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## Original Research Article

# Knowledge regarding reverse osmosis (R.O) waste water utilization among general public in urban areas

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**A B S T R A C T**

**Introduction:** Reverse osmosis (RO) is a water purification process that uses a partial permeable membrane to remove ions, unwanted molecules and larger particles from drinking water. In reverse osmosis, an applied pressure is used to overcome osmotic pressure, a colligative property that is driven by chemical potential differences of the solvent, a thermodynamic parameter. In the process of reverse osmosis the amount of water that is drained is a concern area for the people using the R.O. filtration device in their household because it wasted about 70% of the water to purify just one liter of water. This R.O. waste water can be utilized for various purposes such as washing vehicle like car bike etc, cleaning toilet this study is aimed to assess the knowledge reverse osmosis waste water utilization among general public at Indore.

**Objectives:** 1. To assess the pretest knowledge regarding reverse osmosis (R.O) waste water utilization among general public. 2. To assess the posttest knowledge regarding reverse osmosis waste water utilization among general public. 3. To evaluate the effectiveness of structured teaching program on reverse osmosis (R.O) waste water utilization among general public.

**Hypothesis:** H1- there will be significant difference between pretest and posttest knowledge who received structured teaching program regarding the utilization of waste R.O water.

**Materials and Methods:** Quantitative, pre-experimental, one group pretest posttest design was adopted for the study. Total of 60 general public selected by using simple randomized sampling technique was used.

**Description of Tools:** Structured knowledge questionnaire.

**Result:** Data was analyzes using descriptive and inferential statistics.

**Major Finding:** In the pre-test majority of the sample (44 out of 60, 73.3%) had inadequate knowledge and in the post-test, majority (54 out of 60, 90%) had adequate knowledge regarding reverse osmosis. A paired 't' test was done and it showed a 't' value of 22.34 at 0.05 level of significance, this indicates the effectiveness of structured teaching programme in enhancing the knowledge of the general public. There was no association found between the mean pre-test knowledge of the general public. There was no association found between the mean pre-test knowledge scorer with the selected socio-demographic variable such as age ($\chi 2 = 8.643$), gender ($\chi 2 = 4.455$), education qualification ($\chi 2 = 4.706$), Occupation ($\chi 2 = 2.531$), number of family member ($\chi 2 = 5.653$) and previous knowledge about reverse osmosis filter water ($\chi 2 = 0.393$).

**Conclusion:** There is a significant difference between the mean pre-test and post-test knowledge score among general public regarding reverse osmosis waste water utilization.

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## 1. Introduction

Water- a must for all life forms on earth and the most important natural resource. We all know that about three-

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fourths of the earth's surface is covered with water. But about 96.5% of the global water resources come from the oceans and seas. In India, the water resources amount to an estimated 1897 square kilometer per annum. However, we all know about the shortage of water we are facing as a country.

The total volume of water on earth's surface is about 96.5%, from which the amount of usable freshwater is 2.5%, the volume of freshwater in ice-sheets and glaciers is about 70%, Stored groundwater is about 30%, and precipitation (rainfall) in India- 4% of earth's total.

An old saying states that: Water everywhere, not a drop to drink.' This is exactly what we fear will happen very soon, if we do not wisely use and conserve our water resources. And with the reverse osmosis there is a huge wastage of water is generated through the water filtration process.

A Swedish expert on water in his research suggested that there will be water stress when the water availability will fall below 1000 cubic meters per person per day. [1]

Now that almost in every household people prefer to use R.O filter water for drinking purpose and for other household uses like cleaning utensils, washing, bathing etc. it is a concern that more the amount of water is processed through the R.O system there is increase in the wastage of water in the process. [2,3]

One of the most important technologies for purifying water is the reverse osmosis approach (RO). This method utilizes semipermeable membrane for the purpose of removing large particles, molecules and ions from drinking water. Concerning RO, applied pressure is utilized for overcoming osmatic pressure, a colligative property which depends on chemical possible difference with regard to the solvent and thermodynamic part meter. Various suspended and dissolved species could be removed from water via RO such as bacteria. Also, it could be utilized in producing potable water and for industrial processes. The outcome is that the solute will be kept on the pressurized side to the other side. Ions and large molecules must not get through the pores of the membrane to be considered "selective", yet it must only permit small pieces of the solution (solvent molecules) to get through in the normal osmosis procedure, then the solvent will move in a natural manner from the area of low-solute concentration (high water potential) via a membrane to the area of high solute concentration (low water potential). The reason of this movement is the decrease in system's free energy as the difference is reduced in the solvent concentration on either side of the membrane, which will generate osmotic pressure because of the movement of the solvent to the high concentration solution.

Due to the ease of drinking bottled water, the better taste of bottled water and the harms presented in tap water, recently, consuming bottled drinking water has been elevated quickly. In addition, RO water has become a major source for drinking water next to tap water. [4–8]

## 2. Need For Study

In this present millennium, there is a huge problem with the source of water and in regard to availability of drinking water the problem is increasing rapidly on a daily basis. The water resources are getting polluted in the environment by various pollutants that are present in the environment which is leading to scarcity in the availability of drinking water for the general public. Meanwhile, there are number of establishments and companies working towards providing better water for drinking for the people. This establishments like the water treatment plants, R.O water Plants, 7 mechanical filter plants are working towards providing safe and clean water for the use of drinking purpose. These mechanical processes use reverse osmosis for treating the unclean water present with organic and inorganic harmful bacteria, ions, elements which can have an adverse effect on the health of any individual. The R.O membranes effective clean the water and also reduces the high TDS level and make the water suitable for drinking and other uses but in the processes of doing so there is a huge wastage of water which is not regulated by the treatment plant centers or others. This is where there is a need for the people to understand that though the R.O water systems that is installed in the home setting and shops where R.O water is available are providing safe water to drink but there is huge wastage of water which goes unnoticed by the people. Different studies have shown that approximately 80 percentage of water is wastage for only one litter of water being filtered from the R.O system. So on an average if a there are 'n' number of individuals in the family then there is huge amount of water wasted from the R.O system which indeed is an area of concern for the scarcity of water. There for there the manufacturing companies should be made aware about the wastage of water through the R.O system and also people should understand the utilization of these waste water that is generated. These R.O rejected or waste water can be used for various purpose such as cleaning utensils, washing, gardening, flushing, plantation, drinking water for farm animals etc. The reverse osmosis waste water cannot be used for the purpose of drinking because it contains high concentrations of salts, heavy metals and pollutants of feed water in the R.O system. In research, Phytoremediation is the answer to this problem. Phytoremediation is the process where the plants use this waste water and converts them to usable water. It is an eco-friendly method that helps in decontaminating the waste water economically. [9,10]

### 2.1. Statement problem

"A study to assess the effectiveness of structured teaching program on knowledge regarding reverse osmosis (R.O) waste water utilization among general public in urban areas

of selected district in Indore, MP"

## 3. Objectives

1. To assess the pretest knowledge regarding reverse osmosis (R.O) waste water utilization among general public.
2. To assess the posttest knowledge regarding reverse osmosis waste water utilization among general public.
3. To evaluate the effectiveness of structured teaching program on reverse osmosis (R.O) waste water utilization among general public.

### 3.1. Hypothesis

1. H0- (null hypothesis) – there will be no significant mean score between the pretest and posttest knowledge score.
2. H1- there will be significant difference between pretest and posttest knowledge score regarding the utilization of waste R.O water.

### 3.2. Operational definition

1. *Assess:* To evaluate or estimate the nature, ability or quality of something. In this assess is to evaluate the knowledge regarding the reverse osmosis waste water utilization.
2. *Effectiveness:* is the result that is obtained after the delivery of the structured teaching program.
3. *Structured teaching program:* it is the method of teaching used to deliver knowledge to the individual so as to gain information about something.
4. *Knowledge:* it refers to the level of understanding and retaining the information.
5. *Reverse osmosis:* A process by which a solvent passes through a porous membrane in the direction opposite to that for natural osmosis when subjected to a hydrostatic pressure greater than the osmotic pressure.
6. *R.O waste water:* The water discharged from the R.O chamber which does not meet the parameters standard for drinking water.

## 4. Review of Literature

The Review of the study is proposed under these headings:

1. Studies related to knowledge regarding reverse osmosis and its impact on health.
2. Studies related to awareness about reverse osmosis waste water generated from the R.O treatment system/ plant.

## 5. Materials and Methods

### 5.1. Research approach

Research approach is a systematic, objective method of discovery with empirical evidence constant and varying only the phenomenon under the study, in this an Experimental research approach was used.

### 5.2. Research design

Pre-experimental one group pre and post test design.

| X1 | 0 | X2 |
|---|---|---|
| PRE TEST | STP | POST TEST |

It determines the effectiveness of structured teaching program on knowledge regarding reverse osmosis (R.O) waste water utilization among general public in urban areas of selected district in Indore, MP". The schematic representation of study Methodology is presented in the Table 1.

### 5.3. Variables

Variables are properties or characteristics of person, thing or situation that change or vary. "A variable is as the name implies something is an attribute of a person or object that varies i.e. It take on different values.

1. *Independent Variables:-* "In the present study the independent variable was Struct.
2. *Dependent Variables:-* "Dependent variables are the condition or a characteristic that appears, disappears or change as the experimenter introduces removes, or change independent variables." The present the dependent variable is knowledge and attitude of parents of children of 0-5 years regarding prevention and management of malnutrition.

## 6. Setting of the Study

Study done at village pipalda urban areas of Indore, Madhya Pradesh was selected.

1. *Population:-* In this study it refers to the urban population of urban areas of Indore District.
2. *Target Population:-* Population for present study is the urban population those who are using R.O water for drinking purpose.
   Accessible population for present study is urban population those who are using R.O water for drinking purpose, Indore District.
3. *Sample:-* In this study the sample consisted of urban population who use the R.O filter water for drinking purpose.

4. *Sample Size:-* The sample size of present study will be – 60 samples.
5. *Sampling Techniques:-.* Simple random sampling technique, was used to select the sample.

## 6.1. Sampling criteria

### 6.1.1. Inclusion criteria

According to Tabak & Elliner "Inclusion criteria for a meta-analysis of urban population education studies regarding reverse osmosis waste water utilization among the general public in urban areas of selected in the district of Indore" Urban population who are willing to participate in the study. Urban population who are available at the time of data collection.

### 6.1.2. Exclusion criteria

1. Age:- {Children, Father, Mother},
2. Gender,
3. Education:- {Children, Father, Mother},
4. Occupation:- {Father, Mother},
5. Religion
6. Family Income, Number of family member,
7. Previous knowledge about reverse osmosis.
8. Urban population who are not willing to participate in the study.
9. Urban population who are not available at the time of data collection.

## 7. Description of Tool

The investigator developed a self-structured questionnaire and attitude check list which contained items under the following section:

1. *Section A:* Socio-demographic data: This section consisted of Age, Gender, Educational qualification, Occupation, Number of family members, previous knowledge on R.O water.
2. *Section B:* Assessment of knowledge through self-structured knowledge questionnaire regarding reverse osmosis (R.O) waste water utilization among general public in urban areas. This section consisted of 20 questions regarding reverse osmosis (R.O) and R.O waste water utilization. The items were developed as to cover the different areas. The total possible score was 20 with one correct response, score of 1 is given. The respondents were requested to tick (√) mark against the correct responses in the box.

Criterion Measures For Knowledge Questionnaire:- To assess the knowledge score it is classified in 3 levels of knowledge / range percentage/ correct answer contain 1 mark and incorrect answer contain 0 marks.

## 8. Result

### 8.1. Description of socio demographic variables in frequency and percentage

The obtained data on socio demographic profile are described under the following sub headings which include age, gender, marital status, education qualification, occupation, number of family members, and previous knowledge about reverse osmosis waste water utilization. The data was analyzed by using descriptive statistics and are summarized in terms of frequency and percentage distribution.

**Table 1:** Frequency and percentage distribution according to their age in years

| Characteristics | Category | Respondents | |
|---|---|---|---|
| | | Frequency | Percentage |
| | 21-25 | 15 | 25.0 |
| Age in years | 26-30 | 17 | 28.3 |
| | 31-35 | 18 | 30.0 |
| | >36 | 10 | 16.7 |
| Total | | 60 | 100 |

Table 1 depicts the classification on the basis of age in years. The findings regarding age group indicate that, the majority of population 18 (30%) were in the age group of 31-35 years, 17 (28.3%) were from 26-30 years of age group, 15 (25.0%) were in the group of 21-25 years, and remaining 10 (16.7%) in the age group of > 36 years.

**Table 2:** Frequency and percentage distribution of to their gender

| Characteristics | Category | Respondents | |
|---|---|---|---|
| | | Frequency | Percentage |
| Gender | Male | 43 | 71.7 |
| | Female | 17 | 28.3 |
| Total | | 60 | 100 |

Table 2 depicts the classification on the basis of gender. With regard to gender, it is observed that majority of the population 71.7% (43 out of 60) were male and remaining 28.3% (17 out of 60) were female.

**Table 3:** Frequency and percentage distribution based on educational qualification

| Characteristics | Category | Respondents | |
|---|---|---|---|
| | | Frequency | Percentage |
| Educational Qualification | Higher secondary education | 10 | 16.8 |
| | Secondary | 13 | 21.6 |
| | Undergraduate | 25 | 41.6 |
| | Post graduate | 12 | 20.0 |
| Total | | 60 | 100 |

Table 3 depicts the classification on the basis of Educational Qualification. With regard to educational

qualifications, it was observed that majority of the population 41.6% (25 out of 60) had completed under graduation, 12 (20.0%) of them had completed post-graduation, 13 (21.6 %) of them had completed Secondary and remaining 10 (16.8%) of respondents had completed higher secondary education.

**Table 4:** Frequency and percentage distribution based on occupation

| Characteristics | Category | Respondents | |
| | | Frequency | Percentage |
|---|---|---|---|
| | Private job | 22 | 36.7 |
| Educational | Government job | 28 | 46.7 |
| Qualification | Self employed | 5 | 8.3 |
| | Others | 5 | 8.3 |
| Total | | 60 | 100 |

Table 4 depicts the classification on the basis of Occupation. With regard to occupation of people, it was observed that majority of the population 46.7% (28 out of 60) were working in government sector, 22 (36.7%) were working in Private sector, 5 (8.3%) were Self-employed and remaining 5 (8.3%) of respondents belonged to other occupations.

**Table 5:** Frequency and percentage distribution based on number of family members

| Characteristics | Category | Respondents | |
| | | Frequency | Percentage |
|---|---|---|---|
| Number of family members | 1-2 | 33 | 55.0 |
| | 3-4 | 15 | 25.0 |
| Respondents | 5-6 | 8 | 13.3 |
| | More than 7 | 4 | 6.7 |
| Total | | 60 | 100 |

Table 5 depicts the classification on the basis of number of family members in the family. With regard to number of family members, it was observed that majority of the Population 55.0% (33 out of 60) belong to fist category (1-2) members, 15 (25.0%) of them belong to second category (3-4) members, 8 (13.3%) belong to third category (5-6) members and remaining 4 (6.7%) of respondents belong to fourth category (more than 7) members.

**Table 6:** Frequency and percentage distribution according to previous information regarding reverse osmosis and utilization of waste water

| Characteristics | Category | Respondents | |
| | | Frequency | Percentage |
|---|---|---|---|
| Have you ever been given knowledge on R.O filter water? | Yes | 10 | 16.7 |
| | No | 50 | 83.3 |
| Total | | 60 | 100 |

Table 6 depicts the classification of respondents on the basis of previous information regarding reverse osmosis (R.O) waste water utilization among general public. In regard to previous information regarding reverse osmosis (R.O) waste water utilization, majority 83.3% (50 out of 60) had no previous knowledge and only 16.7% (10 out of 60) had some previous knowledge regarding reverse osmosis (R.O) waste water utilization.

This section deals with the findings related to overall and aspect wise pretest knowledge scores regarding reverse osmosis (R.O) waste water utilization.

**Table 7:** Classification of respondents based on overall pretest knowledge scores on reverse osmosis (R.O) waste water utilization

| Knowledge level | Category | Respondent | |
| | | Number | Percentage |
|---|---|---|---|
| Poor | 01 – 10 | 44 | 73.3 |
| Average | 11 – 20 | 15 | 25.0 |
| Good | 21 – 25 | 1 | 1.7 |
| Total | | 60 | 100 |

The data presented in the above table shows the classification of women with regard to their pretest knowledge level regarding reverse osmosis (R.O) waste water utilization. It was observed that majority of the samples 44(73%) had inadequate knowledge, 15(25%) had moderately adequate knowledge. Only 1.7% (1 out of 60) of them had adequate knowledge regarding reverse osmosis (R.O) waste water utilization in the pretest.

The data presented in the above table shows the aspect wise mean pre- test knowledge scores of general public on reverse osmosis (R.O) waste water utilization. It is evidenced that the subjects have high knowledge scores on the aspect of General information regarding of general public on reverse osmosis (R.O) waste water utilization and its function with a mean percentage score of 56.83% with a standard deviation of 21.35%. It was further followed by the aspect about reverse osmosis (R.O) and usable water with the mean percentage score of 42.61% and a standard deviation of 20.79%, and in the aspect of R.O waste water and its management with a mean percentage score of 38.43% and a standard deviation of 11.22%.

Aspect wise pretest and post test knowledge scores on reverse osmosis waste water utilization.

The data depicted in the above table shows the aspect wise comparison of pretest and post test mean knowledge scores of general public on reverse osmosis R.O waste water utilization, a paired' test was done on each aspect.

General information of general public on reverse osmosis (R.O) waste water utilization and its function was 90.16 %. Regarding reverse osmosis (R.O) and usable water the mean post test knowledge score was 89.76%. The mean Post test knowledge score related to R.O Waste

**Table 8:** Aspect wise analysis of mean pretest knowledge scores of general public on reverse osmosis (R.O) waste water utilization.

| Sl. No. | Knowledge aspect | Items | Max score | Knowledge score | | | |
|---|---|---|---|---|---|---|---|
| | | | | Mean | SD | Mean % | SD % |
| I | General information regarding reverse osmosis | 6 | 6 | 5.68 | 2.14 | 56.83 | 21.35 |
| II | About reverse osmosis and usable water | 14 | 14 | 2.98 | 1.46 | 42.6 | 20.79 |
| III | Waste water and its management | 5 | 5 | 6.53 | 1.91 | 38.43 | 11.22 |
| | Combined | 25 | 25 | 15.2 | 4.14 | 44.70 | 12.16 |

**Table 9:** Aspect wise pretestand post test knowledge scores on reverse osmosis waste water utilization.

| S.No. | Knowledge Aspects | Respondents Knowledge (%) | | | | | | Paired 't' test |
|---|---|---|---|---|---|---|---|---|
| | | Pre test | | Post test | | Enhancement | | |
| | General information regarding reverse osmosis | Mean | SD | Mean | SD | Mean | SD | 9.851* |
| | | 56.83 | 21.35 | 90.16 | 13.59 | 33 | 26 | |
| | About reverse osmosis and usable water | 42.61 | 20.79 | 89.76 | 16.654 | 47 | 27 | 21.183* |
| | Waste water and its management | 38.43 | 11.22 | 88.6 | 9.85 | 50 | 14 | 28.166* |
| | Combined | 44.7 | 12.16 | 89.3 | 9 | 44.6 | 8.57 | 22.34* |

\* Significant at 0.05 level of significance t (0.05, 59df) =1.96

water and its management was 88.6%. Mean Percentage wise Post test knowledge shows that the respondents had adequate knowledge in all aspect regarding R.O waste water utilization. General information regarding reverse osmosis waste water utilization and its function, the obtained 't' value is 9.851 and it is found to be significant at 0.05 level of significance ( t=0.05, 59df =1.96).

In the area of R.O and waste water utilization, obtained 't' value is 21.183 which is also significant at 0.05 level of significance (t =0.05, 59df =1.96).

Regarding reverse osmosis (R.O) and usable water 't' value is 28.166 which is also significant at 0.05 level of significance (t =0.05, 59df =1.96).

For the mean post test knowledge score regarding reverse osmosis (R.O) and usable water was 88.6%. Mean Percentage wise Post test knowledge shows that the respondents had adequate knowledge in all aspect regarding reverse osmosis R.O waste water utilization.

From this, it is evident that self-structured teaching program was effective in enhancing the knowledge of general public in all areas of investigations.

In the present study, the comparison of overall pretest and posttest knowledge scores of general public regarding R.O waste water utilization showed an enhancement Mean of 15.17 with Standard deviation ±2.91. The observed Mean percentage enhancement score is found to be 44.61 with Standard deviation ±8.57. When a paired 't' test was done

the obtained 't' value was 22.34 (t59df = 1.96) at 0.05 level of significance, from this it can be inferred that the self-structured teaching program is effective in enhancing the knowledge of the general public. The findings of study was supported by the study conducted by Nwozichi CU, Ojewole FO et al. which stated that the mean pretest knowledge score was 16.03 with and SD of 2.951 and 59 the mean post-test knowledge score was 28.22 with SD of 3.273 proving that the SIM was very effective. 48 94.

## 9. Conclusion

Regarding age group the findings indicate that, the majority of general public the majority of population 18 (30%) were in the age group of 31-35 years, 17 (28.3%) were from 26-30 years of age group, 15 (25.0%) were in the group of 21-25 years, and remaining 10 (16.7%) in the age group of > 36 years.

In regard to gender, regard to gender, it is observed that majority of the populationv 71.7% (43 out of 60) were male and remaining 28.3% (17 out of 60) were female.

In regard to educational qualifications, it was observed that majority of the populationv 41.6% (25 out of 60) had completed under graduation, 12 (20.0%) of them had completed post-graduation, 13 (21.6 %) of them had completed $10^{th}$ and remaining 10 (16.8%) of respondents had completed higher secondary education.

In regard to occupation of people, it was observed that majority of the populationv 46.7% (28 out of 60) were working in government sector, 22 (36.7%) were working in Private sector, 5 (8.3%) were Self-employed and remaining 5 (8.3%) of respondents belonged to other occupations.

With regard to number of family members, it was observed that majority of thev Population 55.0% (33 out of 60) belong to fist category (1-2) members, 15 (25.0%) of them belong to second category (3-4) members, 8 (13.3%) belong to third category (5-6) members and remaining 4 (6.7%) of respondents belong to fourth category (more than 7) members.

On the basis of previous information regarding reverse osmosis (R.O) waste water utilization among general public. In regard to previous information regarding reverse osmosis (R.O) waste water utilization, majority 83.3% (50 out of 60) had no previous knowledge and only 16.7% (10 out of 60) had some previous knowledge regarding reverse osmosis (R.O) waste water utilization.

In the present study, it is observed that the mean pretest knowledge scores of generalv public regarding R.O waste water utilization is inadequate. Among the respondents it was observed that majority of the samples 44 (73%) had inadequate knowledge, 15(25%) had moderately adequate knowledge. Only 01.7% (1 out of 60) of them had adequate knowledge regarding R.O waste water utilization in the pretest. In the present study, it is observed that in the posttest 54 subjects (90%) has adequate knowledge, 6 (10%) had moderately adequate knowledge and none of the subjects had inadequate knowledge on R.O waste water utilization. In the present study, the comparison of overall pretest and posttest knowledge scoresv of general public regarding R.O waste water utilization showed an enhancement Mean of 15.17 with Standard deviation ±2.91. The observed Mean percentage enhancement 62 score is found to be 44.61 with Standard deviation ±8.57. When a paired 't' test was done the obtained 't' value was 22.34 (t59df = 1.96) at 0.05 level of significance, from this it can be inferred that the self-structured teaching program is effective in enhancing the knowledge of the general public.

## 10. Source of Funding

None.

## 11. Conflict of Interest

None.

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