

UNDERSTANDING AND ADDRESSING POLLUTION'S ADVERSE EFFECTS ON HEART HEALTH

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Introduction

Imagine a world where the air we breathe is as clear as the mountain spring, where each breath enriches our body with life-giving oxygen without the invisible taint of pollutants. Unfortunately, for many, this is a distant dream. The reality is that the air enveloping our cities is a cocktail of invisible enemies, with air pollution standing as a significant modern health hazard that affects the heart- our life's engine.

Epidemiology- Air pollution is a significant contributor to the global disease burden. In 2019, approximately 12% of all deaths were linked to outdoor and household air pollution. 1 Notably, heart diseases accounted for 50%

of the 6.7 million deaths related to air pollution.² The American Heart Association recognizes air pollution as a critical risk factor for heart conditions, such as heart attacks, strokes, arrhythmias, and heart failure, surpassing traditional factors like diabetes, smoking, or obesity.

Air Pollution and Heart Health- The connection between air pollution and heart health is a complex web that science has begun to unravel. Recent studies have found that air pollution, far from being just a lung irritant, is a serious threat to heart health.³ A toxic mix including carbon monoxide, nitrogen oxides,

sulphur dioxide, volatile organic compounds, and fine particulate matter- known as PM2.5 (particles with a diameter of 2.5 micrometres or less)-can penetrate deep into lung tissue and enter the bloodstream, leading to a range of health issues including heart attacks, strokes, and chronic heart and lung diseases. These effects are primarily caused by mechanisms like systemic inflammation, oxidative stress, and autonomic nervous system imbalance, leading to disrupted electrical heart rhythms, constricting blood vessels, and accelerating the progression of

Yoga: An Ancient Solution to a Modern Problem



atherosclerosis (blockage of blood vessels supplying nutrition to the heart), leading to heart attacks. The lung inflammation can originate from the particles or damage they cause, triggering further immune responses. Studies in animals and humans have shown that inhaling Particulate Matter can cause mild inflammation and increase specific immune cells within the lungs. This inflammation results from the stress and harm caused by these particles, and it has been shown that using antioxidants can help alleviate these effects. Particulate matter (PM2.5) is a particle with an aerodynamic diameter of less than 2.5 μm ; it is mainly absorbed through the lungs, where it can infiltrate the lung alveoli and reach the bloodstream. The impact of lung inflammation and stress, however, extends beyond the lungs and can affect the entire body. Research involving women and older adults has indicated that exposure to PM2.5 results in elevated markers of damage in urine and blood, suggesting that the toxicity of these entities affects the entire body.⁵ This systemic stress can lead to vascular problems, such as decreased flexibility and increased stiffness in blood vessels. Interestingly, even in young, healthy adults, PM2.5 exposure has been observed to damage the cells lining the blood vessels in our breathing apparatus. What is even more diabolic is the fact that these particles, other than directly inflicting damage to the blood vessels in different organs, simultaneously hamper the functioning of the body's own repair mechanism, thus initiating and perpetuating a cascade of pathophysiological damage to the entire blood vessel system supplying vital organs particularly the heart and the brain. As a result, the risk of heart disease increases, and the progression of conditions like atherosclerosis - characterized by

clogged and hardened arteries - is accelerated, potentially leading to heart attacks.

Yoga: An Ancient Solution to a Modern Problem

Amid this silent threat, there is a ray of hope. Yoga, an ancient practice with deep roots in holistic well-being, has emerged as a potent tool in the fight against pollution-induced heart disease. The essence of yoga in combating heart disease lies not just in its physical postures but also in its ability to reduce stress, improve respiratory function, and promote overall well-being.

Pranayama: The Art of Breathing

Within the realm of yoga, pranayama is the practice that most directly counteracts the effects of air pollution. By learning to control our breath, we can improve the efficiency of our lungs, which in turn helps to filter out some of the toxins we inhale daily.

These techniques include:

- a) Nadi Shodhana (Alternate Nostril Breathing): This technique is thought to balance the nervous system, reduce stress, and improve cardiovascular function. It involves inhaling through one nostril while closing the other with a finger and then exhaling through the opposite nostril and vice versa.
- b) Kapalabhati (Skull Shining Breath): Often considered a cleansing practice, Kapalabhati is a series of short, explosive exhales followed by passive inhales. This practice is said to improve lung capacity and blood circulation.
- c) Bhramari (Bee Breath): This involves making a humming sound during exhalation, which is believed to calm the mind and reduce stress, potentially lowering blood pressure and improving heart rate variability.



Pranayama: The Art of Breathing

d) Dirga Pranayama (Three-Part Breath): This deep breathing technique encourages full oxygen exchange and is believed to be beneficial for heart rate and blood pressure.

e) Anulom Vilom (Similar to Nadi Shodhana but without breath retention): This variant involves a continuous flow of breath through alternate nostrils and is said to help improve lung function and respiratory endurance.

f) Bhastrika (Bellows Breath): With rapid and forceful inhalation and exhalation, Bhastrika is claimed to increase the oxygen supply to the blood and strengthen the heart muscle.

These practices are traditionally believed to purify the nadis (energy channels) and help the body utilize oxygen better, thus potentially reducing the adverse effects of Pollution on the heart and lungs.

Asanas: Yoga Poses for a Stronger Heart and a healthy body

These postures help enhance physical strength and flexibility and promote relaxation, which can contribute to better heart health. Here are some asanas that are often recommended:

a) Tadasana (Mountain Pose): This foundational standing pose helps to improve posture, strengthens the thighs, knees, and ankles, and may help to increase circulation, which is beneficial for heart health.

b) Ardha Matsyendrasana (Half Lord of the Fishes Pose): This seated spinal twist is said to stimulate the heart, liver, kidneys, and digestive system and improve the elasticity of the spine.

c) Setu Bandhasana (Bridge Pose): This gentle backbend opens up the chest and lungs, potentially improving the oxygen flow and aiding in respiratory function, which is crucial when dealing with air pollution.

d) Sukhasana with Anjali Mudra (Easy Pose with Salutation Seal): Sitting cross-legged with hands in a prayer position can help calm the mind and reduce stress, an important factor in cardiovascular health.

e) Vrikshasana (Tree Pose): This balancing pose helps stabilize the body and mind, improve neural muscular coordination, and aid in circulatory health.

f) Adho Mukha Svanasana (Downward-Facing Dog): This pose rejuvenates the body, improves blood flow to the brain, and may help reduce stress, which can lower the risk of hypertension and heart-related issues.

g) Uttanasana (Standing Forward Bend): This pose stimulates blood circulation throughout the body, including the heart, and can help calm the nervous system.

h) Bhujangasana (Cobra Pose): This gentle backbend can help open the chest and improve oxygen intake, particularly in polluted environments where oxygen levels may be compromised.

i) Savasana (Corpse Pose): Often used for relaxation at the end of a yoga session, Savasana helps to reduce blood pressure, anxiety, and stress, providing a beneficial effect on overall cardiovascular health.

Incorporating these asanas into a regular yoga practice can help to strengthen the body, improve lung capacity, and reduce stress levels, all of which are important when dealing with the cardiovascular stress of air pollution.



It is important to understand that these processes are ancillary to having clean air to breathe. Lack of clean air and heavy pollution will continue to affect health irrespective of what is done to prevent it. Thus, public activism against industries polluting the atmosphere and political initiative to have an active governmental effort to counter pollution is mandatory.

Take Home Message:

The impact of air pollution on heart health is both significant and multifaceted. In an era where the air we breathe may act as an invisible adversary, yoga is our protector. This ancient practice has endured through the ages, proving its value and relevance in contemporary times just as it did millennia ago. While it is essential to ensure the air quality is appropriate and adequate steps are mandated, every individual can contribute effectively. Smoking should be banned from inside homes and in public places. Burning things in the open air on a large scale should be avoided and punishable by law. At a personal level, keeping healthy is essential through practicing yoga, pranayama, and meditation. Yoga should be adopted as a form of physical activity and an integral part of our lifestyle. This choice can guide us toward equilibrium and well-being amidst today's environmental challenges.



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Vitality and Energy: Prāna and the Action Principle

Dr. Mrittunjoy Guha Majumdar

Energy forms the underlying basis for the diversity we see manifested in the Universe. Albert Einstein formulated the much-celebrated mass-energy equivalence: in 1905, thereby establishing the manner in which any form of matter is inherently just energy. Energy is ubiquitous and happens to be a conserved quantity, with the law of conservation of energy stating that energy can be converted in form, but not created or destroyed. Some common forms of energy include kinetic energy of moving objects, potential energy stored in fields like the gravitational or electromagnetic, elastic energy stored by stretched objects, chemical energy released with the burning of fuel, the radiant energy carried by light, and the thermal energy due to an object's temperature. In classical mechanics, the total energy of a system is at times called the Hamiltonian, after William Rowan Hamilton, while another closely related concept - Lagrangian, refers to the kinetic energy minus the potential energy of the system. We can use the Lagrangian in the following equation obtained from the calculus of variations to obtain the equations of motion of a system with generalised coordinates.

Both these conceptual elements help in describing the dynamics of a system given

certain energetic constraints. In quantum mechanics, energy is defined in terms of the energy operator (Hamiltonian) as a time derivative of the wave function of the quantum system. While this relates to the miniscule, one extreme of physical phenomena, the other extreme - fast moving objects, also offer an interesting perspective on energy. While the aforementioned mass-energy equivalence related to the rest-mass of the system (energy which every massive body must possess even when being at rest), energy is found to be invariant with respect to rotations of space but not invariant with respect to rotations of spacetime, being a time component of the energy-momentum 4-vector. Energy can be transformed between different forms with disparate efficiencies and the entities that transform energy between these forms are known as transducers. All of nature is nothing but transduction in myriad ways that coordinate to create stable and sustainable structures, leaving the total energy in the Universe constant. The absoluteness of this conservation of energy was beautifully put forth by Richard Feynman in the following words, in a lecture he gave in 1961:

There is a fact, or if you wish, a law, governing all natural phenomena that are known to date. There is no known exception to this law - it is exact so far as we know. The law is called the conservation of



energy. It states that there is a certain quantity, which we call energy, that does not change in manifold changes which nature undergoes. That is a most abstract idea, because it is a mathematical principle; it says that there is a numerical quantity which does not change when something happens. It is not a description of a mechanism, or anything concrete; it is just a strange fact that we can calculate some number and when we finish watching nature go through her tricks and calculate the number again, it is the same.

In Dharmic traditions, the concept of Prāṇa - 'life force' or 'vital principle' is said to permeate reality on all levels of reality including inanimate objects. It is called Nephesh in Ebreo, Ki in Japanese, Chi in Chinese, Pneuma in Greek, Ema in Catalan, Mana in Polynesian, and Ruah in Hebrew. Vaman Shivram Apte gave fourteen distinct meanings of Prāṇa, one of which happens to be energy, albeit in the context of 'vital air'.



Thomas McEvilley translates it as 'spirit-energy'. Clearly, an element of dynamism and definite movement is attributed to the energetics of this concept. Prāṇa is seen as a universal sea of energy that infuses and vitalizes all matter. This sea of energy is what coalesces into sub-atomic particles and atoms, which become the basic building blocks of all matter in the physical world. Therefore, every atom, molecule, and cell is an extension of Prāṇa. One of the most famous verses from the Upanishads speaking of Prāṇa is Brihadaranyaka Upanishad II.1.20: स यथोर्णनाभिस्तन्तुनोच्चरेत्, यथाग्नेः कशुद्रा विस्फुलिङ्गा व्युच्चरन्ति, एवमेवास्मादात्मनः सर्वे प्राणः, सर्वे लोकाः, सर्वे देवाः, सर्वानि भूतानि व्युच्चरन्ति; तस्योपनिषत्-सत्यस्य सत्यमिति प्राणा वै सत्यम्, तेषामेष सत्यम्॥

which talks of the vital force being truth, and it being the truth of the absolute reality -

Brahman. We can see how the perception of vital energy in these texts is essential to creation and the Universe at its most fundamental. While modern science talks of the universality of energy and its pre-eminence in defining the manner in which physical systems and processes are, it does not quite talk of the manner in which 'vitalisation' is carried out by energy in various forms. The stream of vitalism is seen sceptically in modern science and thought. William Bechtel stated that vitalism 'is often viewed as unfalsifiable, and therefore a pernicious metaphysical doctrine'. Francis Crick, who discovered the structure of the DNA, stated 'And so to those of you who may be vitalists I would make this prophecy: what everyone believed yesterday, and you believe today, only cranks will believe tomorrow'. Advocates of vitalism have resorted to trying to explain life-energy in terms of electromagnetic fields and quantum physics. The whole idea of coordination at a holistic level requires a continuum

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of energy that has an inherent self-coordinating aspect to it, which goes against the quantised nature of energy that we know of, by contemporary physics. Scholars like Victor Stenger have spoken of how the effects of electromagnetic forces have been measured as accurately as one part in a billion and there is yet to be any proof of any unique field emitted by living organisms.

While vitalism in the way in which western philosophers speak of it may not be apt to describe the interconnection of energy and vitality, there is one conceptual element that does directly guide and define the manner in which processes take place given certain energy constraints - the Action Principle. The Action S of a physical system is defined as the integral of the Lagrangian L between two instances of time, and is technically a functional of the generalised coordinates of the system. The path (or trajectory of evolution) taken by a particular system between these time instances and associated configurations is the one for which there is no variation in the Action to first order. This idea was developed at different points in time by luminaries such as Pierre de Fermat, Pierre Louis Maupertuis, Leonhard Euler, Carl Gustav Jacobi, Marston Morse and Constantin Caratheodory. While this principle has teleological characteristics has been a matter of great debate, I do not think we need to attribute an objective or goal to this principle for it to hold relevance in the context of the aforementioned discussion. The ontological truth in this principle is sufficient to speak of the manner in which energy dynamics can define the multiplicity of elements and phenomena that we see around us. In the quantum formalism of path integration, the stationary paths are obtained as a result of interference of amplitudes along all possible paths that the quantum system can take.

Just like Brahman is not quite an entity but closer to a principle, a reality so to say, what if the Prāṇic formulation is similar? A function derived from the modes of energy available to the system that defines the movement and trajectory of the system. I like to see the concept of Prāṇa as going beyond living systems, and with principles such as Maximum Entropy Production (there have been scientific works that suggest that the principle of least action in a probabilistic situation is equivalent to the principle of maximum associated with a particular probability distribution), being a universal guiding principle that relates energy and vitality as well as dynamics.

Unveiling the Science Behind Yoga's Benefits for the Cardiovascular System

In today's fast-paced world, where stress and sedentary lifestyles are the norm, our heart health is often at risk. Enter Yoga - an ancient practice that not only trains the body but also calms the mind and soul. As Yoga spreads globally, becoming a staple in many spiritual and physical routines, research into its benefits, particularly for cardiovascular health, has surged. This flexible form of exercise is more than just about flexibility and mindfulness; it's a key player in enhancing heart health.

Yoga's Holistic Approach to Heart Health: A Deeper Dive

Yoga's impact on cardiovascular health is profound and multifaceted. It's not just an exercise; it's a comprehensive approach that nurtures the entire body and mind. This holistic engagement is what sets Yoga apart in its ability to enhance heart health.

Physical Benefits: Yoga's series of postures and movements improve circulation, enhance cardiac efficiency, and strengthen the heart muscle. These physical benefits are crucial in preventing heart diseases and managing symptoms in those already diagnosed.





Mental and Emotional Balance: Stress is a significant contributor to heart problems. Yoga's meditative aspects, including deep breathing and mindfulness, help in managing stress and anxiety. This mental balance is vital in reducing the production of stress hormones like cortisol, which are linked to heart disease.

Lifestyle Impact: Regular Yoga practice encourages a more mindful lifestyle. It often leads to healthier eating habits, better sleep patterns, and a more active lifestyle, all of which are essential for heart health.

The Silent Killer: High Blood Pressure and Yoga's Role

High blood pressure, often asymptomatic, is a critical risk factor for heart disease. Yoga offers a natural and effective way to manage and reduce high blood pressure. **Controlled Breathing:** Pranayama, or yogic breathing, is a cornerstone of Yoga that directly impacts blood pressure. These breathing techniques help in calming the nervous system, thereby reducing blood pressure. **Gentle Movements:** Unlike high-intensity workouts that can spike blood pressure, Yoga's gentle movements ensure a safe and effective way to exercise without putting undue stress on the heart. **Mind-Body Connection:** Yoga fosters a strong mind-body connection. This awareness leads to better recognition of stressors and more effective management of stress, a key factor in controlling blood pressure. **Holistic Health Improvement:** By lowering blood sugar levels and cholesterol, and improving overall cardiovascular function, Yoga acts as a comprehensive tool for heart health maintenance and improvement.



Exploring the Science Behind Yoga's Heart-Healthy Magic

The world of science is increasingly captivated by Yoga's remarkable effects on cardiovascular health. Let's dive into some of the fascinating scientific discoveries that reveal how this ancient practice is a boon for our hearts. **Battling Hypertension:** Hypertension, or high blood pressure, is a stealthy adversary for heart health. But Yoga emerges as a powerful ally. Studies, like those published in the *European Journal of Preventive Cardiology*, have shown that regular Yoga practice can significantly lower blood pressure in individuals with hypertension. This is not just a small win; it's a game-changer in the fight against one of the leading causes of heart disease. **Heart Rate Variability (HRV): A Key Indicator:** HRV measures how adaptable our heart is to stress and relaxation. A study in the *Journal of Clinical Psychology* shed light on how Yoga enhances HRV. This means that Yoga doesn't just help our hearts beat; it helps them dance gracefully to the rhythms of life's ups and downs. **The Inflammation Connection:** Chronic inflammation is like a slow-burning fire in the body, contributing to various cardiovascular diseases. Yoga, however, has been shown to douse these flames. Research in journals like the *Journal of Behavioral Medicine* reveals that Yoga practitioners have lower levels of inflammatory markers like interleukin-6. It's as if Yoga whispers to the body, "Calm down, I've got this." **Autonomic Nervous System: The Unseen Maestro:** The autonomic nervous system, which includes the sympathetic (fight or flight) and parasympathetic (rest and digest) responses, plays a crucial role in heart function. Yoga, through its blend of physical postures, breathing techniques, and meditation, fine-tunes this system. Studies in the *International Journal of Yoga* show that Yoga can improve autonomic function, leading to better heart rate and blood pressure regulation. It's like Yoga conducts the orchestra of our nervous system to create a symphony of heart health.