# Nadi Pariksha: A Comprehensive Survey of an Ancient Ayurvedic Method for Diagnosis and Health Prediction

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## ABSTRACT
Nadi Pariksha, an ancient Ayurvedic technique, is a non-invasive diagnostic and health prediction method that relies on the examination of a patient's pulse to gather insights into their physiological, mental, and emotional state. This comprehensive survey aims to provide an in-depth understanding of the principles, methods, and applications of Nadi Pariksha in modern medical practice. We review the historical and philosophical context of this technique and explore its significance in contemporary Ayurvedic medicine. We discuss the methodology of Nadi Pariksha, including the identification and interpretation of pulse characteristics, and provide examples of its use in diagnosing and managing various health conditions. Additionally, we examine the scientific literature to evaluate the efficacy and reliability of Nadi Pariksha as a diagnostic tool, highlighting its potential benefits and limitations. This survey offers a holistic understanding of Nadi Pariksha, emphasizing its value as a complementary diagnostic and health prediction approach in the modern healthcare landscape.

**DOI Number: 10.48047/NQ.2022.20.4.NQ22345 NeuroQuantology2022;20(4): 1188-1196**



## 1. INTRODUCTION
The phrase "Nadi Pariksha" is well-known in the field of Ayurveda, and traditional writings have emphasised the relevance of this practise in the evaluation of the three doshas, which form the foundation of illness diagnosis and prognosis. According to Yoga Ratnakara, all ailments may be identified through the Nadi, and the importance of Nadi Pariksha was symbolised by comparing it to the strings of a veena playing all of the Ragas. In Ayurvedic medicine, the Nadi signify the state of the entire body, similar to how the pulse in modern medicine reflects the nature, scope, and purpose of life. Examining a patient's pulse, urine, faces, eyes, tongue, speech, skin, and shape are the eight clinical limbs that make up Ayurvedic medicine [1].

**Description of radial pulse waveform**
The radial pulse wave and PPG pulse wave each represent the pressure and flow within blood vessels, and their relationship forms critical cardiovascular blood parameters, including peripheral resistance and arterial compliance. Both radial pulse wave and PPG pulse wave provide insights into the pressure and flow of blood vessels. Figure 1 below illustrates the radial pulse wave.

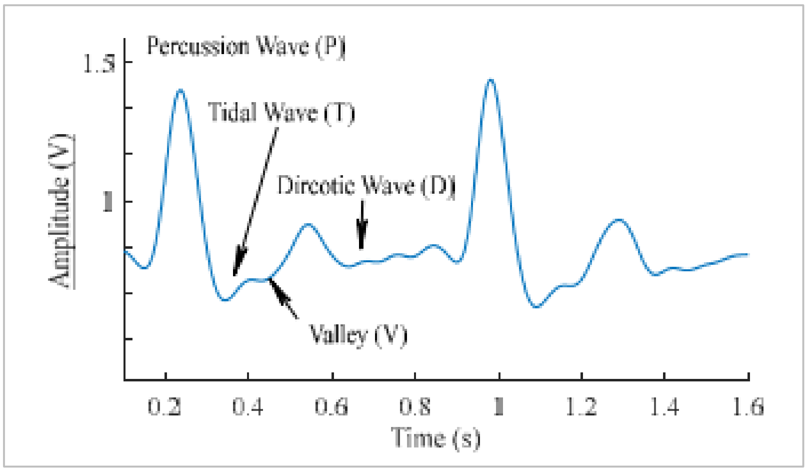


Figure 1. Radial Pulse Wave

The practise of Ayurvedic pulse opens up the doors of perception, allowing one to investigate the concealed mysteries of existence. The delicate expression of global awareness that is flowing within a person's constitution is what we mean when we talk about pulse. It transports nutrients to the cells of the body along with the blood as it circulates throughout the body. Because of this, there is a constant flow of communication between the cells, and it is this constant flow of communication that constitutes intelligence. According to the non-invasive pulse testing technique used in Ayurveda, it is thought that the function of the entire human body is regulated by three humours that are collectively referred to as Tridosha. These humours are vata, pitta, and kapha. The conventional approach for detecting these three forces within the body is to take a pulse waveform from the wrist and feel it with the index, middle, and ring fingers, in that order [1], as illustrated in Figure 2.



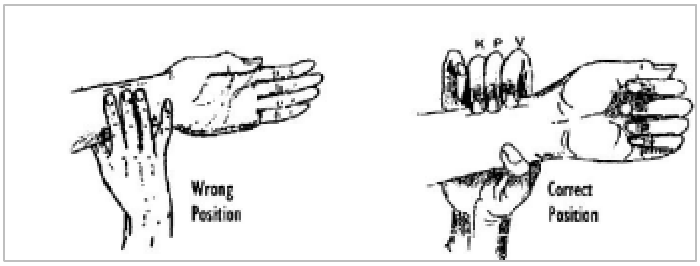


Figure 2. The process of Pulse Diagnosis

The technique of interpreting these three waveforms and identifying any inconsistencies that may exist within them is essential to the practise of Ayurveda.

According to Ayurveda, which literally translates to "the science of life," the universe is made up of five fundamental components: air, water, earth, fire, and space. It is believed that a human life is comprised of three humours, known as Vata, Pitta, and Kapha; seven dhatus, also known as tissues; and three mains, also known as waste products.

- The principle of movement and impetus is referred to as vata (wind, air).
- The principle of absorption and transformation is referred to as pitta (bile, fire).
- Kapha, also known as mucus and water, represents the principle of stability.

**Pulse Parameters as described in Ayurveda**

**a. Gati (pulse movement):**

Gati, a highly unique diagnostic method in Ayurveda, involves comparing pulse movements to those of animals, birds, and reptiles to accurately determine the predominant dosha in an individual's body. The vata pulse movement, known as sarpa gati, is described as curved in the scriptures, resembling the movements of a snake (sarpa) and a leech (jaluka). The curved and zigzag motion is a key characteristic of the vata pulse. Basavarajeeyam, where the significance of the vata pulse was first identified, describes it as vakra and kutil in nature, emphasizing its curved movement [11].

**b. Pitta:**

The movement of the pitta pulse, also known as Manduka gati, has been compared to the hopping and jumping of a frog, which is referred to using the phrases capal and utplutya. Because of its slow, sluggish motion (manda gati), the Kapha pulse is sometimes compared to the motion of a swan. This is because the Kapha pulse is also known as Hamsa gati. Pulse gati is a combination of sarpa and manduka for aggravated vata and pitta doshas, sarpa and hamsa for aggravated vata and kapha doshas, and manduka and hamsa for aggravated pitta and kapha doshas when more than one dosha is present. The body of published work reveals that old Ayurvedic practitioners were highly skilled at determining the prevailing dosha by analysing gati derived from the nadi [11].

**c. Vega (speed of the pulse):**

Ayurveda also emphasises pulse speed in understanding physiological, psychological, and pathological conditions. According to Sarangadhara et al [12], passion and wrath accelerate nadi, while grief and fear slow it. Sarangadhara stated nadi is rapid when digestive fire is active and sluggish when it is weak. With biomedical tools, ayurvedic physicians may now easily measure pulse pace from nadi. In clinical practise, pulse rate is used to monitor health but requires further testing to detect illness. Pulse wave velocity, which is linked to vega, should be studied in ayurveda.

**d. Sthiratva (stability of the pulse):**

The stability of the pulse has been well covered in the ayurvedic classics, along with the intermittent nadi, which alternates between slow, rapid, and pauses. In Basavarajeeyam, the term "sthitva sthitva" is used to describe the intermittent pulse of the sannipatha nadi [11]. The scriptures suggest that a pulse with an intermittent nature, felt in locations other than the designated site, can be fatal and may lead to the premature passing of the patient.

**e. Kathinya (hardness of artery):**

The nature of the kathin nadi has only been thoroughly addressed by Basavarajeeyam, and the hardness of the artery is directly related to it [11]. According to Basavarajeeyam, the vata nadi is described as hard, with terms such as kathor and kathin used to convey the artery's hardness. However, arterial hardness related to pitta and kapha doshas is not mentioned. In Ayurveda, the hardness (kathin) and roughness (khara) of the artery are associated with the vata dosha. Basavarajeeyam likens the vata nadi to a veena string, emphasizing its hardness. Hardened arteries typically have a faster blood flow compared to healthy ones, which aligns with the idea of a faster vata pulse in Ayurvedic theory. Basavarajeeyam also states that a nadi that is kathin, or moves extremely slowly and curvedly, and shifts from its original position, is considered a mrityu nadi, signaling that the patient may be nearing the end of their life.



## 2. LITERATURE REVIEW

Authors Yukti Tiwari at el in [1] perform the review on the ancient ayurvedic method for diagnosis and prediction of diseases. They discuss about the Method of examination of Nadi, Nadi Gati of Doshas, Nadi Gati in Prakruti state, Nadi Gati in Vikruti state, Nadi Gati for Dhatus, Subdosh & Nadi, Nadi Gati for Bad Prognosis, etc. In their study, Nadi Pariksha is considered a significant diagnostic tool for detecting diseases at early stages and also providing predictions about disease prognosis.

The fluctuation in the various Nadi and pulse parameters according to Prakriti is the subject of authors at el in [2]. For this, 200 healthy volunteers served as the subjects for the study of the Prakriti, Nadi, and pulse. The primary goal of the author was to identify any variations in the parameters of the pulse and Nadi in relation to Prakriti. For the inference of the differences between the variables of the Nadi and pulse according to Prakriti, they utilised ANOVA, the Chi square test, etc. Only a small number of factors show statistical variation in accordance with Prakriti, according to their findings. Additionally, it was noted that there is some association between Nadi and Prakriti. Using a manual approach, irregular pulse was seen in those with Vata Prakriti. While Pitta and Kapha Prakriti individuals showed regular pulsation. By using a manual technique, the mean pulse rate was shown to be highest in Pitta Prakriti individuals and lowest in Kapha Prakriti individuals.

## 3. DIFFERENT TECHNIQUES AND SENSORS USED FOR HEALTH PREDICTION AND DIAGNOSIS OF DISEASE

### A. NADI PARIKSHA USING DIFFERENT SENSORS

Shashi Sharma and Neelam Prakash Rup acquired wrist pulse signals using an optical sensor. These wrist pulse signals are comparable to those that the clinical researchers obtained using a radial artery catheter. Thus, employing a non-invasive approach, powerful digital signal processing algorithms may be used to extract numerous properties from pulse signals obtained from human wrists [3].

Suket Thakkar and Bhaskar Thakker's technology relies on pressure sensors to get wrist pulse data on three channels. Circuits are used to provide the amplification and filtering of wrist pulse signals. An sophisticated microcontroller with the ARM Cortex M4 architecture is employed to digitise signals. A graphic colour LCD is used to monitor these digital signals in real time. Touch interface is incorporated for zooming in or out. The signals are recorded on micro SD memory cards for offline processing and analysis [4].

The approach put out by Rushikesh et al in [5] employs ayurvedic knowledge to diagnose diabetes based on a person's prakriti, or constitution. Three piezoelectric pressure sensors are installed on a person's wrist to record Vaat, Kapha and Pitta signals. The analysis of variances in these signals results in the determination of a person's specific dosha and prakriti. Artificial neural network (ANN) is utilised in addition to tridosha analysis to classify the patterns of pulse signals.

### B. VARIOUS FEATURES AND FEATURE EXTRACTION METHODS

In their research, Rushikesh et al highlighted the use of signal processing techniques to determine Nadi signal characteristics in both time and frequency domains. To extract features more effectively, they employed signal processing methods such as filtering, differentiating, and squaring of the signal. They also used ANN for feature classification [6].

Various properties, including mean, total amplitude, standard deviation, positive and negative amplitude, positive energy, total energy, and negative energy, are considered in the analysis of collected pulse data. Furthermore, the Fourier transform and Wavelet Transform can be employed to identify features across different domains [7]. Some researchers utilize the Gabor spectrogram to extract information from the time-frequency domain, and the mean square error is considered one of the most crucial aspects [8].



Signal processing techniques allow one to acquire features such as peak amplitude, PSD, spectral centroid, and average band power. Other features that can be retrieved include spectral centroid. Data on the patient's pulse that was collected from three different locations on the wrist provides information that is unique and serves as the basis for making a diagnosis of the disease [9].

The ''Nadi Parikshan Yantra,'' which was developed in their laboratory, was used by A. E. Kalange and colleagues to collect pulse signals data from a large number of individuals. A person qualified as a Nadi Vaidya (an Ayurvedic Expert) also examined the people. According to what is written in Ayurveda, the data on the pulse was gathered from three different pulse points: vata, pitta, and kapha. Additionally, they demonstrated that time domain analysis is an extremely helpful tool for determining which dosha predominates in an individual [10].

The wrist pulse waves were analysed by D. Rangaprakash at el in [13], who used signal processing techniques to extract useful information from the data. Radial artery pulse pressure signals are collected noninvasively at the wrist location for many people for two cases of interest, namely before and after exercise, as well as before and after lunch. The two cases are compared side-by-side. In the next step of the study, a bi-modal Gaussian model is fitted to the data, and then spatial features are extracted from the model fit. A classifier that is based on support vector machines and employs recursive cluster elimination is what is used to differentiate between the groupings. In the workout example, a high classification accuracy of 99.71% is reached, and in the lunch scenario, a classification accuracy of 99.94% is attained.

### C. DISEASES DIAGNOSED, ALGORITHMS USED, SUBJECT INVOLVED

Unsupervised and supervised learning approaches for pulse signal identification were used in a comparative research to compare the signal obtained in two distinct forms of liver illness, namely Fatty Liver illness and Cirrhosis. The principles of Traditional Chinese Medicine were used to gather the pulse signals in this investigation, and they were pre-treated before parameter extraction was carried out based on Wang Nanyue's work on harmonic fitting [14].

By using an appropriate pressure sensor and a statistical tool for data processing, N. Arunkumar at el. [15] created a system that focused on comparing the signal collected from normal healthy individuals and diabetes patients. The MLT1010 piezoelectric pressure sensor from AD Instrument was used to progressively capture the data from the radial artery. By directly connecting the output to AD Instruments' Power Lab 16/30 data collecting equipment, this signal was recorded in a PC.

## 4. RESULT AND DISCUSSION

Table 1 shows the comparative analysis of various researcher's techniques, their feature extraction methods, sensors used, etc. for detection of pulse wave.



Table 1. Details description of features used, features extraction methods and hardware / sensor used in detection of pulse wave.

| Ref | Sensors / Hardware Used | Features / Feature extraction methods | Disease Diagnosed / Work Done |
|---|---|---|---|
| [16] | Using a milli volt output medium pressure sensor with a data acquisition card (NI USB-6210) and 16-bit precision, a pressure sensing approach is applied. | Important time domain characteristics include the percussion wave (P), tidal wave (T), valley (V), dicrotic wave (D), and the standard pulse waveform with a known amplitude and length. | Various Disease are diagnosed |
| [17] | The radial artery was sensed using piezoelectric sensors, and the hardware employed was the BioPac150TM (data collecting system). | A tidal wave, a percussion wave Valley; c) Dicrotic Wave. We created a technique for extracting features from radial pulse signals using wavelet-based multiresolution analysis. | Autonomic Nervous System Assessment |
| [18] | Doppler ultrasonic blood analyzer module with sensors. Pulse readings were acquired from the pitta location using just one probe. Recognises doppler spectograms or pulse waveforms. | Features: Beginning of a time, the main wave's apex Dicrotic notch, secondary wave's peak start of the next period Extraction techniques HHT: Hilbert-Huang transform | analysis of wrist blood flow signals for computerized pulse diagnosis |

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|---|---|---|---|
| [19] | By inflating and deflating an air bag, they have offered a technique and system for measuring the pulse pressure signals of the radial artery. To give doctors more accurate pulse diagnostics information, the TCM's pulse diagnosis was simulated. | Pressure-based acquisition of pulse data from Radial site<br>Wiry pulse<br>Slippery pulse<br>Hesitant pulse | provide insights into the overall functioning of the autonomic nervous system |
| [20] | Piezoelectric sensors and a pulse oximeter arrangement were used as the sensor to determine the mean tridosha factor. The aforementioned sensors were unable to reliably report data like pulse duration and pulse width. | peak value (P Vmax), power (P P), ascent (P AS), and descent (P DS), respectively. | Aims is to determine differences in pulse diagnosis |
| [21] | They have looked at the idea of array sensors. There are 12 detecting sites on each tactile capacitive array pressure sensor. H/W: Pulse signals were collected using an analogue to digital acquisition card (D 600, PPS, USA) after 100 Hz sampling. | Signal processing Pattern classification improved Gaussian model, | Created methodology for extracting features from pulse signals |
| [22] | Sensor: A pressure sensor that is sensitive to changes in pressure and is compact in size. In order to relax the wrist and apply pressure, a mechanical structure called a semiconductor strain gauge (SSG) has been created. | The gauge's micro strain is converted into a voltage change using a Wheatstone bridge circuit. technique of multiscale sample entropy (SampEN) Sample entropy, approximate entropy, and multiscale entropy | multichannel wrist pulse signal analysis |
| [23] | Optically-based sensors H/W: Labview filters and the Arduino Uno are created The Butterworth Low-pass Filter is a software filter that was created, and it has the following characteristics: .0.125Hz is the lower cutoff frequency. 180 Hz is the upper cutoff frequency. | Features: Pulse Repetition Rate, Pulse Frequency Pulse Amplitude, Methods: Mean Value of the signal Standard Deviation of the signa | Nadi Pariksha |
| [24] | Piezoelectric pressure transducer When pushed on the wrist, this sensor recognises dynamic pulse pressure and rejects static pressure. Amplifiers and filters filter the pressure-proportional electrical signal. H/W: NI USB-6210 multipurpose data acquisition card collects data. | Features: shape, rhythm, amplitude, frequency pulse rate Analysis done using ANN | Diabetes |
| [25] | Sensor: IR-based photo plethysmography sensors emit IR light into the artery and measure the light reflected back from the tissue. Sensors create signals at certain intervals based on incident and reflected light. USB DAQ | Number of Pulses: The pulse count varies across all three signals, reflecting the balance or imbalance of the Tridosha. Pulse rate is measured using Peak | Health Diagnosis |

| | | | |
|---|---|---|---|
| | card connects these sensors to PC. | Detection VI. Pulse Amplitude and Approximate Entropy are also considered in the analysis. | |
| [26] | This gadget uses fibre optic sensors. | Gaussian filter, Signal Segmentation (ISW algorithm) | Lung Cancer |
| [27] | Sensor: Photoplethysmography (PPG) (Provided Skin thickness less and complexity of blood vessel less | Rising & Falling Peaks Pulse Wave Velocity Augmentation Index ( Stiffness) Reflectivity Index (Blood Volume | Nadi Pariksha |
| [28] | Sensors: optical Photoplethysmographic (PPG) sensor H/W: 200 KHz NI DAQ card 8th-order Butterworth Filter myRIO1900 board, MXP connection, LabVIEW PC, USB storage. | pulse wave : 1000 samples/s and frequency band of 0–400 Hz Pulse Wave Velocity: Pulse transit time 7.4m/s Effect of breath holding on pulse | No disease is dignosed. The aim was to capture and analyze pulse wave signals |



## 5. CONCLUSION

Nadi Pariksha, as an ancient Ayurvedic diagnostic and health prediction method, has the potential to contribute significantly to the modern healthcare landscape. By examining the pulse characteristics, practitioners can gain insights into a patient's physiological, mental, and emotional well-being, providing valuable information for diagnosis and treatment. This comprehensive survey has delved into the history, principles, methodologies, and applications of Nadi Pariksha, as well as evaluated its efficacy and reliability based on existing scientific literature. While the technique may have limitations, its non-invasive nature and holistic approach make it an attractive complementary tool in modern medical practice. Further research and standardization are necessary to optimize the potential benefits of Nadi Pariksha and to better integrate it into the global healthcare system.

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