Original Article

Effect of Mind Sound Resonance Technique on Pulmonary Function and Smoking Behavior among Smokers – A Prospective Randomized Control Trial

K. S. Moodala Girishankara, Shivaprasad Shetty, Krithika A. Ramaswamy, Prashanth Shetty

Department of Yoga, Sri Dharmasthala Manjunatheshwara Naturopathy and Yogic Sciences, Ujire, Karnataka, India

Abstract

Background: Smoking is one of the leading causes of death in the world, and the respiratory tract is the major body system affected by smoking. Yoga has shown promising effects in improving lung function in previous studies. Mind sound resonance technique (MSRT) is one of the Yoga-based relaxation techniques, which improves internal awareness and reduces impulsivity. **Aim:** Hence, we aimed to assess the efficacy of MSRT on pulmonary function and smoking behavior among smokers. **Methodology:** A total of 197 subjects were screened among whom 80 were recruited and randomly allocated (1:1) to a study group (SG) (n = 40) who received 10 days of 25-min MSRT intervention and a control group (CG) (n = 40) who received health education during the same period. Baseline assessment was taken before intervention for both the groups. Pulmonary function was assessed by spirometry. All subjects were administered the Smoking Abstinence Self-Efficacy Questionnaire (SASEQ) to assess the motivation to quit smoking, the Minnesota Tobacco Withdrawal Scale-Revised (MTWS) to assess withdrawal symptoms on smoking cessation, and the Questionnaire of Smoking Urges to evaluate the urge to smoke, before and after the 10-day intervention. The data were analyzed based on the intention-to-treat principle. **Results:** There were no baseline differences across all parameters between the two groups. There was a statistically significant change in all pulmonary function variables including FVC ($P < 0.001$), FEV_1 ($P < 0.001$), FEV_1/FVC ratio ($P < 0.05$), forced expiratory flow 25%–75% ($P < 0.001$), peak expiratory flow rate ($P < 0.001$), and breath-holding time ($P < 0.001$) both within the SG and when compared to the CG. Within the CG, only FEV_1 ($P = 0.002$) showed a significant change when compared to baseline. Within-group comparison showed a significant change in all the domains of SASEQ ($P < 0.001$) and few of the domains of MTWS-Revised ($P < 0.001$) and Questionnaire of Smoking Urges ($P < 0.001$) in both the groups. Between-group comparison showed a statistically significant difference in all three smoking behavior assessments in the SG when compared to the CG after 10 days of intervention. **Conclusion:** The practice of MSRT might help in improving the lung function and also reduce the withdrawal symptoms, craving, urge, and negative affect among smokers. Hence, it can be explored as a low-cost, easy to self-administer, and adjuvant intervention in aiding smoking cessation among smokers.

Keywords: *Breath-holding time, mind sound resonance technique, pulmonary function test, smokers, yoga*

Introduction

An important global health issue is smoking cigarettes.[1] The World Health Organization (WHO) estimated in 2010 that tobacco use primarily smoking is responsible for 4.9 million premature deaths yearly.[2] The 1.3 billion tobacco users worldwide, or more than 80% of them, reside in low-and middle-income nations. In 2020, 36.7% of men and 7.8% of women consumed tobacco globally, accounting for 22.3% of the population.[3] Tobacco use has a disproportionately large negative impact on health in developing nations. According to estimates, between 2005 and 2030, tobacco use in these countries will kill almost 40 million people overall.[2] In India, the prevalence of tobacco usage among those aged 15 years and older was reported to be 37%.[4] Nearly, 6 million people die each year from tobacco use, and the WHO predicts that the number might rise to 8 million by 2030.[4,5]

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: WKHLRPMedknow_reprints@wolterskluwer.com

How to cite this article: Girishankara KS, Shetty S, Ramaswamy KA, Shetty P. Effect of mind sound resonance technique on pulmonary function and smoking behavior among smokers – A prospective randomized control trial. Int J Yoga 2024;17:222-31.

Submitted: 07-Jun-2024 **Accepted:** 17-Sep-2024
Published: 14-Dec-2024

Address for correspondence:
Dr. K. S. Moodala Girishankara, Sri Dharmasthala Manjunatheshwara Naturopathy and Yogic Sciences, Ujire, Karnataka, India.
E-mail: drshankara930@gmail.com

Access this article online

Website: https://journals.lww.com/IJOY

DOI: 10.4103/ijoy.ijoy_117_24

Quick Response Code:

© 2024 International Journal of Yoga | Published by Wolters Kluwer - Medknow

Smoking cigarettes has significant health problems, with respiratory and cardiovascular conditions accounting for the majority of cause-specific mortality.[6] To smoke tobacco, one draws smoke from burning tobacco into their mouth and, typically, their lungs.[7] The most common product smoked is cigarettes, although there are also alternative options such as cigars, cigarillos, pipes, and water pipes.[8] Lung cancer, coronary heart disease, and cerebrovascular disease account for most smoking-related deaths.[9] Smoking is a significant contributor to the risk of stroke, glaucoma, hearing loss, back pain, osteoporosis, and peripheral vascular disease.[7] Cigarette smoking has been causally linked to multiple diseases of the respiratory system such as chronic obstructive pulmonary disease (COPD), emphysema, chronic bronchitis, and asthma, which are the nonmalignant respiratory diseases that contribute substantially to the burden of morbidity and mortality.[10,11] Some previous studies have shown that smoking can affect pulmonary function,[12,13] including decreased forced vital capacity (FVC), forced expiratory volume in 1 s (FEV_1), FEV_1/FVC, and forced expiratory flow at 25%–75% (FEF25%–75%).[14]

Yoga comes from the Sanskrit root word "Yuj" which means union. Yoga is an ancient, traditional practice of holistic living that includes the practice of certain postures, controlled breathing, and meditation.[12] In the Western world, Yoga has gained popularity as a way to lessen the negative physical and psychological impacts of stress.[13] One of the essential symbols employed in the Yoga tradition is the combination of the letters A, U (O), and M, i.e. OM. OM represents the three levels of consciousness, waking state, dream state, and profound sleep, respectively.[15]

Mind sound resonance technique (MSRT) is developed by SVYASA to specifically strengthen the defense and willpower, thereby promoting health and happiness, combating cancer, AIDS, etc., and thus, improving the quality of life.[16] This technique is based on a powerful Mantra called Mahamrityunjaya Mantra that helps one to realize their true state of being and at the same time removes fear of death.[17] MSRT is one of the advanced Yoga-based relaxation techniques that uses Mantra to generate resonance which mainly works through Manomaya Kosha and induces deep relaxation to both the body and mind.[16] It can be practiced either in a sitting or prone position to improve relaxation and also overall well-being.[18]

One pilot research revealed that MSRT practice significantly reduced anxiety and improved psychomotor activity in individuals with generalized anxiety disorder right after the practice.[18] MSRT helps in reducing blood pressure and heart rate and also helps in reducing anxiety among hypertension individuals[19] and also improves the quality of sleep among the geriatric population,[20] reduces stress by improving vagal tone and stabilizes autonomic functions of the body,[17] reduces pain and disability,[21] and improves cognitive function.[20-22] Humming bee chanting[23,24] and OM chanting[23] help in improving lung function among healthy individuals. Nicotine withdrawal is known to directly or indirectly cause negative emotions,[25] and the relationship between negative affect and tobacco use is directional.

While some preliminary evidence suggests that chanting practices may improve lung function, there is a notable gap in the literature, as no studies have specifically examined the effects of MSRT on lung function. We also hypothesize that the relaxation effect produced by the MSRT practice, the effect of improved self-awareness, and stress reduction might help in reducing smoking urge and increase motivation to quit. Therefore, we planned to conduct the present study with the aim and objective to evaluate the effect of MSRT on pulmonary function and smoking behavior among smokers.

Objectives

The objectives of this study were to examine whether MSRT affects the pulmonary function among smokers and to examine whether MSRT significantly affects the smoking behaviors such as self-efficacy to quit smoking, smoking withdrawal symptoms, and the desire to smoke.

Methodology

Study design with recruitment strategy

This was a single-center, open-label, two-arm, parallel-group, prospective randomized control trial. The study was conducted from July 2023 to March 2024 at a nature cure and Yoga clinic in a rural area of South India. Participants provided written informed consent before commencing the study.

Sample size

The sample size was calculated using G*Power 3.1.9.4. (Developed by Erdfelder, Faul, Buchner (1996), Universität Düsseldorf, Germany). The required sample size was estimated *a priori*. Based on previous literature assuming a medium-to-large effect size of 0.71[24] for the primary outcome pulmonary function, a two-tailed, level 5% *t*-test requires a total of 35 patients per group to detect a respective group difference with a statistical power of 80%. Accounting for a potential loss of power from maximum of 10% dropouts, at least 80 participants will be recruited to the trial.

Recruitment and allocation

Prospective subjects were selected by perusing the outpatient records of visitors to our nature cure and Yoga clinic, who mentioned a history of smoking. They were invited to participate in the study by phone and through information letters sent by post. Subjects that proved eligible and expressed interest were further called for a screening visit. Figure 1 presents participant flow by

group. After screening 197 subjects, 80 eligible participants were recruited and randomly assigned (1:1) to the study group (SG) (MSRT) (n = 40) or control group (CG) (health education group) (n = 40).

Randomization

A chit randomization method was employed to assign participants to either the study or CG. A total of 80 chits were prepared in advance, with 40 chits labeled as "SG" and 40 as "CG." As each cohort of 8–10 participants was recruited, a technician, who was not involved in data collection or intervention administration, was asked to randomly select a chit. This chit revealed the participant's group allocation, ensuring random and unbiased assignment. The study comprised eight consecutive cohorts, one cohort starting every month.

Participants

Inclusion criteria

The following inclusion criteria would be the basis for selecting subjects.

Males in the age range of 18–60 years[26] who meet the criteria for moderate or above tobacco use disorder defined by the DSM-5[27] with smoking exposure of 5–10 pack-years.[14,28] If patient is suffering from anxiety neurosis,[18] insomnia,[18] and posttraumatic stress disorder, who understands the English language,[29] and be motivated to make a quit attempt during the intervention period. Subjects who are willing to participate in the study. Only male participants were included in this study, as demographic data from the rural setting where the study was conducted indicated that males constitute the majority of smokers. However, this gender-specific inclusion criterion may limit the generalizability of the findings, as the results may not fully apply to female smokers or populations in other settings where smoking prevalence differs across genders.

Exclusion criteria

The following subjects will be excluded from the study:

People who were using illegal substances,[30] suffering from COPD,[26] currently using anticraving medication,[31] reported current use of psychotropic medication such as antidepressants, antipsychotics, and/or anxiolytic medications.[31] Had a current diagnosis of heart disease such as coronary artery disease and arrhythmia and lung disease such as pneumonia, fibrosis of the lung, and emphysema. Reported a traumatic injury or acquired brain injury or a loss of consciousness for more than 30 min,[31] self-reported problematic drug(s) use other than tobacco, were currently practicing Yoga, and who were not speaking English.

Intervention

Study group

Mind sound resonance technique

The MSRT was conducted once a day with 25 min per session for 10 days in the department of Yoga therapeutics.

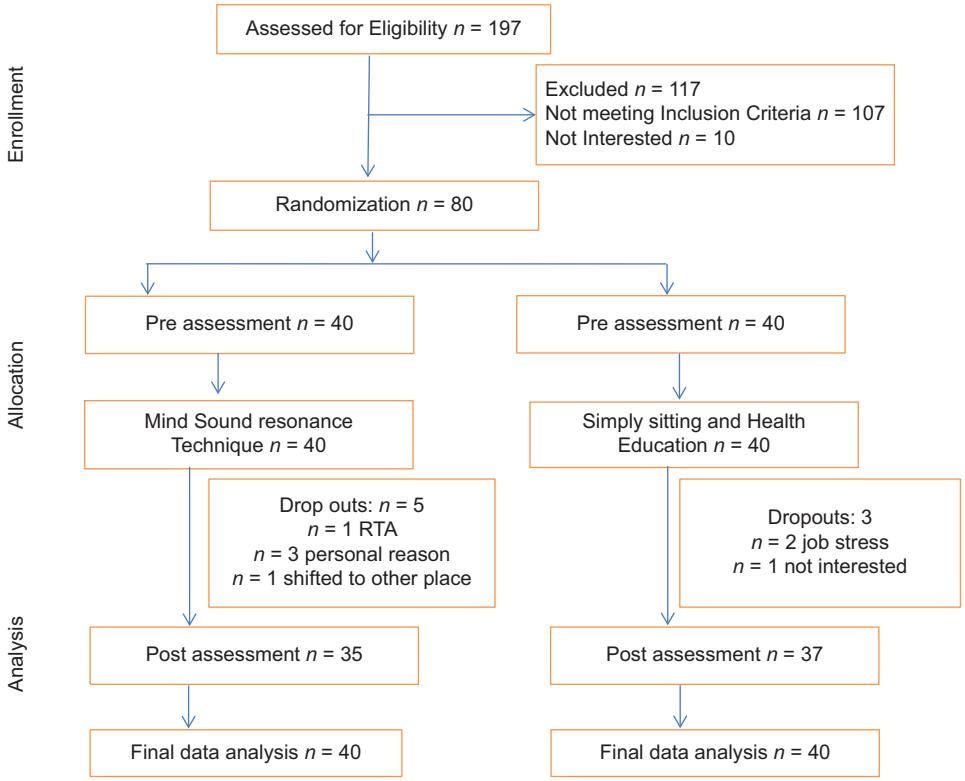

Figure 1: CONSORT flow diagram showing participants' flow

It was administered at the same time each day by a certified Yoga physician with a BNYS degree. The number of participants per group ranged from 8 to 10.

MSRT was developed by SVYASA to specifically strengthen the defense and the willpower, thereby promoting health and happiness, combating cancer, AIDS, etc., and thus, improving the quality of life. The practice of the Mahamrityunjaya Mantra and Pranava (AUM or OM) and its components (A, U, and M) is used in MSRT.

Briefly, the steps involved in MSRT are elucidated below:

Prayer:
- *OM. Tryambakam Yajamahe*
- *Sugandhim Pushtivardhanam*
- *Urvarukamiva Bandhanat*
- *Mrityor Mukshiya Mamritat.*

Meaning "OM We worship and adore you, O three-eyed one, O Shiva. You are sweet gladness, the fragrance of life, which nourishes us, restores our health, and causes us to thrive. As, in due time, the stem of the cucumber weakens, and the gourd is freed from the vine, so free us from attachment and death, and do not withhold immortality".

a. Loud chanting of A, U, M, and AUM (3 rounds). Feel complete body resonance
b. Āhata–Anāhata of A, U, M, and AUM next time A-, U-, and M–AUM (3 rounds). Feel the resonance even with Anāhata (mental) phase
c. Loud chanting of Mrityunjaya Mantra (MM)
d. Āhata–Anāhata of MM-, MM-, and MM- (3 rounds).

Anāhata AUM (9 rounds) and Ajapājapa AUM to silence (9 rounds). Stay in silence. Resolve, closing prayer (Shanti Mantra).[16]

Recorded audio tape was used for the session. During the practice of MSRT, if subjects feel the pain in the knee or ankle joint, they were advised to change their posture to any of their comfortable posture.

Control group

The SG received the MSRT that involves chanting and listening to both one's own chanting and the group's chanting sounds. To provide a comparable control condition, the CG was given health education for the same duration (25 min per day for 10 days). The health education lectures, delivered by the same Yoga physician who conducted the study intervention, allowed for passive listening, serving as a comparison to the active listening and engagement required in the MSRT. A potential drawback of this design is that while both the groups are exposed to an auditory experience, the content and engagement levels differ. The MSRT involves active participation and resonance with sound, whereas the CG experiences a more passive form of engagement through listening to a lecture. This difference in the level of engagement may influence outcomes related to attention and cognitive focus.

Outcomes

Outcomes were assessed at two time points: baseline T_0 and postintervention T_1 (10 days).

Primary outcome

Pulmonary function test

Spirometry was used to assess lung function.[32] The measure was assessed with the use of Contec SP10 handheld Spirometer which is a low-cost and convenient method for pulmonary function monitoring.[33,34] It was used to find the following measures:
- Forced vital capacity (FVC) expressed in liter
- Forced expiratory volume at 1 s (FEV_1) expressed in liter
- FEF25%–75% and peak expiratory flow (PEF) expressed in liter/second.

Maneuver was repeated thrice during each measurement, and the highest reading among all three acceptable readings was taken as the final value of that sitting.[35]

Secondary outcomes

a. Breath-holding time (BHT): The individual was seated, and he/she was asked to hold his/her breath. A timer was used to record the duration of the breath-hold until the participant was unable to do it on their own. Thus, the BHT was recorded.[36,37] Normal BHT is 45–55 s
   Smoking Abstinence Self-Efficacy Questionnaire (SASEQ): The SASEQ was developed using significant knowledge of smoking cessation interventions.[38] Two dimensions make up the eight-item self-efficacy subscale: Four items describe "social" situations and four items describe "emotional" situations. Based on face validity, two things were removed: "going out with friends," which depicts the same circumstance as "being at a café or at a party," and another emotional item ("feeling bored"), which is substantially distinct from the other emotional items: irritated, furious, and depressed.[39] The remaining six items describe situations in which smokers can indicate on a 5-point Likert scale (0–4) whether they will be able to stop from smoking. The higher the score, the greater the level of self-efficacy in quitting the smoking. The SASEQ scale has a range of 0–24[40]
b. Minnesota Tobacco Withdrawal Revised Scale (MTWS-Revised): The Minnesota Nicotine or Tobacco Withdrawal Scale.[41] The Self-Report Scale contains 15 items and is the most used tool for assessing cigarette withdrawal[42] along with its revised version (MNWS-R), which includes seven additional parameters (i.e., inpatient, constipation, cough, dizziness, dreams or nightmares, nausea, and sore throat)[43,44]
c. Brief Questionnaire of Smoking Urges (QSU-Brief): Smoking desires have been evaluated using the Questionnaire of Smoking Urges.[45] Included a 10-item QSU-Brief questionnaire in the study.[46,47] It

takes <2 min to finish. The QSU-Brief consists of two distinct factors, the first of which is defined by the purpose and desire to smoke and the second by the need to smoke urgently to relieve bad feelings.[46]

Statistical analysis

Analysis of endpoints was based on the principle of intention-to-treat basis using the R and jamovi software (The jamovi project (2022). jamovi. [Version 2.3]. Retrieved from https://www.jamovi.org.). The descriptive statistics were done, and demographic variables were expressed as frequency graphs. Missing data analysis was done by Little's MCAR test, and data were found to be missing at random. Missing values were multiply imputed by chained equations with five iterations by predictive mean matching method for continuous variables and logistic regression method for categorical variables. All data were analyzed for normality by Shapiro–Wilk's test. Pulmonary function variables and BHT were found to be normally distributed. Hence, for these variables, within-group analysis was done by paired *t*-test and between-group analysis by independent samples *t*-test. Smoking behavior assessment scales were not normally distributed. Hence, for these variables, within-group analysis was done by Wilcoxin's signed-rank test and between-group analyses by Mann–Whitney *U*-test. $P < 0.05$ was considered statistically significant.

Results

Of 80 smoking individuals, only 72 subjects completed the study [Figure 1]. No adverse events were observed during the study period. The final analysis was done by intention-to-treat method. The mean ± standard deviation age in the MSRT group was 40.85 ± 6.48 years, whereas in the CG was 38.37 ± 5.99 years. Table 1 shows the anthropometric, resting cardiovascular parameters, Perceived Stress Score, and pack-year in the MSRT group and CG. Figure 2 shows smoking intensity. Overall, Group 1 (MSRT group) has shown significant changes in both physiological and psychometric scales across all variables in comparison to Group 2 (CG).

Baseline pulmonary function test parameters [Table 2], in both the groups, did not show any significant difference. The Student's paired *t*-test was used to find the changes within the group. The intervention group has shown statistical significance ($P < 0.001$), and within the group analysis in the CG did not show any significant changes except FEV_1 ($P = 0.002$). The independent *t*-test was used to find the changes in-between the two groups. It showed significant ($P < 0.05$) improvement in all the lung function parameters such as FVC ($P < 0.001$), FEV_1 ($P < 0.01$), FEV_1/FVC ratio ($P = 0.039$), peak expiratory flow rate (PEFR) ($P < 0.001$), and FEF75%-25% ($P < 0.001$) in the MSRT group after 10 days of practice.

The psychometric parameters [Table 3], SASEQ, Minnesota Tobacco Withdrawal Revised Scale (MTWS-Revised), and QSU-Brief were not normally distributed. Wilcoxon signed-rank test within the group. SASEQ has shown significant improvement ($P < 0.001$) in both the SG and CG. QSU-Brief scale and MTWS-Revised few categorical data have shown significant improvement ($P < 0.001$) in both SG and CG [Table 3]. Mann–Whitney *U*-test was used between the groups, which showed significant ($P < 0.05$) improvement in all the parameters in the MSRT group compared to the CG after 10 days of practice.

Discussion

The present study was conducted to see the effect of MSRT on pulmonary function and smoking behavior among smokers. The results confirmed our hypotheses, and the practice of MSRT had a significant effect on improving

Table 1: Baseline characteristics of the subjects in the intervention and control groups

Variables	Intervention group	CG
Age	40.85±6.482862	38.375±5.998698
Height (cm)	169.45±4.521891	166.6±5.180734
Weight (kg)	80.825±10.03466	77.45±5.674284
BMI (kg/m^2)	28.1025±2.9607	27.9375±2.076378
SBP (mmHg)	131.2±5.38145	126.5±5.705261
DBP (mmHg)	83.55±3.361175	81.4±4.079216
Pulse rate (bpm)	78±6.870226	78.25±5.919248
Respiratory rate (cpm)	16.45±1.580348	16.975±1.680588
Perceived stress level (total score)	22.85±2.185749	22.75±2.266605
Cigarettes per day	13.775±2.867817	12.725±2.20213
Years of smoking	12.15±3.525266	12.025±2.079513
Smoking exposure (pack-years)	7.9875±1.271453	7.51875±1.17509

Data expressed mean±SD. BMI: Body mass index, SBP: Systolic blood pressure, DBP: Diastolic blood pressure, bpm: Beats per min, cpm: Cycle per min, SD: Standard deviation, CG: Control group

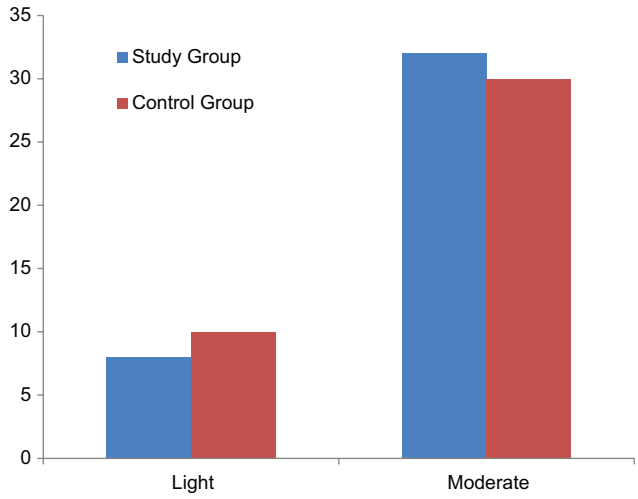

Figure 2: Smoking intensity in the study and control groups. The blue color indicates the study group and the red color indicates the control group

Table 2: Baseline (T_0) and posttest (T_1) assessment with statistical analysis within (Student's paired *t*-test) and between (independent *t*-test) intervention and comparator group

Variables	SG		Within the group (Student's paired *t*-test)	CG		Within the group (Student's paired *t*-test)	Between the group (independent *t*-test)	Effect size
	Pre, mean±SD	Post, mean±SD*	*P* value*	Pre, mean±SD	Post, mean±SD	*P* value*	*P* value#	Cohend
FVC (L)	3.12875±0.416924	4.09±0.355206	<0.001**	2.98175±0.414861	2.74167±0.373403	0.007	<0.001##	−2.852
FEV_1 (L)	2.83925±0.350994	3.894857±0.361697	<0.001**	2.87325±0.394775	2.659722±0.332052	0.002*	<0.001##	−3.012
FEV_1/FVC (%)	90.56675±6.45135	94.39971±3.176269	<0.001**	96.7675±4.907136	97.32056±4.116075	0.763	0.039#	0.469
PEF (L/s)	7.083±1.509916	10.85714±1.280401	<0.001**	7.8635±1.303019	7.210556±1.170479	0.149	<0.001##	−1.916
FEF25%–75% (L/s)	3.435±0.839774	5.100857±0.75361	<0.001**	4.04025±1.224284	3.769444±1.148298	0.731	<0.001##	−0.909
BHT (s)	34.1±4.4156	61.2±4.880281	<0.001**	37.25±5.038601	37.02778±4.986014	0.082	<0.001##	−2.282

#P<0.05- significant, ##P<0.001-highly significant, P<0.05*- significant P<0.001**- highly significant. Values expressed as mean±standard deviation. FVC: Forced vital capacity, FEV1: Forced expiratory volume in 1 s, PEF: Peak expiratory flow rate, FEF 25%–75%: Forced expiratory flow

pulmonary function, reducing smoking urges, and its withdrawal symptoms. The results are in concurrence with previous studies with similar findings.

One study that evaluated the effect of Bhramari pranayama for a period of 12 weeks on healthy individuals found improvement in all the lung function parameters such as FVC, FEV_1, FEV_1/FVC ratio, FEV 25%–75%, PEFR, maximal voluntary ventilation, and slow vital capacity.[25] Another study showed Bhramari pranayama and OM chanting for 10 min per day, for a period of 2 weeks, significantly increased the PEF, FEF25%, and MVV but did not find any significant improvement in FVC, FEV_1, and FEV_1/FVC ratio.[23] A study showed that 16 weeks of Yoga practice for people working in industrial areas significantly improved their lung function parameters such as FVC, FEV_1, and PEFR.[48] Regular pranayama practitioners may notice a significant improvement in the FVC due to the strengthening of their inspiration and expiration of respiratory muscles.[49] A deep breathing practice for a short duration of 2–10 min had an impact on improving FVC, forced inspiratory vital capacity, and PEFR.[50]

Slow and deep breathing exercises when practiced on a regular basis enhance flexibility and chest muscle strength due to work hypertrophy.[51] In deep yogic breathing, the lungs get inflated to their maximum capacity by releasing surfactants and prostaglandins into the alveolar space. Hence, overall lung capacity and volume increase as a result of decreased bronchial smooth muscle tone and increased lung compliance.[51,52] Deep breathing activates stretch receptors that reduce tone in the tracheobronchial smooth muscle, which in turn reduces air resistance, increases airway diameter, and increases PEFR.[53] These mechanisms might explain the current results in our study since the practice of MSRT involves deep yogic breathing and chanting.

Our study also showed a statistically significant improvement (P < 0.01) in the BHT. Improvement in BHT is consistent with the previous studies.[54,55] Fifteen days of regular practice of pranayama and meditation significantly improved chest expansion, BHT, and PEFR.[55] Stretch receptors in the alveoli are stimulated during regular breathing after a certain amount of stretching, and this information is sent to the respiratory centers to trigger exhalation. The inhalation phase of deep breathing, or pranayama, is continued with strong voluntary control, allowing the lungs to expand significantly and the alveolar walls to stretch to their maximum extent. The chest continues to expand under the control of the cerebral cortex. As a result, the stretch receptors become increasingly capable of withstanding stretching. This facilitates prolonged breath-holding.[56]

In the current study, there was also a significant change in SASEQ, QSU-Brief, and MTWS-Revised in the SG compared to the CG, indicating a change in smoking

Table 3: Baseline (T_0) and posttest (T_1) assessment with statistical analysis within (Wilcoxon's signed-rank test) and between (Mann–Whitney *U*-test) intervention and comparator group

Variables	SG		Within the group (Wilcoxon's signed-rank test)	CG		Within the group (Wilcoxon's signed-rank test)	Between the group (Mann–Whitney *U*-test)	Effect size
	Pre, mean±SD	Post, mean±SD*	*P* value*	Pre, mean±SD	Post, mean±SD	*P* value*	*P* value#	Rank-biserial correlation
SASEQ	8.425±1.855903	9.8±2.063977	<0.001**	15.91429±2.247175	8.194444±1.838167	<0.001**	<0.001##	0.870
QSU-Brief								
I have a desire for a cigarette right now	4.1±0.7	1.828571±0.608779	<0.001**	4.15±0.691014	5.444444±0.598352	<0.001**	<0.001##	0.941
Nothing would be better than smoking a cigarette right now	4.45±0.668954	1.971429±0.696346	<0.001**	4.425±0.737818	5.4±0.598352	0.003*	<0.001##	0.787
If it were possible, I would smoke now	4.9±0.734847	2.057143±0.629869	<0.001**	4.8±0.734847	5.777778±0.785674	<0.001**	<0.001##	0.789
I could control things better right now if I could smoke	4.575±0.703118	2.085714±0.691641	<0.001**	4.825±0.833292	5.72±0.691661	0.003*	<0.001##	0.863
All I want now is a cigarette	4.7±0.714143	1.885714±0.666395	<0.001**	4.65±0.792149	5.583333±0.794949	0.003*	<0.001##	0.806
I have an urge for a cigarette	4.6±0.6245	2.085714±0.603392	<0.001**	4.775±0.688749	5.777778±0.711458	<0.001**	<0.001##	0.907
A cigarette would taste good now	4.5±0.67082	2.142857±0.59247	<0.001**	4.85±0.88176	6±0.414039	0.002*	<0.001##	0.872
I would do almost anything for a cigarette now	4.525±10.741198	1.971429±0.65403	<0.001**	4.525±0.894078	5.555556±0.761739	<0.001**	<0.001##	0.941
Smoking would make me less depressed	5.375±0.578252	2.085714±0.438923	<0.001**	5.325±0.754569	6.027778±0.440083	0.049*	<0.001##	0.799
I am going to smoke as soon as possible	4.8±0.678233	2.142857±0.638877	<0.001**	4.7±0.678233	6±0.527046	<0.001**	<0.001##	0.732
MTWS-revised								
Angry, irritable, and frustrated	3.2±0.781025	0.657143±0.474664	<0.001**	3.05±0.630476	3.22±0.67128	0.941	<0.001##	0.866
Anxious and nervous	2.825±0.862772	0.714286±0.564241	<0.001**	2.925±0.720677	3.1111±0.698323	0.416	<0.001##	0.863
Depressed mood and sad	3.15±0.88176	0.657143±0.531459	<0.001**	2.525±0.670354	2.6944±0.659101	1.000	<0.001##	0.750
Desire or craving to smoke	2.9±0.830662	0.457143±0.647759	<0.001**	2.975±0.724137	2.944444±0.704921	0.140	<0.001##	0.798
Difficulty concentration	2.825±0.862772	0.628571±0.483187	<0.001**	2.15±0.653835	2.194444±0.699978	1.000	<0.001**	0.834
Increased appetite, hungry, and weight gain	2.6±0.943398	0.742857±0.647759	<0.001**	2.07±0.84816	2.055556±0.779759	1.000	<0.001**	0.728
Insomnia, sleep problems, and awakening at night	2.675±1.034106	0.628571±0.539085	<0.001**	2.05±1.047616	2.055556±1.104145	1.000	<0.001##	0.556
Restless	2.3±0.842615	0.342857±0.582745	<0.001**	1.375±0.73101	1.472222±0.798822	0.901	<0.001##	0.603
Impatient	2.3±0.81244	0.285714±0.451754	<0.001**	1.325±0.87714	1.305556±0.937474	0.286	<0.001##	0.427

Contd...

Table 3: Contd...

Variables	SG			CG				Effect size
	Pre, mean±SD	Post, mean±SD*	Within the group (Wilcoxon's signed-rank test) *P* value*	Pre, mean±SD	Post, mean±SD	Within the group (Wilcoxon's signed-rank test) *P* Value*	Between the group (Mann–Whitney *U*-test) *P* Value#	Rank-biserial correlation
Constipation	1.6±1.090871	0.285714±0.451754	<0.001**	1.075±0.84816	1.194444±0.937474	0.152	<0.001##	0.532
Dizziness	1.45±1.094303	0.2±0.4	<0.001**	0.85±0.763257	0.972222±0.763257	0.235	<0.001##	0.449
Coughing	1.85±1.130265	0.257143±0.437059	<0.001**	1.275±0.670354	1.305556±0.568597	0.608	<0.001##	0.646
Dreaming or nightmares	1.8±1.28841	0.342857±0.474664	<0.001**	1.075±0.787004	1.027778±0.798822	0.345	<0.001##	0.359
Nausea	1.3±0.9	0.057143±0.232115	<0.0010**	1.2±0.798822	1.194444±0.810331	0.186	<0.001##	0.568
Sore throat	1.675±1.104253	0.285714±0.451754	<0.001**	1.55±0.739932	1.666667±0.745356	0.219	<0.001##	0.795

#P<0.05- significant, ##P<0.001- highly significant, P<.05*- significant, P<0.001**- highly significant. Values expressed as mean±standard deviation. SASEQ: Smoking Abstinence Self-Efficacy Questionnaire, MTWS-revised: Minnesota Tobacco Withdrawal Revised Scale, QSU-Brief: Brief Questionnaire of Smoking Urges, SD: Standard Deviation, SG: Study Group, CG: Control Group

behavior. Previous literature supports this finding. Yoga combined with cognitive behavioral therapy for a period of 8 weeks, helped in encouraging smoking cessation, in both men and women. Not only they stopped smoking but also their level of confidence in quitting smoking improved, by reducing anxiety and improving quality of life.[57,58] Another study concluded that practicing of aerobic exercise and Hatha Yoga helps in reducing craving, increasing positive affect, and decreasing negative affect. While those who participated in Hatha Yoga reported an overall decrease in cravings, those who participated in cardiac exercise specifically reported a reduction in cravings in response to smoking cues.[54]

Another study compared mindfulness training (MT) with Freedom From Smoking, a conventional smoking cessation workshop. It concluded that MT had a greater reduction in smoking than the standardized smoking cessation treatment.[55] Another evaluated a mobile MT-experience sampling Craving to Quit program on smoking cessation and showed that it was effective in reducing smoking, reducing cravings, and increasing mindfulness.[59]

Neuroimaging studies on Yoga practitioners have shown an increase in the activity of the anterior cingulate gyrus and prefrontal cortex of the brain, which are the areas of the brain related to self-control.[59] This could be the mechanism by which Yoga helps in coping with addiction symptoms such as impaired self-awareness, bingeing, withdrawal, and managing emotional dysregulation.[57,58,60]

To the best of our knowledge, this is the first Yoga-based relaxation technique that has been administered on smokers, and outcomes assessed were pulmonary function and subjective variables such as SASEQ, Minnesota Tobacco Withdrawal Revised Scale (MTWS-Revised), and Brief sQSU-Brief. The acceptance of Yoga intervention was high among the study population, and none of them attempted to smoke during the study period.

One of the major limitations of the study was the duration was very short, limited to 10 days, and the lack of follow-up. We also did not have a waitlist CG due to lack of resources; hence, the CG could not get the benefit of the study. Larger multicenter studies with longer follow-ups are needed to explore the effect of MSRT on smokers, in more diverse populations across the country.

Conclusion

The present study found that the practice of MSRT (a Yoga-based relaxation technique) helps in improving the pulmonary function and BHT and also reduces the withdrawal symptoms, craving, smoking urge, and negative affect. Hence, we conclude that MSRT is a feasible intervention for improving the pulmonary function and regulating smoking behavior among smokers.

Ethical considerations

The study was approved by Institutional Ethics Committee of SDM College of Naturopathy and Yogic Sciences (vide EC Approval No EC537). CTRI Registration number (CTRI/2023/06/053878).

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Benjakul S, Termsirikulchai L, Hsia J, Kengganpanich M, Puckcharern H, Touchchai C, *et al.* Current manufactured cigarette smoking and roll-your-own cigarette smoking in Thailand: Findings from the 2009 Global Adult Tobacco Survey. BMC Public Health 2013;13:277.
2. Shaikh R, Janssen F, Vogt T. The progression of the tobacco epidemic in India on the national and regional level, 1998-2016. BMC Public Health 2022;22:317.
3. Tobacco. Available from: https://www.who.int/news-room/fact-sheets/detail/tobacco. [Last accessed on 2024 Apr 10].
4. Rani M, Bonu S, Jha P, Nguyen SN, Jamjoum L. Tobacco use in India: Prevalence and predictors of smoking and chewing in a National Cross Sectional Household Survey. Tob Control 2003;12:e4.
5. Singh A, Ladusingh L. Prevalence and determinants of tobacco use in India: Evidence from recent Global Adult Tobacco Survey data. PLoS One 2014;9:e114073.
6. Tantisuwat A, Thaveeratitham P. Effects of smoking on chest expansion, lung function, and respiratory muscle strength of youths. J Phys Ther Sci 2014;26:167-70.
7. West R. Tobacco smoking: Health impact, prevalence, correlates and interventions. Psychol Health 2017;32:1018-36.
8. Critchley JA, Unal B. Health effects associated with smokeless tobacco: A systematic review. Thorax 2003;58:435-43.
9. Kenfield SA, Wei EK, Rosner BA, Glynn RJ, Stampfer MJ, Colditz GA. Burden of smoking on cause-specific mortality: Application to the Nurses' Health Study. Tob Control 2010;19:248-54.
10. Burchfiel CM, Marcus EB, Curb JD, Maclean CJ, Vollmer WM, Johnson LR, *et al.* Effects of smoking and smoking cessation on longitudinal decline in pulmonary function. Am J Respir Crit Care Med 1995;151:1778-85.
11. Urrutia I, Capelastegui A, Quintana JM, Muñiozguren N, Basagana X, Sunyer J, *et al.* Smoking habit, respiratory symptoms and lung function in young adults. Eur J Public Health 2005;15:160-5.
12. Vempati RP, Telles S. Yoga-based guided relaxation reduces sympathetic activity judged from baseline levels. Psychol Rep 2002;90:487-94.
13. Field T. Yoga clinical research review. Complement Ther Clin Pract 2011;17:1-8.
14. Kuperman AS, Riker JB. The variable effect of smoking on pulmonary function. Chest 1973;63:655-60.
15. Kumar S, Nagendra H, Manjunath N, Naveen K, Telles S. Meditation on OM: Relevance from ancient texts and contemporary science. Int J Yoga 2010;3:2-5.
16. Nagendra HR. Mind Sound Resonance Technique. Bangalore: Swami Vivekananda Yoga Prakashana; 2001. p. 59-60.
17. Nikkam V, Shetty S, Shetty S. Effect of mind sound resonance technique on autonomic variables in occupational stress individuals – A randomized controlled trial. JETIR 2018;5:555-61.
18. Dhansoia V, Bhargav H, Metri K. Immediate effect of mind sound resonance technique on state anxiety and cognitive functions in patients suffering from generalized anxiety disorder: A self-controlled pilot study. Int J Yoga 2015;8:70-3.
19. Wang Y, Metri KG, Singh A, Raghuram N. Immediate effect of mind sound resonance technique (MSRT – A yoga-based relaxation technique) on blood pressure, heart rate, and state anxiety in individuals with hypertension: A pilot study. J Complement Integr Med 2018;17:20170177.
20. Dhanjani S, Vijayakumar PS, Sahana AU. Effect of MSRT mind sound resonance technique on quality of sleep in geriatric population. Int J Yoga Allied Sci 2018;7:87-92. Available from: https://indianyoga.org/wp-content/uploads/2018/03/v7-issue2-article2.pdf. [Last accessed on 2024 May 24].
21. Yogitha B, Nagarathna R, John E, Nagendra H. Complimentary effect of yogic sound resonance relaxation technique in patients with common neck pain. Int J Yoga 2010;3:18-25.
22. Anusuya US, Mohanty S, Saoji AA. Effect of mind sound resonance technique (MSRT – A yoga-based relaxation technique) on psychological variables and cognition in school children: A randomized controlled trial. Complement Ther Med 2021;56:102606.
23. Mooventhan A, Khode V. Effect of Bhramari Pranayama and OM chanting on pulmonary function in healthy individuals: A prospective randomized control trial. Int J Yoga 2014;7:104-10.
24. Kuppusamy M, Dilara K, Ravishankar P, Julius A. Effect of Bhrāmarī Prāṇāyāma practice on pulmonary function in healthy adolescents: A randomized control study. Anc Sci Life 2017;36:196-9.
25. Carmody TP, Vieten C, Astin JA. Negative affect, emotional acceptance, and smoking cessation. J Psychoactive Drugs 2007;39:499-508.
26. Webb J, Peerbux S, Smittenaar P, Siddiqui S, Sherwani Y, Ahmed M, *et al.* Preliminary outcomes of a digital therapeutic intervention for smoking cessation in adult smokers: Randomized controlled trial. JMIR Ment Health 2020;7:e22833.
27. Baker TB, Breslau N, Covey L, Shiffman S. DSM criteria for tobacco use disorder and tobacco withdrawal: A critique and proposed revisions for DSM-5. Addiction 2012;107:263-75.
28. Bhatt SP, Kim YI, Harrington KF, Hokanson JE, Lutz SM, Cho MH, *et al.* Smoking duration alone provides stronger risk estimates of chronic obstructive pulmonary disease than pack-years. Thorax 2018;73:414-21.
29. Shah MR, Zala K. Effectiveness of mind sound resonance technique versus progressive muscle relaxation in common neck pain individuals: A comparative study. Int J Health Sci Res 2019;9:62-7. Available from: https://www.ijhsr.org/IJHSR_Vol.9_Issue.4_April2019/IJHSR_Abstract.011.html. [Last accessed on 2024 May 25].
30. Mégarbane B, Chevillard L. The large spectrum of pulmonary complications following illicit drug use: Features and mechanisms. Chem Biol Interact 2013;206:444-51.
31. Staiger PK, Hayden MJ, Guo K, Hughes LK, Bos J, Lawrence NS. A randomised controlled trial examining the efficacy of smoking-related response inhibition training in smokers: A study protocol. BMC Public Health 2018;18:1226.
32. Gold WM, Koth LL. Pulmonary Function Testing. In: Murray and Nadel's Textbook of Respiratory Medicine. Amsterdam: Elsevier Publisher; 2016. p. 407-35.e18. Available from: https://

www.ncbi.nlm.nih.gov/pmc/articles/PMC7158317/. [Last accessed on 2024 May 25].
33. Xu Q, Fang Y, Jing Q, Hu N, Lin K, Pan Y, *et al*. A portable triboelectric spirometer for wireless pulmonary function monitoring. Biosens Bioelectron 2021;187:113329.
34. Mgbemena N, Jones A, Leicht A. Assessment of inter-instrument reliability for dominant handgrip dynamometry and spirometry. Internet J Allied Health Sci Pract 2022;20:8.
35. Miller MR, Hankinson J, Brusasco V, Burgos F, Casaburi R, Coates A, *et al.* Standardisation of spirometry. Eur Respir J 2005;26:319-38.
36. Shankarappa V, Prashanth P, Annamalai N, Malhotra V. The short term effect of pranayama on the lung parameters. Clin Diagn Res 2012;6:27-30. Available from: https://www.academia.edu/download/102759570/6_20-_203476.A.pdf. [Last accessed on 2024 May 25].
37. Sütterlin S, Schroijen M, Constantinou E, Smets E, Van den Bergh O, Van Diest I. Breath holding duration as a measure of distress tolerance: Examining its relation to measures of executive control. Front Psychol 2013;4:483.
38. De Vries H, Mudde AN, Dijkstra A, Willemsen MC. Differential beliefs, perceived social influences, and self-efficacy expectations among smokers in various motivational phases. Prev Med 1998;27:681-9.
39. Dijkstra A, De Vries H, Roijackers J. Computerized tailored feedback to change cognitive determinants of smoking: A Dutch field experiment. Health Educ Res 1998;13:197-206.
40. Spek V, Lemmens F, Chatrou M, van Kempen S, Pouwer F, Pop V. Development of a smoking abstinence self-efficacy questionnaire. Int J Behav Med 2013;20:444-9.
41. Hughes JR, Hatsukami D. Signs and symptoms of tobacco withdrawal. Arch Gen Psychiatry 1986;43:289-94.
42. Etter JF, Ussher M, Hughes JR. A test of proposed new tobacco withdrawal symptoms. Addiction 2013;108:50-9.
43. West R, Ussher M, Evans M, Rashid M. Assessing DSM-IV nicotine withdrawal symptoms: A comparison and evaluation of five different scales. Psychopharmacology (Berl) 2006;184:619-27.
44. Svicher A, Beghè A, Mangiaracina G, Cosci F. Factor analysis and psychometric properties of the minnesota nicotine withdrawal scale and the minnesota nicotine withdrawal scale-revised: Italian version. Eur Addict Res 2017;23:157-62.
45. Cox LS, Tiffany ST, Christen AG. Evaluation of the brief questionnaire of smoking urges (QSU-brief) in laboratory and clinical settings. Nicotine Tob Res 2001;3:7-16.
46. Toll BA, Katulak NA, McKee SA. Investigating the factor structure of the questionnaire on smoking urges-brief (QSU-Brief). Addict Behav 2006;31:1231-9.
47. West R, Ussher M. Is the ten-item questionnaire of smoking urges (QSU-brief) more sensitive to abstinence than shorter craving measures? Psychopharmacology (Berl) 2010;208:427-32.
48. Rajbhoj PH, Pathak SD, Patil SN. The effects of yoga practice on lung function and sIL-2R Biomarkers in individuals working and living in the lonavala industrial area: A randomized controlled trial. Indian J Occup Environ Med 2023;27:159-65.
49. Halder K, Chatterjee A, Kain TC, Pal R, Tomer OS, Saha M. Improvement in ventilatory function through yogic practices. Al Ameen J Med Sci 2012;5:197-202.
50. Sivakumar G, Prabhu K, Baliga R, Pai MK, Manjunatha S. Acute effects of deep breathing for a short duration (2-10 minutes) on pulmonary functions in healthy young volunteers. Indian J Physiol Pharmacol 2011;55:154-9.
51. Mandanmohan, Jatiya L, Udupa K, Bhavanani AB. Effect of yoga training on handgrip, respiratory pressures and pulmonary function. Indian J Physiol Pharmacol 2003;47:387-92.
52. Yadav RK, Das S. Effect of yogic practice on pulmonary functions in young females. Indian J Physiol Pharmacol 2001;45:493-6.
53. Ankad Roopa B, Ankad Balachandra S, Herur Anita PS, Chinagudi Surekharani GV. Effect of short term pranayama and meditation on respiratory parameters in healthy individuals. Int J Collab Res Intern Med Public Health 2011;3:430-7.
54. Elibero A, Janse Van Rensburg K, Drobes DJ. Acute effects of aerobic exercise and Hatha yoga on craving to smoke. Nicotine Tob Res 2011;13:1140-8.
55. Brewer JA, Mallik S, Babuscio TA, Nich C, Johnson HE, Deleone CM, *et al.* Mindfulness training for smoking cessation: Results from a randomized controlled trial. Drug Alcohol Depend 2011;119:72-80.
56. Ankad RB, Herur A, Patil S, Shashikala GV, Chinagudi S. Effect of short-term pranayama and meditation on cardiovascular functions in healthy individuals. Heart Views 2011;12:58-62.
57. Elwafi HM, Witkiewitz K, Mallik S, Thornhill TA 4th, Brewer JA. Mindfulness training for smoking cessation: Moderation of the relationship between craving and cigarette use. Drug Alcohol Depend 2013;130:222-9.
58. Gard T, Noggle JJ, Park CL, Vago DR, Wilson A. Potential self-regulatory mechanisms of yoga for psychological health. Front Hum Neurosci 2014;8:770.
59. Garrison KA, Pal P, O'Malley SS, Pittman BP, Gueorguieva R, Rojiani R, *et al.* Craving to quit: A randomized controlled trial of smartphone app-based mindfulness training for smoking cessation. Nicotine Tob Res 2020;22:324-31.
60. de Souza IC, de Barros VV, Gomide HP, Miranda TC, Menezes Vde P, Kozasa EH, *et al.* Mindfulness-based interventions for the treatment of smoking: A systematic literature review. J Altern Complement Med 2015;21:129-40.