



## Letter

## Effect of high-frequency yoga breathing on pulmonary functions in patients with asthma

### A randomized clinical trial

Bronchial asthma is one of the most common respiratory disorders with significant morbidity and mortality. Patients with asthma experience declined lung function. Among patients with asthma, forced expiratory volume in 1 second (FEV<sub>1</sub>), forced vital capacity (FVC), and FEV<sub>1</sub>/FVC ratio were found to be lower than in age- and height-matched healthy individuals.<sup>1</sup> To arrest the decline in ventilatory function is one of the major objectives of management of asthma.

Yoga has been used to manage asthma in several clinical trials. A recent Cochrane review found yoga useful in alleviating symptoms of asthma and improving the quality of life.<sup>2</sup> However, there is lack of empirical studies on the effect of specific yoga practices on lung functions in patients with asthma.

Kapalabhati is a technique described in the traditional texts of yoga indicated for phlegm-related diseases, such as bronchial asthma and other respiratory disorders.<sup>3</sup> The practice of kapalabhati has been found to enhance pulmonary functions.<sup>4</sup> It has also been used in combination with other yoga practices for asthma in most earlier clinical trials.<sup>5,6</sup> We evaluated the immediate effects of kapalabhati on lung function among patients with mild and moderate asthma, comparing it with deep breathing with breath awareness.

This was a single-center, randomized, prospective, controlled study performed at an inpatient yoga and naturopathy facility from South India. After screening 78 patients with clinician-diagnosed asthma, 60 patients were recruited for the study. A total of 35 men and 25 women, with the mean (SD) age of 31.5 (8.23) years, were included in the study. We included patients from the age group of 20 to 50 years to restrict the study population to adults. Patients with severe asthma (predicted FEV<sub>1</sub> ≤60%) and any other respiratory disorders that influence pulmonary function or a prior history of abdominal or thoracic surgery were excluded from the study. Individuals with a history of tobacco smoking were excluded because smoking exacerbates symptoms and restrict the lung functions. The demographic data of the subjects are given in Table 1. All the patients were trained in the practice of kapalabhati for a period of 10 min/d for 1 week before they were randomly assigned to different groups.

The patients were randomly assigned to experimental (18 men and 12 women) and control (17 men and 13 women) groups using random numbers generated by a computer-based program ([www.randomizer.org](http://www.randomizer.org)) with a 1:1 ratio. The protocol of the study was reviewed and approved by the institutional ethics committee of the SDM College of Naturopathy and Yogic Sciences, Ujire,

India. Informed written consent was obtained from each patient before the commencement of the intervention.

The practice of kapalabhati included breathing at 1 Hz in which the exhalations are kept as an intentionally active process. The participants were asked to sit in cross-legged position, keeping the back erect. On the assessment day, the experimental group practiced kapalabhati for 10 minutes. The practice was repeated, giving a break of half a minute between 2 bouts of practice. The control group practiced deep breathing at 6 breaths per minute for the same duration, maintaining awareness on the nostrils. The assessments were performed before and immediately after the practice.

On the day of assessment, the patients were asked to evacuate the bowels and bladder and restrain from consuming food for at least 2 hours before recording. The participants were also restrained from the use of all bronchodilators for at least 24 hrs before assessment. Spirometry was performed using the BIOPAC MP36 system ([www.biopac.com](http://www.biopac.com)). Three recordings were averaged to obtain the values of FEV<sub>1</sub> (liters), FVC (liters), and FEV<sub>1</sub>/FVC ratio.

The data were analyzed using SPSS statistical software, version 16 (SPSS Inc, Chicago, Illinois). The means of preintervention and postintervention values in each group were analyzed using the paired-samples *t* test, and the between-group comparisons for the postintervention values were made using the independent-samples *t* test. The data were found to be normally distributed (Shapiro-Wilk test). The within-group analyses revealed a significant increase in FEV<sub>1</sub> (1.91 [0.31] to 2.12 [0.35]; *t* = −8.149; *P* < .001), FVC (2.62 [0.68] to 2.70 [0.57]; *t* = −2.438; *P* < .05) and FEV<sub>1</sub>/FVC ratio (0.75 [0.12] to 0.80 [0.10]; *t* = −4.232; *P* < .001) in the kapalabhati group. None of the variables had a significant change in the deep breathing group. The between-group analyses revealed a significant difference between the postintervention values of FEV<sub>1</sub> (*t* = 2.319, *P* < .05) and FEV<sub>1</sub>/FVC ratio (*t* = 2.173, *P* < .05). The results are summarized in Table 2.

**Table 1**  
Demographic Data of the Study Participants

| Demographic                                          | Experimental group<br>(n = 30) | Control group<br>(n = 30) | Total<br>(N = 60) |
|------------------------------------------------------|--------------------------------|---------------------------|-------------------|
| Male/female                                          | 18/12                          | 17/13                     | 35/25             |
| Age, mean (SD), y                                    | 31.8 (8.47)                    | 31.1 (8.11)               | 31.5 (8.23)       |
| Height, mean (SD), cm                                | 165.67 (9.51)                  | 165.83 (10.35)            | 166.33 (10.66)    |
| Weight, mean (SD), kg                                | 67.53 (9.32)                   | 69.57 (9.27)              | 68.55 (9.28)      |
| BMI, mean (SD)                                       | 24.52 (1.86)                   | 25.21 (1.53)              | 24.87 (1.73)      |
| Predicted FEV <sub>1</sub> at baseline, mean (SD), % | 66.86 (6.74)                   | 66.21 (6.24)              | 66.53 (6.45)      |

Abbreviations: BMI, body mass index (a measure of the weight in kilograms divided by square of height in meters); FEV<sub>1</sub>, forced expiratory volume in 1 second.

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**Table 2**  
Preintervention and Postintervention Effects of Kapalabhati and Deep Breathing on Pulmonary Function<sup>a</sup>

| Variable                           | Kapalabhati |                          |        | Deep breathing |             |       |
|------------------------------------|-------------|--------------------------|--------|----------------|-------------|-------|
|                                    | Pre         | Post                     | t      | Pre            | Post        | t     |
| FEV <sub>1</sub> , L <sup>b</sup>  | 1.91 (0.31) | 2.12 (0.35) <sup>c</sup> | –8.149 | 1.89 (0.31)    | 1.91 (0.37) | 0.474 |
| FVC, L                             | 2.62 (0.68) | 2.70 (0.57) <sup>d</sup> | –2.438 | 2.589 (0.74)   | 2.59 (0.62) | 0.902 |
| FEV <sub>1</sub> /FVC <sup>b</sup> | 0.75 (0.12) | 0.80 (0.10) <sup>c</sup> | –4.232 | 0.76 (0.14)    | 0.75 (0.08) | 0.309 |

<sup>a</sup>Data are presented as mean (SD).

<sup>b</sup>P < .05 (independent-samples t test).

<sup>c</sup>P < .05 (paired-samples t test).

<sup>d</sup>P < .001 (paired-samples t test).

The current study indicates a significant increase in lung functions immediately after the 10-minute practice of kapalabhati among the patients with bronchial asthma. There were no significant changes observed in the deep breathing group. In addition, a significant difference was observed between the 2 groups in the FEV<sub>1</sub> and FEV<sub>1</sub>/FVC ratio after the intervention. A mean increase of approximately 200 mL in FEV<sub>1</sub> was observed in a single session of kapalabhati for just 10 minutes. During the trial, none of the patients reported any untoward effects attributable to the practice. They found the practice comfortable and reported fewer episodes during the training phase, although we did not systematically record the same. Thus, this preliminary trial found the practice of kapalabhati an easy-to-perform and cost-effective means of enhancing lung function.

Inconsistent results are reported on the effects of breathing practices in patients with asthma.<sup>7</sup> To the best of our knowledge, this was the first systematic attempt to examine the immediate effects of kapalabhati in patient with asthma. The results concur with the earlier yoga studies reporting beneficial effects of yoga practices.<sup>2</sup>

Parasympathetic dominance plays an important role in the pathophysiology of bronchial asthma.<sup>8,9</sup> Earlier studies have indicated sympathetic activation after the practice of kapalabhati.<sup>10,11</sup> One of the postulated mechanisms of action for the observed effects in the study could possibly be immediate sympathetic activation after the practice of kapalabhati. Future trials may include measures of autonomic functions to understand whether sympathetic activation is the background mechanism.

The practice of yoga breathing may also increase the lungs capacity and decrease the airway resistance. Forceful expiration, as practiced in kapalabhati, may lead to efficient use of the intercostal and diaphragmatic muscles, leading to better lung functions. The part of kapalabhati that involves isometric contraction and expansion of abdominal and intercostal muscles may also improve the strength of the intercostal muscles and thus lead to increased FVC and FEV<sub>1</sub>. We speculate this increase in FEV<sub>1</sub> will lead to a transient increase in the muscle tone immediately after

kapalabhati. The increase in FVC is suggestive of a probable role of kapalabhati in enhancing the oxygen-carrying capacity of the red blood cells and overall respiratory muscle endurance.

Although this study found significant improvements in lung functions immediately after the practice of kapalabhati, the long-term effect of the practice in the patients remains to be estimated. There is also a need for further evaluation of the effects of the practice on the overall functional status in patients with asthma.

Hence, we conclude that kapalabhati might be an effective intervention to improve pulmonary function among patients with bronchial asthma. The practice of kapalabhati, being simple and cost-effective, can be adapted easily by the patients. Further clinical trials to estimate the long-term effects and underlying mechanisms of effect of kapalabhati on pulmonary function are warranted.

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