Original Article

Practices and Techniques of Jal Neti Across Indian Institutions: A Cross-sectional Study

Abstract

Background: Nasal irrigation, including the traditional practice of Jal Neti, is increasingly used as an adjunctive treatment for various sinonasal disorders. It enhances mucociliary clearance, reduces mucus contact with irritants, and helps alleviate sinonasal symptoms. Despite its benefits, the practices and techniques vary widely across yoga traditions, necessitating a systematic examination of these differences. **Methods:** This cross-sectional observational study was conducted at nine renowned yoga and naturopathy institutes in India to document and analyze the diverse practices of Jal Neti. Data were collected through direct interviews with experts, observations, and a review of institutional practices. Parameters studied included water source, purification methods, salt type and measurement, water temperature, and quality testing. **Results:** The study revealed significant variations in Jal Neti practices among institutions, influenced by expertise, philosophy, and environmental factors. Water sources ranged from municipal to natural sources such as dams and ground water with purification methods including reverse osmosis and chlorination. Water temperatures varied seasonally, and salt types included rock, sea, and iodized salts, with measurement techniques often subjective. The pH, total dissolved solids, and salinity levels differed, reflecting the influence of local water characteristics. Although consistent water quality testing was observed, the frequency and parameters varied, affecting practice safety and effectiveness. **Conclusion:** Jal Neti practices across major Indian yoga institutes exhibit significant diversity in methods, reflecting the individualistic yet systematic nature of this ancient technique. These findings highlight the need for standardized guidelines to ensure safety and efficacy, especially concerning water quality and salt concentration. The clinical relevance of these findings lies in the potential for improving the safety and effectiveness of Jal Neti for sinonasal disorders. Variations in salt types, concentrations, and water temperatures could influence mucosal irritation, symptom relief, and overall therapeutic outcomes. Standardizing these parameters could enhance the consistency and reliability, ensuring better patient outcomes in both traditional and clinical settings.

Keywords: *India, Jal Neti, practice, Yoga*

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Introduction

Nasal irrigation is increasingly recommended as an adjunctive treatment in various sinonasal disorders by several national and international consensus conferences.[1-6] This practice facilitates the mechanical removal of mucus, crusts, cellular debris, and various airborne contaminants, including pathogens, allergens, and particulates. It also enhances mucociliary clearance,[7,8] reduces the mucus contact time with airborne irritants, lowers local concentrations of pro-inflammatory mediators,[9-11] and moisturizes the nasal mucosa, which is particularly beneficial postoperatively and in chronic sinonasal conditions. A meta-analysis of 10 controlled trials, selected from a review of 11,500 studies, involved over 400 patients with allergic rhinitis.[7] Regular saline irrigation improved nasal symptoms in 35% of adult and pediatric cases and enhanced quality of life in 30%. Mucociliary clearance, measured via the saccharin test, improved by approximately 30%. However, the impact on medication usage was difficult to quantify, partly due small sample size, varying methods, and different administration schedules.[7] The variability in the literature complicates understanding the optimal solutions and administration methods for nasal irrigation. The composition of the irrigation solution appears to be a crucial factor; certain studies indicate that solutions derived from specific

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seas might provide superior functional benefits.[12,13] The inconsistencies in practices, such as variations in water quality, salt concentration, and technique, could lead to potential risks, including mucosal irritation, infection, or reduced therapeutic efficacy. Improper practices, such as using nonsterile water or incorrect salt proportions, may compromise safety and fail to provide clinical benefits. This nasal irrigation has been practised in Yoga, known as Jal Neti, for thousands of years. It is one of the 6 cleansing procedures mentioned in the ancient texts of Hath Yoga.[14] Despite its widespread use, the specific practices, techniques, and adaptations of Jal Neti vary significantly across different yoga traditions and institutions. These variations, influenced by the teachings, environmental factors, and the individual expertise of practitioners, highlight the need for a systematic exploration of how Jal Neti is practiced in various prominent Indian yoga institutes. Although studies outside India have tried to focus on standardization of this technique, there are seldom studies which report of its validation from Indian perspective. This study aims to document and analyze the diverse practices of Jal Neti across nine renowned yoga institutions in India. Each institution represents a significant school of thought within the broader framework of Hatha Yoga and has been instrumental in disseminating yoga practices both within India and internationally. By investigating the methods employed at these institutions, this study aims to provide a comprehensive overview of the current practices of Jal Neti, contributing to the understanding of this ancient practice in modern contexts.

Methods

Study design and subjects

The study was designed as an observational cross-sectional survey conducted across nine renowned yoga and naturopathy institutes in India: Morarji Desai National Institute of Yoga, New Delhi; Yoga Vidya Gurukul, Nashik; Kaivalyadham Yoga Institute, Lonavala; Morarji Desai Institute of Naturopathy and Yoga Science, Swami Vivekananda Yoga Anusandhana Samsthana, Bangalore; Swami Patanjali University, Haridwar; Government NC and Y Medical College, Mysuru, Vemana Yoga Research Institute, Hyderabad and Gandhi Naturopathic Medical College, Hyderabad. The selected institutions represent premier centers for Yoga and Naturopathy in India, recognized for their expertise and leadership in the field. These institutions were chosen based on their reputation, the diversity of their practices, and their adherence to traditional yet scientifically informed methods. They collectively offer a broad spectrum of practices and perspectives, making them representative of established Indian yoga practices. This selection ensures that the findings are grounded in the experiences of institutions that set benchmarks in Yoga and Naturopathy, providing insights that are both authoritative and relevant to the wider yoga community. The data were collected from December 2023 to March 2024. The aim was to gather comprehensive data on the practices related to water use, salt measurement, and other related parameters for traditional yogic cleansing techniques. Data were collected through direct interviews with experts, observations, and a review of institutional practices. Experts were those actively involved in teaching and performing yogic cleansing techniques involving saline water. The structured interview format was used to collect data, focusing on qualifications, years of experience, school of thought, and specific details related to water use for cleansing practices. Information regarding the water source (surface, ground, or municipal) was documented during the data collection. An automated hand held calibrated instrument, Oakton pH test waterproof pocket tester was used to test the pH, total dissolved solid (TDS), and salinity across all the participating institutes by the researcher.

Experts were asked about their water purification methods, which included Reverse Osmosis (R.O.) and chlorination processes. Details on the frequency of water quality testing were also recorded, though this varied across institutes. Information about water temperature was gathered through direct questioning, and the reported temperatures were verified where possible using available measuring equipment. Observations were made to confirm the consistency of the reported data. Salt-related practices were also carefully documented, including the type of salt used (rock, sea, or common iodized salt) and the method of salt measurement. Each expert was asked to describe how they determined the salt quantity, whether it was measured manually using spoons, by taste, or through other methods. Apparatus used for measuring and verifying the water temperature were recorded, and they were queried on the specific tools or physical methods used to ensure the correct temperature and salinity. Challenges faced in adjusting water parameters for specific environmental conditions were noted. Seasonal adjustments, alterations in water temperature, and specific practices avoided during certain weather conditions were carefully recorded. The measurements were taken on-site. The data were systematically recorded and organized for analysis. Each parameter was carefully evaluated to maintain consistency and accuracy, ensuring that the practices documented were representative of the standard approaches used at each institute.

Ethical statement

The study was approved by the Ethics Committee of National Institute of Naturopathy, Pune (Letter-NIN03/2023, Dated -November 31, 2023)

Results

The comparative analysis of Jal Neti practices across various institutions reveals diverse approaches based on experience, school of thought, and water preparation methods, and the years of experience varied significantly, with some practitioners having over 30 years. In comparison, others

had around 5–15 years. Most practitioners sourced water from surface, ground, or municipal supplies, with standard purification methods such as R.O. and chlorination.

Water temperature during practice varied from room temperature adjustments in winter to specific measurements such as 38–55.5°C, demonstrating the importance of temperature in the Jal Neti process. Quantity of salt added varies across institutions proportional to the water and salt types predominantly being rock, sea, or iodized salts. Average ranged from 5.55 to 12 g/L. The salt measurement was often based on personal judgment, i.e. by tasting the water after salt addition. Usage for water temperature assessment was consistent, with most relying on physical checks. Water quality testing was conducted across all centers, although the frequency varied. pH levels generally stayed within a range suitable for nasal cleansing (6.63–8.14). Overall, these findings underscore the personalized yet systematic nature of Jal Neti, adapting traditional methods to contemporary safety standards [Table 1].

Discussion

Nasal irrigation may soften and dislodge the mucus lining the nasal cavity. A review by Meera *et al.* reported the evidence supporting use of Jal Neti in treating sinusitis, rhinosinusitis, allergic conditions and in improving vision with added benefits of improving vision as well as presence of mind.[9,14-16] However, evidence suggests that saline solution composition can affect N. I.'s effectiveness. Although the impact of salt concentration on mucociliary clearance through alterations in ciliary beat frequency remains unclear due to conflicting *in vitro* and *in vivo* data, it is known that the solution's tonicity influences the composition and activity of nasal secretions.[17] Low-salt and isotonic solutions have significantly reduced microbial antigens and microbial burden, while hypertonic solutions (2.7% Na) have shown only marginal effects on microbial antigen concentrations. In addition, lysozyme and lactoferrin levels increased by approximately 30% 24 h after N. I.[18]

We observed that most institutions follow Hatha Yoga principles with distinct interpretations influenced by their specific philosophies, leading to diverse practices, especially concerning water quality and salt usage. Water sources primarily include surface, ground, and municipal water, some using unique sources like dam water. Purification methods commonly involve R. O. treatment,

Table 1: Outcome of the observation across the nine centers

Parameter	Institute 1	Institute 2	Institute 3	Institute 4	Institute 5	Institute 6	Institute 7	Institute 8	Institute 9
Qualification	MSc	BA	MA	MA	PhD	MSc	BNYS	BNYS	BNYS
Years of Experience	Ten years	31 years	15 years	30 years	11 years	5 years	5 years	10 years	10 years
Source of Water	Surface/ Ground/ Municipal	Surface/ Ground/ Municipal	Directly from the dam nearby	Not specified	Surface/ Ground/ Municipal	Surface, Ground, or Municipal water	Surface, Ground, or Municipal water	Surface, Ground, or Municipal water	Surface, Ground, or Municipal water
Water Purification	R.O./ Chlorinated	R.O.	R.O.	R.O.	R.O.	R.O.	R.O.	R.O.	R.O.
Water Quality Testing	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Water Temperature	Warm (exact temperature not notified)	Warm (exact temperature not notified)	38°C	55.5°C	Room temperature (adjusted in winter)	43.8°C	39.1°C	Warm (exact temperature not notified)	Warm (exact temperature not notified)
Salt Quantity	15 g for 1.5 litres	4.7 g per litre	5.55 g per litre	4.815 g per litre	10-12 g per litre	9.5 g per litre	28.271 g for≈5 litres of water	7 g per litre	5.5 g per litre
Salt Type	Iodised Salt	Iodised Salt	Iodised Salt	Iodised Salt	Iodised Salt	Iodised Salt	Iodised Salt	Iodised Salt	Iodised Salt
Salt Measurement Method	Tasting	Tasting	Tasting	Tasting	Tasting	Tasting	Tasting	Tasting	Tasting
Equipment Used	Physical examination	Physical examination	Physical examination	Physical examination	Physical examination	Physical examination	Physical examination	Physical examination	Physical examination
Challenges Faced	None	Seasonal temperature variations	Seasonal temperature variations	Seasonal temperature variations	Seasonal temperature variations	Seasonal temperature variations	None	None	None
pH	6.79	6.63	7.72	8.1	8.14	7.94	7.77	7.72	6.63
TDS (Total Dissolved Solids)	130 ppm	560 ppm	430 ppm	508	931 ppm	453 ppm	705 ppm	550 ppm	475 ppm
Salinity/litre	13.99	6.9	7.20	9.11	5.7	7.7	3.10	6.9	8.1

R.O.: Reverse Osmosis

though specifics are often not detailed, which can lead to varying mineral contents and safety levels. Water quality testing is a standard practice; however, consistency in testing frequency suggests potential variations in the safety and quality of the water used. Studies have shown that adult irrigation bottles can become contaminated with various bacteria,[19] with contamination rates increasing over time.[20-23] While some experts downplay the clinical relevance of such contamination, the potential risks – such as primary amebic meningoencephalitis from contaminated water – underscore the importance of proper cleaning and sterilization.[24] Methods to reduce contamination include using sterile water and rinsing devices with boiled or distilled water.[24] Although studies on contamination in children are limited, similar precautions are advised, with sterile solutions and single-use devices potentially reducing risks.[25]

Isotonic saline (0.9%) and hypertonic saline (1.5%–3%) are N. I.'s most commonly used solutions.[26] These solutions are typically acidic, with pH values ranging from 4.5–7. Solutions with NaCl concentrations above 3% are generally not recommended, as concentrations of ≥5.4% can lead to adverse effects such as pain, blockage, and rhinorrhea, which are dose dependent.[25] Some physicians prefer Ringer's lactate, which contains additional minerals and has a pH between 6 and 7.5.[27] Several commercial products dilute seawater with distilled water to create isotonic or hypertonic solutions with neutral or alkaline pH (e.g., Libenar®, Sterimar®, and Marimer®). These products offer higher mineral content than NaCl and Ringer's solutions. Electrodialysis seawater products (e.g., Physiomer®) retain nearly all the minerals from the original seawater. Homemade solutions can also be prepared by mixing boiled water with a table or canning salt and occasionally baking soda. The final tonicity ranges from 0.9% to 3% and an acidic pH unless baking soda is added. Water temperature control varies, with some institutions adjusting it according to seasons or specific conditions, highlighting an adaptive yet nonstandardized approach. Equipment used for temperature and salt adjustments includes basic apparatus and physical examination methods, and subjective techniques such as tasting introduce variability. Seasonal adjustments, such as modifying water temperature during different weather conditions, are standard but lack uniformity across institutions. Such variations can result in inconsistent user experiences. The physiological basis of Jal Neti lies in replicating the natural salinity and pH of human tears, which are crucial for maintaining comfort and safety during the nasal cleansing process. This balance is essential as it ensures that the solution used for Jal Neti is isotonic and matches the body's natural fluids, thereby preventing irritation or discomfort to the delicate nasal mucosa. By adjusting the salt quantity to mirror the saltiness of tears, practitioners can achieve a solution that feels natural and nonirritating, supporting the cleansing process while maintaining the integrity of the nasal passages. In the present study, we observed a significant variation in salt quantities, ranging from approximately 4.7 g to 28.271 g/L, which could influence the physiological effects of saltwater intake. The types of salt used include rock salt, sea salt, and common iodized salt, with preferences driven by traditional beliefs. Measurement methods are primarily manual, often involving spoon estimates or tasting, which lack precision and could lead to inconsistencies in salt intake, underscoring the need for standardized measurement techniques.

Various methods can be used for N. I., including the traditional Neti pot filled with lukewarm water.[28] Studies suggest that methods ensuring large-volume irrigation are generally more effective. Although the optimal duration of treatment remains unclear, using positive pressure offers more significant benefits than negative pressure (e.g., sniffing), nebulization, or spray.[29] Large-volume (at least 100 mL) low-pressure irrigation is preferred over low-volume high-pressure irrigation for maximizing efficacy.[30] Compressible douching systems are recommended for adequate nasal and sinus cavity irrigation, providing a minimum output pressure of 120 mbar, a good nostril fit, possible nasal vestibule insertion, and an upward (45°) irrigation stream.[31]

In the community, syringes are commonly used for N. I. However, it has limitations, including poor nostril fit, variable pressure application, and the need for frequent refilling with a small syringe.[32] For children, especially neonates, infants, and toddlers, who cannot use adult douching systems, drops, sprays, or disposable syringes are often employed. However, there is no consensus on the most effective method, volume, or duration of treatment for children. Different studies have used varying techniques and volumes with varying degrees of effectiveness.[33-35] Adults typically experience minimal side effects from N. I., with transient reactions such as nasal irritation, discomfort, otalgia, or saline pooling in the paranasal sinuses being common (10%–20% of cases), especially with high-volume devices.[35] Although these reactions are usually mild, they do not significantly affect compliance.[36] It is essential to ensure the solution is at a comfortable temperature, as extremes can cause tolerance issues. Compliance is more challenging for children, often relying on parental judgment. Jeffe *et al*. found high compliance rates among children, with most continuing N. I. use as needed.[37] The issue of solution and device sterility is significant. Contamination risks arise when large volumes of solutions are prepared and stored at home or when devices are not appropriately cleaned.[38] While a standard Neti pot is now used throughout, the volume of water used is not debated further.

Variations in water quality, salt concentration, and solution preparation methods significantly influence the clinical

outcomes of N. I.[39] For instance, differences in salt concentration can affect mucociliary clearance and the degree of mucosal hydration. Isotonic solutions (0.9% NaCl) are widely recommended due to their compatibility with nasal physiology, while hypertonic solutions (≥1.5%) can enhance decongestion[19] but may cause irritation with prolonged use. Evidence suggests that both isotonic and hypertonic saline solutions have their benefits, but isotonic saline is generally preferred due to its affordability, ease of use, and safety.[42] As discussed previously variations in hypertonic and isotonic salinity has been dealt with, but most of the studies support the use of hypertonic as compared to no salinity at all. A recent study by Yata *et al*.,[43] compared, 3% hypertonic saline with no saline and found no significant clinical difference. This was supported by other trails by Sansila *et al*.;[44] where 1.8% hypertonic saline was compared to isotonic saline. Similarly, temperature plays a pivotal role; lukewarm solutions (around body temperature) optimize mucosal comfort and clearance.[40] Deviations from these parameters – such as higher concentrations or extreme temperatures – can impair patient compliance, diminish therapeutic effects, and even induce adverse reactions. The therapeutic efficacy of Jal Neti hinges on the consistency and accuracy of its practice.[41,42] A few studies have compared use of Syringe with bottles. Piromachi found that squeeze bottles are better than syringes.[42] Whereas Sansila *et al*. and Yata *et al*. used syringes effectively in their trails.[43,44] A study revealed that 48% of patients used tap water directly without boiling, and 27% failed to disinfect the bottles used for irrigation.[45] This poses significant risks, as tap water contaminated with *Naegleria fowleri* has been linked to fatal cases of amebic meningoencephalitis through the olfactory nerve, as reported in a U. S. patient.[24] In addition, even sterilized fluids can support the regrowth of infectious pathogens within a short period, necessitating proper storage, such as refrigeration, to minimize contamination risks.[46] Both isotonic and hypotonic solutions are susceptible to contamination, underscoring the need for precautionary measures. It is recommended to boil the irrigation fluid for at least 5 min and cool it, or alternatively, expose it to UV light for at least 45 s before use.[47] Given these recommendations, there is a discrepancy in terms of following these as standard protocols. More studies to highlight the contamination control are warranted. Therefore, public education on proper preparation and device maintenance, combined with institutional efforts to improve access to pre-tested and standardized irrigation kits, can significantly reduce health risks while enhancing the overall efficacy of Jal Neti.

The observed variations in Jal Neti practices across institutions reveal significant clinical implications, emphasizing the individualized yet systematic adaptation of traditional techniques to modern safety and efficacy standards. Variability in practitioner experience, ranging from 5 to over 30 years, highlights the influence of expertise on procedural nuances, potentially affecting patient outcomes. Differences in water sources and purification methods (e.g. RO, chlorination) underline the need for consistent standards to mitigate the risk of contamination and ensure patient safety. Water temperature, adjusted from 38°C to 55.5°C or room temperature in winter, underscores its critical role in enhancing comfort and therapeutic efficacy, particularly for nasal congestion. Salt concentration, ranging from 5.55 g/L to 12 g/L, and the type of salt used (rock, sea, or iodized) may influence mucosal compatibility, underscoring the need for precise measurements to avoid irritation or suboptimal cleansing. The common reliance on taste to determine salt concentration reflects a personalized approach but may introduce variability, impacting clinical outcomes. Furthermore, water quality parameters such as pH (6.63–8.14) and TDS highlight adherence to physiological norms, essential for minimizing mucosal damage. Despite systematic efforts, challenges such as seasonal temperature adjustments and fluid contamination risks reinforce the importance of standardized guidelines to optimize the safety and efficacy of Jal Neti practices.

Limitations of the study

The reliance on self-reported practices, including water quality testing frequency, purification methods, and salt measurement techniques, introduces recall and reporting bias, particularly as many institutions lack standardized protocols. The wide variation in salt quantities and subjective methods like tasting or manual measurements may lead to inconsistent salt concentrations, influencing physiological outcomes and user experiences. The lack of uniformity in water temperature adjustments across institutions adds another layer of variability, which could bias results toward an overestimation or underestimation of N. I.'s efficacy. In addition, contamination risks from irrigation devices and solutions, exacerbated by inconsistent sterilization practices, might lead to underreported adverse events, skewing the study towards a favorable view of N. I. The inclusion of diverse water sources, such as municipal or dam water, without comprehensive mineral content analysis introduces potential confounding factors. These biases, primarily nondirectional are due to the variability in practices and user experiences.

Conclusion

In the present study, water parameters such as pH, TDS, and salinity show considerable variation across institutions. pH levels, while generally within a safe range, vary from mildly acidic to neutral. TDS values differ significantly, reflecting varying mineral contents that may influence health outcomes. Similarly, variations in salinity levels can impact both the taste and physiological effects of the

water used during practices. These discrepancies highlight the need for standardized guidelines to ensure safety and consistency in Jal Neti practices. Practical recommendations include developing standardized protocols for water quality testing, defining optimal salt concentrations, and establishing precise measurement methods to minimize variability. Such guidelines would help mitigate risks associated with contamination, improper salinity levels, and inconsistent practices, ultimately enhancing safety and effectiveness. Further research is crucial to advance the field. Clinical trials evaluating the optimal water quality parameters (e.g. pH, TDS, salinity) and salt concentrations for therapeutic efficacy and safety are recommended. In addition, studies exploring the long-term health impacts of these variations could provide valuable insights. Establishing evidence-based standards and validating them through research will support more uniform and reliable Jal Neti practices across institutions.

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Conflicts of interest

There are no conflicts of interest.

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