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Research Article

Assessment of Household Water Treatment Practices in Odaya Kebele at Dilla Town, Southern Ethiopia

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Abstract

The global population continues to grow, the availability of fresh and safe water remains limited, posing significant public health challenges. Household water treatment (HWT) has the potential to improve water quality at the point of use and reduce waterborne diseases such as diarrhea. However, adoption of HWT in Ethiopia remains low, with limited evidence to guide interventions. A community-based cross-sectional study conducted in Odaya Kebele, Dilla Town, Southern Ethiopia, from March 18 to April 18, 2023, assessed household water treatment practices among 72 systematically selected households through structured interviews. The study revealed that only 31.94% of households practiced HWT, with boiling (52.17%), chlorination (21.74%), filtration (13.04%), and sedimentation (8.67%) being the primary methods. Despite access to various water sources, low educational levels, inadequate cleaning of water storage containers, and lack of awareness were key barriers to HWT adoption. The study recommended enhancing health education programs to raise awareness of simple and cost-effective water treatment methods, encouraging community engagement for consistent HWT application, and improving access to affordable resources like chlorine while providing proper training on their use. These measures could significantly improve HWT practices, reduce waterborne diseases, and enhance community health.

Keywords

Household Water Treatment Practices, Community, Point of Consumption

1. Introduction

1.1. Background

Water is essential for all life, which is why human settlements are typically established near sources of freshwater. While the human population has grown significantly over the years, the availability of freshwater has remained constant, leading to increased pressure on this vital resource. Access to safe and readily available water is crucial for public health, supporting activities such as drinking, cooking, and recreation [27].

Household Water Treatment (HWT) refers to the process of purifying water at home before use. It encompasses several methods for treating water at the household level, including boiling, chlorination, filtration, and sedimentation. These methods are collectively referred to as point-of-use (POU) water treatment technologies [22].

Worldwide, Household Water Treatment (HWT) methods such as boiling, chlorination, filtration, and sedimentation can enhance water quality at the point of use (POU) and lower the risk of diarrhea among millions who depend on both unim-

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proved and improved drinking water sources. When implemented correctly and consistently by at-risk populations, effective HWT techniques can reduce waterborne disease risks by up to 61% [13].

Household Water Treatment (HWT) is recognized as one of the most effective and cost-efficient strategies for preventing waterborne diseases. Therefore, vulnerable communities should take responsibility for their water security by adopting water treatment practices [16].

When household water sources are unsafe, HWT can enhance water quality at the point of consumption. By preventing recontamination within the home, treating water at the household level is more effective than traditional improvements to water supply systems in maintaining the microbiological quality of drinking water [14].

1.2. Statement of the Problem

Globally, over 1 billion people lack access to safe drinking water, accounting for 17% of the world's population. Additionally, around 1.8 billion people use water sources contaminated with fecal matter, with the majority residing in low- and middle-income countries. Consuming water polluted by fecal pathogens poses the highest health risk related to water contamination [25].

Diarrheal diseases, which claim the lives of 2,195 children daily, surpass AIDS, malaria, and measles combined as the second leading cause of death in children under five years old [18].

Although many people rely on improved community water systems, these systems often fail to consistently deliver microbiologically safe water, highlighting the need for additional treatment at the household level. In low-income countries, household water treatment (HWT) methods have proven to be effective in significantly improving water quality during field trials. These interventions serve as crucial measures to reduce waterborne diseases and ensure safer drinking water for communities, especially in areas where infrastructure and resources are limited [3] and [6].

For instance, the use of flocculent disinfectants has been shown to reduce diarrheal diseases in children under two years old by more than 25% compared to untreated water [10].

A substantial portion of diarrheal illnesses can be prevented through safe drinking water, proper sanitation, and hygiene (WASH) measures [15].

Despite the availability of simple, low-cost, and effective HWT practices, many communities lack awareness and exhibit poor adherence to these practices [1].

Factors such as limited knowledge, misinformation, lack of experience, and household perceptions are among the primary barriers to adopting effective water treatment methods [9].

Evidence from the Demographic and Health Survey in sub-Saharan Africa indicates that only 18% of households adequately treat their drinking water [12].

In Ethiopia, studies show that efforts to reduce waterborne diseases through water treatment at the source have been insufficient without proper household treatment and hygienic handling practices [20].

Access to safe drinking water remains extremely low, and even water deemed safe at distribution points is often contaminated during collection, transportation, and storage. Nationwide, less than 6% of Ethiopian households practice HWT [2].

The United Nations' Sustainable Development Goal 6.1 aims to achieve universal and equitable access to safe and affordable drinking water by 2030 [21]. However, ensuring effective water treatment practices remains a significant challenge in communities where waterborne diseases pose severe health threats. Moreover, research on household water treatment practices and their determining factors remains limited, particularly in Ethiopia.

There is a lack of consistent and conclusive evidence on the factors influencing household water treatment practices. Additionally, studies examining these practices and associated factors are scarce in Ethiopia and specifically in the study area. This study, therefore, aims to assess household water treatment practices in Odaya Kebele, Dilla, Ethiopia.

1.3. Significance of the Study

After completion of the study, identifying the level of HWT practices had benefits in reducing burden of diseases due to water with poor quality which in turn improve public health. It was used as an input to mobilize the community and gave awareness on HWT for Gedio Zone health office and other stake holders.

The study was aid as a source of direction for intervention by being an input in planning future services for policy makers and planners and was help to raise awareness of the community on the existing problem for community. It also enriches literatures available on household water treatment practice and may trigger other researcher to conduct related studies in various parts of the globe.

1.4. Review Objectives

The objectives of this study are: To assess household water treatment practices in Odaya Kebele, Dilla Town, Ethiopia, in 2023; then, to identify the level of these practices; and finally, to measure household water treatment practices in the area.

2. Literature Review

2.1. Household Water Treatment Practices in Ethiopia

In 2016, only 9.4% of Ethiopian households treated their drinking water, highlighting a significant gap in safe water practices and the need for improved access to treatment methods [11].

A study in Northwest Ethiopia showed that approximately 25% of households utilized at least one water treatment method, with 52.3% practicing plain sedimentation, 25.1% boiling water, 20.5% straining water through a clean cloth or local sieves, and 2.1% using chlorine solutions [9].

Another study in Burie Zuria Woreda revealed that 44.8% of rural households treated water at home, employing various methods. Among them, 59.7% boiled water, 20.7% used sedimentation, and 19.6% relied on chlorine chemicals [4].

In Bahir Dar City, only 11% of households reported treating their water at home, reflecting a low adoption of household water treatment practices and the associated risks of consuming unsafe water [19].

A community-based study in Sodo Zuria District found that 44.1% of households treated water before use. Factors significantly associated with water treatment practices included higher monthly income, age over 45 years, frequent water collection (twice daily), weekly cleaning of water storage containers, and the method of drawing water from collection jars.

2.2. Methods of Household Water Treatment

2.2.1. Sedimentation

Sedimentation is a physical process that reduces water turbidity by allowing particles to settle naturally in a container, such as a bucket. The process can be accelerated by adding coagulants, either chemical or natural. However, some particles and pathogens cannot be removed through sedimentation alone [5].

2.2.2. Filtration

Filtration, often used after sedimentation, reduces turbidity and removes pathogens by passing water through a filter medium. Filters may include sand, ceramic, cloth, or membranes, and some filters encourage the growth of biological layers to enhance pathogen removal. Sand filtration, one of the oldest techniques, removes suspended solids and larger microorganisms. Slow sand filtration is particularly effective, though it requires significant space [17].

2.2.3. Disinfection

Disinfection eliminates remaining pathogens to ensure safe drinking water. Common household disinfection methods include chlorination, solar disinfection (SODIS), solar pasteurization, ultraviolet (UV) light, and boiling. Chlorination is particularly effective, low-cost, and widely used globally due to its ability to kill a broad range of microorganisms and prevent regrowth in water distribution systems [26].

2.2.4. Distillation

Distillation purifies water by evaporating it and then condensing the vapor back into liquid form, leaving contaminants behind. This process can use solar energy and is effective in removing pathogens and other impurities [24].

2.3. Benefits of Household Water Treatment Practices

Household Water Treatment (HWT) significantly improves water quality at the point of consumption, especially in areas where drinking water is distant, unreliable, or unsafe. While HWT serves as a temporary measure, it does not replace the responsibility of service providers to deliver safe drinking water. It is particularly useful for those without access to improved water sources, individuals using contaminated storage methods, and populations facing emergencies [23].

HWT can contribute to achieving global goals for universal access to safe drinking water. Even in urban and rural settings with adequate water supplies, contamination—both microbiological and chemical—is a widespread issue. Piped water systems often lack continuous delivery, suffer from poor maintenance, and become contaminated during storage, necessitating additional treatment at the household level [7].

However, it is important to note that while HWT methods can mitigate risks, they do not equate to sustainable access to safe drinking water. Reliance on HWT as a primary solution shifts responsibility from service providers to consumers, which is not a long-term or equitable solution [25].

3. Methodology

3.1. Study Area

The study was conducted at Odaya kebele, Dilla Town. Dilla town is located in Southern Ethiopia at a distance of 359 km from the capital city, Addis Ababa, on the way from Addis Ababa to Moyale. It is located at 6°22´to 6°42´N and 38°21´to 38°41´E longitude with an altitude of about 1476 m.a.s.l. The mean annual daily maximum and minimum air temperature is 28.4 and 12.8 ℃, respectively [8].

3.2. Study Design and Period

A community-based cross-sectional study was conducted from March, 20/2023 –May, 20/2023 in Odaya Kebele at Dilla Town, Southern Ethiopia

3.3. Population

3.3.1. Source Population

The source populations were all households in Odaya Kebele at Dilla Town, Ethiopia.

3.3.2. Study Populations

The study populations were the selected households in Odaya Kebele at Dilla Town, Ethiopia.

3.4. Sampling

3.4.1. Sample Size Determination

A single population proportion formula was used considering the proportion of HWT practices from a study conducted in Southern Ethiopia which is 44%. With an assumption of 95% confidence level, 5% margin of error, and an anticipated non response of 5% was considered. Based on the above assumptions, using the single proportion formula, the total sample size was calculated as the following.

$$n = \frac{z2pq}{d2}$$

Where:

n = Sample size; z = 95% confidence level corresponds to the value 1.96;

p = 0.44 (HWT practices from a study conducted in Southern Ethiopia); q =1-p;

d = proportion of sampling error (marginal error)) tolerated at 0.05.

Thus, n = (1.96) 2(0.44) (0.559)/0.0025=379. The total number of HHs in the Kebele was 617. Since it is less than 10,000 the sample size was reduced using a correction formula (finite population correction formula) mentioned below.

$$nf = \frac{no}{1+(\frac{no-1}{N})}$$

Where nf= final sample size, no=sample size calculated, N=total population (618). The final sample size for this study was found to be 72.

3.4.2. Sampling Procedure

A systematic random sampling method was employed to select households in the chosen kebele. The sampling interval (k) was calculated by dividing the total number of households (617) in the kebele by the required sample size. The first household was selected through a lottery system, and subsequent households were chosen systematically based on the interval.

3.5. Study Variables

3.5.1. Dependent Variable

The dependent variable for this study was the practice of household water treatment (HWT).

3.5.2. Independent Variables

The independent variables included:

Socio-demographic factors: Sex, age, educational background, family size, and marital status. Water source and handling characteristics: Source of water and related practices.

3.6. Operational Definition

Household water treatment practice: Households were classified as having good practices if they used at least one method of HWT within a few days prior to the study.

3.7. Data Collection Tools and Procedures

Data collection was carried out using a structured questionnaire that was designed after reviewing relevant literature. The questionnaire was initially prepared in English, translated into Amharic to facilitate understanding, and then retranslated into English to ensure consistency. It comprised three sections:

1) Socio-demographic information
2) Water source and related practices
3) HWT practice questions

Data collection was conducted through face-to-face interviews and direct observation.

3.8. Data Processing and Analysis

The collected data were exported to SPSS version 25 for statistical analysis. The data were organized, compiled, and presented using tables, graphs, charts, and narrative text for clarity and interpretation.

3.9. Ethical Consideration

Ethical approval was secured from the College of Natural and Computational Sciences at Dilla University. Study participants were fully informed about the purpose and objectives of the research and its anticipated outcomes. Participation was voluntary, and informed consent was obtained to ensure their understanding and agreement. Confidentiality was maintained throughout the study.

4. Result and Discussion

4.1. Socio-Demographic Data of Respondents

The study included a total of 72 selected households. The majority of participants were female, comprising 69.45% of the sample. In terms of age distribution, 18.06% were aged 18 to 30 years, 31.94% were between 31 and 45 years, and 50% were above 45 years old, with an average age of 35.65 years. Regarding family size, 52.78% of households had fewer than five members, while 47.22% had five or more members. Marital status data indicated that 87.5% of respondents were married, while the remainder were unmarried. Additionally, less than half (45.85%) of the respondents were literate, able to read and write, as shown in Table 1.

Table 1. *Socio-demographic Profile of Respondents in Odaya Kebele, Dilla Town, Southern Ethiopia, 2023 (n = 72).*

Variables	Categories	Frequency	Percent (%)
Sex	Male	22	30.55
	Female	50	69.45
Age	18-30	13	18.06
	31-45	23	31.94
	>45	36	50
Marital status	Married	63	87.5
	un Married	9	12.5
Educational status	Unable to read and write	33	45.85
	Read and write	39	54.13
Family size	<5	38	52.78
	>5	34	47.22

4.2. Household Water Sources and Handling Practice of Respondents

Out of the 72 households surveyed, 31.94% accessed water through private piped connections on a weekly basis, 25% relied on the Wallame River as their water source, and 43.06% obtained water from groundwater sources delivered by donkey carts, lorries, or water trucks (Figure 1).

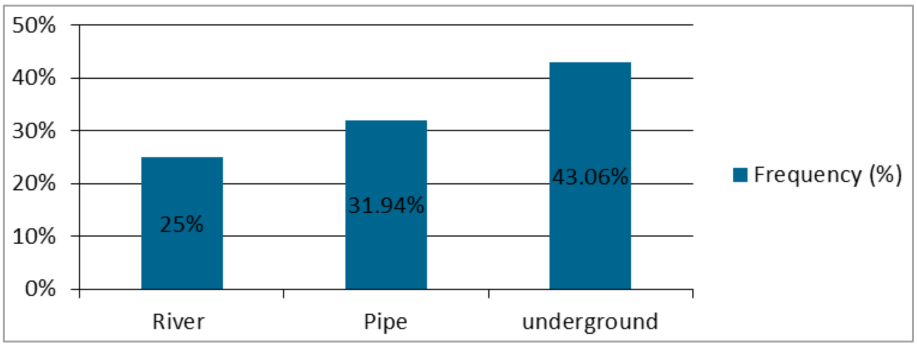

Figure 1. *Water Sources for Selected Households.*

The figure illustrates the distribution of water sources among the surveyed households. Nearly all respondents (93.06%) reported cleaning their water storage containers, and 65.25% specifically mentioned washing their containers to maintain hygiene.

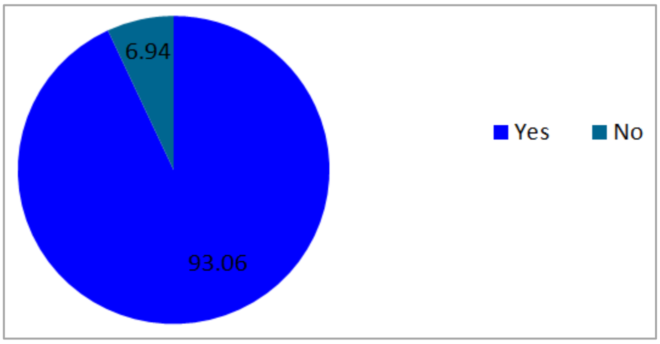

Figure 2. *Responses on Cleaning Water Storage Containers at the Household Level in Odaya Kebele, Dilla Town, Southern Ethiopia, 2023.*

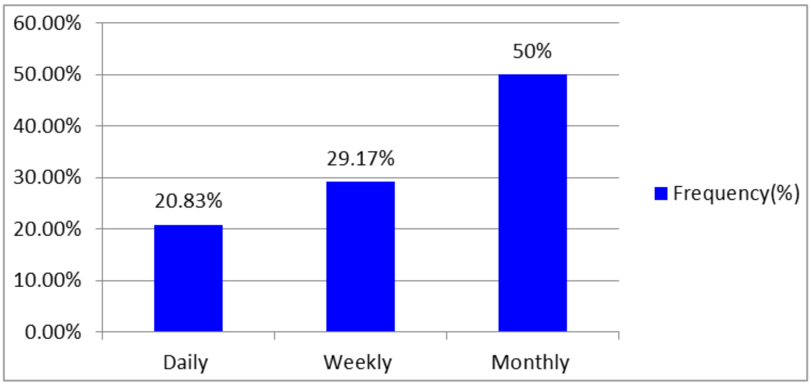

***Figure 3.** Frequency of cleaning practices to water storage containers at household level.*

The figure depicts household practices related to cleaning water storage containers. It shows that 93.06% of respondents cleaned their containers, with 65.25% indicating they specifically washed them to ensure proper hygiene.

The majority of respondents (50%) reported cleaning their water storage containers frequently, with the cleaning frequency largely influenced by the size of the containers. Smaller containers, such as jerry cans and plastic drums, were typically cleaned daily or weekly, while larger poly tanks were cleaned after several months of use. Respondents storing water in poly tanks mentioned cleaning them monthly, often because the stored water was not consumed directly. These findings align with a study by [28], which reported that 53.8% of participants cleaned their storage containers on a monthly basis.

4.3. Household Water Treatment Practice of Respondents

However, this result falls slightly short of the Ethiopian Health Transformation Plan's target to raise HWT practice to 35% by 2020 and previous studies in Ethiopia, such as Burie, Northwest Ethiopia (44.8%), Gibe (34.3%), and Bahir Dar, Northwest Ethiopia (34%). The disparity may stem from differences in access to information about HWT across regions.

Conversely, the current findings are marginally higher than studies conducted in Dabat, Northwest Ethiopia (23.1%), Degadamot, Northwest Ethiopia (14.2%), and Harar, Eastern Ethiopia (16.5%). These variations might be attributable to differences in study periods, sample sizes, and levels of community awareness about household water treatment practices.

***Table 2.** Respondents' household water treatment practices in Odaya Kebele, Dilla Town Southern Ethiopia (N = 72).*

Variables	Categories	Frequency	Percent (%)
water treatment practicing in household level	Yes	23	31.94
	No	49	68.06
method of water treatment	Boiling	12	52.17
	Adding chlorine	5	21.74
	Filtration	3	13.04
	Sedimentation	2	8.67

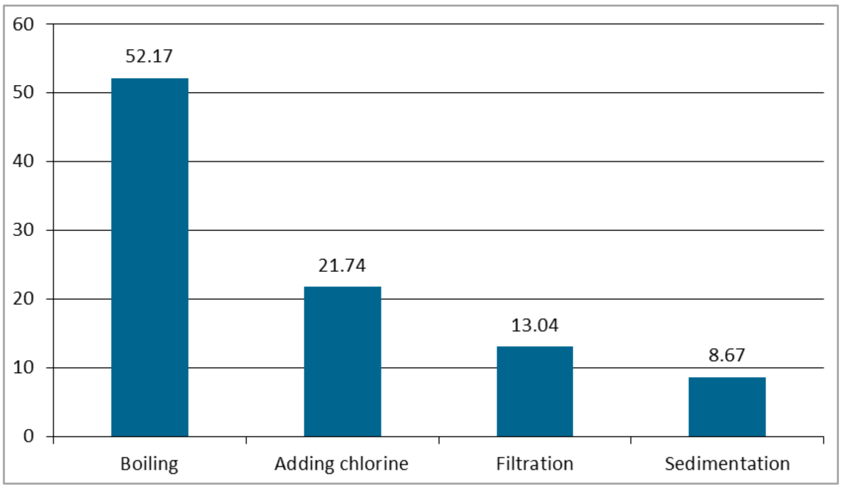

***Figure 4.** Household water treatment practices in Odaya Kebele, Dilla Town Southern Ethiopia, 2023.*

5. Conclusion and Recommendation

5.1. Conclusion

The current study found that household water treatment (HWT) practices were notably low in the study area. Of the 72 respondents, only 31.94% were engaged in water treatment activities. Despite having access to different water sources (rivers, piped water, and groundwater), the low HWT practices were attributed to factors such as educational status, infrequent cleaning of water storage containers (monthly), and a lack of awareness about effective water treatment methods.

5.2. Recommendations

Based on the study findings, the following recommendations are proposed:

1) Strengthen Health Education: The government and relevant organizations should enhance health education initiatives focusing on household water treatment practices. These efforts should aim to increase community awareness and understanding of the importance of water treatment and make essential supplies more accessible.
2) Community Engagement and Responsibility: The community should take an active role in adopting and consistently practicing effective water treatment methods, such as chlorination, boiling, sedimentation, and filtration. These methods should be implemented correctly and consistently to ensure improved water quality at the point of consumption. By implementing these measures, the level of household water treatment can be increased, thereby reducing the risks associated with waterborne diseases.

Abbreviations

DTAPA	Dilla Town Administration Population Affairs
DTWSSE	Dilla Town Water Supply Service Enterprise
HH	Household
HWT	Household Water Treatment
POU	Point-of-Use
UV	Ultraviolet
UN	United Nations
EDHS	Ethiopia Demographic and Health Survey
PAC	Polyaluminium Chloride
WASH	Water Sanitation and Hygiene

Author Contributions

Sara Alemayehu Assefa is the sole author. The author read and approved the final manuscript.

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Data Availability Statement

Data sharing not applicable to this article as no datasets were generated or analyzed during the current study.

Conflicts of Interest

The author declares no conflicts of interest.

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