

Letter to the Editor

Breath characteristics in four volitional yoga breathing practices

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Dear Sir,

Voluntary breath regulation is a well-recognised method to self-regulate psychophysiological functions including affect and cognition.^[1] *Pranayama* practice uses volition to modify breath characteristics including the breath rate, depth of breathing and the relative duration of inspiration to expiration.^[2] The effects of consciously changing these breath characteristics have been reported in separate studies.^[3-6] For instance, deep breathing has been reported to improve attention, reduce negative affect and help in stress management,^[3] breathing with prolonged expiration relative to inspiration improved the performance in a decision-making task,^[4] and increased relaxation,^[5] while volitional modification of the breath rate has definite effects on physiology, attention and affect.^[6]

There are several studies on *Pranayama* practices and the effects of practicing the *Pranayamas*. However, to our knowledge, there is no documentation on the characteristic breath pattern during *Pranayama* to better understand the psychophysiological effects of these practices. Hence, the present study examined the (i) breath rate, (ii) depth of breathing and (iii) inhalation to exhalation ratio during (a) *Kapalabhati* practice, (b) *Bhastrika Pranayama*, (c) *Anuloma-viloma Pranayama* and (d) *Bhramari Pranayama* and two control sessions, that is, breath awareness and quiet sitting in a healthy male practitioner (27 years) of yoga who had been practicing the *Pranayama* techniques regularly for 7 years and could be expected to practice the techniques consistently. The participant was selected based on his ability to practice all four *Pranayamas* effortlessly. The signed consent of the participant was obtained after explaining the study. The study was approved by the Institution's Ethics Committee (approval number: PRF/YRD/012/1-4). The participant was assessed on 6 consecutive days at the same time of the day, with 2 min for each assessment. The first 1 min of 'Pre' was followed by 1 min of practice. The participant was assessed in a sound attenuated and dimly lit, air conditioned recording room and continuously monitored with closed circuit television to note any movement.

Respiration was recorded with a respiratory strain gauge transducer (SS5LB) of MP 45 acquisition system using (BIOPAC System Inc., U.S.A) placed 8.0 cm below the lower costal margin when the subject sat erect. The respiratory strain gauge transducer recorded abdominal contraction and expansion with exhalation and inhalation, respectively.^[7] The difference between the inhalation and exhalation volume was measured (in mV) as the amplitude of the waveform generated by abdominal volume changes with respiration. The respiration traces are shown in [Figure 1].

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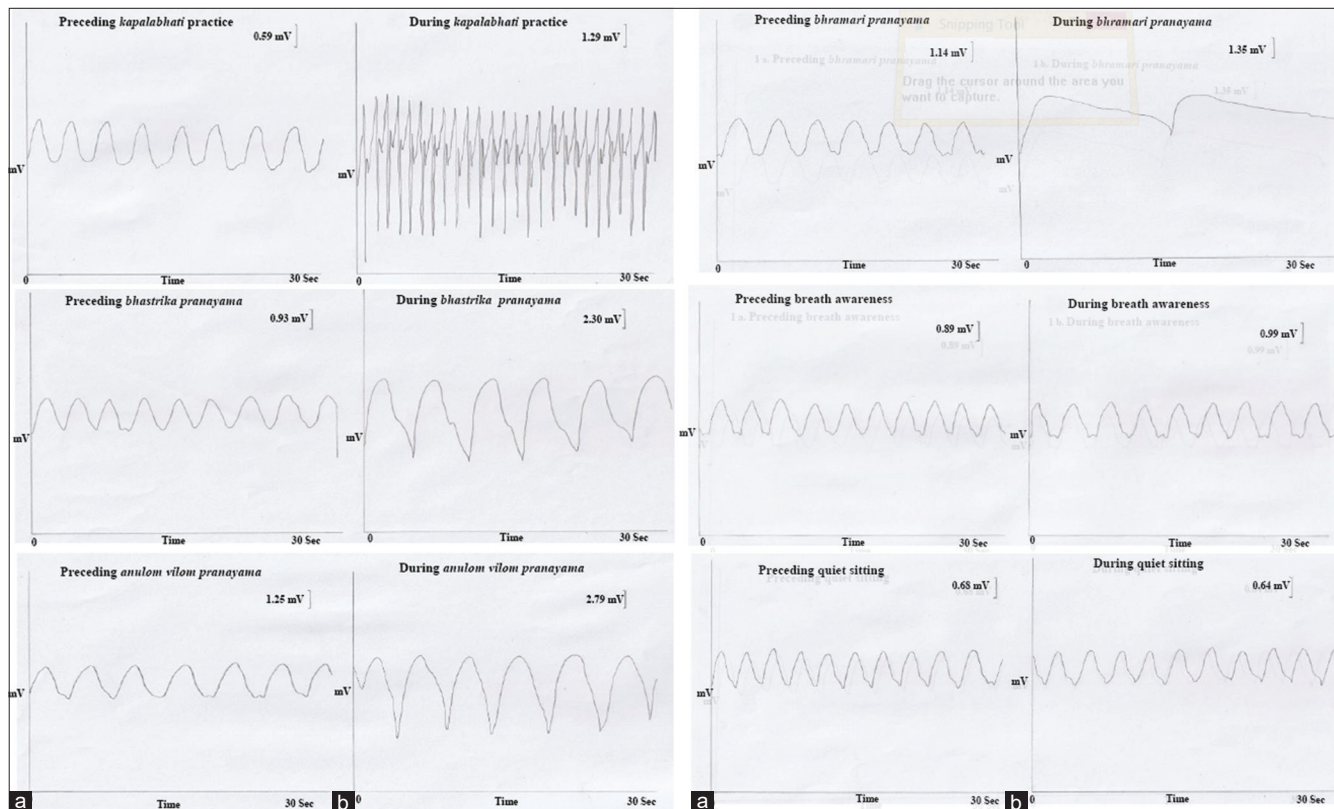


Figure 1: (a and b) Vertical direction of traces represents vertical displacement of respiration sensor (SS5LB of MP45 acquisition system [BIOPAC System Inc., U.S.A]) during abdominal movements based on respiratory inductive plethysmography and the horizontal direction represents time.

The breath rate increased by 242.30% (15.79–54.05 bpm) and decreased by 36.30% (17.60–11.21 bpm), 27.16% (14.32–10.43 bpm) and 80.94% (16–3.05 bpm) during *Kapalabhati* practice, *Bhastrika pranayama*, *Anuloma-viloma pranayama* and *Bhramari Pranayama*, respectively, compared to the preceding phase. The depth of breathing increased by 118.64% (0.59–1.29 mV), 147.31% (0.93–2.30 mV), 123.20% (1.25–2.79 mV) and 18.42% (1.14–1.35 mV) during *Kapalabhati* practice, *Bhastrika Pranayama*, *Anuloma-viloma Pranayama* and *Bhramari Pranayama*, respectively, compared to the preceding phase. The ratio of inhalation to exhalation decreased by 87.88% (1:0.66–1:0.08) and increased by 9.70% (1:1.03–1:1.13), 28.73% (1:0.87–1:1.12) and 399.01% (1:1.01–1:5.04) during *Kapalabhati* practice, *Bhastrika Pranayama*, *Anuloma-viloma Pranayama* and *Bhramari Pranayama*, respectively, compared to the preceding phase.

During all four yoga breathing practices (*Pranayamas*), there was an increase in the breath amplitude which corresponds to the depth of breathing.^[7] The breath frequency changed during all four yoga breathing practices, with a 5.2 times decrease during *Bhramari Pranayama* and 3.4 times increase during *Kapalabhati* practice. The relative duration of exhalation (relative to inhalation) increased 5 times during

Bhramari Pranayama, while exhalation was shorter than inhalation during *Kapalabhati* practice. Among all four practices, *Bhastrika Pranayama* showed the highest increase in depth of breathing.

The present, preliminary study on a single experienced yoga practitioner who could practice the four *Pranayamas* consistently serves to indicate the importance of understanding the breath pattern in *pranayama*. However, to get a better understanding of the inter-session variability, the recordings should have been carried out on a minimum of three occasions.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

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Conflicts of interest

There are no conflicts of interest.

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