

CHAPTER-8

Appraisal

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GENERAL

The appraisal of the research work in this doctoral thesis is presented under the following headings:

1. Summary of the findings
2. Conclusions
3. Strengths of the study
4. Limitations of the study
5. Implications of the study
6. Suggestions for future studies

Summary of the findings:

Phase 1: SBP, PP, and MAP were significantly lower in Yoga practitioners compared to non-Yoga practitioners. BHT was higher in Yoga practitioners compared to non-Yoga practitioners.

Phase 2: Cerebrovascular hemodynamics: There was a significant increase in EDV, and MFV with a reduction in PI during internal and external *Kumbhaka*. Whereas, during *Bhastrika* and *Kapalbhati*, there was a significant reduction in EDV, and MFV with an increase in PI were observed. **Cardiovascular functions:** There was a significant increase in DBP, MAP, HR, and CO along with a reduction in PI during the practice of *Bhastrika*, while there was a significant increase in DBP, MAP, HR, and PR with a reduction in SV, CO and PI during the practice *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* a significant increase in SBP, DBP, MAP, HR and CO with a reduction in PI was observed during the practice.

Conclusions:

Practicing Yoga for more than one year improves cardiovascular health and reduces physiological arousal. Also, Pranayama and a Yogic kriya produce differential physiological responses. Practice of Kumbhaka produced an increased flow velocity and decreased resistances in MCA. Both high frequency breathings (bhastrika pranayama and Kapalbhati Kriya) produced a decreased flow velocity and increased resistances in MCA.

Strengths of the study:

To the best of our knowledge this is the first study used the best diagnostic tools such as TCD and non-invasive continuous blood pressure monitoring system to study the difference in cerebrovascular hemodynamics and cardiovascular functions of Yoga and non-Yoga practitioners; Investigator who had done the assessment was blind to the Yoga and non-Yoga practitioners group. First study evaluated the cerebral hemodynamics and cardiovascular functions of different pranayama techniques & a yogic kriya during its practices period; each practice was repeated 3 times to assess the consistent change in blood flow pattern. Cerebral hemodynamics was assessed in MCA which is the commonly used artery to measure cerebral hemodynamics.

Limitations of the study:

Certain limitations of the study need to be acknowledged. We did not monitor the partial pressures of Oxygen and CO₂ during various Pranayama techniques and a yogic kriya to delineate the underlying physiological mechanisms for the observed changes in cerebral hemodynamic parameters. Since study subjects were recruited from a narrow age range, its application to the wide age range of population is limiting the scope of findings.

Implications of the study:

Phase 1: Yoga practice for the duration of 1 hour a day for the period of more than a year shown to have better cardiovascular and respiratory functions in healthy individuals. Hence, add-on yoga practices to daily routine may reduce risk and prevent the development of cardiovascular and pulmonary diseases.

Phase 2: Practice of Kumbhaka produced an increase in cerebral blood flow and thus it can be used as a potent vasodilatory technique and it can be used in therapeutics to produce vasodilation and to increase cerebral perfusion (e.g. improving cognitive function, memory etc.). As breath holding for more than 30 seconds produces more drastic changes in cerebral blood flow, it is advised for naïve practitioners to do breath holding only for short duration (< 30 seconds) under expert's guidance. Kapalbhata and Bhastrika have shown to produce increase in cerebrovascular resistance. Thus these practices should be avoided or practiced with care by people with hypertension and other neurodegenerative disorders. Naïve practitioners are advised to begin with minimum stroke under expert's guidance. Since practice of Bhramari pranayama maintains constant cerebral blood flow it can be considered as a safe practice. Hence, the findings of this study might play a potential role in designing the yogic breathing techniques according to patients' requirements.

Suggestions for future studies:

1. Impact of yogic breathing techniques on cerebrovascular hemodynamics has to be understood in different age groups.
2. Long-term effect of each breathing techniques has to be evaluated.
3. Long-term effect of combination of breathing techniques has to be evaluated.
4. Long-term study on impact of yogic breathing techniques in high risk populations of cardiovascular and cerebrovascular diseases has to be evaluated.