



## Original Article

## Investigating the Reason of Tendency to Use Point-of-Entry and Point-of-Use Household Water Filters in Sari

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## ABSTRACT

**Background:** Due to the pollution of drinking water resources and increasing consumer concerns and awareness about unhealthy drinking water, the urgent need for communities to have access to and produce safe water is felt more than ever, so in recent years the use of Point-of-entry (POE) and point-of-use (POU) filters (known as Household water treatment devices in Iran) in urban and rural communities of Iran, it has become very popular. In this regard, the purpose of this study was to investigate the causes of households in Sari, Mazandaran Province to use POU/POE treatment devices.

**Methods:** This descriptive cross-sectional study was conducted in the fall of 2020 and using an electronic questionnaire to investigate the causes of the tendency of people in Sari to use POU/POE treatment devices. The number of participants in the study was 117 households that were selected according to the simple random sampling method.

**Results:** The results of the present study showed that 73.5% of the surveyed households used the municipal tap water for drinking and 23.1% of the households applied the POU/POE treatment devices. The most common reason for dissatisfaction with urban water was related to the formation of sediments inside the pipe, kettle and water heaters.

**Conclusion:** This study revealed that 23.1% of respondents used POU/POE water treatment devices because of low quality of municipal drinking water. About 17.9% of respondents are distrustful of municipal water system, which was mostly due to the high salt content and scaling of municipal drinking water in Sari.

**Keywords:** Drinking water, Hygiene, Sari, Water purifier

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## Introduction

Everyone should be able to access adequate and safe water sources and, every urban water supply for each person must be sufficient, have adequate quality (chemical and microbial), and be continuous for personal and domestic uses. These uses ordinarily include drinking, personal sanitation, washing of clothes, food preparation, personal and household hygiene. According to the World Health Organization (WHO), between 50 and 100 liters of water

per person per day are needed to ensure that most basic needs are met and few health concerns arise (1, 2). Drinking water needs depend on age, gender, body weight or level of physical activity. The European Food Safety Authority (EFSA) has set a daily water intake of two liters for women and two and a half liters for men (3). Although water is one of the most abundant substances found in nature, various factors limit the amount of water available for human consumption (4). Water with unpleasant color, taste and

smell may not be consumed by human being. There are some other properties that make it unsuitable for home use, such as excessive hardness, high concentration of soluble solids or stains on clothing and fabric accessories. Drinking water should be clear and bright, cool, odorless, relatively stable (Neither corrosive nor sedimentary), abundant and cheap (5). Waterborne disease is one of the most common infectious diseases and is considered as one of the greatest health threats worldwide. 70 to 80% of health problems in developing countries and more than 80% of infectious diseases worldwide are caused by contaminated drinking water (6, 7). In recent years, in urban and rural communities of Iran due to the increase in water soluble substances, limited water resources in some urban areas, the inevitable use of unreliable resources and also media propaganda about various urban water pollution, there is an increasing interest to use home water filtration system (8). Previous studies have shown that home water filters can only be useful in areas with contaminated water, but there are concerns about water-related health risks and advertising messages for home water filters that have led to increased use of these devices and have been used without information about the appropriate conditions (9, 10). Point-of-entry (POE) and point-of-use (POU) filters are becoming increasingly popular with consumers as a countermeasure for removing waterborne pathogens and undesirable pollutants from water supply where there is no other treatment or urban water in distribution systems that have low quality (11). The use of POU/POE treatment devices to improve family health and increase the quality of drinking water in most developed countries. In recent years in Iran, POU/POE water treatment devices are commonly being used by households due to providing a low microbial and chemical quality or salinity of water (12). There are different types of POU/POE water treatment devices that use different methods such as mechanical purification, softeners, anion exchangers, ultraviolet disinfectants, reverse osmosis systems, ozonizers, chlorinators, etc. and based on water properties which are refined are selected (3, 13). POU/POE water treatment devices are used in many households primarily for the purpose of removing contaminants from tap water with the help of physical, chemical or biological processes (14). Increasing public awareness about the effects of drinking contaminated water and concerns about the quality of tap water in households has led to an increase in the use of POU/POE water treatment devices (15). Water filters on the market today not only eliminate contaminants, but also eliminate heavy ions, chlorine and odors (15). It also reduces salinity and salts and improves the taste of water and slightly reduces the acidity and acidification of water (12). A meta-analysis performed in this field showed that a reduction in the risk of diarrhea was observed in the range of 31% to 63% for various household water filters (16). In the absence of a centrally safe centralized power supply or a compromised purified water supply system, home water treatment devices can be used to improve the quality and safety of drinking water (17). Articles on household POU/POE water treatment devices are growing. Recent studies have shown that simple and relatively inexpensive household water treatment methods

can significantly improve the microbial quality of drinking water and reduce the risk of disease and death (18, 19). Several studies have been conducted in this regard, including a study by Zazouli et al. in Sari to determine people's satisfaction with the quality of drinking water. It was found that 11% of the interviewees used household water treatment devices to provide water (5). In another study in Bandar Lengeh, it was reported that none of the households used the distribution water of the city network directly for drinking and only bad color of tea and late cooking of food was the highest percentage of reasons for not using the distributed water of the urban network (8). In a study conducted by Varbanets et al. On the benefits of drinking water treatment using home-based decentralized treatment systems, it was found that the use of these systems due to low cost, ease of use, low maintenance and low dependence on energy resources, They are suitable for water purification (20). Although POU/POE water treatment devices can contribute to increased water quality, but they can have a number of undesirable problems such as: accumulate sludge, scale, rust, algae or biofilm deposits in the water treatment filters and potentially represent a temporary reservoir of undesirable contaminants (11). Considering current concerns about chemical pollution of drinking water in the city of Sari, and consequences of using a home water purification system, the purpose of this study was to investigate the causes of the tendency to use POU/POE water treatment devices.

## Methods

### *Type and place of study*

This study was a descriptive cross-sectional study that was conducted on households in the city of Sari, in 2020. The information about public views were collected using an electronic questionnaire and the reasons for their tendency to use a household water treatment filters were investigated. The city of Sari is one of the cities of Mazandaran province in the north of Iran, which has a population of 309,000 (21) And is the title of the largest city and political-administrative center of the province, which in terms of geographical location is located at 53 degrees east longitude and 36 degrees north latitude (22). Sari drinking water is supplied through groundwater, wells and surface water. In recent years, due to water shortage in this city, the use of water collected behind the Shahid Rajaei Dam was on the agenda in cooperation with Mazandaran Province Water & Wastewater Co. So that by delivering part of the water supply of Sari at the rate of 500 liters per second, this problem was partially solved by the water of Salim Bahrami water treatment plant (Shahid Rajaei dam).

### *Data collection tool*

The data collection tool was a questionnaire consisted of five questions related to demographic characteristics and source of water used for drinking and washing (well, public water distribution network or home water treatment devices), eighteen questions related to municipal tap water quality (color, salinity, hardness, test and odor, scaling, corrosiveness, Causes digestive problems, turbidity, temperature, pH, residual chlorine, Acidity, microbial quality, alkalinity, tea color, Satisfaction rate of quality), and six questions related to home water filters (price,

operation method, kind of water treatment devices, satisfaction, consumption rate, and filters replacement time). In order to evaluate the level of satisfaction to the quality of water consumption, a 10-point scale was used where 1 indicated lowest and 10 denoted highest satisfactions. The present questionnaire was reviewed by eight health professionals working at the executive sections of the Ministry of Health (4 faculty member and 4 environmental health expert) yielding a content validity index of 0.75 and content validity ratio of 0.81. The reliability of the questionnaire was confirmed by Cronbach's alpha coefficient of 0.78.

Sample were selected from household health records of health care centers. In order to facilitate the access of the participants during the pandemic, the questionnaire was given to those who have access to the common social media networks in Iran such as WhatsApp and Telegram and were responsive. The electronic questionnaire was designed by PorsLine web method. Ethics in research and confidentiality of the answers were given on the first page of the questionnaire.

## Results

From 138 samples, 117 people responded to the electronic questionnaires completely, yielding a response rate of 85.2%. Sociodemographic characteristics of respondents are presented at Table 1. According to the results, 15.4% of the respondents to the questionnaire were the father of the family and 36.8% of them were the mother of the family and 47.9% of them were other family members. The age distribution of the respondents indicates that a high percentage was in the age-group of 30-40 years old.

**Table 1.** Sociodemographic Characteristics of Respondents (n = 117)

Characteristics	N	%
Sex		
Male	50	42.7
Female	67	57.3
Age		
< 20	18	15.7
21-30	38	33
31-40	29	25.2
41-50	20	17.4
51-60	5	4.3
> 61	5	4.3
Educational level		
Lower than diploma	23	19.7
Diploma	24	20.5
Bachelor	51	43.6
MS and above	19	16.2
Occupation		
Jobless	15	12.8
Student	35	29.9
Housekeeper	25	21.4
Governmental jobs	26	22.2
Non-governmental jobs	16	13.7
Position in family		
Father	18	15.4
Mother	43	36.8
Children	56	47.9

The source of drinking water in 73.5% was municipal tap water, followed by domestic water filters (23.1%), and bottled water (3.4%).

The water usage of municipal tap water among the studied households are presented in Table 2. Sixty two percent of households have used the municipal tap water directly for drinking.

**Table 2.** Municipal Tap Water Usage from the Perspective of Target Households

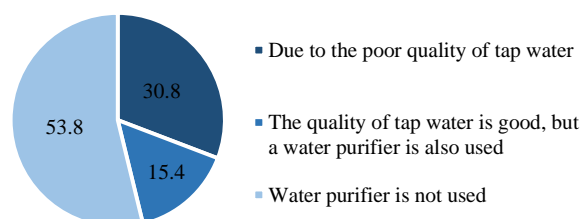
Type of usage	%
Drinking	62.4
Cooking	83.6
washing Dish	98.3
Washing clothes	95.7
Bath	96.6

Table 3 shows the respondents' views on the quality of municipal tap water. Mineral sedimentation creating a mass on pipes, kettles and packages was the most important reason for dissatisfaction with the quality of distributed water (63.2%) followed by Unfavorable taste (33.3%) and chlorine smell (33.3%).

**Table 3.** Views of Respondents on the Water Quality of the Municipal Water Network

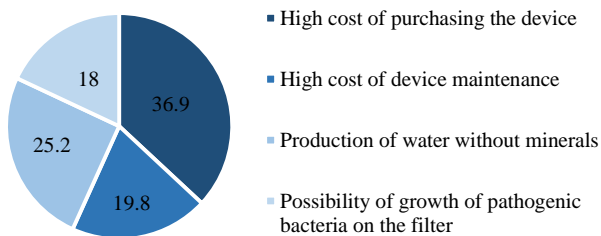
Reasons for dissatisfaction	Yes	No	I do not know
Odor	22.4	69.8	7.8
Unfavorable taste	33.3	60.7	6
Digestive problem	13	67	20
Salinity	17.1	73.5	9.4
Bitterness	15.4	73.5	11.1
Mineral sedimentation	63.2	19.7	17.1
Late cooking	15.5	48.3	36.2
Kidney stones	30.8	35.9	33.3
Chlorine smell	33.3	56.4	10.3

The average score on the quality of drinking water given from 1 to 10 was 6.42, indicating that the satisfaction on quality of drinking water in Sari was moderate. Regarding to water chemical pollution, 31.6% believed that water has no pollution, 22.2% considered the municipal tap water sometimes polluted and non-drinkable, and 17.9% did not trust municipal tap water, and 28.3% did not respond. More than half of the respondents (55.6%) addressed the necessity to install a household POE/POU devices and 44.4% of the respondents intended to install household POE/POU devices. The motivation of individuals for using a household POE/POU devices is illustrated in Figure 1, showing that 31% used it due to poor quality of water. Regarding to the timing of device filter replacement, 41.7% of the respondents replaced it in a timely manner.



**Figure 1.** Motivation of Using Household POE/POU Devices

Figure 2 shows the reasons of not using home water purifier. The most common reason was high cost of purchasing a device (37%). While, 25% was not interested in application of home water purifier because of removing suitable minerals during purification process and 18% was concerned about the possibility of growth of pathogenic bacteria on the filter.



**Figure 2.** Reasons of not Using Household POE/POU Devices

### Discussion

The main method of drinking water supply in households in Sari was the use of Municipal tap water. This finding is not consistent with the study of Imami et al.(2017) In Bandar Lengeh, which found that 71.4% of the interviewees uses a household POE/POU devices to improve water quality (8). Cultural differences and geographical conditions play an important role in this discrepancy. But it is consistent with the results of Dr. Zazouli et al.(2013) That 69% of people used municipal tap water in Sari (5). From the point of view of the target households, one of the most important reasons for their dissatisfaction with the water quality was due to the salts, unpleasant odor and chlorine odor of piped water, which is consistent with the results of Emami et al. (8).

In general, most of the respondents have been dissatisfied with the creation of mass on the package pipes and kettles, which indicates the presence of large amounts of minerals in the piped water of Sari. But in the study of Emami et al., Discoloration of tea with 84.1% was the most important reason for not using and dissatisfaction with municipal tap water (8). The most important minerals needed by the body are supplied through water, but the results show that the hardness of drinking water in Sari was very high and should reach the desired level. The maximum optimum total hardness in drinking water in terms of calcium carbonate is 200 mg / L and the maximum allowable is 500 mg / L (19). Therefore, solving this problem will increase the level of people's satisfaction. Studies have shown that home water purifiers increase coliform growth as well as reduce water hardness and the level of minerals such as calcium, magnesium or fluoride (3, 24). Therefore, monitoring the quality of drinking water from source to point of consumption is essential to ensure compliance with standards and maintain public health. Study by Nriagu et al. (2018) on domestic water filters in Doha showed that POE / POU devices can reduce the quality of tap water in Doha. POE and POU filters have changed the chemical and biological characteristics of domestic water compared to treated municipal water. They also cause microbial growth

and biofilm formation in the domestic water distribution system (11). On the other hand, there is an accumulation of minerals, organic matter and essential trace elements on the filters used in POE / POU devices, which can cause the growth of bacteria and the formation of biofilms on their surface. It has also been reported that carbon filters may be less effective in removing microbial contaminants from water than in removing organic compounds (25).

Studies have shown that many of the essential minerals that are added to water in post-desalination treatment have been largely removed by POE and POU filters, resulting in the demineralization of tap water. It has been stated that the consumption of this water causes metabolic diseases and increases the incidence of cancer (26, 27). A study by Su et al. (2009) showed that bacteria were washed out from the surface of the activated carbon filter at a low rate because the adhesion of bacteria (biofilm) to the surface of the activated carbon filter inside a POU device was weak (28).

In the present study, only 41.7% of the studied households tried to replace the filters on time. Failure to pay attention to timely replacement of filters in the absence of chlorine causes the accumulation of substances on the filters, the growth of bacteria and even the creation of a specific taste and odor (8). Due to the lack of awareness of many people about the proper use of the device, the efficiency of the devices decreases. For this reason, it is recommended that people be given the necessary training in the proper use of such devices. Because timely replacement of the filter prevents microbial contamination from entering the outlet water due to the function of the filters (6).

### Conclusion

This study revealed that 23.1% of respondents used POU/POE water treatment devices because of low quality of municipal drinking water. About 17.9% of respondents are distrustful of municipal water system, which was mostly due to the high salt content and scaling of municipal drinking water in Sari. So, there is a responsibility for government officials to provide safe and high quality drinking water to the citizens, and there is a need to educate the public on the use of POE and POU filters with its economic and health consequences.

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### Ethical consideration

This study was extracted from approved by the Ethics Committee of Mazandaran University of Medical Sciences, Mazandaran, Iran.

### Conflicts of interests

Authors declared no conflict of interest.

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