

ABSTRACT

Background:

Yoga is the science of holistic living and can be incorporated in daily life. *Pranayama* (Voluntarily regulated breathing) is one of the important component of *Yoga* which bridges the most grosser (physical) and subtle techniques (mental). Different types of *Pranayama* produce selective physiological responses such as practice of slow *Pranayama* reported to produce reduction in heart rate, rate pressure product and double product, whereas rapid/fast *Pranayama* reported to increase it. To the best of our knowledge there is no known previous study evaluating the impact of different *Pranayama* techniques as well as the most commonly practiced high frequency breathing based *yogic kriya* i.e. *Kapalbhati* on cerebrovascular hemodynamics and cardiovascular functions in healthy volunteers.

Aim and objectives:

To evaluate the effect of different *Pranayama* techniques and a *yogic kriya* on cerebrovascular hemodynamics and cardiovascular functions in healthy volunteers

Materials and Methods:

Phase 1: Fifteen *yoga* practitioners with the mean age (standard deviation) 23.62 (3.57) were recruited. An equal number of age and gender matched individuals with the mean age (standard deviation) 22.69 (4.05) with no exposure to *yoga* were recruited as matched controls. Assessments such as cerebrovascular hemodynamics and cardiovascular functions were assessed for both *Yoga* and non *yoga* groups at one point of time without any intervention.

Phase 2: Twenty healthy *yoga* practitioners with the mean age (standard deviation) of 23.40 (3.05) were recruited. The subjects were asked to perform two *Pranayama* techniques i.e., *Bhastrika* and *Bhramari*, two breath holding techniques i.e., Internal (*Antar Kumbhaka*), and External (*Bahir-Kumbhaka*) and a *Yogic kriya* i.e., *Kapalbhati*. The order of the intervention was randomly allocated to each subject. Cerebrovascular hemodynamics was measured using transcranial Doppler and cardiovascular functions using non invasive blood pressure monitoring system. Assessments were done at baseline, during and immediately after each practice.

Results:

Phase 1: Systolic blood pressure (SBP), pulse pressure (PP), mean arterial pressure (MAP) were significantly lower in *Yoga* practitioners compared to non-*Yoga* practitioners. Breath holding time (BHT) was higher in *Yoga* practitioners compared to non-*Yoga* practitioners.

Phase 2:

Cerebrovascular hemodynamics: There was a significant increase in end diastolic velocity (EDV), mean flow velocity (MFV) with a reduction in pulsatility index (PI) during internal and external *Kumbhaka*. Whereas during *Bhastrika* and *Kapalbhati*, there was a significant reduction in EDV, MFV with an increase in PI.

Cardiovascular functions:

There was a significant increase in diastolic blood pressure (DBP), MAP, HR, and cardiac output (CO) along with a reduction in pulse interval (PI) during the practice of *Bhastrika*, while there was a significant increase in DBP, MAP, HR, and total peripheral resistant (PR) with a reduction in stroke volume (SV), CO and PI during the practice of *Bhramari*.

There was a significant increase in SBP, DBP, MAP, and PR with a reduction in SV and CO during the practice of *Internal Kumbhaka*, while there was a significant increase in SBP, DBP, and MAP during the practice of *External Kumbhaka*. In *Kapalbhati Kriya* significant increase in SBP, DBP, MAP, HR and CO with a reduction in PI was observed during the practice.

Conclusion:

As an immediate effect, High frequency *Yoga* breathing practices (*Bhastrika Pranayama* and *Kapalbhati Kriya*) decrease flow velocity and increase vascular resistance in Middle Cerebral Artery, while holding breath either external or internal produces opposite effects. However, Practising *Yoga* in combination as one hour practice a day for more than one year improves cardiovascular health and reduces physiological arousal.