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ANALYTICAL STUDY OF PRANA VATA IN VARIOUS BODY SYSTEMS

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ABSTRACT
Prāṇa Vāta, a sub-type of Vāta Dosha, plays a fundamental role in regulating respiration, cognition, sensory perception, and autonomic functions, ensuring the smooth coordination of vital physiological processes. It governs the nervous system by influencing cognition, memory, motor control, and reflex actions, resembling autonomic and higher cortical functions. It controls respiration through brainstem mechanisms, ensuring efficient oxygen exchange and maintaining rhythmic breathing. Additionally, it influences cardiac rhythm, linking it to circulatory regulation and heart-brain communication. In digestion, it governs swallowing, gastric emptying, and gut motility through vagal regulation, facilitating nutrient assimilation. Its role in sensory integration enhances perception, responsiveness, and mental clarity. Furthermore, it plays a crucial role in maintaining circadian rhythms by regulating the sleep-wake cycle, aligning with the hypothalamic-pituitary-adrenal axis. Prāṇa Vāta acts as a vital force that sustains homeostasis, supports physiological equilibrium, and ensures harmony between various systems of the body. This study analytically explores its role across physiological systems by correlating Ayurvedic descriptions with modern science.

KEYWORDS: *Prāṇa Vāta, Nervous System, Respiration, Circadian Rhythm, Ayurveda*

INTRODUCTION
The fundamental theory of *Tridosha* is central to Ayurveda's understanding of health and disease [1]. This concept comprises three essential biological energies—*Vata, Pitta*, and *Kapha*—which regulate homeostasis and overall well-being in living beings. *Vata* represents kinetic energy, *Pitta* corresponds to thermal energy, and *Kapha* signifies mechanical energy. When these energies are in balance, health is maintained; any disturbance in their equilibrium leads to disease[2]. Thus, sustaining harmony among the *Tridoshas* is crucial for overall well-being.[3]

Doshas are composed of the five fundamental elements (*Panchabhautika Dravyas*)[4].They function as the *Samavayi Karana*, the inherent cause of both health and disease[5]. Among them, *Vata* derives its name from the root "Va," which signifies movement (*Gati*) and sensory perception (*Gandhana*). *Gati* encompasses motion(*gati*), cognition (*Gnana*), and attainment (*Prapti*), while *Gandhana* represents enthusiasm (*Utsaha*), expression (*Prakasha*), guidance (*Soochana*), and destruction (*Himsa*)[6]. These attributes highlight *Vata's* regulatory influence on physiological functions.

TYPES OF VATA DOSHA
Vata dosha is composed of five subtypes: *Prana, Udana, Samana, Apana*, and *Vyana*[7]. *Prana* governs mental and sensory functions, *Udana* controls speech and expression, *Samana* regulates digestion and metabolism, *Apana* is responsible for elimination and reproductive functions, and *Vyana* circulates energy throughout the body, coordinating movement and overall vitality. Each subtype influences specific physiological and emotional aspects.

OBJECTIVES
To develop a contemporary aspect of the functions of *Prana vata*.

MATERIALS AND METHODS
Data was collected from various texts in Ayurveda including the *Brhatrayee* and *Laghutrayees* and necessary Modern textbooks. Articles available in the search engines were used.

PRANA VATA
The word *prana* is derived from the root word 'an' with the prefix- pra 'An' means to breathe. *Prana vata* is responsible for all vital functions like respiration which are essential for human existence. Of this *Prana vata* is considered as the life of a human being. According to Goudapada, *pranayati iti praana* indicates the relation of *Prana vata* to the control of respiratory functions in the body.

LOCATION OF *PRANA VATA*
Prana vata is located in the *murdha*(head) and it traverses along *uras*(thorax) and *kantha*(throat)[8,9,10].Sharangadhar mentions *nabhi* and *hrdaya* as the seats of *Prana vata*[11]

FUNCTIONS OF *PRANA VATA*
It ensures the proper functioning of *buddhi* (intelligence and judgment), *hrdaya* (brain), *indriyas* (sense organs), and *citta* (mind). It also carries out functions such as *kshteevana*

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(spitting), *ksavathu* (sneezing), *udgāra* (belching), *niśvāsa* (breathing), and *annapravēsha* (swallowing). These processes are essential for maintaining overall bodily and mental health.[12] It is also said to do the function of *dhamani dharana* (control of nerves)[13]. Another function told by Aacharya Sushrutha is *prana cha avalambathe* (filling the entire body with air)[14].

SYSTEMS

Nervous System

The nervous system is a complex network that coordinates and regulates bodily functions, enabling communication between different parts of the body. It is primarily divided into the central nervous system (CNS), consisting of the brain and spinal cord, and the peripheral nervous system (PNS), which includes nerves extending throughout the body. The CNS processes sensory information, controls motor functions, and governs higher cognitive activities like memory, learning, and consciousness. Through intricate neural connections and processes like neuroplasticity, the nervous system continuously adapts, ensuring efficient responses to both internal and external stimuli.

Respiratory System

The respiratory system is responsible for the exchange of oxygen and carbon dioxide, essential for sustaining life. It includes the lungs, airways, and respiratory muscles, working together to facilitate breathing and gas exchange. Oxygen is taken in through inhalation, transported to the bloodstream, and delivered to cells, while carbon dioxide, a waste product, is expelled through exhalation. This system plays a crucial role in maintaining pH balance, supporting cellular metabolism, and ensuring overall homeostasis.

Digestive System

The digestive system is responsible for breaking down food, absorbing nutrients, and eliminating waste to support the body's energy needs. It includes the gastrointestinal tract (mouth, esophagus, stomach, intestines) and accessory organs (liver, pancreas, gallbladder) that aid in digestion and metabolism. Through mechanical and chemical processes, food is converted into essential nutrients, which are absorbed into the bloodstream for cellular functions. This system plays a vital role in maintaining overall health, energy production, and waste elimination.

Endocrine System

The endocrine system is a network of glands that produce and regulate hormones, which control various physiological processes in the body. It includes glands such as the pituitary, thyroid, adrenal, and pancreas, which influence metabolism, growth, reproduction, and stress response. Hormones act as chemical messengers, traveling through the bloodstream to target organs, ensuring coordination and balance within the body. This system plays a crucial role in maintaining homeostasis and adapting to internal and external changes.

Circulatory System

The circulatory system is responsible for transporting oxygen, nutrients, hormones, and waste products throughout the body. It consists of the heart, blood vessels, and blood, working together to ensure efficient circulation. The heart pumps oxygen-rich blood to tissues and organs while carrying carbon dioxide and waste back to the lungs for elimination. This system is essential for maintaining homeostasis, supporting cellular function, and sustaining overall health.

DISCUSSION

Prana vata consists of various functions throughout the body. The effect of *Prana vata* is seen in various systems of the body. The different effects of the system are as following.

Prana vata in the Nervous system

Prana vata controls *buddhi* (intellect), *Smriti*(memory), and *Chetana*(consciousness).[15]It is associated with the functions of the cerebral cortex and higher cognitive processes. The central nervous system is the main system involved in memory. The hippocampus is required for the consolidation of memories from short-term to long-term, whereas the amygdala adds emotional pertinence to memories. The pattern and strength of the connections between cortical structures that permit the storage and retrieval of encoded information.[16] Here we can consider that *Prana vata* represents the neuronal response of consolidating experiences and new learning to form new neural connections leading to the formation of memory.

Buddhi or intellect can be understood by the following points. Brain development, particularly the prefrontal cortex plays a key role in intellect formation. The prefrontal cortex is thought of as the “personality centre” and is the cortical region that makes us uniquely human. It is where we process moment-to-moment input from our surroundings, compare that input to past experiences, and then react to them.[17]

Chetana or consciousness can be analysed by the concept of neuroplasticity. Neuroplasticity is the ability of the nervous system to change its activity in response to intrinsic or extrinsic stimuli by reorganizing its structure, functions, or connections.[18] The everyday stimulus give rise to new neuronal connections. The ability of an individual to be aware of the present situation or environment is what we can call as consciousness.

Prana vata in the Respiratory system

Prana vata governs respiration and the movement of air in the body. This aspect corresponds to the pulmonary ventilation, gas exchange, neural respiratory control and protective reflexes. *Prana vata* controls the act of inhalation (*uchvasa*) and exhalation(*nishvasa*) facilitating the entry of fresh oxygen and the removal of carbon dioxide. During inspiration the diaphragm contracts and moves downwards increasing the lung volume. The external intercoastal muscles expand the rib cage, drawing air into the lungs. During expiration the Diaphragm relaxes, reducing lung volume and forcing the CO2 out. *Prana vata* regulates the rhythmic function of the respiratory muscles just as the autonomic nervous system controls the involuntary breathing.

Prāṇa Vāta operates from the *Mūrdha* (brain), *Hṛdaya* (heart), and *Uras* (chest), ensuring involuntary respiration continues even during sleep or unconscious states. It works alongside

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Udāna Vāta to regulate voice and exhalation. In modern science, this function aligns with the Medulla Oblongata and Pons in the brainstem, which control involuntary breathing. Chemoreceptors in the brainstem and carotid body detect CO_2 and pH levels, adjusting the breathing rate accordingly. The Phrenic Nerve (C3–C5) controls the diaphragm, while the Vagus Nerve (Cranial Nerve X) coordinates breathing with heart rate and digestion. Thus, *Prāṇa Vāta* functions as the neurological control system for respiration, similar to how the brainstem regulates involuntary breathing.

Prāṇa Vāta ensures a continuous oxygen supply to all *dhātus* (tissues) while maintaining the balance between *Prāṇa* (oxygen intake) and *Apāna* (carbon dioxide removal). In modern science, this aligns with alveolar gas exchange, where oxygen diffuses into the blood, binds with haemoglobin in red blood cells, and is transported to tissues, while carbon dioxide (CO_2) moves from the blood into the lungs for exhalation. Efficient gas exchange relies on healthy alveolar function and lung compliance. Thus, *Prāṇa Vāta* plays a crucial role in oxygen-carbon dioxide homeostasis, mirroring the function of alveolar respiration and haemoglobin transport in modern physiology.

***Prana vata* role in Protective respiratory reflexes**

Prāṇa Vāta governs essential protective respiratory reflexes, including cough (*Kāsa*), sneezing (*Nīsāra*), and hiccups (*Hikka*), which help clear airway obstructions and prevent foreign particles from entering the lungs. In modern science, the cough reflex is triggered by airway irritation and mediated by the Vagus Nerve, while the sneezing reflex, responsible for clearing nasal passages, is controlled by the Trigeminal Nerve (Cranial Nerve V). Hiccups result from involuntary diaphragmatic spasms, often linked to Phrenic Nerve irritation. Thus, *Prāṇa Vāta* plays a vital role in airway defence, aligning with brainstem-mediated autonomic responses in modern physiology.

***Prana vata* in Circulatory System**

Prāṇa Vāta plays a crucial role in heart-brain communication, acting as a regulatory force that maintains the synchronization of vital functions. In Ayurveda, *Prāṇa Vāta* operates from the *Mūrdha* (brain), *Hṛdaya* (heart), and Uras (chest), controlling respiration, circulation, and neural activities. Modern science mirrors this concept through the autonomic nervous system (ANS), where the Vagus Nerve (Cranial Nerve X) serves as a primary channel linking the heart and brain[19]. This connection regulates heart rate variability (HRV), blood pressure, and emotional responses, ensuring physiological balance. Additionally, the baroreceptor reflex in the cardiovascular system and chemoreceptors in the brainstem continuously adjust circulation and respiration[20], akin to *Prāṇa Vāta's* role in sustaining homeostasis. Thus, *Prāṇa Vāta* acts as a biological bridge between the heart and brain, much like the neurocardiac axis in modern physiology, harmonizing cognitive, emotional, and autonomic functions.

***Pranavata* in Digestive System**

The role of *Prana vata* in the digestive system can be understood scientifically through its connection with the autonomic nervous system (ANS), central nervous system (CNS), and gut-brain axis. *Prana vata* is primarily responsible for initiating and regulating digestion, which corresponds to the functions of the parasympathetic nervous system (PNS) and higher brain centres involved in digestive control.

It governs the swallowing reflex, ensuring smooth ingestion of food, which corresponds to the coordination of the medulla oblongata and cranial nerves (glossopharyngeal and vagus nerves). These structures control the muscles responsible for swallowing, facilitating the movement of food from the mouth to the esophagus.[21]

Additionally, *Prana vata* influences digestive secretions by stimulating the production of saliva, gastric juices, and digestive enzymes, a function primarily regulated by the vagus nerve within the parasympathetic nervous system. This nerve plays a key role in enhancing digestive activity by promoting the release of hydrochloric acid in the stomach and pancreatic enzymes essential for nutrient breakdown.[22]

Prana vata also initiates and modulates **peristalsis**, the rhythmic contractions that propel food through the digestive tract, paralleling the role of the **enteric nervous system (ENS)**. The ENS, often called the "second brain," operates independently while maintaining communication with the central nervous system to regulate gut motility and coordination.[23] *Prana vata*'s influence extends to the **gut-brain axis**, a bidirectional communication system between the gastrointestinal tract and the brain.[24] This involves neurotransmitters such as **serotonin and dopamine**, which are abundant in the gut and help regulate digestion, mood, and overall gastrointestinal function.[25]

***Pranavata* in Endocrine System**

Prana vata plays a crucial role in the regulation of the endocrine system by influencing the neuroendocrine axis, particularly the hypothalamus, pituitary gland, and autonomic nervous system. Through its influence on the hypothalamic-pituitary axis (HPA), *Prana vata* regulates the release of key hormones such as thyrotropin-releasing hormone (TRH) for thyroid function, corticotropin-releasing hormone (CRH) for stress response, and gonadotropin-releasing hormone (GnRH) for reproductive health. It is closely linked to the autonomic nervous system, where its effects on sympathetic and parasympathetic activity modulate endocrine secretions via neurotransmitters like norepinephrine. The role of *Prana vata* is particularly evident in stress response, as its imbalance can activate the HPA axis, leading to excessive cortisol secretion, which affects metabolism, immunity, and inflammation. Also *Prana vata* governs circadian rhythms, correlating with the function of the pineal gland in melatonin secretion, thus regulating sleep-wake cycles.

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