=.03 using a non-equal variance t-test), however, adjusting for multiple comparisons attenuated this result. Specifically, during the

first 30 minutes there was a 1.4 bpm decrease from V1 to V2 (14.87 ± 3.01 vs. 13.49 ± 3.13 bpm) for the Intervention Group, while within the Control Group, there was a 0.2 bpm increase from V1 to V2 (15.71 ± 1.76 vs. 15.93 ± 1.46 bpm). During the final hour, the Intervention Group exhibited a 2.1 bpm decrease in respiratory rate from V1 to V2 (16.25 ± 3.28 vs. 14.19 ± 3.56 bpm); while the Control Group showed a 0.4 bpm increase in respiration rate during this part of Visit 2.

Figure 3 depicts the notable decrease in respiratory rate beginning during the practice of Yoga Nidra and continuing throuhgout the 90-minute measurement period, as compared to the negligible change occuring in the control group. Comparison of indiviudal activities of the Yoga Nidra practice shows statistically significant reductions in respiratory rate (*P*-value < .05) in the Intervention vs. Control Group during the portion of the practice that was *most imaginative*. Specifically, when participants were asked to mentally cultivate polar opposite experiences (heaviness/lightness, cold/hot, and pain/pleasure) which occurs for roughly four minutes, midway into the Yoga Nidra practice. Respiration rate remained significantly decreased during the check to see if participants were awake ("Are you awake? Please do not sleep."), and also during the Visualization portion of the practice (the longest singular step in the practice, lasting 2.5 minutes [55]), and during 38 minutes of the hour napping period following Yoga Nidra. Notably, the period of significantly decreasd RR during the practice was immediately *following* a breathing practice (pranayama) of mental alternate nostril breathing. There was not a significant difference in respiration rate during this pranayama practice, but observed effects could represent a delayed effect on breath rate, in the period that followed. Values for V1-V2 change in respiratory rate can be observed in (Figure 3).

The range of respiration rates measured in this study (10-20 breaths per minute), are in a normal range defined by the Spire® (where "Calm" for our population was defined as 6-12 breaths per minute; "Focus", 16-20 bpm and consistent in pace; and "Tense", 18-24 bpm and erratic/inconsistent in pace). Notably, no one's average breath rate/breathing pattern during Yoga Nidra was classified by Spire® as "Tense", whereas nearly 30% of those recorded during the lying quietly control were Tense by this definition.

Heart Rate Variability

Changes in measures of HRV (RMSSD and HF) from V1 to V2 were not significantly different between Intervention and Control groups during the first 30-minutes (RMSSD: *P*=.90 [Intervention: −8 ± 11 vs. Control: −7 ± 12]; and HF: *P*=.75 [Intervention: −316 ± 518 vs. Control: −234 ± 516];), or the final 60-minutes (RMSSD: *P*=.78 [Intervention: −8 ± 16 vs. Control: −6 ± 9]; and HF: *P*=.73 [Intervention: −314 ± 713 vs. Control: −206 ± 470]).

Feasibility

This study showed high "implementation" feasibility, in terms of recruitment and retention rates, with 136 inquiries, 64 screened, and our target sample size of 22 participants enrolled in under 3 months.

We observed high "acceptability" [23], with participant satisfaction indicated by mean comfort and tolerability ratings of >50% on a 0-100 slider scale, from both intervention and

control groups at both visits (Figure 1S). Specifically, 72% of our sample reported 50% or greater comfort ratings at V1, and 100% reported the same at V2. Similarly, 94% reported greater than or equal to 50% tolerability ratings at V1, and 100% reported this finding at V2. Perceived benefit ratings (when the intervention group was asked after the intervention to what extent they felt Yoga Nidra could help them fall asleep in the future) produced a mean value of 70 ± 32 % perceived benefit on a 0-100 slider scale, following Yoga Nidra. Pre/post treatment ratings showed no significant changes at either visit in terms of expected effects (pre) vs. experienced effects (post) on physical, mental, or emotional relaxation with all ratings above 50% on a 0-100 slider scale indicating how likely they felt it was to experience (pre) vs. extent to which they experienced (post) each outcome ($P>.05$ for each measure in a paired t-test; values visible in Table 3). There was only one reason for dropout, which was scheduling difficultly, occurring for one participant.

Further Bowen feasibility characteristics [23] assessed in our post hoc analysis are displayed in Table 2. These results highlight the interest by both intervention and control groups to try Yoga Nidra again in the future, the very low (5%) dropout rate, and minimal distractions and challenges during our study (shown in Figure 2S). We evaluate potential to adapt the intervention as necessary for individual needs, integrate it into daily life, and expand its use amongst populations. Lastly, we evaluate the Bowen characteristic of “limited-efficacy testing” of the intervention by demonstrating promising results with respect to our outcomes of interest (respiration rate, alpha EEG power, sleep production, and physical/mental/emotional relaxation).

Self-Reported Changes in Anxiety, Mood, and Relaxation

Momentary Anxiety—While average anxiousness (STAI score) went down after each visit, in both groups, and showed greater change at V2 than V1 (VI pre/post change: −15% for Control and −14% for Intervention; V2 pre/post change: −20% for control and −18% for Intervention) there was no significant difference in pre/post change between groups ($P=.71$, V1; $P=.51$, V2). Post-visit values within each group were also not significantly different from pre-visit values ($P=.06$, V1 Control; $P=.17$, V1 YN; $P=.06$, V2 YN) except in the case of the Control group at Visit 2, which exhibited a 20% decrease in anxiety ($P=.04$). It should be noted however, that the Control group started Visit 2 with a significantly higher STAI anxiety score than the Intervention group (44 ± 6 vs. 32 ± 8, $P=.003$). All pre/post visit STAI values are shown in Table 3.

Positive and Negative Affect (Mood)—Similarly, while average values of positive and negative affect (PANAS scores) decreased following each visit, for both groups, there was no significant difference in pre/post change between groups at either visit ($P>.05$ for all comparisons). There was no significant change in either measure at Visit 1 or 2 within either group, except for the Control group at Visit 2, which showed decreased negative affect (14%, $P=.04$). It should be noted, however that like anxiousness, negative affect started significantly higher in the control group at the beginning of Visit 2 (13 ± 2 vs. 11 ± 1, $P=.01$), and positive affect started significantly lower at V2 ($P=.04$), as shown in Table 3. All pre/post visit PANAS values are shown in Table 3.

Physical, Mental, and Emotional Relaxation—Participants reported feeling "more than somewhat relaxed" after both intervention and control visits, via average relaxation ratings of 50% or more on 0-100 slider scales measuring physical, mental, and emotional relaxation. See Table 3.

Expectancy

Expectancy is demonstrated, with all pre/post visit values shown in Table 3, which indicates pre visit expectancy ratings for relaxation and sleep production, as well as post-visit evaluation of relaxation and sleep, as experienced, at Visits 1 and 2. Anxiousness and mood are also shown pre and post Visits 1 and 2. In the Intervention group, expectancy was significantly higher toward sleep production and physical relaxation even at Visit 1, when both groups were lying quietly (P=.01 for physical relaxation and .04 for sleep production), however post-Visit 1, there were no between- or within- group differences for these measures. At Visit 2, the control group had a lower expectancy for mental relaxation (P=.05), and sleep (P=.003), higher anxiousness (P=.002), lower positive affect (P=.04), and higher negative affect (P=.01). After Visit 2, there were no between-group differences, however, within-group decreases in anxiety (P=.04) and negative affect (P=.04) were shown in the control group.

Discussion

To our knowledge this is the first feasibility study and controlled investigation of physiological and psychological effects during and after a Yoga Nidra practice, in adults with self-reported symptoms of insomnia. We found this practice to be a feasible and acceptable intervention within a population of Yoga-Nidra-naïve adults reporting insomnia symptoms, and that while the practice caused no statistically significant changes in our primary EEG outcome, a it produced a statistically significant decrease in respiration rate (secondary/hypothessis generating outcome) compared to lying quietly, and also produced sleep in 89% of participants, which extended into the hour that followed practice. Because feasibility was assessed in first-time practitioners (rather than the experienced yoga experts studies elsewhere), and because self-reported symptoms of insomnia were used for recruitment (rather than clinically diagnosed insomnia), these results are generalizable to the broader US population that may not have mind-body experience or a formal insomnia diagnosis, but that may experience trouble sleeping and also be open to a free and accessible guided meditation practice.

Clincial Significance

This study supports Yoga Nidra as an acceptable/well-received and highly implementable intervention for use within a population of individuals with self-reported insomnia. Although preliminary, this study shows evidence that Yoga Nidra may produce relaxation, as indicated by self-reported physical, mental, and emotional relaxation following the practice, as well as significantly lowered respiratory rate compared to control. Notably, most participants fell asleep during the practice, and remained asleep after the practice, suggesting its possible utility in initial insomnia, and aligning our intervention with traditional descriptions of the practice, in which participants are estimated to sleep for 10-50% of a Yoga Nidra session

[6]. EEG findings did not provide significant evidence that Yoga Nidra may facilitate the transition toward sleep, in terms of drowsiness/meditative state (EEG-measured alpha and theta power [56]) or sleep drive (EEG-measured delta power [57]), though this result may be due to our small sample size, or study design. Furthermore, although not statistically significant, the changes in self-reported anxiety (−18%) in the Yoga Nidra group may be important, as anxiety is very closely linked with insomnia and is the most common comorbid diagnosis alongside insomnia. [58] Future studies are needed to determine if the outcomes investigated here are reliable mechanisms of Yoga Nidra as it relates to mental/physical/emotional relaxation, anxiety, and sleep.

Importantly, the decrease in respiratory rate observed here is useful for hypothesis generation in future studies. In acute healthcare settings, respiratory rate is a vital sign which provides information on clinical deterioration, predicts cardiac arrest, and supports the diagnosis of severe pneumonia[59-64]. Furthermore, respiratory frequency seems responsive to a variety of stressors, including emotional stress, cognitive load, cold, and hyperthermia [65-68]. Additionally, during exercise, respiratory rate is a good marker of physical effort and fatigue [59, 69-76] and is associated with exercise tolerance in different populations [71, 77].

Support/Extension Upon Prior Work

This work as a whole supports the relaxation effects of Yoga Nidra that have been studied previously, with applications toward stress, [78] anxiety and depression, [11, 14] pain, [27, 79] and other conditions. [79] Our results also support the accessibility and tolerability of the practice that has been reported in other studies, [17] and supports the need for further research on Yoga Nidra as a potential intervention for insomnia, that could feasibly be readily adopted by many indivduals.

Data acquired in this trial builds on our previous qualitative investigations of Yoga Nidra as a relaxation technique [52] and will inform the design of larger efficacy studies that will apply this practice over time, within a larger population, for lasting effects on sleep.

While the EEG changes observed in this pilot trial were not significant, the 13% increase in mean alpha power here is similar to a 10% intra-individual increase in alpha at O1, observed in a study of mindfulness meditation on which we based our sample size, [47] and therefore reinforces the liklihood that Yoga Nidra is a meditative practice that may produce a transition toward a sleep-like state. The observed changes in mean alpha and beta power during Yoga Nidra are of interest for future investigation in larger sampes, to determine if they were caused by the intervention. Alpha brainwaves are correlated with the state between waking and sleeping, and increased alpha values have been observed during other meditative/creative activities. Conversely, beta brainwaves are correlated with wakefulness or awareness. Combined elevated alpha and beta power may support hypothesized mechanisms of Yoga Nidra, wherein the practicioner of Yoga Nidra is both paying attention to the speaker, while also becoming deeply relaxed, and moving toward sleep or actually sleeping [80].

Importantly, the greater decrease in respiration rate observed in our Intervention Group *after* the practice compared to *during* the practice supports Yoga Nidra texts, [6] that describe sleep following Yoga Nidra as more restful, and free from mental, physical or emotional stress; colloqually referrred to as the “sleep after throwing off the burdens”

This work also supports the claims of traditional Yoga Nidra texts that estimate the average person actually sleeps during 10-50% of a Yoga Nidra practice, [6] as those who slept during Yoga Nidra (78%) in our study remained asleep for an average of 39% of the practice.

Strengths

Other EEG studies have focused on experienced practitioners [21] and this study shows how novice practitioners respond to the practice. We measured physiogical changes occuring in real-time during and after the practice of Yoga Nidra, and also surveyed participants for self-reported perceived psychological changes, allowing us to evaluated whole-person effects of a single exposure to Yoga Nidra. We additionally controlled for “first-night” effects in our study design by allowing participants to attend a baseline visit (V1), in order to acclimate to our clinic site.

Limitations

We used a small sample size of 18, based on our primary EEG outcome, yet future studies should be longitudinal and employ a large enough sample size to measure more precise effects on insomnia and secondary outcomes. While this study provided a preliminary look at the changes occurring in the brain and body during and after Yoga Nidra, it took place mid-afternoon at our research clinic, rather than around or before bedtime (where EEG could be monitored during the practice and throughout a night of sleep). In future studies, this type of measurement would provide more detailed information about whether the practice affects and facilitates sleep throughout the night. Additionally, there was evidence of decreased expectancy in the Control group in this study, with self-report surveys after group assignment (prior to V2) showing significantly increased anxiousness and negative affect plus decreased positive affect and decrease sleep expectancy compared to the YN group. Lastly, Yoga Nidra is purported to be more effective with practice, and thus, it is possible that our mechanistic EEG measures could be more obvious with a seasoned practitioner. However, in this pilot study, we aimed to mimic a likely scenario in the US, in which an adult with trouble sleeping would try Yoga Nidra for the first time.

Future Work

Larger studies with evaluation of a Yoga Nidra practice used at home before bed, over the course of several weeks, would allow more realistic evaluation of the potential of Yoga Nidra to impact insomnia, while allowing more power to detect change in our outcomes of interest (EEG, HRV, and respiratory rate); and if ambulatory EEG and biomonitoring can be incorporated into this study design, objective response to the practice could be readily evaluated. Increased alpha power, and changes to respiratory rate and/or HRV, if evident in future larger studies, may help elucidate the mechanistic underpinnings of the commonly reported benefits of Yoga Nidra. Furthermore, additional exploration of our HRV data may include examination of other parameters that may be more responsive including

SDNN or heart rate itself. And lastly, future studies could compare scripts used by various schools of Yoga Nidra (such as the Himalayan Institute, the Amrit School, iRest, and the Scandinavian School) in order to investigate differences that exist within each protocol, and how they may affect various outcomes including sleep and the autonomic nervous system. To minimize effects of expectancy, we will re-evaluate how we present the intervention options to participants, i.e., not describing either condition as the “control” or “intervention”. Furthermore, as the COVID-19 pandemic has increased sleep disturbances greatly, there is a need for accessible in-home/remote practices that can be used for help relaxing, and falling asleep (including during the night, upon waking). Future studies of remotely-delivered Yoga Nidra would be appropriate, especially considering the wide prevalence of insomnia in the US [81] and around the world [82-84].

Conclusion

This study is the first feasibility trial and mechanistic investigation of various outcomes (brainwave patterns, sleep production, respiratory rate, HRV, axiety, mood, and perceived relaxation) produced by Yoga Nidra-naïve adults with insomnia, in response to a single afternoon Yoga Nidra practice, performed alone in a clinic room. We demonstrate production of sleep and statistically significant reduction in respiratory rate during and after a single Yoga Nidra practice; both of which support the relaxation effects of the practice that may be helpful for individuals with insomnia. These findings support our view that Yoga Nidra remains a candidate for further investigation as a non-pharmacological, accessible, and tolerable intervention for insomnia, while also illuminating some design requirements (i.e., larger required sample size due to high variation) for future research.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Highlights

- Yoga Nidra was a feasible intervention for adults with self-reported insomnia
- Yoga Nidra did not increase alpha power compared to lying quietly (p=.57)
- Yoga Nidra decreased respiration rate compared to lying quietly (p=.03)
- Yoga Nidra produced sleep in 89% of participants
- This work represents a critical starting point for future analyses of Yoga Nidra for insomnia

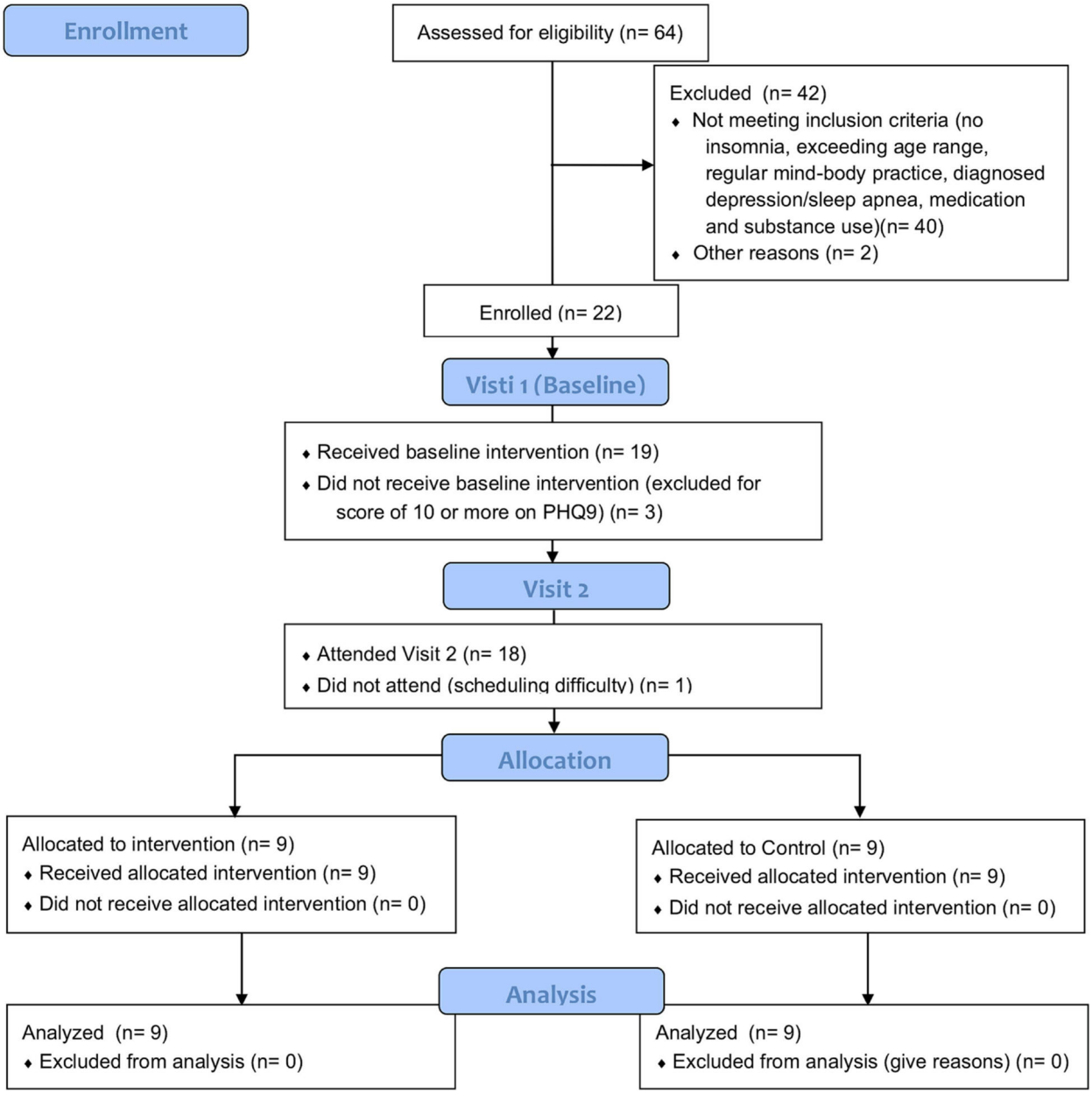
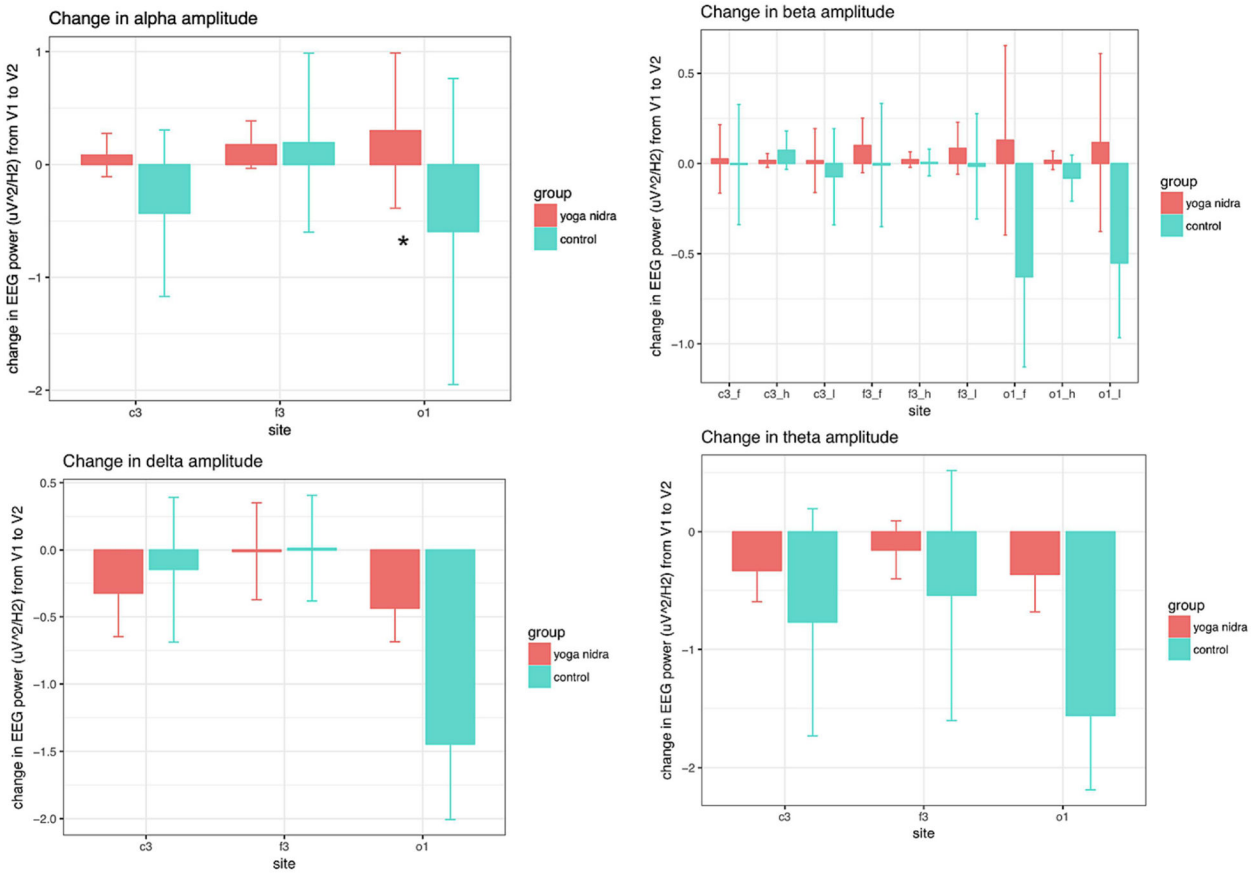


Figure 1.
Description of recruitment and retention data.



A. During Yoga Nidra

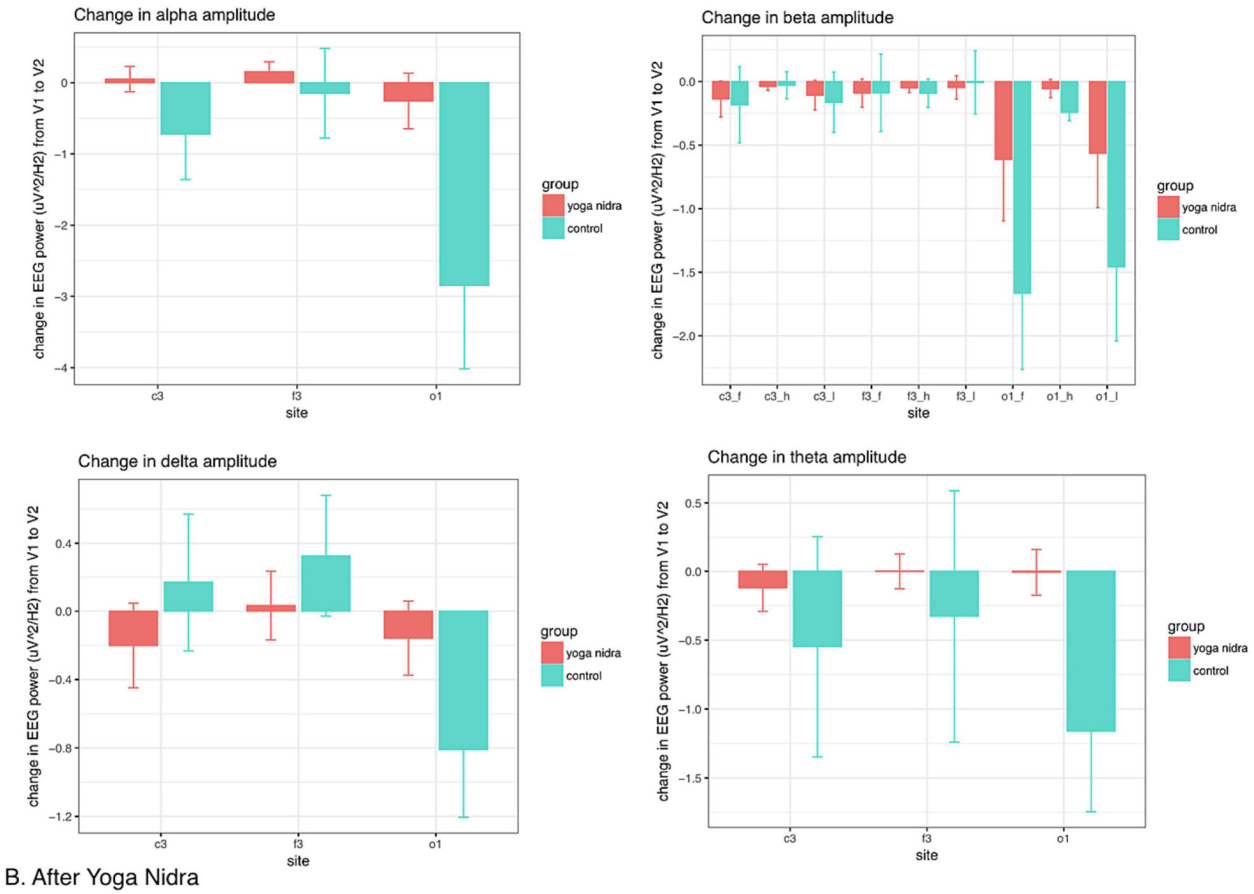


Figure 2.

Change in EEG power from Visit 1 to Visit 2 at four frequency ranges (alpha, beta, theta and delta), measured at three locations or sites (central [C3], frontal [F3], and occipital lobes [O1]) during the first third of the 90-minute measurement period (A: “During Yoga Nidra”; during which Yoga Nidra took place at V2 in the Intervention Group); and during the last hour of the measurement period (B: “After Yoga Nidra”; during which time both groups were allowed to nap). While average values demonstrate changes occurring between groups, none of these changes were significantly different between groups (*P*-value> .05). However, changes in alpha and theta at O1 approached significance after the nap (between-group *P*-values of .05 and .08). The asterisk in 2A indicates our primary outcome, alpha power at O1.

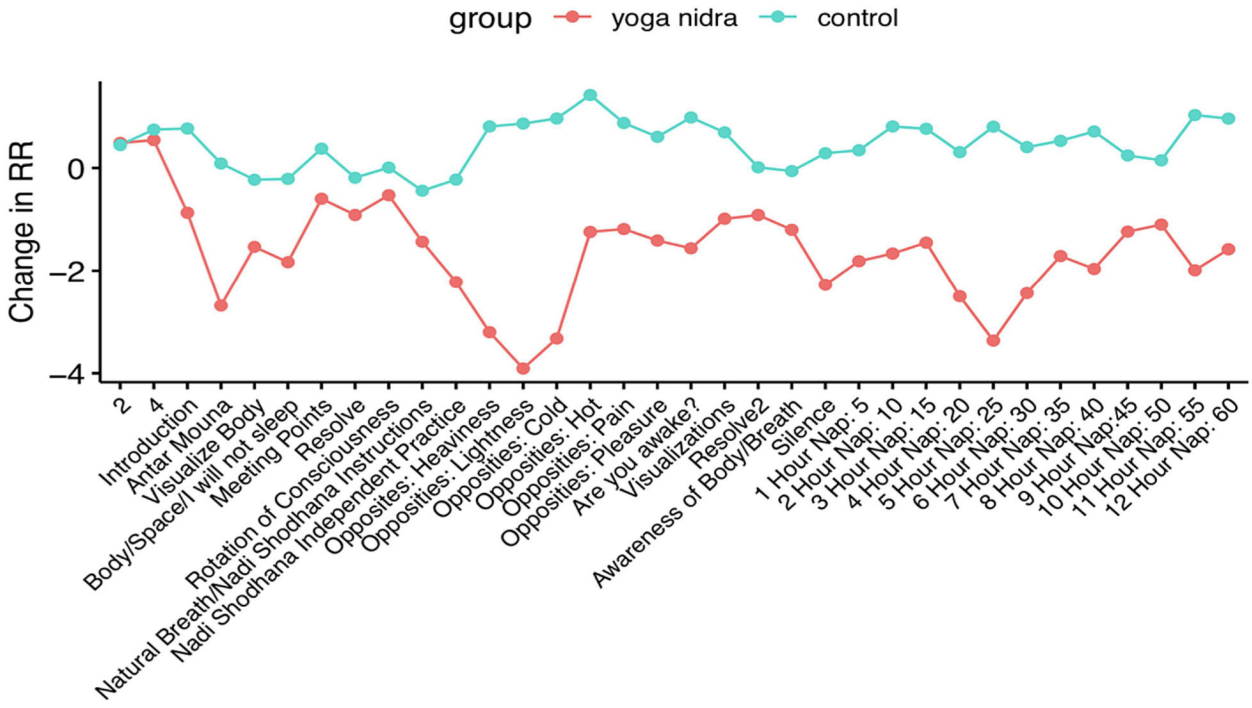


Figure 3.

Time-course analysis of mean respiration rate changes (Visit 1 to Visit 2), throughout 90-minutes of measurement comparing guided Yoga Nidra + unguided rest vs. unguided rest alone. Y axis shows difference between respiration rate (RR) at Visit 1 and Visit 2.

Table 1.

Description of our study population.

	Intervention (n=9)	Control (n=9)
Age		
Mean (SD)	33 ± 7	30 ± 6
Range	25-44	22-39
Gender		
Male	33%	11%
Female	67%	89%
Other	--	--
Ethnicity		
Hispanic or Latino	--	22%
Not Hispanic or Latino	100%	78%
Not Reported	--	--
Race		
Black or African American	-	-
White, Caucasian, or European-American	89%	67%
American Indian or Alaskan Native	-	-
Caribbean Islander or African National	-	-
Native Hawaiian or Pacific Islander	-	-
Asian or Asian-American	-	-
More than one Race	-	-
Unknown/Not Reported	-	-
	-	-
	11%	-
	-	33%
	-	-
Education		
High School	11%	-
Undergraduate Degree	56%	67%
Graduate Degree	33%	-
Terminal Degree	-	11%
Other [a]	-	22%
Insomnia Severity (ISI)	14 ± 4	16 ± 5
Self-Reported Sleepiness[b]	44 ± 22	50 ± 23
Self-Reported Restedness[b]	51± 20	43 ± 11
Pittsburgh Sleep Quality Index (PSQI)	9 ± 3	10 ± 4
Generalized Anxiety (GAD-7)	3 ± 4	5 ± 3
PROMIS-29		
Pain	42 ± 0	45 ± 7
Depression/Sadness	44 ± 5	52 ± 7

	Intervention (n=9)	Control (n=9)
Physical Function	57 ± 0	54 ± 6
Ability to Participate in Social Roles/Activities Fatigue	56 ± 6	52 ± 8
Anxiety/Fear	50 ± 13	57 ± 7
Sleep Disturbance	48 ± 9	58 ± 7
	54 ± 10	59 ± 5

[a]Any relevant educational training (e.g., technical, self-guided, or a non-university degree or certificate).

[b]Participants were asked how rested they felt before vs. after the intervention, using a 0-100 slider scale, where 0=not at all rested, 50=somewhat rested, and 100=extremely rested.

Table 2.

Assessment of Bowen feasibility characteristics as they relate to Yoga Nidra.

Feasibility Characteristic	Evaluation of Yoga Nidra
Demand	Interest in attending future weekly classes (if offered): • 89% of intervention group • 89% of control group Interest in using the recording at home for insomnia: • 89% of intervention group • 100% of control group
Implementation	• Recruited our intended sample size (N=22) within 3-months. • Every participant completed each study visit they attended. • Only one participant lost to follow-up, due to scheduling issue (5% dropout rate).
Practicality	Minimal reports of distractions or challenges that would affect implementation of the intervention (see Figure 3).
Adaptation	Potential for adaptation into different study designs and environments: • can as a recording or script at home or in person • can use independently or in a group • can use portable HRV and breath monitors (i.e. Bodyguard® and Spire®) at home with very little guidance, or in clinic.
Integration	Potential for "integration" into daily life, and the existing system of insomnia treatment: • very low-cost • accessible • can be used independently • low-risk • 30-minute intervention • trained provider not required (administered via recording)
Expansion	There would be very few limitations to which populations could safely complete this practice. • little to no supervision or training required for practice • passive practice (no physical requirements) • accessible to anyone with the ability to rest comfortably • accessible to anyone with the ability to listen to the script
Limited Efficacy	Promising effects of Yoga Nidra on outcomes of interest were displayed: • alpha brainwave power at O1 (**Figure 4**): insignificant between-group changes, yet similar magnitude of change to prior meditation studies. • respiratory rate (**Figure 5**): significantly decreased • sleep (Figure 2S): produced during and after Yoga Nidra • mental, physical, and emotional relaxation reported after the practice.

Table 3.

Pre-visit expectancy and post-visit outcomes for Yoga Nidra and Control Groups. Differences between groups are in bold and p values are shown for those with significant differences (*P*-values not shown are >.05). Between group comparisons were made using two sample t-tests assuming unequal variances. Within-group comparisons were made using two-sample t-tests for means. Anxiousness was measured via the STAI-. Positive and negative affect were measured via the PANAS before and after the intervention. Expectancy was measured via a pre/post visit in-house survey.

	Control	Yoga Nidra	p-value (if <.05) between-group
Pre-Visit 1			
Expectancy-Relaxation and Sleep[a]			
Physical Relaxation	**52 ± 24**	**80 ± 16**	**.01**
Mental Relaxation	56 ± 22	74 ± 20	
Emotional Relaxation	57 ± 29	70 ± 24	
Sleep Production	**41 ± 20**	**62 ± 18**	**.04**
Anxiety and Mood			
Momentary Anxiousness [b]	40 ± 11	33 ± 10	
Positive Affect	25 ± 10	31 ± 8	
Negative Affect	12 ± 2	12 ± 3	
Post-Visit 1 Outcome[c]			
Relaxation and Sleep			
Physical Relaxation	66 ± 30	74 ± 15	
Mental Relaxation	58 ± 31	67 ± 11	
Emotional Relaxation	56 ± 30	68 ± 16	
Sleep Production (% reporting sleep)	89 ± 33	78 ± 44%	
Anxiety and Mood			
Momentary Anxiousness	34 ± 11 (p=.056) [d]	28 ± 7 (p=.17) [d]	
Positive Affect	23 ± 10 (p=.32) [d]	26 ± 7 (p=.12) [d]	
Negative Affect	11 ± 1 (p=.19) [d]	11 ± 1 (p=.27) [d]	
Pre-Visit 2 (after group assignment)			
Expectancy- Relaxation and Sleep			
Physical Relaxation	64 ± 26	78 ± 12	
Mental Relaxation	**58 ± 29**	**80 ± 13**	**.05**
Emotional Relaxation	56 ± 28	74 ± 17	
Sleep Production	**42 ± 22**	**74 ± 16**	**.003**
Anxiety and Mood			
Momentary Anxiousness	**44 ± 6**	**32 ± 8**	**.003**
Positive Affect	**23 ± 8**	**33 ± 9**	**.04**
Negative Affect	**13 ± 2**	**11 ± 1**	**.01**
Post-Visit 2 Outcome			
Relaxation and Sleep			

	Control	Yoga Nidra	p-value (if <.05) between-group
Physical Relaxation	70 ± 20	84 ± 17	
Mental Relaxation	59 ± 20	75 ± 25	
Emotional Relaxation	55 ± 24	78 ± 26	
Sleep Production (% reporting sleep)	67 ± 50	78 ± 44	
Anxiety and Mood			
Momentary Anxiousness	**36 ± 9 (p=.04)**[d]	26 ± 10 (p=.06) [d]	
Positive Affect	21 ± 9 (p=.06) [d]	29 ± 11 (p=.22) [d]	
Negative Affect	**11 ± 2 (p=.04)**[d]	10 ± 1 (p=.17) [d]	

[a]Pre-visit, participants were asked “How positive are you that your experience today will cause [physical, mental, or emotional] relaxation [or sleep]?” and rated their expectancy on a slider scale of 0-100, where 0=not at all, 50=somewhat, and 100=very positive.

[b]“normal” anxiousness is between 34-36.

[c]Post-visit, they were asked “Do you feel that your experience created [physical, mental, emotional] relaxation?” and responded on the same slider scale where 0=not at all, 50= somewhat and 100= yes, very much. They were also asked “Do you think you fell asleep at any point during our intervention today?” and responded yes/no.

[d]within-group comparison of pre/post measures.