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Household Water Treatment Practice and Related Factors among rural villages in Prayagraj (India): A Community Based Study

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Introduction
Safe drinking water is a fundamental human right and it is remains essential for billions. Contaminated water harbors pathogenic bacteria, viruses and parasites, leading to a spectrum of waterborne illnesses. The study examined water access, storage and treatment practices in rural households of Prayagraj District, Uttar Pradesh.
Materials and Methods
A community based survey was conducted. Semi-structured interview schedule was used for interviewing the respondents. The study participants were selected by simple random sampling method. The survey data was cleaned and coded before data entry was carried out. SPSS-21 software was used for analysis. A multivariate analysis has been carried out. Frequency, percentage and central tendency was used to measure the strength of association and statistical significance. Odd ratio (OR) with 95 percent confidence interval was used to measure the strength of association and statistical significance was declared at $p<0.05$.
Results
The result of the study shows that, only 11.2 percent of the study participants were practicing household water treatment. The most commonly practiced household water treatment methods were; boiling (68.7 percent) and cloth filtration and medicine (29.9 percent). Factors significantly associated with household water treatment was BPL category (P-0.001, AOR =2.474, 95% CI =1.383-4.424).
Conclusion
From the finding it was evident that the water collection and storage practice remain the part of female's responsibility in the household. Household water treatment practice was limited in Prayagraj District. The BPL categories were associated with household water treatment practice.

Keywords: Safe drinking water, women, water collection, storage and treatment

1. INTRODUCTION

The NARSS Round-2 findings reveal that nearly 99.6 percent of households across India have access to water for domestic purposes. The responsibility of gathering water for household use predominantly falls upon women (Ghosh & Sarkar 2023, Charles *et al.* 2023). In families, women are not only responsible for collecting water they are also responsible for storing and treating water as well. These women collect water from different sources for domestic use.

Groundwater is the main source of water for drinking, washing and cleaning in rural India. In the past few decades, the problems of groundwater are widespread globally (The United Nations World Water Development Report 2017) and developing countries are most affected with the polluted water (Kumar *et al.,* 2014). India is one of the affected developing countries with four percent of the world's safe water resources (Yadav *et al.*, 2015, Bhadbhade *et al.*, 2002). However, India is the third most water polluted country in the

world and majority people in the country depend on ground water for the domestic use (Jain *et al*., 2004, Sabater *et al*., 2018).

When water is polluted, it can cause diarrhoea and other illnesses, tragically taking the lives of many children under five years. A study (NFHS-5) revealed a high number of mortality of children under five years of age in Prayagraj District, Uttar Pradesh, India. The under-five mortality rate (U5MR) in Prayagraj is 62.5 percent. This concerning statistic could be linked to the prevalence of diarrhea among young children. In rural Prayagraj where people primarily rely on untreated groundwater for drinking, 5.7 percent of children under five experience diarrhea. Even in urban areas, the rate is 5.6 percent. These findings highlight the urgent need for ensuring access to clean drinking water, especially in rural communities.

The Indian government initiated the Swachh Bharat Mission programme in 2014 with the ai of ensuring all households have access to safe drinking water. The program encourages rural communities to adopt safe drinking habits and water treatment methods at home. Therefore, the study conducted in Prayagraj District, Uttar Pradesh examined water access, storage and treatment practices in rural households.

2. MATERIALS AND METHODS

2.1. Study area

This research was carried out within the Prayagraj District, situated in Eastern Uttar Pradesh, India. Prayagraj stands as one of India's ancient urban centers, positioned at the intersection of three significant rivers: the Ganga, Yamuna, and Saraswati. Geographically, it resides at 25.45°N 81.84°E in the southern area of Uttar Pradesh. Prayagraj District covering a total land area of 5482 square kilometers and it is segmented into 8 Tehsils, 20 development blocks, and encompasses 2802 inhabited villages.

2.2. Study design

A community-based survey was carried out in rural areas of Prayagraj District to examined water access, storage and treatment practices in rural households of Prayagraj District, Uttar Pradesh.

2.3. Study population

Study population was the rural households of 20 selected villages of Soraon and Meja Blocks of Prayagraj District, Uttar Pradesh, India.

2.4. Sample size

Within each selected *Gram Panchayat* (village) based on latest voters' list of 2015, 30 respondents in each study villages were randomly selected. In this way, a total of 600 respondents were interviewed in Prayagraj District, Uttar Pradesh, India for the purpose of data collection.

2.5. Sampling technique and procedure

To collect data from study population first Prayagraj District was selected by purposive sampling technique out of 75 districts in Uttar Pradesh State. Then from selected district two blocks one near to the district headquarter (Soran Block) and another far from the district headquarter (Meja Block) were selected by random sampling technique. In each block 10 villages were selected through systematic random sampling technique. Therefore, 30 households in each selected villages were randomly selected. In this way, total of 600 respondents were interviewed.

2.6 Illegibility criteria

2.6.1. Inclusion criteria

In the selected village, the adult respondents above 18 years of age were selected as a sample from the latest voter's list. However, only one respondent in each household was considered for interview. In-depth study included Village Pradhan, AWWs and ASHAs as stakeholders in the study.

2.6.1 Exclusion criteria

In the selected village, outside the voter list candidates were excluded in the study.

2.7 Data collection tool

Separate interview schedules for quantitative and qualitative study were prepared in Hindi language. The quantitative data were collected by using semi-structure interview schedule. The interview schedule consists of socio-economic characteristics, source, transport, and storage of water for domestic use, perceived mortality and household water treatment practice of respondents of the household. The interview schedules were formed through literature review.

2.8 Data quality management

The tools were designed by the Project Director. The tools were pre-tested by the Research Team. Based on the feedback of pre-test, the relevant changes in the tools were incorporated.

A two layer monitoring strategy was employed to ensure good data quality. The first layer of monitoring was involved Research Assistant who lead the field investigation team. 100 percent filled-in schedules of a Field Investigator were thorough checked by the Research Assistant each day. The Research Assistant also validated information collected by the Field Investigator by visiting respondents (10 percent back check) and verifying information with the respondents. A second layer of quality control mechanism involved Project Director who made surprise visit and carried out spot and back check on random basis. The Research Assistant checked the qualitative filled-in schedule immediately after the interview is over. The transcription of the in-depth filled-in schedule was carried out preferably the same day by the Research Assistant to minimize the information lose and he also reverted back if clarification was required.

2.9 Data analysis

At the time of data entry, a "code book" was developed for open ended questions by the project research team. The survey data was cleaned and coded before data entry and data analysis was carried out on SPSS-21 software. A multivariate analysis has been carried in the paper. Each question on water, sanitation and hygiene (WASH) has been cross-tabulated against block, gender, education, caste, Income group etc.

3. RESULTS

3.1 Respondent's Characteristics

Tables 1 provide respondents characteristics information. The respondents consisted of 54.7 percent male and 45.3 percent female which is very close to what has been observed in the district profile and in the State. The average age of the respondents was 42.8 years in which male respondents were 42.6 years old and female 43.1 years old. The average family size of the respondents was 6 percent. Almost four out of 10 respondents (36.8 percent) were illiterate in which female respondents were higher (53.7 percent), thereby reflecting low level of literacy among female respondents. Regarding to their caste the majority (35.0 percent) respondents were OBC. With respective to occupation of respondents (47.7 percent) of them were daily wage labours and about 70.8 percent respondents were belonged to BPL category

Table 1: Socio demographic characteristics of Respondent by block

Background Characteristics	Block				Total	
	Meja		Soraon			
	N	%	N	%	N	%
Sex						
Male	176	58.7	152	50.7	600	100.0
Female	124	41.3	148	49.3		
Age						
18 year to 25 year	20	6.7	17	5.7	37	6.2
26 year to 35 year	93	31.0	105	35.0	198	33.0
36 year to 45 year	80	26.7	65	21.7	145	24.2
46 year to 55 year	44	14.7	62	20.7	106	17.7
Above 55 year	63	21.0	51	17.0	114	19.0
Average age	**43.2**		**42.5**		**42.8**	
Education						
Illiterate	102	34.0	119	39.7	221	36.8
Literate	38	12.7	28	9.3	66	11.0
Primary/Upper Primary	40	13.3	44	14.7	84	14.0
Secondary/ Higher Secondary	74	24.7	63	21.0	137	22.8
Graduation/Post Graduation/ Vocational Training	46	15.3	46	15.3	92	15.3
Total Household Interviewed	300	100.0	300	100.0	600	100.0
Religion						
Hindu	276	92.0	270	90.0	546	91.0
Muslim	24	8.0	30	10.0	54	9.0
Caste						
General	85	28.3	20	6.7	105	17.5
SC/ST	90	30.0	87	29.0	177	29.5
OBC	125	41.7	193	64.3	318	53.0
Average Family Size	**6**		**7**		**6**	
BPL Card						
Yes	203	67.7	222	74.0	425	70.8
No	97	32.3	78	26.0	175	29.2
Main Occupation of Household						
Farmer/cultivator	135	45.0	77	25.7	212	35.3
Wage Labour (Agriculture and /Non-Agriculture)	132	44.0	154	51.3	286	47.7
Business	5	1.7	17	5.7	22	3.7
Service (Gvt. and Pvt.)	21	7.0	19	6.3	40	6.7
Housework	3	1.0	16	5.3	19	3.2
Student/Retired	1	0.3	5	1.7	6	1.0
Others	3	1.0	12	4.0	15	2.5
Type of House						
Kutccha	120	40.0	71	23.7	191	31.8
Pucca	93	31.0	128	42.7	221	36.8
Semi-pucca	87	29.0	101	33.7	188	31.3
Total Household Interviewed	300	100.0	300	100.0	600	100.0

***Source*:** Field Survey

3.2. Sources, collection and storage practice of drinking water

3.2.1. Water Sources

According to table 2, 60.3 percent respondents use hand pump for drinking water followed by tap connection inside the house was available to 14.5 percent households. Similarly, water from public tap outside household was available to 12.2 percent households (Table 2). However, it should be mentioned that for little or 8.3 percent respondents the only source of drinking water is from uncovered well (Fig. 1).

Similar pattern is observed in case of source of water for cooking and washing clothes. These differences are very high in case of below poverty line and above poverty line of respondents in use of water for drinking, cooking and washing (in all three cases around 60.0 percent respondents use hand pump for all three purposes compared to approximately 44.0 percent above poverty line).

Tap connection inside the house is a major source of drinking water for above poverty line respondents (25.9 percent) whereas only 9.9 percent respondents below poverty line have such access thereby showing a direct association between economic status and availability of sources of water for drinking, cooking and washing. The same holds true for uncovered well as a source of water (7.3 percent for below poverty line and 10.8 percent for above poverty line respondents) (Table 2).

Table 2: Sources of water for domestic use

Source of Water	**BPL Card**				**Total**	
	Yes		**No**			
	N	**%**	**N**	**%**	**N**	**%**
Hand pump	285	67.1	69	43.7	362	60.3
Household tap connection	42	9.9	41	25.9	87	14.5
Public tap/ stand post	41	9.6	29	18.4	73	12.2
Tube well/Bore well	6	1.4	2	1.3	8	1.3
Uncovered well	31	7.3	17	10.8	50	8.3
Pond/river/stream	3	0.7	0	0.0	3	0.5
Rain water	4	0.9	0	0.0	4	0.7
Other	24	5.6	6	3.8	30	5.0
Total HHs.	**425**	**100.0**	**158**	**100.0**	**600**	**100.0**

***Source*:** Field Survey

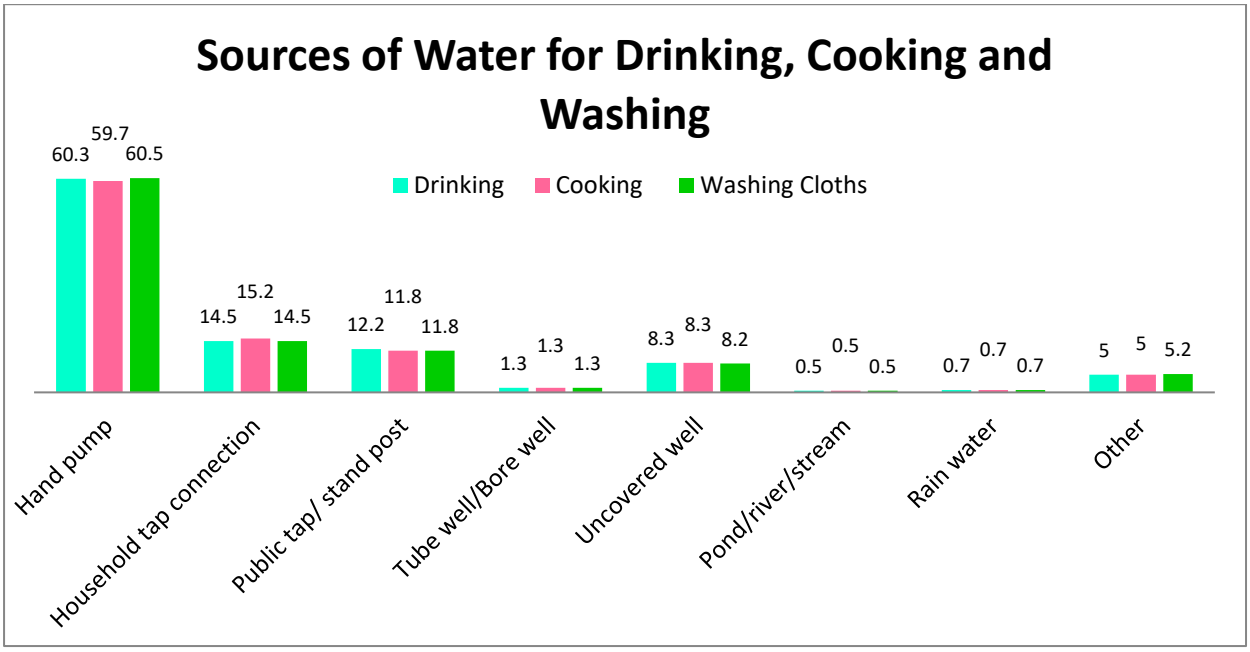

Figure 1: Sources of water for drinking, cooking and washing

3.2.2 Water collection responsibility

Stakeholder's statements and observations support the view that water collection is female specific activity. Both men (91.5 percent) and women (94.1 percent) confirmed that water collection and storage is women's responsibility. Since water collection is generally not carried out by very young children, respondents were further asked as to which age group is responsible to collect water. With few exceptions, above 10 years of age group female is responsible for water collection (92.7 percent for drinking water, cooking water and washing clothes). This pattern holds true regardless of socio-economic status of the household. The pattern is more or less identical both in Soraon Block and Meja Block which further confirms that water collection remains female responsibility in the district (Table 3).

Table 3: Person Responsible for Collection of Water by blocks

Responsibility	Blocks				Total	
	Meja		Soraon			
	N	%	N	%	N	%
Person Collecting Water Drinking						
Female above 10 years	276	92.0	280	93.3	556	92.7
Male above 10 years	68	22.7	43	14.3	111	18.5
Female child under 10 years	3	1.0	3	1.0	6	1.0
Male child under 10 years	2	0.7	0	0.0	2	0.3
Others	1	0.3	5	1.7	6	1.0

***Source*:** Field Survey

3.2.3 Water Storage Methods

Method of water storage shows sharp contrast between 82.8 percent below poverty line respondents who had no storage facility as compared to 78.9 percent above poverty line respondents. Same holds true between Soraon Block (80.7 percent) and Meja Block (82.7 percent). In case of method of drawing water from the storage as much as 4.7 percent below poverty line and 11.4 percent above poverty line respondents who tilt their bucket/container to take the water. Same holds true between Soraon (6.3 percent) and Meja (7.0 percent). No more than 82.4 percent below poverty line respondents use bottles for taking water from the bucket/container whereas 64.6 percent above poverty line do so and opposite picture can be found between Soraon Block (74.3 percent) compared to Meja Block (80 percent) (Fig. 2).

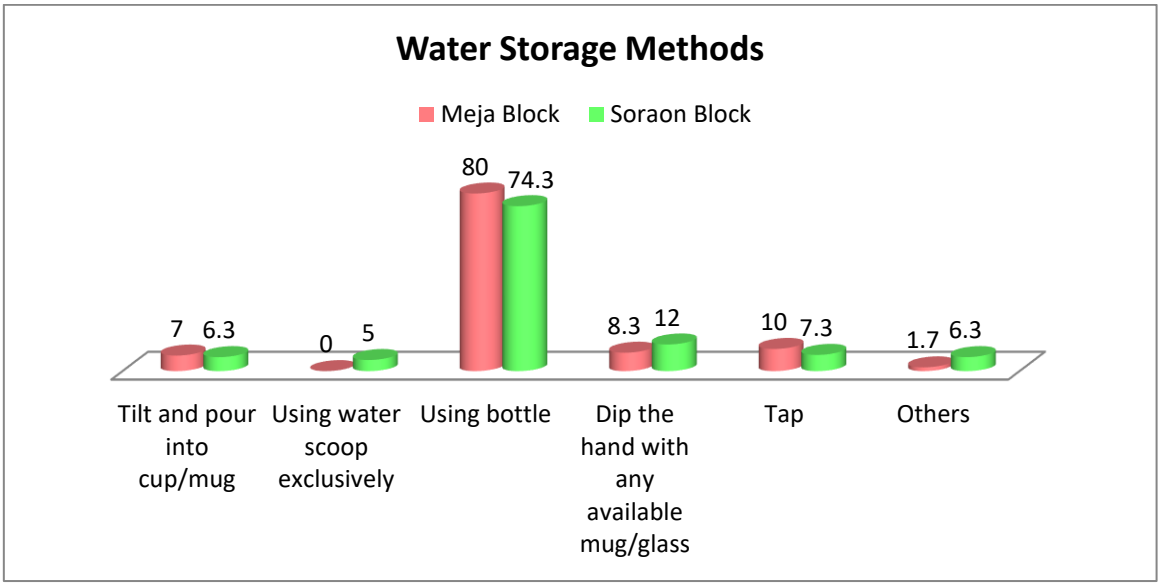

Figure 2: Water Storage Methods

3.3. Health Status

Respondents have reported low level of illness in the household (13.2 percent reported illness in the household) (Fig. 3). Among those who were ill went largely to private hospital/doctor/clinic for treatment (48.1 percent). More female (50.0 percent) compared to (46.8 percent) male received such private treatment, a pattern similar to what has been found elsewhere. CHC/Rural Hospitals/PHC is the second most preferred place for treatment where male (23.4 percent) compared to female (12.5 percent) received treatment (Table 4).

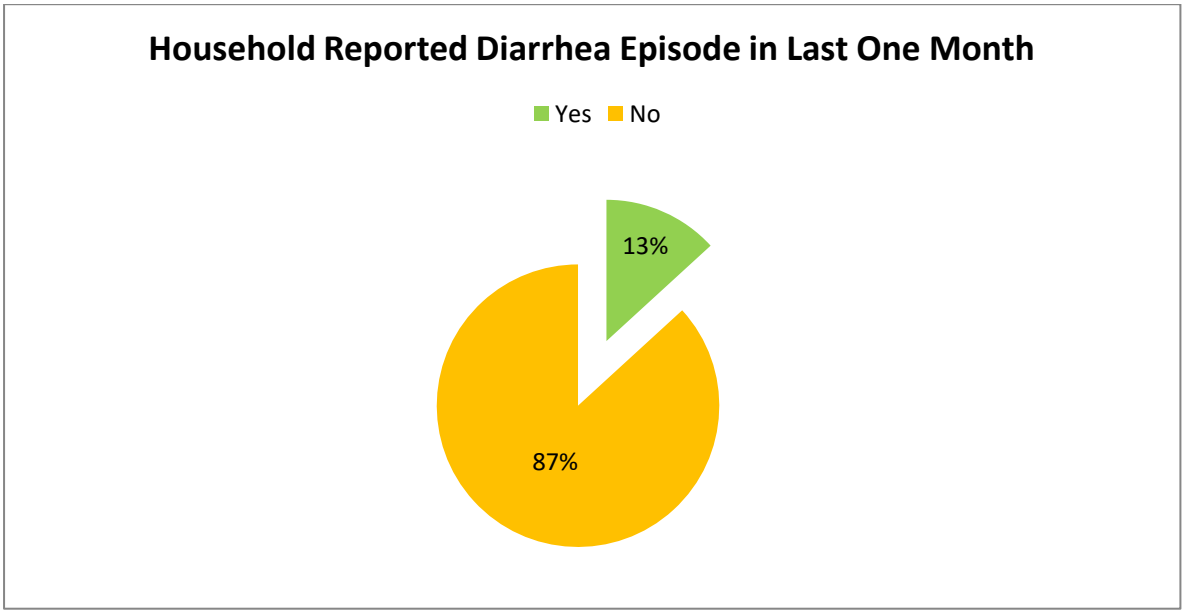

Figure 3: Household Reported Diarrhea Episode in Last One Month

Table 4: Health Status

Health Status	Block				Gender				Total	
	Meja		Soraon		Male		Female			
	N	%	N	%	N	%	N	%	N	%
Place of Treatment										
Sub Centre	12	17.4	1	10.0	5	10.6	8	25.0	13	16.5
Government Clinic/ Hospital	11	15.9	1	10.0	7	14.9	5	15.6	12	15.2
CHC/Rural Hospital/PHC	15	21.7	0	0.0	11	23.4	4	12.5	15	19.0
Anganwadi/ICDS Centre	12	17.4	0	0.0	8	17.0	4	12.5	12	15.2
Govt. Mobile Clinic	7	10.1	0	0.0	5	10.6	2	6.3	7	8.9
Traditional Healing	7	10.1	0	0.0	5	10.6	2	6.3	7	8.9
Pvt. hospital/ doctor/clinic	32	46.4	6	60.0	22	46.8	16	50.0	38	48.1
Village Vaidya/ Hakim/ Homeopath	8	11.6	0	0.0	5	10.6	3	9.4	8	10.1
Dai / neighbor	3	4.3	0	0.0	2	4.3	1	3.1	3	3.8
Home remedy	6	8.7	1	10.0	3	6.4	4	12.5	7	8.9
Others	3	4.3	1	10.0	2	4.3	2	6.3	4	5.1
No. of HHs Suffered from Diarrhea in last one Month	69	100.0	10	100.0	47	100.0	32	100.0	79	100.0

***Source*:** Field Survey

3.4. Drinking Water Treatment

Regardless of gender, 89 percent respondents reported that water is not treated for purification in their households (Fig. 4). Among 11.2 percent respondents who claimed to

have treated drinking water, more literate (13.5 percent) treat water for purification as compared to illiterate respondents (7.2 percent).

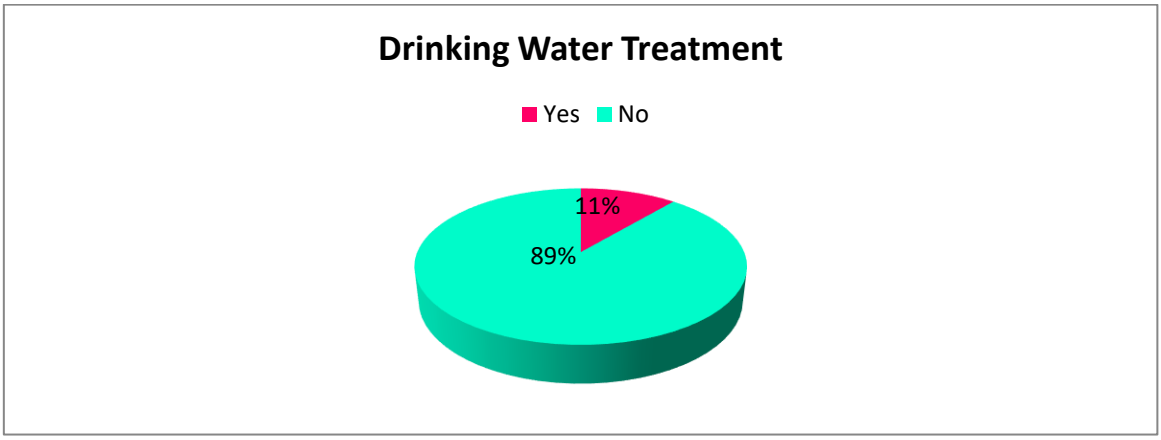

Figure 4: Drinking Water Treatment Practice

Based on this analysis, it is concluded that water treatment for purification is low not exceeding 11.2 percent and those who follow purification process also doing simple boiling (Fig. 5) .

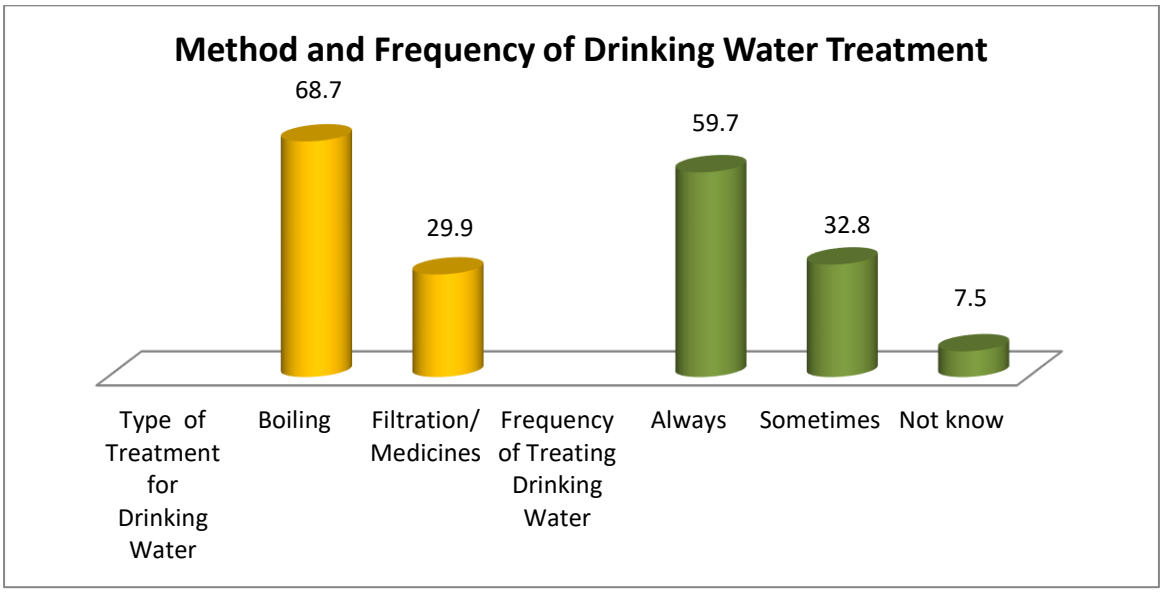

Figure 5: Method of Drinking Water Treatment

Water without Purification

Further, analysis of 89 percent respondents who do not treat their water for purification as indicated in Fig. 4 has been separately carried out. Table 5 indicates that 52.2 percent respondents think water is safe and 24.2 percent feel they are used to drinking water from hand pumps/household tap connection/public tap and uncovered wells without any

apparent problems. Whereas 22.1 percent indicates that they do not know how to purify water.

Table 5: Reason for not Treating Drinking Water

Reasons	**Total**	
	N	**%**
Expensive	6	1.1
We are used to the water	129	24.2
Water is safe	278	52.2
Not know how to treat	118	22.1
Others	2	0.4
Total Interviews	533	100.0

***Source*:** Field Survey

Table 6: Factors associated with household water treatment practice

Variables	**Options**	**HHWT Practice**		**COR**	**AOR**	**P value**
		Yes	No		1	
Education Level	**Illiterate**	16	205	1		0.001
	Literate	10	56	0.437(0.188-1.016)	.540(.228-1.280)	0.054
	Primary/Upper Primary	5	79	1.233(0.437-3.479)	1.330(.459-3.854)	0.692
	Secondary/ Higher Secondary	15	122	0.635(0.303-1.329)	.631(.285-1.396)	0.228
	Higher Education	21	71	0.264(0.130-0.534)	.330(.146-.746)	0.000
Caste	**General**	11	84	1	1	0.805
	SC/ST	20	157	1.328(0.499-3.535)	3.719(1.219-11.350)	0.570
	OBC	28	246	1.365(0.564-3.302)	1.510(.586-3.894	0.490
	other	8	46	1.568(0.655-3.562)	1.935(.770-4.864)	0.326
Income Group	**BPL**	34	391	1	1	0.001
	APL	33	142	0.374(0.223-0.627)	2.474(1.383-4.424)	0.00
Occupation	**Farmer/cultivator**	31	181	1	1	0.000
	Wage Labour	23	263	1.958(1.106-3.469)	1.695(.883-3.254)	0.021
	Business	2	20	1.713(0.381-7.696)	2.056(.427-9.894)	0.483
	Service	8	32	0.685(0.289-1.624)	1.267(.484-3.314	0.391
	Housework	0	19	2.76E8(0.000)	2.324E8(.000)	0.998
	Student/Retired	1	5	0.856(0.097-7.580)	1.632(0.170-15.684)	0.889
	Others	2	13	1.113(0.239-5.176)	1.232(0.247-6.138)	0891

The table-6 presents findings from a survey examining a practice known as HHWT (Household Water Treatment). The results of the multivariate analysis highlight several key factors linked to the adoption of water treatment practices within households.

Contrary to the expectation that higher education levels might positively influence HHWT practice, the data shows a negative correlation, particularly evident among those with

higher education levels (p-value = 0.000). This suggests that higher education does not necessarily translate to increased awareness or adoption of water treatment practices.

On the other hand, certain demographic groups exhibit a stronger association with HHWT practice. Specifically, the SC/ST and BPL (Below Poverty Line) groups demonstrate a higher correlation with practicing HHWT (p-value = 0.001 for both). This indicates that socio-economic factors, such as belonging to marginalized or economically disadvantaged communities, play a significant role in influencing household water treatment behavior.

Additionally, occupation and income level are also found to be statistically significant factors. Farmers, wage laborers, and individuals classified as BPL shows positive correlations with HHWT practice (p-value < 0.05). This implies that individuals engaged in agricultural labor or those with lower income levels are more likely to engage in household water treatment activities.

4. DISCUSSION

In remote areas where people rely on untreated sources like hand pump and wells, and there are no big water treatment plants, treating water at the household level is the best way to prevent diseases and deaths caused by unsafe drinking water (Lawrencia D *et al*., 2021 and Birara A. *et al*., 2021).

The findings of this study reveal that, 11.2 percent of households have practiced household water treatment; this was consistence with study conducted Zambia and Ethopia (Rosa *et al.,* 2016 and Lechisa Asefa *et al.* 2023). Boiling water and straining the water through a cloth before drinking are the most common water treatment practice used prior to drinking in 41.7 percent households in India. However it is lower than that National Family Health Status data (NFHS-5) and study conducted in Southern Ethiopia (Amha Admasie *et al*., 2022). This may be resulted from due to low awareness of the community.

The study conducted in Ethiopia examines water treatment practices in rural area and finds that boiling is the most common method, followed by settling and chlorine disinfection. Factors influencing practice include education level and gender (Belay *et al*., 2016). Another study conducted in rural Indonesia reported that not all the water people drink has been treated (Daniel *et al*., 2023). And also this finding is lower than similar study conducted in Eastern India found that while knowledge of boiling water was high, actual practice was lower this might be due to lack of fuel and time constraints (Pradhan *et al*., 2018).

According to the result of the current study 11.2 percent purified water and those who follow purification process also doing simple boiling (68.7 percent). This was lower when compared with the result of the study conducted in Kaduna state, Nigeria (16.6 percent) used chlorination as water treatment practice method (Sridhar *et al*., 2020). This variation might be due to poverty in the study area as 70.8 percent families belonged to BPL category.

From this study 77.2 percent household used plastic bottles for water storage, 10. 2 percent of household dipping hand with any available mug/glass into the container methods which contributed for contamination. This indicated the way water is stored and drawn in rural Prayagraj increases the chance of contamination within homes.

Households where the head of household is literate were more likely to practice household water treatment (13.5 percent) compared to illiterate households (7.5 percent). Therefore, literate individuals have a greater ability to understand educational materials and public health messages about waterborne diseases and the benefits of water treatment.

Households with higher socio-economic status (APL category) were more likely to practice water treatment (18.9 percent) compared to those with lower socio-economic status (BPL category) at 8 percent. Higher socio-economic status may correlate with greater exposure to education and public health campaigns promoting water treatment practices.

A large number of households drink untreated water (88 percent), and among them, over half (52.2 percent) believe the water is safe to drink. This highlights the potential health risk associated with untreated water consumption. This also emphasizes the lack of treatment and the potential misconception about the safety of the water. The findings of this study support previous researches (Edokpayi, J. N. *et al*. 2018 and N. Luvhimbi *et al.* 2022).

5. CONCLUSION

From this research finding it was evident that the household water treatment practice among rural Prayagraj village was limited. Economic status and occupation of household were factors associated with household water treatment practice. It is recommended that to improve the household water treatment practice the government and non-government organization (NGO) should educate rural community about the risks of untreated water consumption. This can be done through public health campaigns, educational materials and community extension programs. These organizations can also encourage households to adopt water treatment practices like boiling, filtration or disinfection. This can involve providing information on affordable and effective treatment methods. By implementing these

suggestions, we can help ensure access to safe drinking water for these communities. This research study received grant from ICSSR, New Delhi.

6. ACKNOWLEDGEMENT

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