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Yogic meditation improves objective and subjective sleep quality of healthcare professionals

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ABSTRACT

Objective: Our aim was to evaluate the impact of yogic meditation in sleep quality of healthy pediatric healthcare professionals.

Method: Subjects were randomized into a meditation group (MG, n = 32), who attended a yogic meditation class held for eight weeks, or a control group (CG, n = 32). Polysomnography (PSG) and Pittsburgh Sleep Quality Index (PSQI) scores were determined at baseline and after eight weeks.

Results: The PSQI overall score was lower ($p = 0.024$) in the MG. Reported sleep latency ($p = 0.046$) and MG sleep latency ($p = 0.028$) were lower in the MG at eight weeks. PSG showed a time effect ($p = 0.020$) on decreasing minutes of wake after sleep onset in the MG. There were strong and significant correlations between PSG and PSQI variables. There was a significant time effect on heart rate ($p = 0.001$) in the MG.

Conclusion: Yogic meditation may be used as an integrative health tool to foster improvements in the health-related aspects of healthcare professionals' lives.

Trial registration: CinicalTrials.gov identifier: NCT02947074; trial registry name: Meditation Practice in Pediatric Healthcare Professionals: A Randomized Controlled Clinical Trial.

1. Introduction

Insomnia is one of the most prevalent health concerns in the population and clinical practice. The prevalence of insomnia is increasing. Its prevalence is approximately 10–20%, and nearly 50% of those are chronic [1]. Physicians and other healthcare specialists are exposed to many occupational stressors that contribute to a decreased quality of sleep, such as sleep deprivation, prolonged working hours, high demands on professionalism, responsibility over patients' care [2,3], increased administrative responsibilities, and decreased autonomy [4,5]. Consequently, decreased quality of sleep is a main factor for work-related distress and may cause a misalignment of the circadian rhythm [6], which can negatively affect psychological functioning [7]. Some authors have suggested that periods of partial and total sleep deprivation/restriction can impair immune function (e.g., cytokine levels) [8], alter hormone secretion (e.g., cortisol levels) [9,10] and instigate adverse psychological changes (e.g., anxiety and depression) [7,10,11]. In fact, some authors had conducted a longitudinal study on the effects of a 3-year period of healthcare work on regret and sleep quality because it is prone to be negatively impacted by regret [12]. Growing importance is being given to health-related components of healthcare professionals' lives, and since sleep quality seems to be impaired in them [13], interventions that may positively impact it deserve to be properly investigated.

Given the highly demanding environment, health professionals seek strategies that help them cope with adversities and improve their quality of sleep, well-being and quality of life, such as yoga and meditation. Yoga has a comprehensive approach towards the mind and body, addressing physical, mental, and spiritual well-being through diverse psychophysical practices, which include physical and breathing exercises, relaxation and meditation practices [14]. As a multicomponent practice, yoga prescribes a specific philosophical attitude towards life,

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with a meditative and attentional component as the basis for all its practices, thus being shown to have many psychophysiological effects, such as reducing anxiety levels and physiologic arousal [15]; improving subjective sleep quality in patients with chronic insomnia [16]; reducing both subjective and objective insomnia symptoms [17]; and improving quality of life [18,19]. Additionally, meditation/mindfulness programs have also been useful for improving sleep quality. In a recent study [20], the authors concluded that seven weeks of a mindfulness program was effective in improving subjective insomnia, sleep quality, sleepiness, and sleep impairment in fibromyalgia patients.

Yoga and meditation are also inexpensive and side-effect–free interventions, which are well tolerated and used as integrative practices in nondrug treatments in many health-related contexts. There is promising evidence for its efficacy in improving insomnia and sleep quality impairment among cancer patients [21–23]. Yoga was shown to be safe and improved sleep and quality of life in a group of older adults with insomnia [24]; furthermore, it decreased stress symptoms and increased self-confidence in insomniac men who practiced yoga for eight weeks [25].

However, empirical evidence in healthcare professionals remains scarce. There was a study that investigated the effects of eight weeks of a yoga relaxation technique on mindfulness, pain and sleepiness of healthcare workers and found increased levels of "acting with awareness" and "nonjudging of inner experience", subscales of the mindfulness questionnaire, but did not find decreased sleepiness or pain [26]. Other authors [27] have reported significantly higher self-care as well as less emotional exhaustion and depersonalization upon completion of an eight-week yoga intervention among nurses. Although few studies have addressed the influences of yoga on quality of sleep in healthcare professionals, there is a research [28] that studied 120 Chinese nurses distributed into control (60) and yoga (60) groups—the intervention comprised yoga classes (50–60 min) more than two times every week for six months after work hours—nurses in the yoga group had improved sleep quality and decreased work stress which were found to be positively correlated to nursing experience, age and yoga intervention. Mantra meditation was also investigated in an emergency staff sample, and the authors found qualitative improvements in work pressure and perceived stress; perceived benefits of meditation; attention/awareness, emotion regulation and new coping mechanisms, relaxation and sleep quality [29].

Thus, even though evidence is still to be strengthened, yogic meditation seems to have positive effects on many aspects related to the health of healthcare professionals. Our hypothesis is that the practice of meditation can contribute to an improvement in the quality of sleep of health professionals in pediatrics.

2. Material and methods

This study was approved by the ethics committee of Universidade Federal de São Paulo (UNIFESP - 1.454.694) and registered in the Clinical Trials database (NCT02947074). It was a randomized and controlled clinical trial on the practice of yogic meditation for pediatrics health professionals from a tertiary hospital linked to a federal university. The inclusion criterion was being a health professional (e.g., social worker, nursing staff, physiotherapist, physician, nutritionist, dentist, psychologist), working in the Department of Pediatrics. The exclusion criteria were a previous diagnosis of psychiatric or neurological conditions and/or practice of any method of meditation/yoga at the time of the study.

2.1. Subjects

Professionals were invited to voluntarily participate in the study by electronic means of communication and then randomized into two groups: meditation or control. The meditation group participated in an eight-week yoga meditation program, while the control group remained on a waiting list until the end of the program. After this period, the control group was invited to participate in the same program offered to the meditation group. All participants signed the informed consent form.

2.2. Study protocol

Demographic data, including gender, marital status, occupation, body mass index (BMI) and age, were collected from participants by means of a questionnaire.

Upon arrival at the sleep laboratory, the professionals answered self-applied instruments for sleep quality/sleepiness evaluation (the Pittsburg Sleep Quality Inventory—PSQI and Epworth Sleepiness Scale—-ESS). They were then submitted to a polysomnography (PSG) evaluation in the Department of Psychobiology of Universidade Federal de São Paulo (UNIFESP). Evaluations were carried out at two time points: baseline and after eight weeks of the intervention. Participants were entitled to a copy of the results of the questionnaires and polysomnography.

The PSQI, translated and validated for the Portuguese language, provides a measure of standardized sleep quality, is easy to answer and interpret, and is clinically useful in the evaluation of several sleep disorders. It consists of 19 self-administered questions, grouped into seven components: subjective sleep quality; sleep latency; sleep duration; habitual sleep efficiency; sleep disorders; use of sleeping pills; and daytime dysfunction. Scores of these components are summed to produce a global score, ranging from 0 to 21; the higher the score is, the worse the sleep quality. An overall PSQI score >5 indicates that the individual presents major difficulties in at least two components or moderate difficulties in more than three components [30,31].

The ESS, also translated and validated for the Portuguese language, is a self-administered questionnaire widely used to assess sleepiness and the possibility of dozing during eight daily situations. To rate the probability of dozing, the subject uses a scale of 0–3, where 0 corresponds to no possibility and 3 corresponds to a greater possibility of dozing off. A score <10 is used as the cutoff point, while scores >16 indicate severe somnolence, narcolepsy, or idiopathic hypersomnia. Low scores in insomnia patients, both psychophysiological and idiopathic, are consistent with evidence that these patients have low propensity to sleep, even when they are relaxed [32,33].

2.3. Polysomnography (PSG)

A complete full-night PSG was performed on a digital system (EMBLA® S7000, Embla Systems, Inc., Broomfield, CO, USA). The following physiological variables were simultaneously and continuously monitored: electroencephalogram (F3-M2, F4-M1, C3-M2, C4-M1, O1-M2, O2-M1), electrooculogram (EOG-Left-M2, EOG-Right-M2), electromyogram (chin and anterior tibialis muscles), electrocardiogram (modified Lead II), airflow (oronasal thermocouple and nasal pressure transducer), respiratory effort (respiratory inductance plethysmography of thorax and abdomen), snoring, body position, and arterial oxygen saturation. All PSG procedures were performed according to the recommended rules of the American Academy of Sleep Medicine Manual for the Scoring of Sleep and Associated Events [34] The same professional performed both the first (baseline) and second (eight weeks) polysomnographies.

2.4. Meditation training protocol

A 30-min yogic meditation class was held weekly for eight weeks, with a total length of 4 h. After each practice, volunteers were given the written class protocol and asked to practice at least once more during the week. The classes were scheduled on five different times during the week: at noon on Mondays and at 6:20 and 7:00 a.m. on Tuesdays and Thursdays. Volunteers could choose one class among them. The offering of different time possibilities allowed the professionals to participate in the activities without disturbing their work schedule. Practices were carried out in a calm and room suitable for the practice of meditation. The training protocol was as follows:

- ✓ Week 1 - Introduction to the physical practices of yoga (asanas), with an emphasis on relaxation of effort and self-observation. Asanas applied followed the traditional Patanjali's approach, having as main characteristics the search for stability, comfort, effort relaxation and meditation in the infinite, as instructed in sutras II-46 and II-47 [35]. The main asanas were: savasana, pavanamuktasana, parvatasana, vakrasana, pascimotanasana and varunasana [36].
- ✓ Week 2 - Introduction to yoga breathing practices (pranayama), with an emphasis on comfort and tranquility. Only introduction to ujjayi pranayama was applied, as a means to set a tranquil state of mind. As instructed by Svatmarama in the authoritative text Hatha Pradipika [37], a smoot contraction of the glottis was applied in order to produce a subtill internal friction sound and also to increase the length of breathing phases comfortably.
- ✓ Week 3 - Introduction to the practices of concentration of yoga (dharana), with the observation of external object. In order to do this, we took pedagogic help of a kryia (trataka, in which the observer focuses his/her sight in a candle flame, trying to abstract from the exterior environment).
- ✓ Weeks 4–8 – Meditation training: As define by Patanjali (III-2) [35], "The uninterrupted flow of the mind towards the chosen object is meditation". From week 4–8, the chosen object became more and more subtill, in the proposal of ekagrata meditation.
- ✓ Week 4 - Training in meditation (ekagrata dhyana), with an emphasis on counting respiratory cycles.
- ✓ Week 5 - Training in meditation (ekagrata dhyana), with observation of an internal object (temperature of the breathing air).
- ✓ Week 6 - Training in meditation (ekagrata dhyana), with an emphasis on the observation of the flow of thoughts.
- ✓ Week 7 - Training in meditation (ekagrata dhyana), with an emphasis on the detachment from thoughts.
- ✓ Week 8 - Training in meditation (ekagrata dhyana), with an emphasis on possible pauses between thoughts.

2.5. Statistical analysis

The database was composed of several variables measured in two different groups (meditation and control) at two different time-points (baseline and eight weeks). To describe the quantitative variables, measures of central tendency, dispersion and position were used, and to describe the qualitative variables, the absolute and relative frequencies were used.

When normality was found, Student T-test was used for quantitative variables between groups. When normality was not found, Mann-Whitney test [38] was used, and Fisher's exact test was used for the qualitative variables [39] to evaluate the homogeneity of the groups in relation to the variables at baseline [39].

For intra- and intergroup comparisons, the generalized estimating equations (GEE) method [40] was used, which is a way to account for the correlation between repeated measures. The GEE method is known as marginal models and can be considered an extension of generalized linear models (GLM) [41] that directly incorporates the correlation between the measurements of the same sample unit. A log-linear marginal regression was adjusted with the time and group variables along with the interaction between them for each of the variables under study, and the corresponding contrasts were calculated. The software used in the analyses was R (version 3.3.2), and statistical significance was accepted at $p < 0.05$.

3. Results

3.1. Sample

One hundred and eighty professionals of the Pediatrics Department of a public tertiary hospital received an electronic invitation to participate in the study. Among those, 110 volunteered to enter the study. After applying the inclusion/exclusion criteria, 46 subjects could not be included. The final sample was formed by 64 volunteers randomized into two groups: 32 in the meditation group and 32 in the control group. There was no dropout during the entire protocol (Fig. 1).

3.2. Sociodemographic data

The vast majority of participants (84.4%) were female, and 56.2% were single. Regarding occupation, most of the sample was made up of physicians (51.1%), followed by nutritionists (23.4%) and nurses (10.9%). The mean age of the volunteers was 35.8 years, and the mean BMI of the subjects was 25.36 kg/m^2. The volunteers in both the control and meditation groups had similar sociodemographic characteristics (Tables 1 and 2).

3.3. Subjective sleep quality

3.3.1. Pittsburgh sleep quality index—PSQI

Fig. 2 presents the intra- and intergroup comparisons for the overall PSQI score. The overall score was significantly lower ($p = 0.024$) in the meditation group than in the control group at eight weeks (i.e., the meditation group was 23% [3%; 39%] lower than the control group).

Fig. 3 presents the intra- and intergroup comparisons for the Subjective sleep latency that was significantly decreased ($p = 0.046$) in the meditation group: mean sleep latency was 23% [1%; 40%] lower after eight weeks of the intervention compared to baseline. The mediation group had a sleep latency significantly lower than the control group after eight weeks ($p = 0.028$). The score was 37% [5%; 59%] lower in the meditation group than in the control group.

3.3.2. Epworth sleepiness scale—ESS

The Intra- and intergroup comparisons for the ESS score were performed. There was no significant difference between groups ($p > 0.050$) and no significant time effect ($p > 0.050$).

3.4. Polysomnography - PSG

Comparisons between intra- and intergroup for minutes of wake after sleep onset (WASO) were presented in Fig. 4. There was a significant time effect (p-value = 0.020) with a decrease in the WASO minutes in the meditation group, since the mean minutes of WASO was 26% [5%; 43%] lower at time 2 compared to time 1.

Fig. 5 presents the intra- and intergroup comparisons for the heart rate (average). There was a significant time effect (p-value = 0.001) in the meditation group, and the mean level of heart rate was 3% [1%; 5%] lower at time 2 than time 1. There was a significant difference (p-value = 0.035) between the groups at time 2, with the mean heart rate being 7% [1%; 13%] lower in the meditation group than in the control group.

Other evaluated PSG parameters (total recording time, total sleep time, sleep latency, stage R latency, sleep efficiency, percent of total sleep time in each stage, arousal index, apnea-hypopnea index, and oxygen saturation values) did not show any difference in the intra- and intergroup comparisons.

3.4.1. Pearson correlations between variables of interest

In order to check possible interactions and correlations between variables studied, the Pearson's correlation analysis was applied to the acquired data and was presented in Table 3.

The greater positive and significant correlations were between sleep

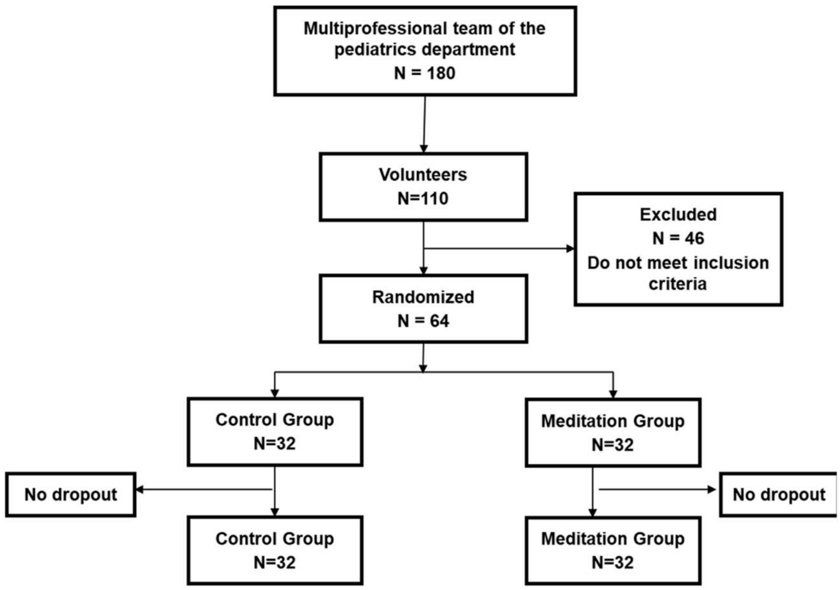

Fig. 1. Flowchart of study recruitment.

Table 1
Descriptive analysis of qualitative sociodemographic variables.

Variables/Groups		Control N	Control %	Meditation N	Meditation %	P-value[a]
Gender	Female	28	87.5%	26	81.2%	0.732
	Male	4	12.5%	6	18.8%	
Marital Status	Single	19	59.4%	17	53.1%	0.699
	Married	11	34.4%	14	43.8%	
	Divorced	2	6.2%	1	3.1%	
Occupation	Social Workers	0	0.0%	2	6.3%	0.119
	Nurses	7	21.9%	2	6.3%	
	Physiotherapists	1	3.1%	2	6.3%	
	Physicians	13	40.6%	19	59.4%	
	Nutritionists	10	31.3%	5	15.6%	
	Dentists	0	0.0%	1	3.1%	
	Psychologists	1	3.1%	1	3.1%	

[a] Fisher's exact test.

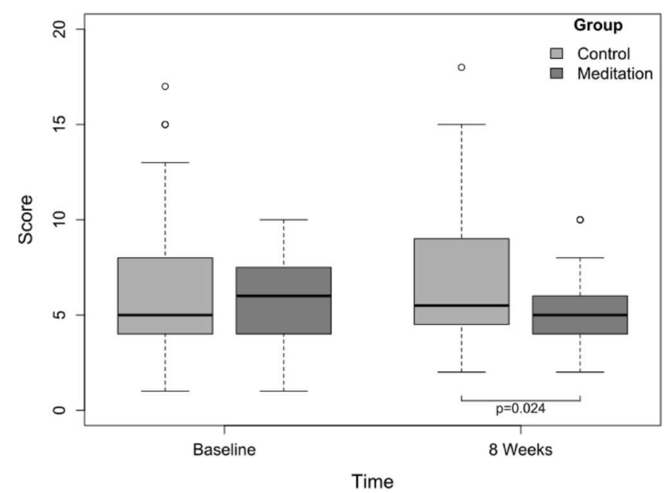

Fig. 2. Intra- and intergroup comparisons of the overall score on the Pittsburgh Sleep Quality Index—PSQI (meditation group, n = 32 subjects; control group, n = 32 subjects).

Table 2
Descriptive analysis of quantitative sociodemographic variables.

Variables/Groups	Control Mean	Control S.D.	Meditation Mean	Meditation S.D.	P-value[a]
BMI (kg/m[a])	24.45	4.50	26.27	5.88	0.124
Age (years)	34.97	13.32	36.63	11.22	0.174

[a] Student T-test; BMI = body mass index.

latency and PSQI_L (Sleep Latency), as well as wake time and PSQI_L (Sleep Latency), which means that questionnaire variables are confirmed by PSG ones. On the other hand, the greater negative significant correlation was between sleep efficiency and PSQI_L (Sleep Latency), indicating that a poor sleep efficiency in PSG baseline is associated to a bigger sleep latency in the Pittsburg inventory. Besides, there was a significant and positive correlation between PSQI total score and resting heart rate, which shows that the increase in quality of sleep (score decrease) is related to a lower heart rate.

4. Discussion

The meditation protocol investigated in this trial brought many benefits to sleep variables in health professionals of a public hospital pediatrics department: there was an improvement in the subjective sleep quality, verified by a reduction in the total PSQI score, as well as a decrease of reported sleep latency; in addition, there was a decrease of the objectively assessed minutes of WASO and of resting heart rate.

Health professionals are prone to a plethora of work-related stressors and to an associated decrease in sleep quality indexes [13]. Nevertheless, the number of investigations available on integrative health practices that may help improve sleep quality and health-related self-evaluation remains low and deserves broader investigative effort. The sample was formed by healthy volunteers who had never practiced meditation, yoga or any kind of contemplative practice. In addition, the protocol was adapted to attend to the peculiarities of the sample, e.g., offering short period practices (30 min) that were not as long as the ones usually offered (approximately 1 h), thus optimizing the adherence, which was largely successful since there were no dropouts.

The PSQI is a validated tool to investigate sleep quality [30,31]. A slight reduction in the total score, even if not statistical, may point to a clinically important improvement in sleep quality. Nevertheless, the reduction found in our study was clinically and statistically significant.

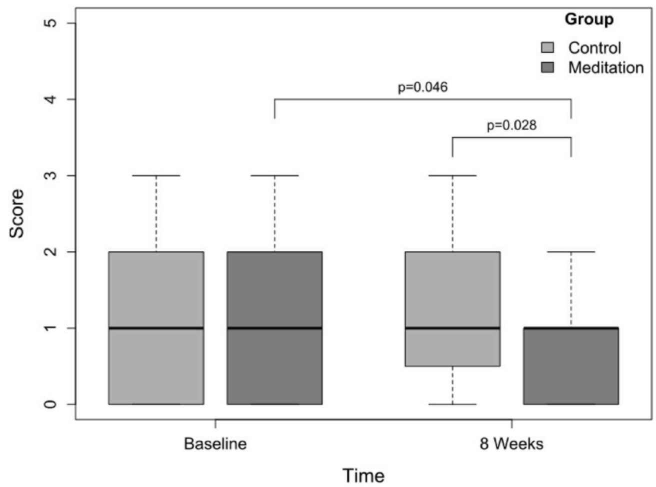

Fig. 3. Intra- and intergroup comparisons for the sleep latency variable of the Pittsburgh Sleep Quality Index—PSQI (meditation group, n = 32 subjects; control group, n = 32 subjects).

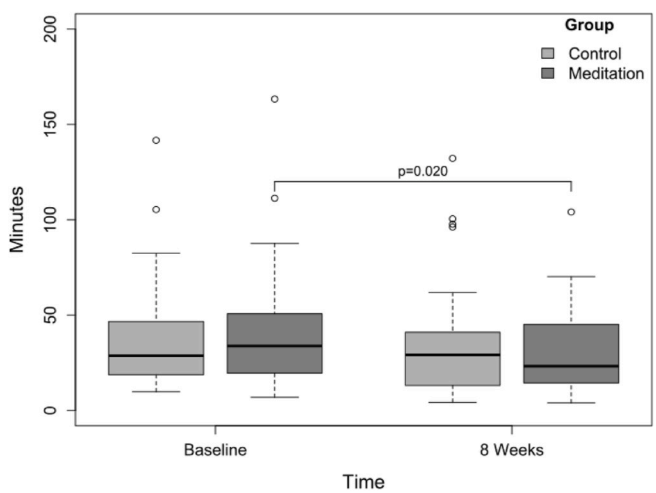

Fig. 4. Intra- and intergroup comparisons for minutes of wake after sleep onset (WASO) (meditation group, n = 32 subjects; control group, n = 32 subjects).

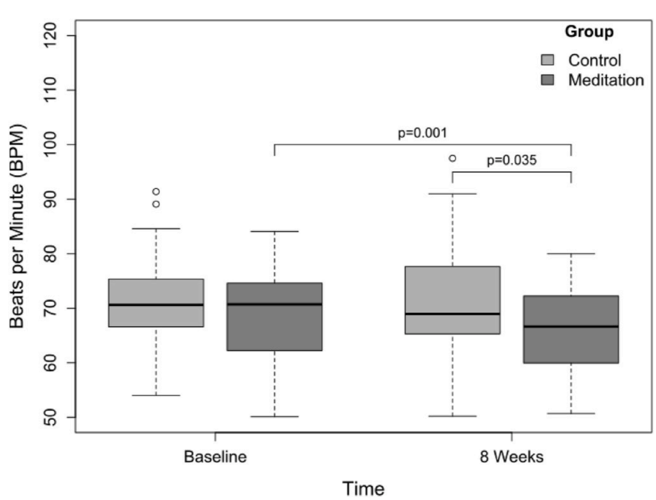

Fig. 5. Intra- and intergroup comparisons for heart rate (average) (meditation group, n = 32 subjects; control group, n = 32 subjects).

There was a reduction of 11% in the total PSQI score, which allows us to state that meditation had a positive effect on sleep quality in these subjects. Furthermore, the reported sleep latency was also positively influenced by meditation and did not change in the waiting list control group (time effect), which is another variable contributing to the improved sleep quality in the healthcare professionals in the Pediatrics Department that practiced meditation.

Our findings are corroborated by other studies that have investigated interventions of the same nature (contemplative practices such as yoga and mindfulness). In a study that offered daily yoga practices to volunteers who had at least two years of training, both total PSQI scores and sleep latencies were significantly lower in the yoga than in the non-yoga group [42]. Similar findings were found in another yoga protocol that included a home practice of meditation in a sample with elderly individuals with insomnia complaints and found significant improvements in subjective sleep quality [24]. Strengthening these findings, even with a small sample size, a study with twenty-six subjects (16 experimental and 10 controls) investigated the effects of long-term yoga practice (minimum three years) on subjective sleep quality through the PSQI and encountered a positive influence of yoga practice on reduced PSQI scores [43]. Furthermore, there was an elegant meta-analysis [44], which investigated the effects of mindfulness meditation on the sleep quality in subjects complaining of insomnia. The authors screened six randomized controlled trials, which included 330 subjects, and concluded that mild, mindfulness meditation has positive effects for improving sleep-quality parameters in patients with insomnia and may be used in integrative care, complementary to medication for sleep complaints. Although this meta-analysis focused on meditation, it was addressed mainly to mindfulness meditation, which includes some, but not many, mixed techniques. In our study, we addressed pure yoga meditation, as described in the traditional texts [14], in which the practitioner focuses his/her attention on the air temperature during breathing in and out and is instructed to avoid getting ensnared in any kind of thought and/or sensorial information other than the air temperature that passes through the nostrils. This fact per se is already a tool that may have facilitated detaching from recurrent thoughts that normally impair sleep quality by increasing sleep latency, which was decreased in our study.

In addition to the questionnaires that evaluated subjective sleep quality, our volunteers underwent overnight PSG to measure objective sleep parameters. There are only a few well-controlled studies that have investigated the effects of meditation on PSG. A recent systematic review about mind-body interventions for the treatment of insomnia selected only 12 high-quality studies; however, among those, only three used PSG to measure the results of the interventions [17]. In one of the studies, objective sleep was unchanged by relaxation, sleep compression or placebo desensitization, although all treatments improved subjective sleep quality [17]. In our PSG results, we found significant decreases in WASO and resting heart rate, which suggest an objective and measurable sleep quality improvement. Such findings are corroborated by the recent literature since another investigation [45] sought to study the effects of adding mindfulness meditation to cognitive behavioral therapy for insomnia (CBT-I) and concluded that the associated protocol increased the benefits on sleep quality, since WASO showed a significantly greater reduction in the CBT-I plus mindfulness meditation than in the CBT-I alone group.

Since the base of knowledge on the influences of meditation on PSG is still being built, some controversial results have been found. On the one hand, some authors find no influence of meditation on PSG, such as those of a randomized controlled trial on mindfulness meditation for chronic insomnia, in which 54 adults with chronic insomnia attended either a mindfulness-based stress reduction program, mindfulness-based therapy for insomnia, or an eight-week self-monitoring control group (SM), using PSG and wrist actigraphy to measure objective sleep variables. PSG and actigraphy revealed significant findings only for 2 actigraphy-measured variables (Total Wake Time and Total Sleep Time)

Table 3
Matrix of correlations between variables. Bold-marked ones are those with $p < 0.05$.

	PSQI Sleep Latency	PSQI Subjective Quality of Sleep	PSQI Sleep Duration	PSQI Sleep Efficiency	PSQI Sleep Disorders	PSQI Daytime dysfunction	PSQI Use of sleeping pills	PSQI Score	ESS
TRT	−0.03	−0.15	−0.04	−0.01	0.00	−0.11	0.05	−0.02	**0.22**
TST	**−0.31**	−0.16	−0.08	−0.14	−0.08	−0.06	**−0.20**	**−0.23**	**0.29**
Sleep Latency	**0.34**	0.16	0.04	0.13	0.04	0.03	0.11	**0.27**	−0.03
REM Latency	−0.05	−0.12	**−0.19**	−0.06	0.07	0.04	−0.07	−0.08	−0.07
WASO	0.16	−0.07	−0.05	0.03	0.14	−0.09	**0.32**	0.10	**−0.18**
Sleep Efficiency	**−0.39**	−0.09	−0.04	−0.16	−0.11	0.09	**−0.30**	**−0.28**	**0.17**
%Wake	**0.34**	0.08	−0.02	0.17	0.08	−0.10	**0.31**	**0.24**	−0.16
%N1	0.02	−0.04	**−0.17**	−0.05	0.02	−0.11	**0.26**	−0.07	−0.10
%N2	−0.01	−0.02	−0.15	**−0.29**	0.05	0.08	**−0.19**	−0.12	0.11
%N3	−0.01	−0.03	0.12	**0.24**	−0.05	−0.05	−0.05	0.03	−0.15
%REM	0.02	0.12	0.13	0.12	0.00	0.04	**0.21**	**0.18**	**0,25**
Arousal Index	−0.06	−0.07	−0.07	−0.06	0.01	−0.15	**0.30**	−0.04	**−0.21**
RDI	−0.07	−0.08	−0.01	−0.04	0.04	−0.13	**0.29**	−0.01	**−0.19**
AHI	−0.02	−0.13	0.00	−0.04	0.05	−0.16	**0.27**	−0.01	**−0.19**
SpO2 Mean	−0.07	0.09	−0.01	0.09	0.02	**0.19**	**−0.31**	−0.02	0.13
SpO2 Minimun	−0.10	0.14	−0.02	0.05	−0.14	**0.19**	**−0.26**	−0.05	0.07
HR Mean	**0.25**	0.04	0.08	0.09	0.16	−0.07	**0.27**	**0.21**	0.02

Legends: PSQI = Pittsburg Sleep Quality Inventory; ESS = Epworth Sleepiness Scale; TRT = total recording time; TST = total sleep time; WASO = wake after sleep onset; % = percentage of sleep stages; RDI = respiratory disturbance index; AHI = apnea-hypopnea index; SpO2 = oxygen saturation; HR = heart rate.

and no significant findings for PSG-based sleep parameters [46]. On the other hand, many other studies have broadened the positive results and influences of meditation on PSG. Recently, a study of whole-night polysomnographic measures and self-rated sleep was conducted after volunteers practiced cyclic meditation twice a day for 23 min each, compared to another night when they had two sessions of supine rest of equal duration on the preceding day. Practicing cyclic meditation increased slow-wave sleep and lowered the percentage of time in rapid-eye-movement sleep, as well as reduced the number of awakenings per hour. The authors suggested that the practice of cyclic meditation improved both objective and subjective quality of sleep [47].

Meditation also has reported effects on heart rate, which were similar to our findings. The same authors [48] found reduced heart rate and breath rate during sleep following the practice of cyclic meditation compared to supine rest, which was accompanied by positive time and frequency domain changes in heart rate variability. In fact, according to a recent review, yoga practices, including meditation, relaxation, yoga postures, breathing exercises, and integrated practices, appear to improve autonomic regulation and enhance vagal dominance as reflected by heart rate variability measures [49], which corroborate our findings of a lower resting heart rate in the meditation group.

Seeking to build up the validity of our findings, we have performed correlation analysis between all variables acquired in the PSG and PSQI. Not surprisingly, there were many significant correlations among those addressed. A decrease in sleep latency in PSQI was positively correlated to a decrease in sleep latency in PSG. While negative correlations happened only when a decrease in one and an increase in the other was something positive, such as total sleep time at baseline (Baseline TST - PSG) and PSQI Sleep Latency. Our data shows, then, that their information is both additive and complementary.

Nevertheless, our study had some limitations. First, the healthcare professionals could not experience the effects of a 1-h weekly practice, since their tight routines offered them only a 30-min period for practice. If they had had a longer practice interval, the results might have been even more significant. To balance this disadvantage, there was no dropout, which indicated that the participants were truly committed to meditation training and possibly feeling the positive effects of its practice, a fact that might have further strengthened the effects of our intervention.

5. Conclusion

Healthcare professionals in a Pediatrics Department of a public hospital who practiced meditation for eight weeks in the workplace improved their sleep quality, both in subjective (PSQI) and objective (PSG) measures, indicating that yogic meditation may be used as an integrative health tool to foster improvements in health-related aspects of the lives of healthcare professionals.

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Declaration of competing interest

None.

CRediT authorship contribution statement

Priscilla Caetano Guerra: Formal analysis, Conceptualization, Methodology, Writing - original draft, Writing - review & editing. **Danilo F. Santaella:** Formal analysis, Conceptualization, Methodology, Writing - review & editing. **Vania D'Almeida:** Formal analysis, Conceptualization, Writing - review & editing. **Rogerio Santos-Silva:** Formal analysis, Conceptualization, Writing - review & editing. **Sergio Tufik:** Resources, Writing - review & editing. **Claudio Arnaldo Len:** Formal analysis, Conceptualization, Methodology, Writing - review & editing.

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