Water usage pattern in the aftermath of COVID-19

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ABSTRACT

Maintenance of good health and avoiding a viral infection is the prime focus for an individual during COVID-19 pandemic. Water being a universal solvent is used widely to clean the disinfectants in public places and individual household level. This study was designed to find any change in the water consumption pattern among the households after the emergence of COVID-19. To study this, a questionnaire was prepared and sent to the respondents through Google Forms. Collected data was analysed using suitable statistical methods and the results indicate that there was a significant change in the consumption pattern of drinking water from cold to hot (37.98%) among the respondents and also with respect to the total water usage. As the disease is communicable in nature, more water is needed to clean and disinfect the surface areas, washing hands etc. This eventually has a significant burden on the water resources in countries where water is already deficient, like India. It is recommended to adopt water conservation practices/technologies at the individual level by means of rain water harvesting techniques or use of efficient water aerator taps etc. to reduce water consumption.

Introduction

Water, an elixir of life (Mythrey *et al.,* 2012; Bhutiani *et al.,* 2021) without which life on this planet is impossible. It is an essential element for survival (Popkin and Rosenberg, 2011; Wolf *et al.,* 2010; Bhutiani and Ahamad, 2018; Tyagi *et al.,* 2020) of any living being on this planet. People can stay for couple of days without having food (Krecar *et al.,* 2014) but not without sipping water. From the available freshwater, about 70 % of the water is used for agriculture, 23 % for industry and the remaining for domestic usage (de Sherbinin *et al.,* 2007). Domestic consumption of water includes mostly drinking, cooking, washing clothes, surface cleaning and sanitisation etc. Domestic consumption pattern of water varies from country to country. The total fresh surface water withdrawals are more in countries like China followed by India and USA (FAO, 2021). Similarly, within the Nation, the consumption of water varies depending on the availability of water, settlements like Urban or Rural etc. Several factors influence domestic consumption of water like climate, family size, gender, age, education, culture, food habits, urbanization etc. (March *et al.,* 2015; Shaban and Sharma, 2007). As per the Ministry of Housing and Urban Affairs, 135 litres per capita per day (lpcd) is the benchmark for urban and 55 lpcd for rural water supply for domestic usage in India (PIB Delhi. 02 MAR 2020). The use of water appropriately will fetch considerable benefits viz., drinking hot water has more benefits than drinking cold water (Zawn Villines, October 12, 2017; Patel *et al.,* 2015). Hot water consumption helps in reduction in infection level among the general public (Patel *et al.,* 2015). Hydrothermal therapy or Hydrotherapy or hot-cold therapy, wherein water in different forms can be used for the treatment of various diseases. For instance, steam water inhalation provides enormous health benefits in curing different diseases (Galvez *et al.,* 2018; Mooventhan and Nivethitha, 2014). The use of heat in the form of steam inhalations,

hot springs, saunas, steam rooms etc. helps in enhancing the overall health and wellbeing of an individual (Cohen, 2020). It was rumoured that the Chinese used steam water inhalation technique to get rid of COVID-19. As this information spreads through social media, many Indians started practicing it.

"Drinking clean water, maintaining hygienic conditions, proper sanitation and disinfection are essential to prevent most of the transferable diseases including COVID-19. Government recommended several guidelines about safe water consumption and multi modal strategies for avoiding contact with COVID-19 virus like washing hands frequently, cleaning the surface areas and maintaining proper sanitation measures" (WHO, 29 July 2020). Till now, the consumption of water is increasing due to increase in population but now there is one more reason to use more water i.e., preventing the spread of the Novel Coronavirus through cleaning the surface areas, washing hands etc. Keeping these in mind, the study designed to examine the change in consumption pattern of water among the individuals after COVID-19.

Material and Methods

This study aims to investigate the water consumption pattern among Indian households after COVID-19 using a cross-sectional survey. A questionnaire was framed in English and sent to social media platforms through a link generated using 'Google Forms'. The link was first sent to the close-knit groups and asked them to forward in their friends' group or WhatsApp circle. The Google Forms consist of an inventory of questions related to demographic and water utilisation pattern about the households. The queries related to the water utilisation pattern of the respondents was designed using dichotomous answers like yes or no (Table1; Except Query 1). The study employed a snowball sampling method to collect information from the respondents. The survey started on 4th June 2020 and ends on 7th July 2020. After removing the incomplete and random responses, a total of 848 valid responses were selected for analysis.

Table 1: Water related questions included in the questionnaire (After COVID-19 indicates emergence of COVID-19 in India)

Query 1	What is the source of your drinking water?
Query 2	Do you have access to clean drinking water?
Query 3	Are you drinking hot water or cold water?
Query 4	If you started drinking hot water, is this change due to COVID-19?
Query 5	Do you have the habit of drinking more water after COVID-19?
Query 6	Are you washing your hands more frequently after COVID-19?
Query 7	Do you clean products bought from outside (Milk packets etc.,) with water after COVID-19?
Query 8	Do you take a bath as soon as you come to the house from outside (after COVID-19)?
Query 9	Are you practicing hydro-thermal therapy (hot water steam) after COVID-19?
Query 10	Are you consuming more water to clean your hands/disinfect your house/washing clothes/bathing after COVID-19?

The Hypothesis of the study

Hypothesis 1 (H1a): Water drinking habits (More water drinking/ Hot water drinking/Access to clean water) positively improved after wake of COVID-19.

Hypothesis 2 (H2a)

External consumption of water (Clean hands/Disinfect your house/Washing clothes/Hydrothermal therapy) increased after wake of COVID-19.

Analytical methods

Statistical techniques like descriptive statistics, Z-test, Wilcoxon signed rank test and Random Forest, were used to analyse the data. Z- test is used to test improvement in the proportionate response of individuals about water issues by considering H0: There is no change in proportionate response ($\hat{p} = 0.5$) of individuals towards water consumption. Non parametric Wilcoxon signed-rank test is used to compare the changes in drinking

habit after Covid-19 from cold to hot water. H0: No change in median difference between before to after response vs. Ha: the median difference between before response to after response is positive. Random forest is one of the machine learning techniques to choose the variables based on explanatory variables contribution to an outcome (Best *et al.,* 2020; Janitza *et al.,* 2018). Node purity is one of the measures of importance to select variables and is calculated based on the reduction in the sum of squared errors whenever a variable is considered to divide the tree. In this study, the random forest technique was used to identify the contribution of demographic variables and water queries to change in awareness among the respondents about water usage.

Results and Discussion
Demographic profile of the respondents
The analysis of the demographic information revealed that out of total 848 respondents, 36.91 % of the respondents constitute females and the remaining were males (62.97%). The majority of the respondents belong to the age group of up to 45 years (88.68%). In terms of education, as much as 98.23 % had a minimum graduation level of education. More than half of the respondents in the sample constitute bachelors (54.36%), more than half of the respondents (69.2%) had a monthly average income of Rupees less than 50 thousand.

Water usage pattern
The source of drinking water varies among the households, 38 % of the respondents depend on municipal water supply, 29.6% on borewell, 17.70% on open well and remaining on other sources of water (Figure 1). With respect to water consumption pattern among the respondents, it was found that 37.98 % of the respondents started drinking hot water after COVID-19 despite of access to fresh available drinking water (93.27%). It was further found that there was a significant difference in the drinking habit of the respondents from cold to hot water as per the Wilcoxon signed-rank test (p-value <0.01) (Fig 1B). Drinking hot water here refers to normal consumption of drinking and not pertain to drinking tea or boiling the water to kill the pathogens. More than 50 % of the respondents started drinking more water after spread of COVID-19 and about 99 % of the respondents were using more water for their daily needs viz., washing milk packets, washing hands more frequently, etc. (Figure 1). Similarly, Z-proportionate test (Table 2) also indicates significant changes in internal and external usage of water at 5 % level of significance. Whereas, the habit of drinking more water (-13.29**) and Hydro-thermal therapy after COVID-19 (-28.02**) were showing negative significance due to less positive responses.
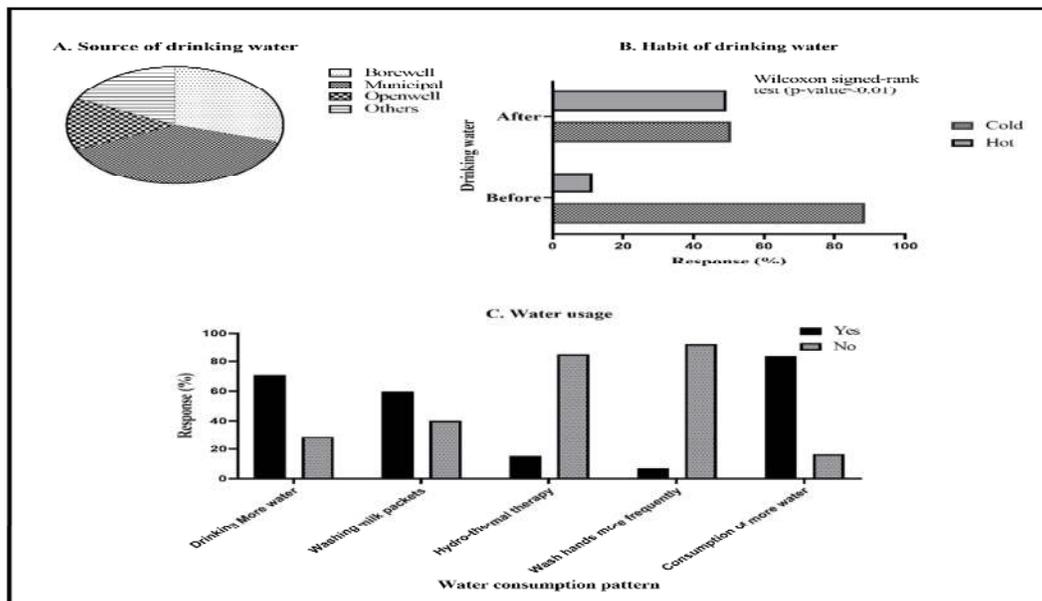

Figure 1: Source and usage pattern of water among the respondents after COVID-19.

Table 2: Changes in water usage pattern after COVID-19.

Water usage	Items	Positive responses	Z score
Internal	a. Access to clean drinking water	791	50.33**
	b. Drinking hot water	525	7.14**
	c. Habit of drinking more water	248	-13.29**
External	a. Washing hands more frequently	788	48.75**
	b. Cleaning food products bought from outside (Milk Packets, etc.)	507	5.81**
	c. Bathing	606	13.84**
	d. Hydro-thermal therapy	130	-28.02**
	e. Consuming more water (overall)	709	26.44**

Based on the water consumption pattern of the households, total water usage level was found out using the total score. Total score is obtained by adding the total score of each attribute measured in the table 2. Thus, the total score indicates the awareness level among the respondents towards the benefits of using water. In the present study, quartile method was used to divide the total score into three parts viz., low (<4), medium (4-6) and high (>6). It was found that 73.94 % of the respondents had moderate level of water usage followed by low (15.10 %) and high (10.96%) (Table 3).

Table 3: Level of water usage by the respondents.

Level of water usage	Score	Frequency	Percentage
Low (<1st quartile)	<4	128	15.10
Medium (1st quartile - 2nd quartile)	4-6	627	73.94
High (3rd quartile)	>6	93	10.96

Personal and social factors will influence the individual awareness level of water consumption and to identify the most influencing factors, we used a Random Forest technique. The relative importance of each factor on water score using IncNode purity values obtained from random forest technique was given in Figure 2A. Respondents monthly income of the family (84.61), age (75.40), child in family (67.50), and education (61.50) were the most influencing factors contributing to the total score. Out of nine queries selected for total score, Figure 2B explains variation of each query with respect to total score. In the present study, consuming more water (overall) (403.44), washing hands more frequently (385.62), taking bath as soon as an individual comes to the house from outside (281.30) and cleaning food products bought from outside (246.86) were shown more weightage to the total score. This indicates that the respondent was given more importance to practicing external consumption of water compared to internal consumption like drinking hot water and consuming more water.

The study also looks into the total water usage of the household and the data collected indicates 83 % of the respondents were using more water after COVID-19 for their daily needs. This includes repeated hand washing, bathing, washing products etc. The average domestic consumption of water was increased more than 210 litres per capita per day (lpcd) in this study as compared to the standard norms of 135 lpcd prescribed by the Central Public Health and Environmental Engineering Organisation of India. This clearly indicates that the households are consuming more water than the normal after COVID-19 due to increased usage. If the people consume water at this rate, there will be an increase in demand for water in the near future. In reality, the availability of water is taking a decreasing trend in India as shown in Figure 3B.

The present study examined the water consumption pattern among the households after COVID-19. The study found that there was a significant difference in the drinking habit from cold to hot water among the respondents. This may be due to the fact that drinking hot water may reduce the symptoms of sore throat that is experienced after COVID-19 infection. Compared to internal consumption of water, like drinking hot water or drinking more water, the respondents gave more importance to external consumption like washing milk packets, taking bath etc. Even the respondents practicing drinking more water and hydro-thermal therapy
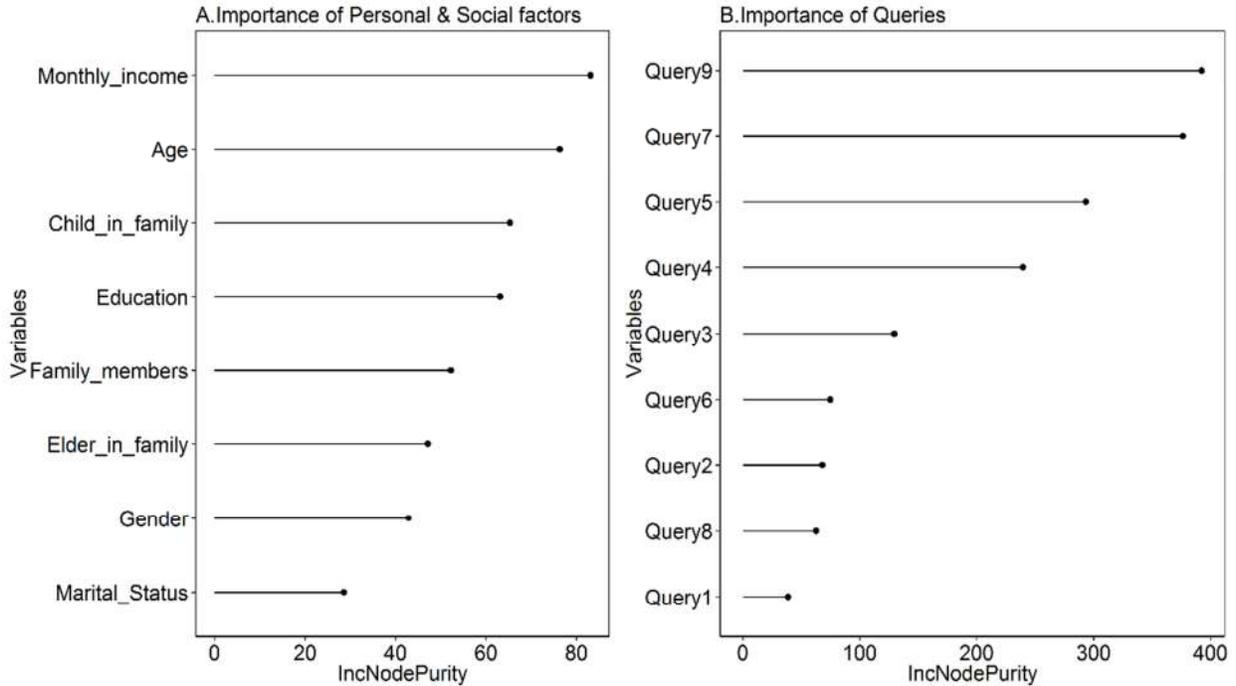
Figure 2: Importance of personal information and queries to total score using Random Forest.
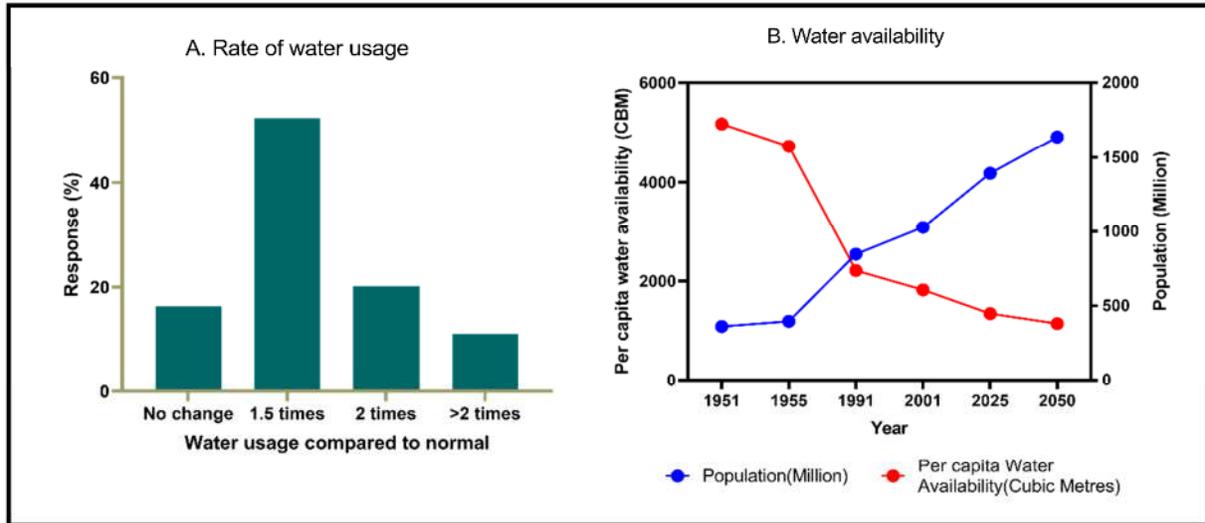

Figure 3: Present availability and domestic usage pattern of water in India. *Source (B): http://www.Indiastat.com.*

were very few despite the fact that the consumption of more water will remove most of the toxins from the body (Patel *et al.,* 2015) and hydro-thermal therapy may increase the chances of survival (Cohen, 2020; Evans *et al.,* 2016; Pilch *et al.,* 2013; Brenner *et al.,* 1999; Ernst *et al.,* 1990) once the individual gets infected with the virus. Though the studies on hydro-thermal or hot-cold water treatment were few and conducted on a limited sample size, the studies of this nature need to be conducted to fill the research gaps that exist with respect to the benefits of water by looking at both micro and macro level scenarios. It is of utmost important to create awareness among the general public to drink hot water and practice hydro-thermal therapy in order to overcome the effects of

viral infection. Age, education and increase in monthly income of the family were the most influencing factors in consuming more water. The findings of this study were associated with the earlier studies of Rathnayaka *et al*. (2017) and Yang *et al*. (2016). As the virus is transmittable in nature, in order to overcome the viral infection, one needs to use more water for washing, drinking, cleaning etc. The International Organisations like United Nations and WHO also recommends washing hands as one of the preventive measures to control COVID-19 pandemic.

Conclusion

This study delves into the domestic usage pattern of water among the households in India through a questionnaire survey and the results revealed that there is a significant change in the consumption pattern of water at the household level and the total consumption of water also increased after the emergence of COVID-19. Practice of drinking hot water and hydro-thermal therapy might reduce the chances of severe infestation of COVID-19. But the awareness about these practices among the households is limited. Hence, Government must ensure to create awareness in these aspects in order to reduce the infection. The study found that the external water usage was increased mainly for cleaning the surface areas and washing hands/sanitisation during COVID-19 pandemic. It is advised to practice water conservation techniques among the households like use of recycled water, practice of rain water harvesting, use of water aerated taps etc. Moreover, Government needs to plan about water demand and supply, as there is already a water deficit in most of the cities in India and ensure quality supply of water to the households, as the consumption of water is increased after the emergence of COVID-19.

Conflict of interest

The authors declare that they have no conflict of interest.

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