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Awareness, Attitudes, and Practices Regarding Water Quality Testing and Safe Drinking Water Consumption Among Residents in a Rural South Indian Locality

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Abstract

Background: Water quality testing is a critical aspect of public health that is frequently overlooked by the general population, despite safe drinking water being essential to prevent waterborne health hazards. Awareness and utilization of water quality testing represent key areas that remain underexplored in rural settings. This study aimed to assess the awareness and utilization of water quality testing facilities, as well as the attitudes and practices concerning drinking water safety, among residents of a rural locality in South India.

Materials and methods: This cross-sectional study was conducted in Manakkad Panchayat, Idukki District, Kerala, India. Data were collected from 160 households using cluster sampling. A semi-structured questionnaire was administered to an adult household member, preferably the head of the family, to capture sociodemographic characteristics, primary water sources, purification methods, storage practices, awareness of water testing facilities, and symptoms of waterborne diseases over the preceding three months.

Results: Among the 160 respondents, 103 (64.37%) were aware of the concept of water quality testing, but 81 (50.62%) were unaware of specific testing locations, and 114 (71.25%) had never tested their household water source. Open wells served as the primary drinking water source for 104 households (65.0%). Overall, 150 households (93.75%) practiced water treatment, with boiling being the predominant method (149, 99%). Regarding health outcomes, 154 respondents (96.25%) reported no waterborne illnesses during the preceding three months, with fever being the most common reported symptom (n=4, 2.5%).

Conclusion: Although residents demonstrated commendable attitudes and practices regarding drinking water storage, usage, and home treatment, there was poor awareness regarding localized water quality testing facilities and low utilization of routine monitoring. Public health interventions in rural areas should focus on improving accessibility and community awareness of local water testing services.

Categories: Environmental Health, Preventive Medicine, Epidemiology/Public Health
Keywords: awareness of water quality testing, rural health, safe drinking water, utilization of water quality testing, water quality

Introduction

Water quality testing is available through government laboratories as well as select private facilities across India. Standard monitoring evaluates the physical, chemical, and microbiological characteristics of drinking water, where the physical parameters include color, odor, taste, and turbidity; chemical parameters include pH, hardness, and concentrations of various organic and inorganic substances; and bacteriological evaluation includes detecting pathogenic organisms such as *Escherichia coli* and fecal streptococci [1].

States in India prone to heavy monsoon rains, such as Kerala, frequently experience seasonal outbreaks of waterborne diseases during the rainy season [2]. Public awareness and regular utilization of water quality testing facilities are critical priorities, not only for the prevention and control of infectious waterborne illnesses but also for addressing the non-communicable health conditions such as heavy metal contamination, fluorosis, iodine deficiencies, and other related toxicities [3].

Despite its public health significance, few studies address the awareness, availability, and utilization of water quality testing services in rural South India [4]. This study aimed to bridge this evidence gap in the South Indian state of Kerala by assessing water quality testing awareness, facility utilization, and household water handling practices within a rural panchayat in central Kerala.

Materials And Methods

Objectives

The primary objective of the study was to assess awareness about water quality testing among the study population, and the secondary objective was to assess the utilization of such services, attitudes, and practices related to the safety of drinking water consumption among the study population.

Study design and setting

The study was conducted as a community-based cross-sectional study, which was set within Manakkad Panchayat, a rural administrative division located in the Idukki District of Kerala State, India.

Study duration

The data collection was conducted between July 18th and August 30th of the year, 2026. The duration of data collection lasted for 42 days; analysis and further steps were completed in the following month.

Selection criteria and sample size

The study population comprised adult residents who had lived in the panchayat for at least one year prior to the commencement of data collection. Individuals who declined to provide written informed consent were excluded.

The required sample size of 160 households was calculated using the standard single-proportion sample size formula for cross-sectional surveys. An assumed prevalence of 50% for awareness of water quality testing was used because of the absence of similar studies in the setting and the higher variability in awareness and utilization parameters reported in a few comparable studies. A relative precision of 20%, a 95% confidence level, and a design effect of 1.6 were considered. Although the study did not strictly employ a cluster sampling strategy, the sample size was inflated using a design effect of 1.6. The final calculated sample size was 160 households [5,6].

Sampling strategy

A two-stage sampling technique was employed for data collection. In the first stage, three wards were randomly selected from the total 13 wards of Manakkad Panchayat using a simple random sampling method. In the second stage, using convenience sampling, households within each selected ward were selected, surveying approximately 10-12 households per day. On each day, we approached households near major alleyways or junction areas of the ward and contiguously selected all consenting households. Different such areas were visited on each separate day. In the event of nonresponse from a household, the immediately next household was approached for data collection, and so on. To achieve the target sample size, 52-54 households were surveyed per selected ward.

Operational definitions

Awareness of water quality testing is defined as whether the respondent had prior knowledge of testing drinking water for physical parameters (color, odor, turbidity, pH), chemical parameters (mineral concentrations), or microbiological safety (presence of bacterial pathogens such as *Escherichia coli*), which was assessed by observing whether or not the person was able to explain something in the context regarding the availability of the scientific water testing process to ascertain its safety when asked about what he or she would do to scientifically ascertain the quality of their drinking water source.

Utilization of water quality testing is defined as whether the household routinely tests drinking water whenever need or suspicion arises related to its quality or has tested its primary drinking water source at least once any year.

Data collection and study tool

Data were collected through face-to-face interviews, which were administered by trained investigators who were medical students, who were given prior experience with administering the questions to their peers. Interviews were conducted with an adult representative of each household, who was preferably the head of the family, during data collection-related house visits, so as to ensure data reliability.

A semi-structured questionnaire in a proforma format was prepared by the investigators for the purpose of data collection, which intended to capture information regarding the sociodemographic characteristics, primary water sources, water purification methods, storage practices, awareness and utilization of testing services, and self-reported symptoms of waterborne diseases (such as fever, abdominal pain, and vomiting) within the households surveyed during the preceding three-month period (Appendices). It was evaluated for face validity by the subject experts in the department prior to field administration.

Ethical considerations

Ethics approval was obtained from the Institutional Ethics Committee prior to study initiation (Approval No.: AAMC/IEC/2026/2-7). Informed consent was obtained from all individual participants prior to data collection.

Statistical analysis

Data were compiled and analyzed using Microsoft Excel (Microsoft Corporation, Redmond, WA, USA) and IBM SPSS Statistics for Windows, Version 25 (Released 2017; IBM Corp., Armonk, New York, United States). Continuous variables were summarized using means and standard deviations, and categorical variables were expressed as frequencies and percentages. No inferential testing was performed.

Results

Sociodemographic characteristics of respondents

A total of 160 households were surveyed for the study. The mean age of the respondents was 54.9 ± 14.19 years (median: 56 years). Females accounted for 56.87% (n = 91) of respondents, while males comprised 43.12% (n = 69).

Regarding educational attainment, the largest proportions of respondents had completed higher secondary education (n = 56, 35.00%) and secondary education (n = 49, 30.62%). The majority of the families were nuclear families (n = 113, 70.62%), followed by joint families (n = 38, 23.75%) and three-generation families (n = 9, 5.62%). The sociodemographic characteristics are summarized in Table *1*.

Variable and category	Mean/Frequency (n)	SD/Percentage (%)
Age(Years)	54.90	14.19 yrs
Gender		
Male	69	43.12%
Female	91	56.87%
Education Level		
Primary	15	9.38%
Secondary	49	30.62%
Higher Secondary	56	35.00%
Graduate and above	40	25.00%
Type of Family		
Nuclear	113	70.62%
Joint	38	23.75%
Three-generation	9	5.62%

TABLE 1: Sociodemographic characteristics of respondents (N = 160)

Water sources, environmental characteristics, and handling practices

For 65.00% (n = 104) of households, wells located within the household premises served as the primary drinking water source. Among well owners (n = 104), wells were maintained in sanitary conditions by 81.73% (n = 85), 70.19% (n = 73) used net coverings, and 90% (n = 94) extracted well water using electric pumps. Environmental vulnerabilities were present in the majority of the households surveyed, including litter, garbage, or mud in the immediate vicinity in 90.00% (n = 144) of households around their drinking water source, and a separation distance of less than 10 meters between the water source and latrine was present in 29.56% (n = 47) of households.

Water treatment was practiced by 93.75% (n = 150) of households, with boiling being the predominant method which was being practiced (n = 149, 99.33%). Storage containers were kept covered by 98.12% (n = 157) of the households. Household water characteristics, storage, and handling practices are detailed in Table *2*.

Variable and category	Frequency (n)	Percentage (%)
Drinking water source location (N = 160)		
Within premises/ within setback area (well)	104	65.00%
Outside premises/ away from setback area (well)	53	33.12%
Community source (pipe/well)	2	1.25%
Others (water can)	1	0.62%
Environmental vicinity and well conditions (N = 159)		
Litter/garbage/mud in vicinity (Present)	144	90.57%
Stagnant water in vicinity (Yes)	1	0.63%
Signs of contamination inside well (Yes)	0	0%
Continuous water supply inside house (N = 160) (Yes)	137	85.62%
Well characteristics (if within premises) (N = 104)		
i. Well covering		
Net	73	70.19%
Grill	30	28.84%
None	1	0.96%
ii. Water drawing method		
Electric pump	94	90.38%
Rope and bucket	10	9.61%
Animal access near well (Yes)	4	3.85%
Sanitary condition of well (satisfactory/sanitary)	85	81.73%
Water storage practices (N = 160)		
i. Container covered (Yes)	157	98.12%
ii. Cleaning frequency		
Daily	98	61.25%
Weekly	22	13.75%
Occasionally	39	24.37%
iii. Water extraction method		
Using mug/ladle	79	49.37%
Tilt / pour	43	26.87%
Through tap	28	17.50%
By dipping hand	9	5.62%
Water treatment practices (N = 160)		
Practicing any treatment method (Yes)	150	93.75%
Treatment method: Boiling (N = 150)	149	99.33%
Treatment method: RO purifier (N = 150)	1	0.67%
Hygiene and sanitation (N = 160)		
Handwashing before meals (Always)	159	99.37%
Type of toilet		

Sanitary latrine	144	90.00%
Pit latrine	16	10.00%
Distance between water source and toilet (N = 159)		
<10 m	47	29.56%
10–30 m	63	39.62%
>30 m	49	30.82%

TABLE 2: Household water sources, well characteristics, storage, treatment, and hygiene/sanitation characteristics

Water quality testing awareness, knowledge, and practices

While 64.37% (n = 103) of respondents were found to have general awareness of water quality testing, 50.62% (n = 81) were unaware of specific locations where testing services were provided, and the majority (71.25%, n = 114) of households had never tested their water source. Routine annual testing was practiced by only 6.87% (n = 11) of respondents (Table *3*).

Variable and response options	Frequency (n)	Percentage (%)
Awareness of water quality testing		
Yes	103	64.37%
No	57	35.62%
Knowledge about testing site		
Yes	79	49.37%
No	81	50.62%
Ever practiced water quality testing		
Yes	46	28.75%
No	114	71.25%
Regular testing practice (e.g., yearly)		
Yes	11	6.87%
No	149	93.12%

TABLE 3: Water quality testing awareness, knowledge, and testing practices (N = 160)

Attitudes toward safe water and recent health outcomes

Respondents demonstrated positive health attitudes, with 98.12% (n = 157) acknowledging the health importance of safe drinking water, 96.25% (n = 154) agreeing on the necessity of treating visually clean water, and 99.37% (n = 159) supporting regular container cleaning.

A vast majority of respondents (n = 154, 96.25%) reported no symptoms in the preceding three months. Among those reporting symptoms, fever was the most common reported symptom (n = 4, 2.5%), which was followed by abdominal pain (n = 1, 0.62%) and vomiting (n = 1, 0.62%). Regarding the utilization of healthcare for illness reported by the subjects, most of them predominantly sought care at government facilities (n = 88, 55.00%) compared to private facilities (n = 70, 43.75%) (Table *4*).

Variable and category	Frequency (n)	Percentage (%)
Attitudes toward safe water		
Safe drinking water is important for health (Strongly agree / Agree)	157	98.12%
Boiling water is necessary before drinking (Strongly agree / Agree)	137	85.62%
Treat water even if it looks clean (Strongly agree / Agree)	154	96.25%
Water storage containers should be cleaned regularly (Strongly agree / Agree)	159	99.37%
Symptoms in the past three months		
No symptoms reported	154	96.25%
Fever	4	2.5%
Abdominal pain and cramps	1	0.62%
Vomiting	1	0.62%
Primary choice of treatment facility (in general)		
Government facility	88	55.00%
Private facility	70	43.75%
Home remedies	2	1.25%

TABLE 4: Attitudes toward safe water and self-reported illness in the past three months (N = 160)

Discussion

The study evaluated the awareness, utilization, attitudes, and practices regarding drinking water quality testing and safe water consumption among residents of Manakkad Panchayat, Idukki District, Kerala during the study period. Although the study found that the household water handling, its storage, and treatment practices among the study population were commendable, there was a significant knowledge-to-practice gap we identified regarding the routine water quality testing and access to laboratory testing facilities from the study results.

Water sources, environmental characteristics, and handling practices

In the present study, private dug wells served as the primary source of drinking water for 65.00% of households (n = 104). Out of the well owners, 81.73% (n = 85) maintained their wells in sanitary conditions, and 90.38% (n = 94) utilized electric pumps to draw water; the following environmental vulnerabilities were evident. There were surface contamination risks, such as surrounding litter or mud, observed in 90.00% (n = 144) of household premises, and 29.37% (n = 47) of water sources were located within 10 meters of a toilet facility, and these findings align with broader environmental assessment studies in Kerala and South India, which indicate that while individual or household-owned dug wells are the primary water source, seasonal monsoon rains frequently compromise the shallow groundwater systems like these wells through surface runoff and fecal-coliform seepage [7,8].

Household water treatment was practiced by 93.75% (n = 150) of households, with boiling being the near-universal method (n = 149, 93.12%). This high rate of boiling as a household water treatment method may reflect the deeply entrenched cultural norms surrounding the benefits of hot water consumption in Kerala. In contrast, many studies from other regions of India report significantly lower treatment practices. A study from Northern India observed that 83.5% of respondents consumed water without any prior boiling, filtering, or chlorination [9]. Similarly, a survey in Chennai, South India, found that 45.0% of households practiced no water treatment, with half of the participants believing that drinking water treatment was unnecessary because the water appeared visually clean [10]. These contrasting reports from studies from various parts underscore the significant regional variations in Water, Sanitation, and Hygiene (WASH) behaviors across the Indian subcontinent, as pointed out by geospatial analysis studies conducted on a pan-Indian scale [11].

Health outcomes and sanitation

Self-reported morbidity due to nonspecific symptoms of waterborne illness, like fever, vomiting, abdominal pain, and diarrhea, over the preceding three months was low, with only 3.74% (n = 6) reporting symptoms

such as fever, abdominal pain, or vomiting. However, the high prevalence of boiling drinking water and clean storage practices (98.12%, n = 157) within the surveyed households can be noted. However, the close proximity between pit latrines/septic tanks and drinking water sources (<10 m in 29.37% of households) remains a critical structural hazard in the areas surveyed. In semi-urban and rural areas of India, inadequate physical separation between latrines and shallow aquifers has been strongly linked to endemic gastroenteritis and localized disease outbreaks, as reported in similar studies [7].

Awareness and utilization of water quality testing

A key finding of this study is the marked disparity between the general awareness and actual utilization and practice of water quality testing. Although 64.37% (n = 103) of respondents had heard of water testing, 50.62% (n = 81) did not know where testing facilities were located, 71.25% (n = 114) had never tested their water, and only 6.87% (n = 11) practiced routine annual testing.

This knowledge-to-practice gap mirrors findings from previous research studies conducted across rural India. Rural Andhra Pradesh studies demonstrated that the abstract awareness of water safety rarely translates into an active utilization of water quality testing laboratories unless supported by direct community outreach or by active public health triggers [12]. Reliance on sensory cues like judging water safety based on visual clarity, taste, or odor rather than microbiological or biochemical testing remains a major barrier to routine laboratory monitoring in South Indian communities, as demonstrated in rural Tamil Nadu [4,13].

Attitudes and public health implications

Respondents demonstrated positive attitudes toward water safety, with 98.12% (n = 157) agreeing that safe water is vital for health and 96.25% (n = 154) recognizing that water should be treated even if it appears clean. But there is enough evidence for the fact that positive attitudes alone are insufficient to overcome institutional barriers to testing, such as distant laboratory locations, lack of transportation, and costs [8]. Community-based water testing drives, supported by local Gram Panchayats and leveraging field testing kits under the Jal Jeevan Mission framework, can substantially improve laboratory access and water monitoring in rural settings [14].

Strengths and limitations

A community-level approach, relevance to rural communities, environmental assessments, and assessments of utilization practices are the strengths of the study. This study has a few limitations. Firstly, it did not examine any causal relationships. Secondly, health symptoms were self-reported and subject to the occurrence of recall bias. Thirdly, convenience sampling was used in the second stage of household selection, which can lead to selection bias and may limit the generalizability of the findings to other rural districts. Finally, physical and microbiological laboratory testing of the water samples was not performed alongside the household survey to objectively verify water safety.

Conclusions

This study highlights a disparity between the compliance of households with household water treatment practices like boiling (high) and the engagement with the available water quality testing services (low) in a certain region in the rural South Indian state of Kerala. While residents demonstrated considerably good attitudes and behaviors regarding water storage, handling, and household treatment practices, predominantly through boiling, there is comparatively lower awareness regarding local water testing facilities, their utilization, and routine monitoring for drinking water quality.

To bridge this gap, there can be localized awareness campaigns, and establishing decentralized water testing camps through local panchayat authorities and leveraging field testing kits under national rural water frameworks can enhance accessibility, which can strengthen the routine monitoring activities and ensure sustainable safe drinking water across rural communities, which were, however, not explored as part of this study and need further exploration.

Appendices

Q. No.	Questions	Response Options / Coding
1	Age (Completed years)	.....Years
2	Gender	a) Male b) Female c) Other / Prefer not to say
3	Education Level	a) Primary b) Secondary c) Higher Secondary d) Graduate and above
4	Type of Family	a) Nuclear b) Joint c) Three-generation

TABLE 5: Questionnaire (Part 1)

Q. No.	Questions	Response Options / Coding
5	Where is your primary drinking water source located?	a) Within premises / minimum setback area (well); b) Outside premises / outside setback area (well); c) Community source (well); d) Other sources

TABLE 6: Questionnaire (Part 2)

Q. No.	Sub-item	Environmental/Well observation parameters	Response Options
6	A	Litter/garbage/mud in vicinity	a) Present b) Absent
	B	Stagnant water in vicinity	a) Yes b) No
7	A	Signs of contamination inside well (If applicable / using own well)	a) Yes b) No
	B	Well covering	a) Net b) Grill c) None
	C	Water drawing method	a) Electric pump b) Rope and bucket
	D	Animal access near well	a) Yes b) No
	E	Sanitary condition of well	a) Satisfactory / Good b) Unsatisfactory
8	A	Continuous water supply inside house	a) Yes b) No

TABLE 7: Questionnaire (Part 3)

Q. No.	Questions	Response Options / Coding
9	Is your water storage container covered?	a) Yes b) No
10	How frequently are the water storage containers cleaned?	a) Daily b) Weekly c) Occasionally
11	What is the primary method used for water extraction from storage?	a) Using mug/ladle b) Tilt / pour c) Through tap d) By dipping hand
Q. No.	Questions	Response Options / Coding
12	Do you practice any water treatment method before drinking?	a) Yes b) No
13	If yes, what is the primary treatment method used? (Select all that apply if applicable)	a) Boiling b) RO purifier c) Other (Specify:)
Q. No.	Questions	Response Options / Coding
14	Do you wash your hands before meals?	a) Always b) Sometimes c) Never
15	What type of toilet facility is used by the household?	a) Sanitary latrine b) Pit latrine c) Open defecation / Other
16	What is the approximate distance between the water source and the toilet?	a) Less than 10 meters (<10m) b) 10 to 30 meters (10–30m) c) Greater than 30 meters (>30m)
Q. No.	Questions	Response Options / Coding
17	Are you aware of water quality testing?	a) Yes b) No
18	Do you know where water quality testing can be done?	a) Yes b) No
19	Have you ever practiced water quality testing for your household water source?	a) Yes b) No
20	Do you practice regular water quality testing (at-least yearly)?	a) Yes b) No
Q. No.	Attitude Statements	Response Options
21	Safe drinking water is important for health	a) Strongly agree / Agree b) Disagree / Strongly disagree
22	Boiling water is necessary before drinking	a) Strongly agree / Agree b) Disagree / Strongly disagree
23	Water should be treated even if it looks clean	a) Strongly agree / Agree b) Disagree / Strongly disagree
24	Water storage containers should be cleaned regularly	a) Strongly agree / Agree b) Disagree / Strongly disagree
Q. No.	Questions	Response Options / Coding
25	Have you or any household members experienced any water-borne or related illness in the past three months?	a) No illness reported b) Fever c) Abdominal pain and cramps d) Vomiting e) Other (Specify:)
26	If medical treatment was sought for illness, what is the usual place of treatment?	a) Government facility b) Private facility c) Home remedies

TABLE 8: Questionnaire (Part 4)

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

Concept and design: Pranav V. Vasisht, Sandhya G. I

Acquisition, analysis, or interpretation of data: Pranav V. Vasisht, Sandhya G. I

Drafting of the manuscript: Pranav V. Vasisht, Sandhya G. I

Critical review of the manuscript for important intellectual content: Pranav V. Vasisht, Sandhya G. I

Supervision: Pranav V. Vasisht, Sandhya G. I

Disclosures

Human subjects: Informed consent for treatment and open access publication was obtained or waived by all participants in this study. Institutional Ethics Committee, Al-Azhar Medical College and Super Specialty Hospital(Reg. No-ECR/1815/Inst/Kl/2023) issued approval AAMC/IEC/2026/2-7. **Animal subjects:** All authors have confirmed that this study did not involve animal subjects or tissue. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

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