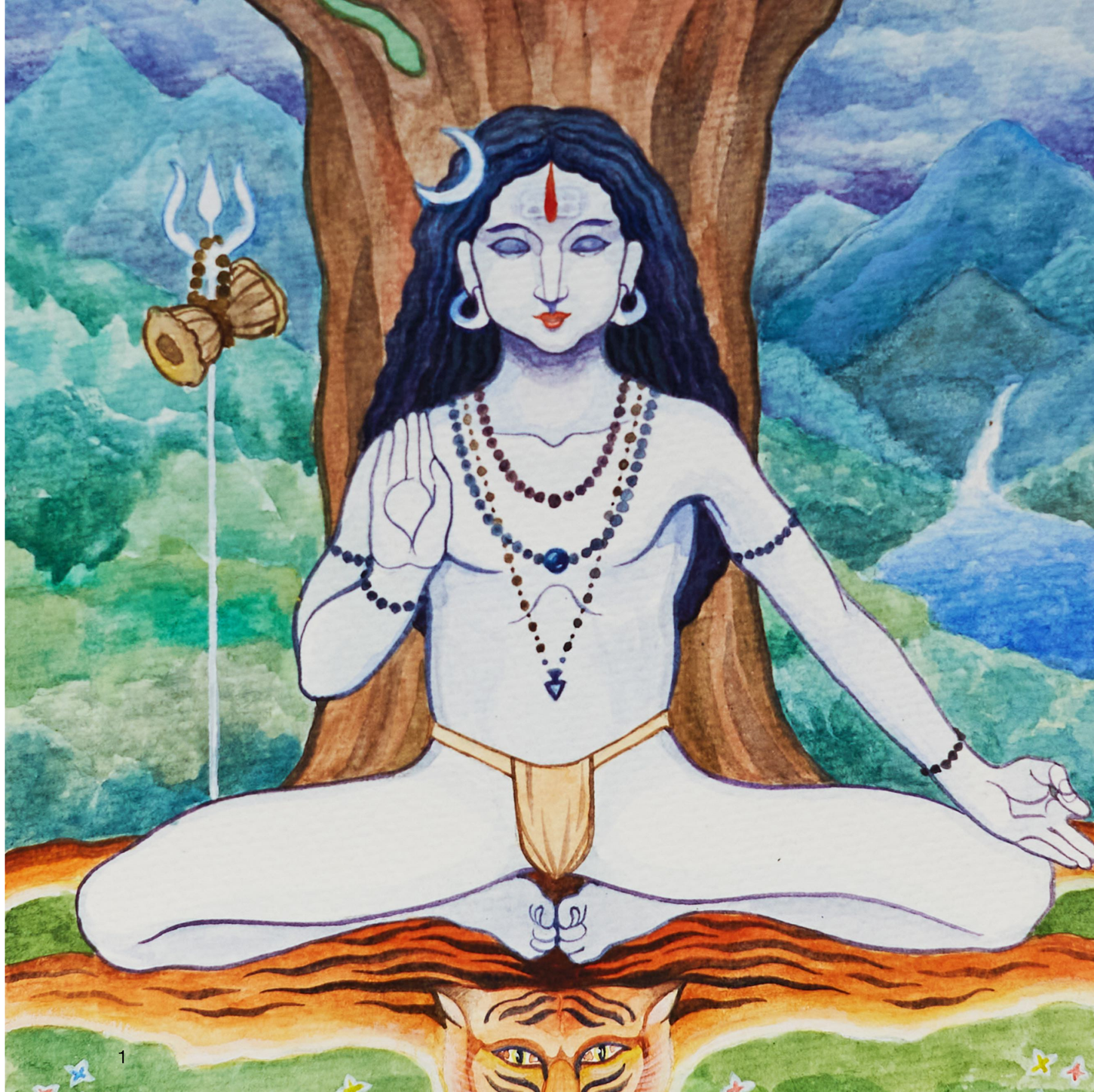
Yoga Education Teacher Training

2024

Module 2

Effects of the Level 1

Pranayama Class



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Opening prayers

ॐ ॐ ॐ

श्री गुरुभ्यो नमः हरिः ॐ

Om Om Om

Sri Gurubhyo Namah Harih Om

Salutations to the Gurus!

ॐ सह नाववतु । सह नौ भुनक्तु ।

सह वीर्यं करवावहै ।

तेजस्वि नावधीतमस्तु मा विद्विषावहै ।

ॐ शान्तिः शान्तिः शान्तिः ॥

auṃ saha nāvavatu saha nau bhunaktu

saha vīryaṃ karavāvahai

tejasvi nāvadhītam astu mā vidviṣāvahai

auṃ śāntiḥ śāntiḥ śāntiḥ

Aum. May that Brahman protect us together. May it nourish us together.

May we both gain great vitality. May our learning be brilliant.

May we never argue.

Om peace, peace, peace.

Effects of the Level 1 Pranayama Class

The basic point of this presentation is…

“What can you safely say to your students about the benefits of these practices.”

… and that the references are primarily from available studies that match certain criteria.

Level 1 Pranayama Class Practice

1. Stages to a full breath
    1. Lying down abdominal breathing - 2 minutes
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    4. Repeat 1-3 in sitting position - 2 minutes
2. Resonance breathing - 2 minutes at 6:6 seconds
3. Single nostril breathing - 2 minutes at 6:6 seconds
4. Alternate nostril resonance breathing - 2 minutes at 6:6 seconds
5. Kapalabhati kriya - 10 pumps > 3 resonance breaths > 3 rounds
6. Bhramari - 3 rounds
7. Rest - 5 minutes

1. General Benefits of Level 1 Pranayama that have been studied.

- **Modulation of autonomic functions (primarily parasympathetic activation and reduction of sympathetic output)**

- **Blood pressure, both systolic and diastolic (BP, SBP, DBP)**
- **Heart Rate Variability (HRV)**
- **Respiratory Rate (RR)**
- **Galvanic skin resistance (GSR)**
- **Pulse Rate (PR)**

2. Resonance Frequency Breathing (RFB)

There have been thousands of studies on RFB.
The studies included have relevance for what you can share with your students.

- **Two minutes of RFB at a 4:6 ratio:**
- **Increased vagal regulation of the heart (intentional slowing of HR)**
- **Enhances HRV during practice**
- **Improved cognitive performance after practice**
- **In elderly population, cognitive performance indicated 40 years younger**
- **Engages anti-inflammation response of vagus nerve**

Taking twelve slow breaths enhances cardiovascular and cognitive plasticity in young and older adults; C. Cammarata, N. Zhou, R. Markello, E. Riley, A.K. Anderson and E. De Rosa

A note on Thoracic Breathing - 1

A breathing pattern characterized as rapid, low-tidal volume, predominantly thoracic ventilation with relatively low alveolar and blood concentrations of carbon dioxide . . . is associated with psychological characteristics of anxiety, neurosis, depression, phobic behavior, and high levels of perceived and objective stressors. Voluntary performance of this breathing pattern seems to intensify subjective and physiological indicators of anxiety when exposed to stress. Cardiovascularly, voluntary production of this ventilatory pattern appears to bring about significantly reduced parasympathetic tone and increased sympathetic dominance, which are expressed in augmented heart rate and cardiac output, muscle vasodilation, decreased blood flow and oxygen supply to the heart and brain, reduced [respiratory sinus arrythmia] and baroreceptor responsiveness, and increased likelihood of major ECG abnormalities.

Grossman, 1983, p.293.

A note on Thoracic Breathing - 2

Various respiratory patterns and maneuvers can provide striking influences on the autonomic nervous system and may exacerbate or reduce adverse responses to stressors. For example, increased breathing rate is a typical response to stressful situations*. This tendency can lead to breathing in excess of metabolic needs (hyperventilation), which causes reduced blood carbon dioxide concentrations. The reduced carbon dioxide causes psychophysiological and psychological effects that include (a) enhanced arousal and anxiety, and (b) decreased cerebral and coronary blood flow, which can lead to a variety of clinical symptoms including dizziness, poor performance, headache, chest pain, cardiac abnormalities, and sleep disturbance**. Certain other respiratory patterns that modestly elevate blood carbon dioxide concentration appear to promote the opposite effects, including reduced anxiety and increased or well-maintained cerebral and coronary blood flow***

*(Brown, 1953; Fried, 1987; Grossman, 1983; Lum, 1976; Magarin, 1982)**(Brown, 1953; Fried, 1987; Grossman, 1983; Lum, 1976; Magarin, 1982)***(Grossman, 1983; Magarin, 1982)(Grossman, 1983)*

A note on Thoracic Breathing - 3

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Takeaways:

Abdominal and Intercostal Breathing:

“Certain other respiratory patterns that modestly elevate blood carbon dioxide concentration appear to promote the opposite effects, including reduced anxiety and increased or well-maintained cerebral and coronary blood flow.”

Habitual Upper Chest Breathing:

“A breathing pattern characterized as rapid, low-tidal volume, predominantly thoracic ventilation with relatively low alveolar and blood concentrations of carbon dioxide . . . is associated with psychological characteristics of anxiety, neurosis, depression, phobic behavior, and high levels of perceived and objective stressors.”

3. Six breaths per minute for five minutes (sukha pranayama)

- **Significant reduction in SBP**
- **Significant reduction in HR**
- **Significant reduction in pulse and arterial pressure**
- **Non-significant fall in DBP**
- **Hypothesis: normalization of cardiac rhythms through vagal modulation, decreased sympathetic activity, and improved baroreflex sensitivity**

Bhavanani AB, Sanjay Z, Madanmohan. Immediate effect of sukha pranayama on cardiovascular variables in patients of hypertension. Int J Yoga Therapy 2011.

4. Useful in hypertension

- **Improves baroreflex sensitivity**
- **Strengthens cardio-respiratory coupling**
- **Increases parasympathetic activity**
- **Reduction of BP**

Dick TE, Mims JR, Hsieh YH, Morris KF, Wehrwein EA. Increased cardio-respiratory coupling evoked by slow deep breathing can persist in normal humans. Respir Physiol Neurobiol 2014.

Chandla SS, Sood S, Dogra R, Das S, Shukla SK, Gupta S. Effect of short-term practice of pranayamic breathing exercises on cognition, anxiety, general well being and heart rate variability. J Indian Med Assoc 2013.

Joseph CN, Porta C, Casucci G, Casiraghi N, Maffeis M, Rossi M, et al. Slow breathing improves arterial baroreflex sensitivity and decreases blood pressure in essential hypertension. Hypertension 2005.

5. Cardiovascular/Respiratory Effects: Which Slow Breathing is Best?

Which is best, resonance frequency breathing with ujjayi, or resonance frequency with simple slow breathing?

Without ujjayi:

- **Maximal increase seen in BRS and decrease of BP**
- **Increase in cardiac-vagal baroreflex sensitivity**
- **Improvement in oxygen saturation and w/o HR increase**

With ujjayi:

- **Ujjayi with forced inhale and exhale, BRS did not improve Oxygenation improved, but no change in BP**

Mason H, Vandoni M, Debarbieri G, Codrons E, Ugargol V, Bernardi L. Cardiovascular and respiratory effect of yogic slow breathing in the yoga beginner: what is the best approach? Evid Based Complement Alternat Med. 2013

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6. Single nostril breathing

Limbic Autonomic Arousal

- Rules over the nasal cycle
- Limbic system: interconnected brain regions that govern emotion, behavior, memories, motivations, and bodily responses.
- Located in the cerebrum and above the brain stem
- Autonomic: automatic functions of the brain stem
- Arousal: general alertness, as well as activation of HR, BP, body temperature, pupil dilation

7. Nasal cycle

- Ultradian rhythm of nasal congestion and decongestion
- 60-240 minutes (numbers vary)
- Dependent on the tonic activity of the LA nervous system, circulating catecholamines and other neurohormones
- Tonic: state of continuous activity in ANS divisions

  Catecholamines: stress response substances including dopamine, norepinephrine (noradrenalin, produced in adrenal glands and brain stem), and epinephrine (adrenalin, produced only in the adrenal glands)

8. Nasal congestion & decongestion

Nasal congestion

Associated with low sympathetic, high parasympathetic activity

Nasal decongestion

Associated with high sympathetic, low parasympathetic activity

Nasal congestion-decongestion

The cycle acts as a “variable valve,” adapting to environmental demands

Deshmukh VD. Limbic Autonomic Arousal: Its Physiological Classification and Review of the Literature. Clinical Electroencephalography. 1991.

9. Brain Areas Stimulated by Unilateral Breathing

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Left vs right nostril breathing with dominant (more open) and non-dominant (less open) nostrils.

The hypotheses were to see if there was lateralization between the left and right hemispheres (lateral axis), activity between the front and back regions of the brain (longitudinal axis), and if when one area was active, would it suppress another area?

10. Brain Areas Stimulated by Unilateral Breathing: Results

- Right nostril breathing is associated with sympathetic activity (arousal states), so both hemispheres of the brain become activated across brain wave bands
- Left nostril breathing is associated with parasympathetic activity, so both hemispheres of the brain show dampened activity (stress-alleviating state).
- Dominant airway elicited higher activity in frontal and central regions, and lower in posterior regions.
- For the gamma band, non-dominant elicited higher activity.
- Dominant airway is related to brain changes confined to the left frontal and parietal regions, regardless of whether left or right.
- Non-dominant airway has bilateral effects across posterior and central cortices.
- Lateralization:
  - Left airway decreased brain activity (parasympathetic)
  - Right nostril decreased activity except delta band, and increased activity in the whole scalp area except the posterior regions.

11. Brain Areas Stimulated by Unilateral Breathing: Takeaways

- **Left nostril and non-dominant breathing are associated with posterior regions of the brain. Posterior EEG power is shown in eyes closed conditions, relaxation, restoration, and meditation. This study suggests breathing affects cortical functioning similar to meditation.**

- **The posterior cortex activates during resting states by increasing connections via the default mode network. The DFMN is involved in introspective brain functions, autobiographical memory, and self-directed identity.**

- **Both hemispheres seem to be equally aroused with right nostril breathing, and both hemispheres are equally calmed with left nostril breathing. This is because both hemispheres are under the influence of sympathetic and parasympathetic inputs.**

Niazi, I.K., Navid, M.S., Bartley, J. et al. EEG signatures change during unilateral Yogi nasal breathing. Sci Rep 12, 520 (2022)

12. Left nostril breathing

- **Spatial task enhancement significantly increased**
- **Non-significant increase in verbal task performance**
- **Parasympathetic activity increases**

Marshall RS, Basilakos A, Williams T, Love-Myers K. Exploring the benefits of unilateral nostril breathing practice post-stroke: attention, language, spatial abilities, depression, and anxiety. J Altern Complement Med., 2014

- **Lowers sympathetic activity**

Naik A, Biswas DA, Patel S: Effect of left nostril breathing in hypertensives. J Indian Acad Clin Med. 2012.

13. Right nostril breathing

- **Sympathetic activation**
- **Increase in heart rate**

Pal GK, Agarwal A, Karthik S, Pal P, Nanda N. Slow yogic breathing through right and left nostril influences sympathovagal balance, heart rate variability, and cardiovascular risks in young adults. N Am J Med Sci., 2014

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14. Alternate nostril breathing

- **20 minutes of ANB increases GSR**
- **Increased PSNS activity**
- **No changes in HR or BP**
- **Showed power of ANB in one week period**

Turankar AV, Jain S, Patel SB, Sinha SR, Joshi AD, Vallish BN, et al. Effects of slow breathing exercise on cardiovascular functions, pulmonary functions & galvanic skin resistance in healthy human volunteers e a pilot study. Indian J Med Res 2013

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15. Kapalabhati

There are several studies on Kapalabhati, with inconclusive results and/or poor research design. The best-designed studies show:

- **Improved executive functions**
- **Improved perceived stress scale scores**
- **Improved reaction time**
- **Improved reverse digit spa**

Sharma VK, M R, S V, Subramanian SK, Bhavanani AB, Madanmohan, et al. Effect of fast and slow pranayama practice on cognitive functions in healthy volunteers. J Clin Diagn Res 2014

16. Kapalabhati continued …

Parasympathetic withdrawal and sympathetic activation during Kapalabhati.

- **Increase in gamma wave activity post kapalabhati, showing control of the default mode network, associated with calm, introverted states.**

Malhotra V, Javed D, Wakode S, Bharshankar R, Soni N, Porter PK. Study of immediate neurological and autonomic changes during kapalbhati pranayama in yoga practitioners. J Family Med Prim Care. 2022

17. Kapalabhati continued …

During and after Kapalabhati, increased HR

- **During and after, decreased HF HRV (parasympathetic vagal influence)**
- **During and after, increased LF HRV (PSNS/SNS balance)**
- **Faster-paced techniques can be good for health in healthy individuals under controlled circumstances but should be closely monitored in others and not overdone in any cases.**

Acute Effect of Kapalbhati Yoga on Cardiac Autonomic Control Using Heart Rate Variability Analysis in Healthy Male Individuals Rajeev Gupta Department of Neurology, All India Institute of Medical Sciences, New Delhi, India, 2020*

18. Kapalabhati: Other studies

After 20 minutes of rest, parasympathetic dominance occurs after five cycles of 1 minute of Kapalabhati.

Lalitha S, Maheshkumar K, Shobana R, Deepika C. Immediate effect of Kapalbhathi pranayama on short-term heart rate variability (HRV) in healthy volunteers. J Complement Integr Med. 2020 May 19;18(1):155-158. doi: 10.1515/jcim-2019-0331. PMID: 32427125.

Limited associations in studies not accepted into meta-analyses with weight reduction, improvement in lipids and glycemic control, polycystic ovarian syndrome, and improvements in forced vital capacity and peak expiratory flow.

NOTE: Studies that include Kapalabhati with other pranayamas have all-around positive outcomes, and on its own without other practices that activate the PSNS, it is not recommended.

19. Kapalabhati: Hyperventilation Technique?

- Kapalabhati is about 50% less than hyperventilation,
  so is more indicative of shallow breathing.

- Rate of breathing is 3.5 times more than hyperventilation
  (60 breaths per minute versus 18-20).

- Most of the gas exchange occurs in the dead air space of the lungs,
  and not in the alveolar where carbon dioxide exchange occurs.

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20. Brahmari

- **Non-epileptic paroxysmal gamma waves**
- **Enhances inhibition and reaction time in stop signal task**
- **Increased theta waves, comparable to other meditative practices**
- **Improvement in HRV during practice, not after**

NOTE: Gamma waves are associated with executive function, cognition, information processing, working memory, and attention.
They are sometimes associated with receptivity and positive mental states.

Nivethitha L, Manjunath NK, Mooventhan A. Heart rate variability changes during and after the practice of bhramari pranayama. Int J Yoga 2017;10: 99e102.

21. Brahmari continued

Improvements in pulmonary function in healthy adolescents

3-6 breaths per minute for five minutes followed by 2 minutes of rest.

Cycle repeated 5 times.

Improvements in:

- **Forced vital capacity**
- **Forced expired volume**
- **Peak expiratory flow**
- **Slow vital capacity**
- **Maximum voluntary volume**

Effect of Bhrāmarī Prāṇāyāma Practice on Pulmonary Function in Healthy Adolescents: A Randomized Control Study. Maheshkumar Kuppusamy,K Dilara, P Ravishankar, A Julius

22. Brahmari continued

Immediate effect of a slow pace breathing exercise Bhramari pranayama on blood pressure and heart rate.

- **Five minutes of Bhramari at a pace of 3-5 breaths per minute lead to significant fall in DBP, with a slight decrease in HR, showing parasympathetic dominance on the cardiovascular system.**

Pramanik T, Pudasaini B, Prajapati R. Immediate effect of a slow pace breathing exercise Bhramari pranayama on blood pressure and heart rate. Nepal Med Coll J. 2010.

23. Nitric Oxide

In 1998, Robert Furchgott, Louis Ignarro, and Ferid Murad won the Nobel Prize in physiology for their work identifying nitric oxide (NO) as a signaling molecule in the human body. Previous to that, NO was known only as a corrosive gas pollutant.

There have been thousands of papers written on NO, which is made in paranasal sinuses, as well as in the endothelium, the inner layer of blood vessels. This vascular NO helps keep blood vessels healthy, and regulates vascular tone, and tissue oxygenation – nasal nitric oxide acts as, among other things, a messenger molecule that supports the downstream effects of vasodilation, thus removing pressure on the heart from the circulatory processes.

24. Nitric Oxide continued

Nasal NO also moves from the nose to the lungs and can improve pulmonary function by relaxing the smooth muscle tissue of the lungs, dilating pulmonary arteries and the branches of the lungs, and fighting off incoming bacteria and pathogens.

Humming will increase NO, but only for short periods. After about 1-2 minutes of humming, the increase in production declines, but resumes after about three minutes of normal breathing. The body will only make as much as it can use (just like we cannot over-oxygenate).

https://indjst.org/articles/nitric-oxide-humming-and-bhramari-pranayama

https://ejo.springeropen.com/articles/10.1186/s43163-020-00011-7

25. Breathing as a Three-Gas System

- In 2015, cardiologist Dr. James Stamler showed that hemoglobin (the protein in red blood cells that picks up oxygen from the lungs) also carries NO to allow the blood vessels to open and supply the carried oxygen to the tissues of the body.

- Without NO, O2 is not released.

26. Studied benefits.

It is safe to tell your students that Bhramari has been shown to:

- **Reduce heart rate**
- **Improve immune function**
- **Improve HRV**
- **Improve lung capacity**
- **Improve sleep quality**

https://www.sciencedirect.com/science/article/pii/S0975947621001376?via%3Dihub

Closing prayers

लोकाः समस्ताः सुखिनोभवंतु ॥
लोकाः समस्ताः सुखिनोभवंतु ॥
लोकाः समस्ताः सुखिनोभवंतु ॥
ॐ शान्तिः शान्तिः शान्तिः ।

lōkāḥ samastāḥ sukhinōbhavantu ॥
lōkāḥ samastāḥ sukhinōbhavantu ॥
lōkāḥ samastāḥ sukhinōbhavantu ॥
AUM śāntiḥ śāntiḥ śāntiḥ ॥

May all worlds be happy.
AUM Peace Peace Peace!