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Assessment of Household Drinking-Water Treatment Practices and Factors Influencing the Selection of Purification Technologies

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Abstract
Household drinking-water treatment can provide an additional protective barrier when source-water quality is uncertain or household supplies are vulnerable to contamination. This study assessed reported drinking-water sources, household treatment practices, filter-maintenance behaviour, perceived effectiveness, user satisfaction, technology-selection criteria, reported barriers, suggested improvements, and awareness of adsorption media using an online questionnaire. The updated export contained 264 records. The earliest record was excluded in line with the exclusion rule applied in the previous manuscript, leaving 263 responses for analysis. Bottled water was the most frequently reported primary source (150/263, 57.0%), followed by the public water network (53, 20.2%) and well water (43, 16.3%). For household treatment use, 165 respondents (62.7%) selected "No", 64 (24.3%) selected "Yes", and 27 (10.3%) selected "Sometimes"; seven records (2.7%) contained unlabelled options. Household filters were the most frequently named technology (77, 29.3%), while 140 respondents (53.2%) selected no treatment technology. Expected purification efficiency was the leading selection factor (75, 28.5%), followed by initial device cost (56, 21.3%). A total of 205 respondents (77.9%) selected "Do not know" in the adsorption-media item. The sample was concentrated in the 20–30-year age group (240, 91.3%) and was self-selected through online recruitment, limiting population-level generalization. No laboratory measurements were supplied; therefore, the findings describe self-reported practices and perceptions rather than actual contaminant-removal performance or potability. The results highlight the need for contaminant-specific public guidance, affordable and maintainable treatment options, and follow-up water-quality testing.
Keywords: drinking water; household water treatment; water purification; adsorption; activated carbon; reverse osmosis; filtration; questionnaire; chemical engineering.

1. Introduction

Safe drinking-water requires risk management from the source through treatment, distribution, transport, and household storage. Water may be affected by microorganisms, dissolved inorganic constituents, organic chemicals, or suspended particles at different points along this chain. The World Health Organization (WHO) frames drinking- water safety through health-based targets, water safety planning, and independent surveillance rather than reliance on a single treatment device or sensory assessment [1]. Household water treatment (HWT) is relevant where centralized services are unavailable, intermittent, or unable to address specific contaminants in a household source. WHO's 2025 compendium describes household treatment and safe storage as components of a broader source-to-consumer system and emphasizes technology selection according to local water quality, resources, and operational conditions [2]. WHO's updated guidance for small water supplies also

recognizes the technical, managerial, and resource constraints that can affect the delivery of safe water [13]. Common household processes include granular filtration, activated-carbon adsorption, membrane separation, thermal treatment, and chemical or ultraviolet disinfection. These processes are not interchangeable. Activated carbon can improve taste and odour and adsorb selected organic compounds; reverse osmosis can reduce dissolved ions and selected contaminants; boiling primarily targets microbial hazards; and granular filtration can reduce suspended particles depending on design. A treatment device should therefore be selected for a defined contaminant and a verified performance claim, rather than solely because it is marketed as a purifier [3–5]. Technology adoption is also affected by initial cost, replacement-cartridge availability, ease of operation, energy and water demand, maintenance knowledge, and trust in suppliers. A technically capable device may not deliver sustained benefits if it is not used correctly or maintained as specified. Research on household treatment adoption has shown that sustained use is influenced by user engagement and practical constraints [12,14]. Affordability is also an important determinant of adoption of residential point-of-use filtration systems [15]. The present study updates a previous questionnaire-based analysis using a larger response export. Its contribution is a user-side assessment linking water sources, treatment adoption, maintenance, perceived outcomes, selection criteria, barriers, proposed improvements, and awareness of adsorption media. The survey does not experimentally measure treatment efficiency; instead, it identifies priorities for subsequent engineering studies, including source- water characterization and controlled comparison of selected household devices.

1.1 Study aim

To assess household drinking-water sources and treatment practices and identify user, operational, and economic factors associated with the selection and maintenance of household purification technologies.

1.2 Specific objectives

- Describe the demographic profile and primary drinking-water sources reported by respondents.
- Quantify reported household treatment adoption and the treatment methods in use.
- Characterize filter-replacement behaviour and perceived treatment effectiveness.
- Identify the leading factors influencing technology selection and satisfaction with treated water.
- Summarize reported barriers and proposed improvements using multiple-response analysis.
- Assess respondents' awareness of commonly discussed adsorption media.

1.3 Research questions

- What drinking-water sources are most frequently reported?
- How many respondents report using household treatment, and which methods are named?
- What maintenance practices and perceived outcomes are reported?
- Which performance, cost, and usability factors influence technology selection?
- What barriers and improvements are most frequently selected?
- How familiar are respondents with adsorption media?

2. Literature Review

2.1 Risk-based drinking-water safety

WHO drinking-water guidelines provide a framework for hazard identification, health-based targets, water safety plans, and surveillance. Water quality cannot be established from appearance, taste, or smell alone. A household treatment choice should be linked to source-water characterization and the contaminant of concern [1,13].

2.2 Household treatment and safe storage

Household treatment and safe storage can supplement centralized or community-scale services. Available options include ceramic filtration, ultrafiltration, chemical disinfection, boiling, biosand filtration, ultraviolet disinfection, solar disinfection, and contaminant-specific filters. Suitability depends on water quality, local conditions, and implementation capacity [2,7]. Safe collection, transport, and storage are also necessary to reduce recontamination after treatment [11].

2.3 Filtration and granular media

Granular media filters retain suspended material through combinations of straining, sedimentation, and surface interactions. Performance depends on media size, bed depth, filtration rate, hydraulic loading, and maintenance. Sand is widely used as a filtration medium and should not automatically be classified as an adsorbent equivalent to activated carbon or zeolite. Microbial removal varies among physical processes and depends on technology and target organism [5,8].

2.4 Activated-carbon adsorption

Activated carbon is a porous adsorbent used for selected dissolved organic compounds and compounds affecting taste and odour. Its performance depends on pore structure, surface chemistry, contact time, adsorbent dose, pH, competing solutes, and target contaminant. Adsorption capacity is finite; exhausted media must be replaced or regenerated. Carbon filtration should not be assumed to provide reliable disinfection or comprehensive dissolved salt removal [3,4].

2.5 Membrane processes and reverse osmosis

Reverse osmosis applies pressure to drive water through a semipermeable membrane and can reduce many dissolved ions and selected contaminants. Performance depends on feed-water composition, pressure, recovery, membrane integrity, pretreatment, and maintenance. Systems may require replacement cartridges and membranes and can generate a reject stream. Product-specific removal claims should be verified [4,9,10].

2.6 Thermal and disinfection processes

Boiling is primarily a microbial inactivation measure and does not remove dissolved salts or most non-volatile chemical contaminants. Chemical disinfection and ultraviolet treatment also target microbial hazards, but effectiveness depends on dose, contact time, water clarity, equipment performance, and correct operation. No single household technology addresses every possible contaminant [5,8].

2.7 Adoption, maintenance, and affordability

A systematic review and meta-analysis reported variation in household water-treatment practices and associated factors across settings [6]. A review of point-of-use chlorination found that adoption can vary widely and may decline over time, emphasizing correct and sustained use [12]. A recent analysis of household water-treatment adoption in Haiti used statistical and machine-learning approaches to investigate adoption determinants [14]. Evidence from China also identifies affordability as a relevant factor in adoption of residential point-of-use filtration systems [15]. These studies provide context but should not be directly compared numerically with the present self-selected sample.

2.8 Research rationale

The present survey does not measure treatment efficiency experimentally. Its contribution is a user-side assessment that combines reported water sources, treatment adoption, maintenance, perceived effectiveness, selection criteria, barriers, and awareness of adsorption media. The results can inform

priorities for subsequent engineering studies, including source-water testing and controlled comparison of selected household devices.

3. Materials and Methods

3.1 Study design and setting

A descriptive cross-sectional questionnaire study was conducted using an online Google Forms questionnaire. The previous manuscript described circulation to residents of Sabratha and surrounding areas, Libya; however, the updated spreadsheet does not contain a respondent-location field, so geographic eligibility cannot be independently verified from the export. The updated response export includes timestamps from 13–14 November 2026.

3.2 Dataset and analytic sample

The spreadsheet contained 264 timestamped records. In accordance with the exclusion rule used in the previous manuscript, the earliest record (13 November 2026, 00:33:13; age 41–50; female; postgraduate) was treated as the pilot/test submission and excluded. The resulting analytic sample was 263 respondents. The author should reconfirm that this is the intended pilot record before submission. Seven records in the treatment-use item were retained as unlabelled options rather than being recoded.

3.3 Questionnaire domains

The questionnaire covered demographics (age, gender, education); water supply (primary drinking-water source); treatment adoption and method; operation and maintenance (filter replacement); motivations and perceptions (reasons, perceived effectiveness, selection factor, satisfaction); barriers and improvements; open comments; and awareness of adsorption materials.

3.4 Data processing

Arabic response labels were retained in the source dataset and translated into English for reporting. Empty cells were treated as missing. Multiple-response fields were split at commas and each selected option was counted separately; consequently, percentages for multiple-response items can exceed 100% when summed. The unlabeled “Option 4” and “Option 5” categories in the treatment-use item were retained separately because their intended labels could not be recovered. Apparent inconsistencies between related questions were not corrected because individual responses could not be verified with participants.

3.5 Statistical analysis

The analysis was descriptive. Frequencies and percentages were calculated using the full analytic denominator (N = 263) for single-choice items. For multiple-response items, each option was counted as a respondent selection and expressed as a percentage of the analytic sample. No inferential model was used because the sample was self-selected, the age distribution was imbalanced, and some response categories were sparse or unresolved. The analysis therefore describes this respondent group and does not estimate population prevalence.

3.6 Ethical considerations and reporting transparency

The supplied export does not contain documentation of institutional ethics approval, an approval/reference number, the exact participant information statement, or the consent wording displayed before questionnaire submission. These details must be confirmed by the author and inserted

in the journal's required format. No claim of ethics approval or formal informed consent is made in this manuscript.

4. Results

The analytic dataset comprised 263 respondents after excluding one earliest pilot/test record from the 264-record export. The age distribution remained concentrated among younger respondents. All results are descriptive and should be interpreted as characteristics of this online respondent group.

4.1 Demographic characteristics

Table 1. Age distribution

Response category	n	% of respondents
20–30 years	240	91.3
31–40 years	13	4.9
41–50 years	7	2.7
>50 years	3	1.1

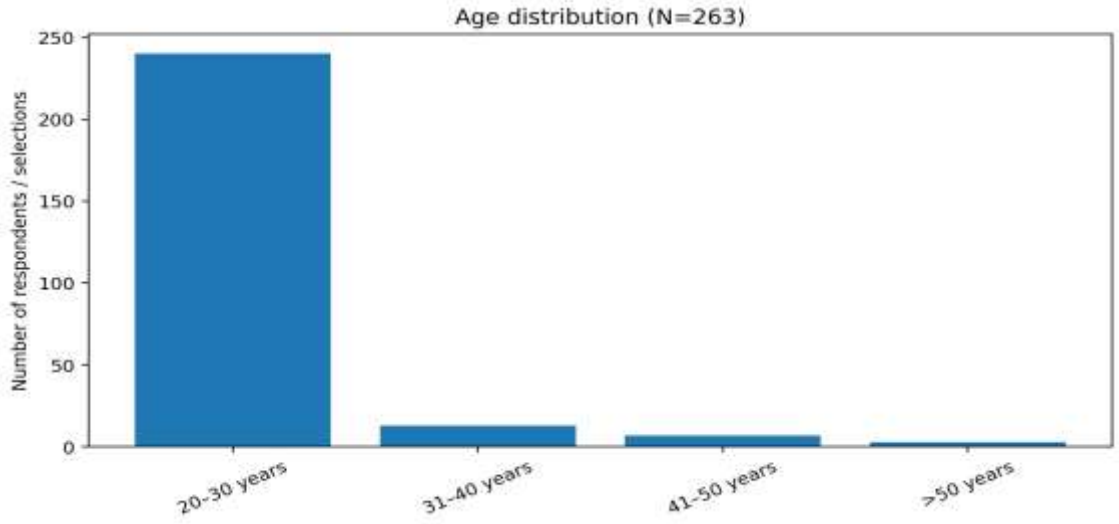


Figure 1. Age distribution of respondents

Table 2. Gender distribution

Response category	n	% of respondents
Female	187	71.1
Male	76	28.9

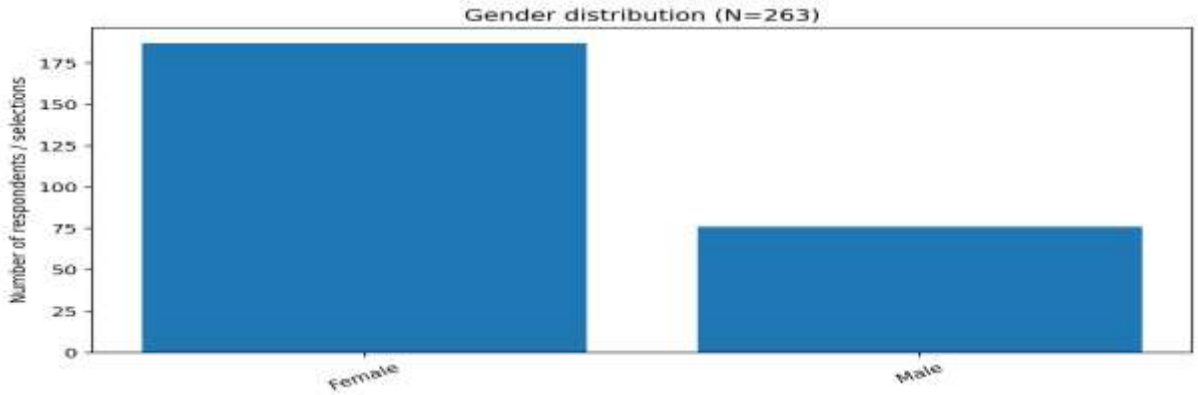


Figure 2. Gender distribution

Table 3. Educational attainment

Response category	n	% of respondents
University degree	232	88.2
Secondary	16	6.1
Postgraduate	14	5.3
Preparatory	1	0.4

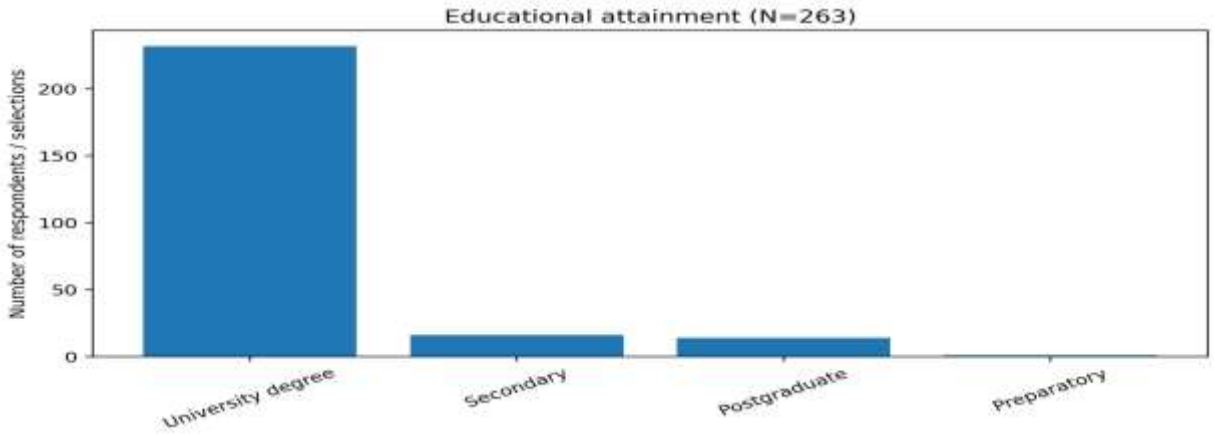


Figure 3. Educational attainment

4.2 Primary drinking-water sources

Table 4. Primary drinking-water source

Response category	n	% of respondents
Bottled water	150	57.0
Public water network	53	20.2
Well water	43	16.3
Other sources	14	5.3
Tanker water	3	1.1

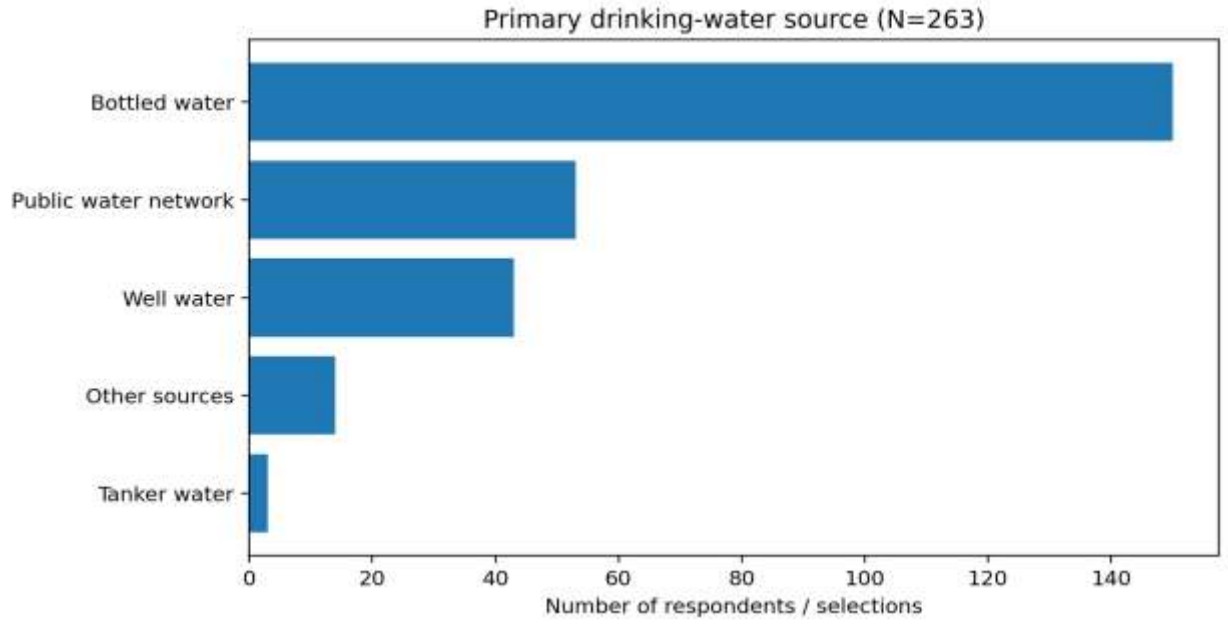


Figure 4. Primary drinking-water source

Bottled water was the most frequently reported source (150 respondents, 57.0%). Public-network water was reported by 53 respondents (20.2%), while 43 (16.3%) reported well water. Other sources accounted for 14 responses (5.3%), and tanker water was reported by three respondents (1.1%). The predominance of bottled water suggests that packaged water is an important drinking-water source within this sample; however, the questionnaire does not establish the microbiological or chemical quality of any source.

4.3 Treatment adoption and reported methods

Table 5. Self-reported treatment use

Response category	n	% of respondents
No	165	62.7
Yes	64	24.3
Sometimes	27	10.3
Option 4 (unlabelled)	6	2.3
Option 5 (unlabelled)	1	0.4

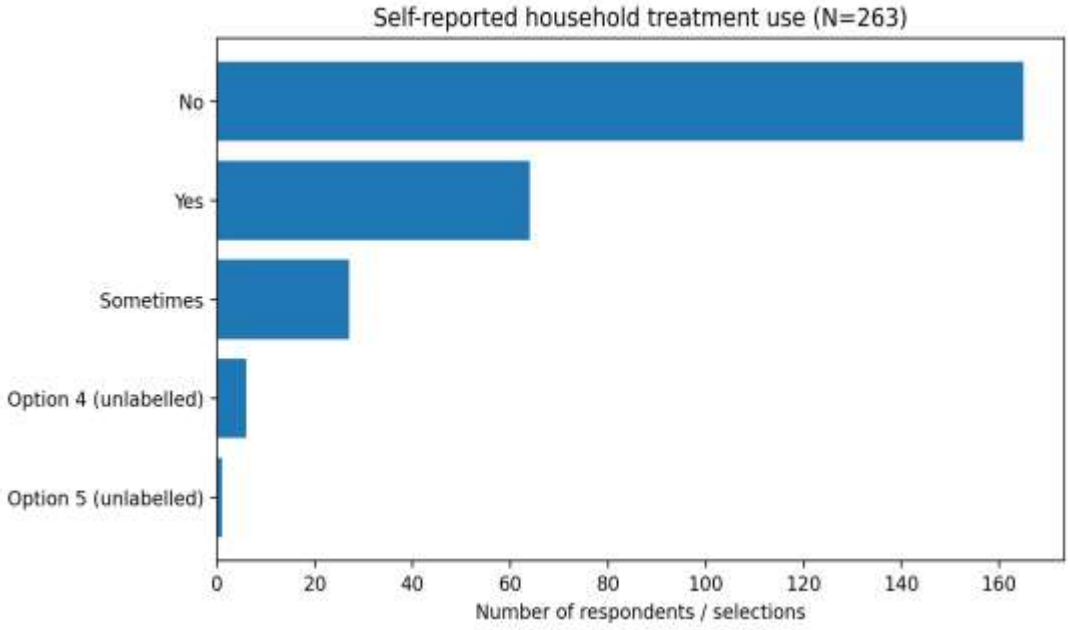


Figure 5. Self-reported household treatment use

Among 263 respondents, 165 (62.7%) selected "No", 64 (24.3%) selected "Yes", and 27 (10.3%) selected "Sometimes". Seven responses (2.7%) appeared as unlabelled options (six "Option 4" and one "Option 5"). These unresolved categories are reported transparently rather than guessed or merged with another response.

Table 6. Reported treatment method

Response category	n	% of respondents
No treatment technology	140	53.2
Household filters	77	29.3
Disinfection	17	6.5
Other	11	4.2
Boiling	11	4.2
Reverse osmosis (RO)	7	2.7

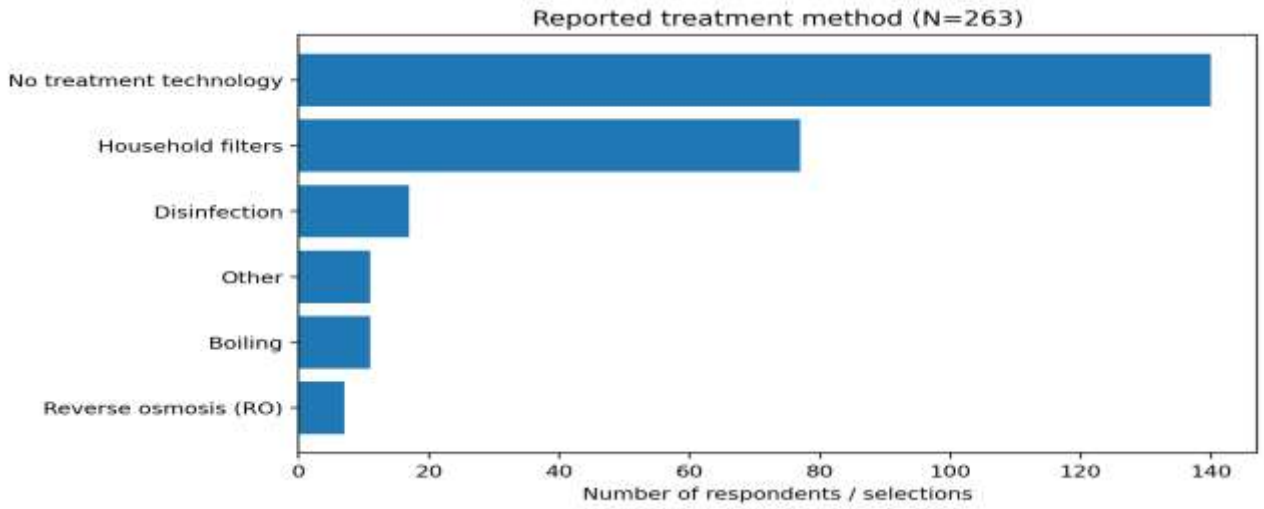


Figure 6. Reported household treatment method

The most frequently selected named method was household filtration (77 respondents, 29.3%). A total of 140 respondents (53.2%) selected "No treatment technology". Disinfection and boiling were each selected by 17 and 11 respondents, respectively; reverse osmosis was selected by seven respondents (2.7%). The method item and treatment-use item are self-reported and show potential inconsistencies; they should not be interpreted as independently validated treatment histories.

4.4 Filter replacement and motivations

Table 7. Filter replacement behaviour

Response category	n	% of respondents
Do not use filters	127	48.3
Sometimes	51	19.4
Regularly	50	19.0
Rarely	20	7.6
Never change them	15	5.7

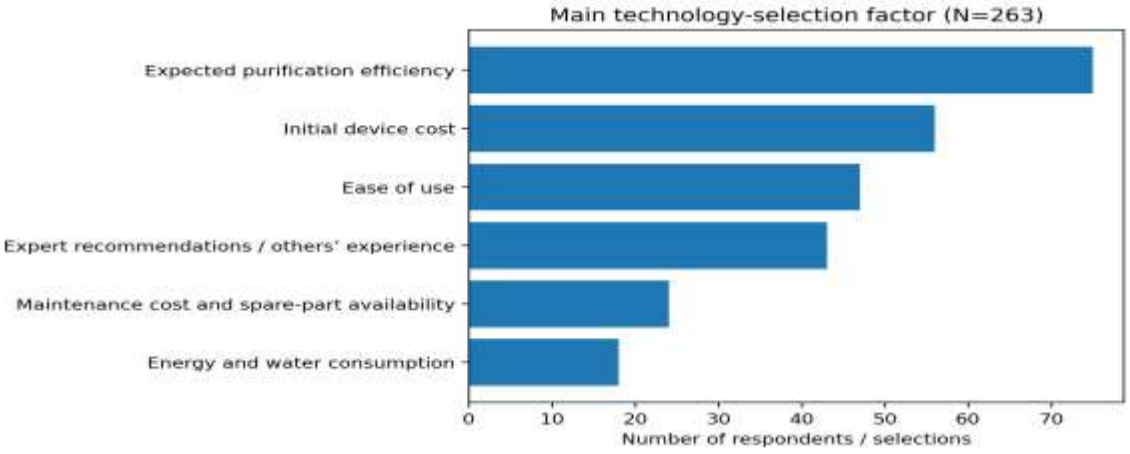


Figure 7. Main technology-selection factor

A total of 127 respondents (48.3%) indicated that they did not use filters. Among the remaining 136 respondents, 50 (36.8%) reported regular replacement, 51 (37.5%) sometimes replaced filters, 20 (14.7%) rarely did so, and 15 (11.0%) never changed them. These conditional percentages describe reported behaviour among respondents who did not select the non-user option; they do not establish whether replacement followed manufacturer specifications.

Table 8. Reasons for using treatment technologies (multiple responses)

Response category	n	% of respondents
Health-related reasons	85	32.3
Reduction of contaminants	74	28.1
Removal of impurities	66	25.1
Other	62	23.6
Reduction of dissolved salts	50	19.0
Improvement of taste and odour	47	17.9

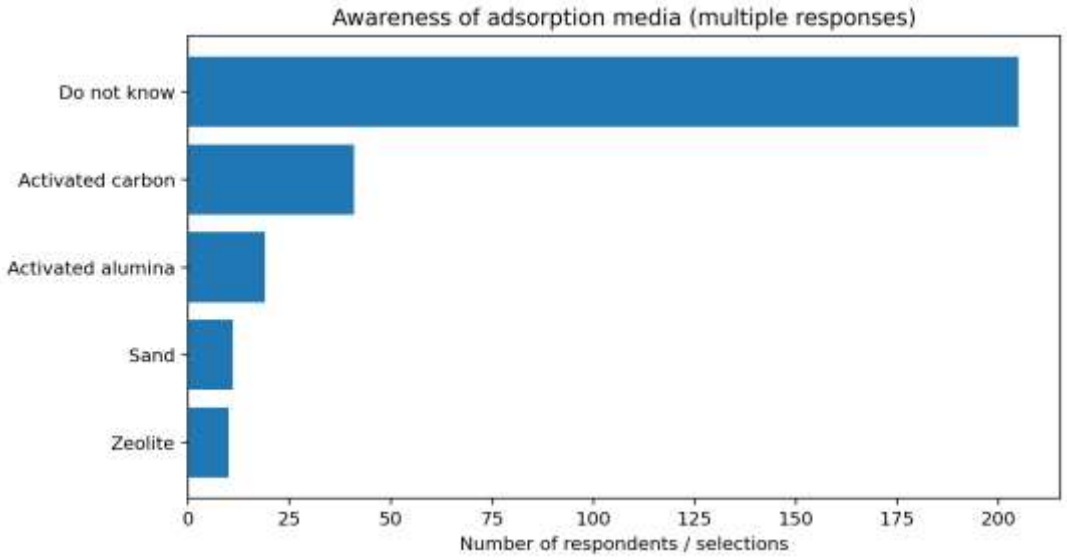


Figure 8. Awareness of adsorp

Health-related reasons were the most frequently selected motivation (85 selections, 32.3% of respondents), followed by reduction of contaminants (74, 28.1%) and removal of impurities (66, 25.1%). Because respondents could select more than one reason, percentages may sum to more than 100%.

4.5 Perceived effectiveness and satisfaction

Table 9. Perceived effectiveness

Response category	n	% of respondents
Effective	82	31.2
Do not know	63	24.0
Moderately effective	57	21.7
Very effective	49	18.6
Weakly effective	12	4.6

A total of 131 respondents (49.8%) described household treatment as effective or very effective. Fifty-seven (21.7%) selected moderately effective, 12 (4.6%) selected weakly effective, and 63 (24.0%) did not know. These are subjective perceptions and cannot establish actual contaminant removal.

Table 10. Satisfaction with post-treatment water quality

Response category	n	% of respondents
Do not use a treatment technology	102	38.8
Satisfied	65	24.7
Moderately satisfied	47	17.9
Very satisfied	39	14.8
Dissatisfied	7	2.7
Very dissatisfied	3	1.1

One hundred and two respondents (38.8%) selected the non-user response in the satisfaction item. Among the remaining 161 respondents, 151 (93.8%) selected one of the three satisfaction categories (satisfied, very satisfied, or moderately satisfied), while ten (6.2%) selected dissatisfied or very dissatisfied. These conditional calculations are descriptive only; the questionnaire does not verify device use or laboratory water quality.

4.6 Technology-selection factors and reported problems

Table 11. Most influential technology-selection factor

Response category	n	% of respondents
Expected purification efficiency	75	28.5
Initial device cost	56	21.3
Ease of use	47	17.9
Expert recommendations / others' experience	43	16.3
Maintenance cost and spare-part availability	24	9.1
Energy and water consumption	18	6.8

Expected purification efficiency was the leading selection factor (75 respondents, 28.5%), followed by initial device cost (56, 21.3%) and ease of use (47, 17.9%). Expert recommendations or others' experience were selected by 43 respondents (16.3%), maintenance cost and spare-part availability by 24 (9.1%), and energy and water consumption by 18 (6.8%).

Table 12. Reported problems (multiple responses)

Response category	n	% of respondents
Other	78	29.7
No problems reported	67	25.5
High initial device cost	65	24.7
High maintenance cost	36	13.7
Limited availability of filters/spare parts	26	9.9
Low purification efficiency	19	7.2
Electricity and water consumption	15	5.7
Difficult operation/use	11	4.2

High initial purchase cost was selected 65 times (24.7% of respondents), high maintenance cost 36 times (13.7%), limited availability of filters or spare parts 26 times (9.9%), low purification efficiency 19 times (7.2%), difficult operation 11 times (4.2%), and electricity/water consumption 15 times (5.7%). Sixty-seven respondents (25.5%) selected “No problems”, while 78 (29.7%) selected “Other”. Multiple-response percentages may exceed 100% when summed.

4.7 Suggested improvements and adsorption awareness

Table 13. Suggested improvements (multiple responses)

Response category	n	% of respondents
Increase contaminant-removal efficiency	97	36.9
Develop more advanced and effective technologies	71	27.0
Reduce device cost	63	24.0
Use environmentally friendly technologies	44	16.7
Other	42	16.0
Reduce energy and water consumption	27	10.3
Improve ease of operation and maintenance	25	9.5

Increasing contaminant-removal efficiency was the most frequent improvement (97 selections, 36.9%), followed by development of more advanced and effective technologies (71, 27.0%) and reducing device cost (63, 24.0%). Environmentally friendly technologies were selected 44 times (16.7%), reducing energy and water consumption 27 times (10.3%), and improving ease of operation and maintenance 25 times (9.5%).

Table 14. Awareness of adsorption media (multiple responses)

Response category	n	% of respondents
Do not know	205	77.9
Activated carbon	41	15.6
Activated alumina	19	7.2
Sand	11	4.2
Zeolite	10	3.8

A total of 205 respondents (77.9%) selected “Do not know” in the adsorption-media item. Activated carbon was selected 41 times (15.6%), activated alumina 19 times (7.2%), sand 11 times (4.2%), and zeolite ten times (3.8%). Sand is commonly used as a granular filtration medium and should not be treated as equivalent to activated carbon, activated alumina, or zeolite in an adsorption-focused

interpretation. The item measures recognition of material names, not demonstrated technical knowledge or adsorption performance.

4.8 Open-ended comments

Seventy-two respondents (27.4%) supplied a non-empty comment after excluding blank cells. Many entries were brief acknowledgements or statements indicating no additional suggestion. Substantive comments included requests for periodic water testing, routine maintenance of treatment stations, provision of replacement parts, lower equipment costs, stronger oversight, separation of wastewater pathways from wells, and access to devices suitable for well water. Because the comments were not collected through a dedicated qualitative interview protocol and were not independently double-coded, they are summarized descriptively rather than presented as a formal thematic analysis.

4.9 Consolidated findings

Table 15. Summary of principal findings

Indicator	Main finding
Analytic sample	263 respondents after one pilot record was excluded
Dominant age group	20–30 years: 240 (91.3%)
Most common source	Bottled water: 150 (57.0%)
Treatment-use response	No: 165 (62.7%); Yes: 64 (24.3%); Sometimes: 27 (10.3%); unlabelled: 7 (2.7%)
Most reported method	Household filters: 77 (29.3%); no technology: 140 (53.2%)
Leading selection factor	Expected purification efficiency: 75 (28.5%)
Leading reported barrier	Other: 78 (29.7%); high initial cost: 65 (24.7%)
Leading improvement	Increase contaminant-removal efficiency: 97 (36.9%)
Adsorption awareness	Do not know: 205 (77.9%)

5. Discussion

5.1 Interpretation of water-source patterns

The predominance of bottled water (57.0%) indicates that packaged water is a major reported drinking-water source within this online sample. Public-network water and well water were also commonly reported. These source categories differ in their likely treatment needs and monitoring requirements, but the survey did not measure source-water quality. It is therefore not possible to infer that bottled water was safer, or that well water was contaminated, based solely on respondent choices. Risk-based source characterization remains essential [1,13].

5.2 Treatment adoption and technology mix

The treatment-use item indicates that 62.7% selected “No”, while 24.3% selected “Yes” and 10.3% “Sometimes”. The separate method item shows that 53.2% selected no technology and 29.3% selected household filters. The broad pattern suggests that non-use is common and household filtration is the most frequently named technology. However, seven unlabelled responses and inconsistencies between related items require caution. Research has similarly shown that household treatment adoption depends on practical constraints and sustained correct use[6,12,14].

5.3 Maintenance as an operational issue

Among respondents who did not identify themselves as non-users of filters, fewer than half reported regular filter replacement. Occasional, rare, and absent replacement may compromise performance

depending on filter type, influent quality, and manufacturer requirements. Maintenance should therefore be treated as part of process performance rather than as an optional after-sales activity. Users should follow manufacturer replacement instructions and select a device according to the contaminant it is intended to remove [3].

5.4 Perceived effectiveness versus measured performance

About half of respondents described household treatment as effective or very effective, and satisfaction was generally positive among those who did not select the non-user response. These perceptions are important for understanding user confidence and continued adoption, but they are not evidence of microbial safety or chemical contaminant removal. Taste and odour are not reliable indicators of safety, and different filters remove different contaminants. Water testing and product-specific performance evidence are essential when selecting treatmenttechnology [1,3,5].

5.5 Cost, performance, and technology selection

Expected purification efficiency was the most frequently selected selection criterion, while initial device cost was second. This indicates that respondents consider both performance and affordability. Maintenance costs and spare- part availability were also identified. From a chemical-engineering and process-design perspective, these findings support life-cycle evaluation rather than purchase-price comparisons alone. Relevant factors include consumables, membrane replacement, energy use, water recovery, cleaning, downtime, and service availability. Evidence from residential point-of-use filtration research also highlights affordability as a factor in adoption [15].

5.6 Adsorption knowledge and public information

The high proportion of “Do not know” responses (77.9%) suggests limited familiarity with the names of common adsorption media in this sample. This should not be interpreted as a direct measure of scientific literacy, because respondents may understand treatment technologies without knowing the names of their media. Public information should distinguish adsorption from filtration and disinfection and explain the target contaminants and operating limits of each process.

5.7 Engineering implications

The survey identifies several priorities for applied chemical-engineering research. First, source-water samples should be characterized for parameters selected according to local risk, potentially including pH, electrical conductivity, turbidity, total dissolved solids, major ions, selected metals, and microbiological indicators. Second, candidate household devices should be tested under controlled conditions using the same influent water and defined operating conditions. Third, adsorption media such as activated carbon, activated alumina, and zeolite should be evaluated against specific target contaminants using adsorption capacity, kinetics, breakthrough, and regeneration tests. Fourth, membrane systems should be evaluated using permeate flux, rejection, recovery, fouling, and energy demand. WHO’s source-to-consumer approach supports matching technology to local water quality and operational capacity [2,13].

6. Limitations

This study has some limitations. The data were collected through a self-selected online questionnaire, which may limit the generalizability of the findings. The sample was also age-imbalanced, with 91.3% of respondents aged 20–30 years. Furthermore, the results were based on self-reported responses without laboratory verification of drinking-water quality. Some responses were incomplete or inconsistently categorized, while multiple-response questions could result in percentages exceeding 100%. Open-ended responses were analyzed descriptively, and the absence of geographical data

limited regional comparisons. Despite these limitations, the study provides useful insights into household drinking-water treatment practices and the factors influencing the selection of purification technologies.

7. Conclusions

This questionnaire-based study describes household drinking-water sources, treatment practices, maintenance behaviour, perceptions, selection criteria, reported barriers, and awareness of adsorption media among 263 respondents. Bottled water was the most frequently reported primary source, while household filters were the most frequently named treatment technology. Nevertheless, a majority selected "No" in the treatment-use item, and more than half selected no treatment technology in the method item. Expected purification efficiency and initial device cost were the leading technology-selection factors. The most important knowledge-related finding was the high frequency of "Do not know" responses to the adsorption-media item. Respondents also highlighted the need for improved contaminant removal, more effective technologies, and lower device costs. The survey therefore points to opportunities for clearer public guidance and more affordable, maintainable household treatment systems. The findings must be interpreted as self-reported perceptions and practices, not as measurements of water safety. Future work should combine a more representative survey with laboratory analysis of source and treated water and controlled performance testing of selected filtration, adsorption, disinfection, and membrane systems. Such work would provide the engineering evidence needed to recommend technologies for specific local water-quality conditions.

8. Recommendations

Test each principal drinking-water source before selecting a household treatment device. Provide simple, contaminant-specific information explaining what each treatment technology can and cannot remove. Improve access to replacement filters, membranes, spare parts, and maintenance services at transparent prices. Encourage users to follow manufacturer replacement intervals and keep records of maintenance. Conduct laboratory testing of raw and treated water, including microbiological indicators and relevant chemical parameters. Evaluate activated carbon, activated alumina, and zeolite experimentally for defined target contaminants rather than assuming universal adsorption performance. Repeat the survey using a more balanced sampling strategy across age groups and household water-source categories. Revise the questionnaire so that every response option is explicitly labelled and related items are logically consistent

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