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Changes occurring in consumption habits of people during COVID-19 pandemic and the water footprint

Emine Elmaslar Özbaş[1] · Özcan Akın[2] · Sinan Güneysu[1] · H. Kurtuluş Özcan[1] · Atakan Öngen[1]

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Abstract

In this study, it has been aimed to determine the difference between water footprint values of individuals with different socio-economical levels, living in various cities, before and during COVID-19 pandemic period. For this purpose, a questionnaire study has been made and data obtained because of questionnaire have been processes in a water footprint calculation module. Data obtained from questionnaires have also been evaluated statistically in SPSS application. According to the findings obtained, while average water footprint before COVID-19 pandemic has been calculated as 4178.42 L/day, average water footprint during COVID-19 pandemic period has been calculated as 4606.18 L/day. It was determined that the percentage of participants whose water footprint increased during the COVID-19 pandemic period at all education levels was higher than other participants. When the water footprint values of the participants with an income level of 7000 TL and above were compared with the water footprint values of other income groups, it was observed that the water footprint values of the participants with an income of 7000 TL and above increased during the COVID-19 pandemic compared to before the COVID-19 pandemic. When the water footprint values of individuals according to age groups are examined, it has been determined that the water footprint values of individuals tend to increase in all age groups (except for the 51–60 age range) during the COVID-19 pandemic compared to before the COVID-19 pandemic. It has been seen that in the monthly clothing expenses and car washing numbers of participants, there was a tendency to decrease and that in their monthly kitchen expenditures there was a tendency to increase. Because of statistical evaluations, it was seen that there was a meaningful correlation between change in water footprint values and weekly shower numbers, weekly laundry washing numbers, and monthly kitchen expenses. Despite the increase in water consumption with many daily activities, it can be said that the average water footprint value did not increase much due to the decrease in clothing expenditures of the participants during the pandemic process, the change in car washing frequencies, and the fact that red meat consumption did not increase in general despite the increase in kitchen expenses.

Keywords Water footprint · Consumption habits · Pandemic · Statistical analysis

✉ Sinan Güneysu
guneysu@iuc.edu.tr

Extended author information available on the last page of the article

1 Introduction

In order to meet the nutritional needs of humans today and in the future while minimizing water consumption and a negative environmental impact, a number of strategies have been proposed (Foley et al., 2011; Mirzaie-Nodoushan et al., 2020). Water footprint (WF) is the measurement of total water amount we consume directly and indirectly during production and consumption processes of products and services we utilize. This concept was first recorded by Prof. Dr. Arjen Hoekstra working at UNESCO-IHE Water Education Institute in Holland in 2002 (Çapar, 2018).

The hidden connections between human consumption and water use may be illustrated by the WF indicator (Hoekstra, 2003; Mekonnen & Hoekstra, 2015). Humans' water usage recorded in time and space are provided by the WF (Ercin & Hoekstra, 2012; Gómez-Llanos et al., 2020; Hoekstra et al., 2011; Muratoglu, 2019, 2020).

In basic language, WF is a multidimensional indicator of water usage in terms of volume and pollution level. The primary difference to traditional forms of measurement is that, while traditional water indicators like abstraction or withdrawal tend to indicate water usage in gross volume, net water usage is revealed by the WF and the human activity that caused it is clearly connected to it, for example, growing a potato or washing a car. With WF, consumption refers to water that cannot be used for other purposes at a specific time and at a specific location and is thus 'lost' from the system, indicating water consumption in a time- and location-specific manner (Bazrafshan et al., 2020; Hogeboom, 2020). Thus, the WF is a measurement of the cumulative virtual water content necessary for humans (Aldayaet et al., 2012; Wang & Ge, 2020). WF of an individual, product, business of, or a country can be calculated (Mekonnen & Hoekstra, 2011, 2015).

Turkey's surface area is 779500 km^2 and the annual average precipitation volume is 450 billion m^3, and the annual total of consumable surface and underground water potential is 112 billion m^3. As a result of the projects developed by public institutions and organizations responsible for the development of the country's soil and water resources, annual water consumption for various purposes has reached 54 billion m^3 (48.2%). Of this water, 40.0 billion m^3 (74%) is used for irrigation, 7 billion m^3 (13%) for drinking use, and 7 billion m^3 (13%) for industrial water needs. For 2017, 39 billion m^3 (72.2%) of the consumed water is provided by surface water and 15 billion m^3 (27.8%) is provided by groundwater (MAF, 2019).

When Falkenmark Water Scarcity Index is reviewed, it is seen that Turkey is deemed a country faced with water stress. Besides, it is anticipated that with its population that will reach nearly to 100 million until year 2023 under "Water Stress", there will be water amount of 1120 m^3/year remaining per capita, meaning that it is predicted that in year 2050 Turkey will become a country experiencing "water scarcity" (TSKB, 2019). While WF per capita in Turkey was 1642 m^3/year as per the data relating with years of 1996–2005, this figure has been determined as 1977 m^3/year according to the data relating with years of 2006–2011 (Pegram et al., 2014). Nowadays, average WF per capita in Turkey has been determined as 4425 L/day (1422 m^3/person/year) (Hakyemez, 2020).

World has been informed about COVID-19 pandemic when China notified World Health Organization about emergence of a mysterious respiratory track disease, source of which was not known, in the city of Wuhan in the state of Hubei on 31th of December, 2019 (Sherestha, 2020).

First COVID-19 case detected in Turkey in relation to COVID-19 pandemic spreading throughout the world was announced by Ministry of Health on 10th of March 2020.

It has been announced that as of 1st of June, 2021, over 5.2 million people being infected with coronavirus in Turkey in total have lost their lives and that total number of cases was 201,098 (WHO, 2020). Until 1st of May, 2021, it has been limited for those below age of 20 and above age of 65 to go out on the streets. The main measure recommended by WHO to prevent transmission of COVID-19 is hand washing with soap and water (Tabish & Basch, 2020). Increasing hand washing and adherence to basic hygiene principles are expected to increase daily domestic water needs during the COVID-19 pandemic (Siddique et al., 2021). According to the United Nations Economic and Social Commission for West Asia (ESCWA, 2020), inland water demand is expected to increase by 4–5 million cubic meters per day for water-scarce Arab countries (ESCWA, 2020).

The COVID-19 pandemic has many negative consequences. Among these results is the sudden increase in the volume of plastic waste, especially due to products used for personal protection and health purposes (Klemes et al., 2020). On the other hand, Batlle-Bayer et al. (2020), it was stated that the blue WF increased compared to before the COVID-19 pandemic. Roidt et al. (2020), introduces that the WF of thermal power plants consumption in Europe decreased by 1.77 million m^3/day during the lockdowns according to past four years. In other words, after 15th March 2020 WF of Europe's thermal power plant operations decreased by 8.2%. During COVID-19 pandemic, staying indoors and working remotely can affect daily food habits (Muscogiuri & Barrea, 2020; Batlle-Bayer et al., 2020).

The restriction (quarantine) of people during the COVID-19 pandemic has created an extraordinary opportunity to minimize the pressure on global water resources. In many studies, the positive effect of quarantine on water resources (improvement of water quality) has been mentioned as a result of the cessation or reduction of human activities in water resources (Chowdhury et al., 2021; Nundy et al., 2021). In the study conducted by Rume and Islam (2020), the positive environmental effects of the COVID-19 pandemic are listed as reduction of air pollution and greenhouse gas emissions, reduction of water pollution, reduction of noise pollution and ecological restoration. In the same study, the negative environmental effects of the COVID-19 pandemic were listed as increased biomedical waste production, safety equipment use and haphazard disposal, municipal solid waste generation and reduction of recycling (Rume & Islam, 2020).

In the literature, no study has been found about the change of WF values of individuals during the COVID-19 pandemic compared to before the COVID-19 pandemic. In this study, it has been aimed to determine that impact of COVID-19 pandemic on the habits of individuals in daily lives and to determine the difference between WF values before and during COVID-19 pandemic because of this impact.

2 Materials and methods

In this study, data have been collected with a questionnaire study composed of 21 questions. Questionnaire study was performed in June 2020. Questions have been asked to individuals of different ages and income levels, living in various cities in Turkey, in order to determine the differences before COVID-19 pandemic and during COVID-19 pandemic. The study was carried out by selecting at least one province throughout Turkey to represent the seven geographical regions of Turkey (Fig. 1). One thousand people participated in the survey study. The total population of the cities (19 cities) where the respondents live is 42 million 271 thousand 175 people (TUIK, 2021). Answers given by individuals have



Fig. 1 Geographical regions of Turkey and cities where participants live

been processed in a WF calculation module (Hakyemez, 2020). In this way, WF values before pandemic and during pandemic have been separately calculated. Individuals have been grouped as 17–25, 26–30, 31–40, 41–50, 51–60, 61–75 according to their ages. As per income levels, grouping has been done in the form of 1000-2000TL, 2001–3000 TL, 3001–4000 TL, 4001–5000 TL, 5001–7000 TL and above 7000. Furthermore, WF values of individuals have been examined as per their education status. Questionnaire questions have been listed in Table 1.

Data obtained from questionnaire results have been statistically analyzed with IBM SPSS (Statistical Package for the Social Sciences) Statistics Data Editor Version 21. IBM SPSS Statistics is a statistical software that delivers a various features that lets analyze experimental data and better understand it in order to solve research problems. Before statistical evaluation, normality of study data was tested with Kolmogorov–Smirnov normality test. When the data did not show a normal distribution, nonparametric tests were used to compare the means of the two groups. The Wilcoxon Marked Rank Test was used to compare WF values before the COVID-19 pandemic and during the COVID-19 pandemic. The Mann–Whitney U test was used to compare the WF levels of men and women before and during the COVID-19 pandemic. The Spearman rank correlation coefficient was used to compare the change in the WF values of the participants before and during the COVID-19 pandemic and the change in the values related to their consumption habits. The Kruskal–Wallis Test was used to examine whether the WF changes according to education level, income level and age groups. One-Sample Wilcoxon Signed Rank Test was used to compare the WF average with the Turkey WF average during the pandemic.

3 Results and discussion

As the results of questionnaire questions were evaluated and the data being obtained were interpreted, the results obtained were presented in the form of tables and graphics.

In Table 2, average, minimum and maximum values of WFs of individuals participating in the study, before COVID-19 pandemic and during COVID-19 pandemic are given.

When Table 2 is examined, it is seen that the WF values of the participants increased during the COVID-19 pandemic. For the year of 2019, average WF per capita in Turkey

Table 1 Questions directed to the participants in the study for calculating the WF values of the individuals

Number	Question	Number	Question
1	How old are you?	12	How many times do you wash dishes per week?
2	Your gender	13	Do you manually wash your dishes in water before placing them in the machine?
3	Your education level	14	How long do you use kitchen faucets in one day?
4	Number of people living in your home	15	If you have a car, how many times do you wash it per month?
5	The city where you live	16	Your monthly kitchen expense
6	Your monthly income	17	How much is your weekly red meat consumption?
7	How many times do you take shower in a week?	18	How many cups of tea / coffee do you drink per day?
8	Your average shower time	19	With or without sugar?
9	How do you wash your laundry?	20	How many sugars do you use?
10	How many times do you wash your clothes per week?	21	Your monthly clothing expenses
11	How do you wash your dishes?		

Table 2 WF values of individuals who participated in the study before COVID-19 pandemic and during COVID-19 pandemic

WF (L/day)	Minimum	Maximum	Mean	Std. deviation
Before COVID-19 pandemic	704	11419	4178.42	2431.07
During COVID-19 pandemic	1073	14941	4606.18	2906.89

was determined as 4425 L/day (1422 m^3/person/year) (Hakyemez, 2020). It is seen that during COVID-19 pandemic this average value was exceeded. When the results of the survey were examined, it was seen that the highest WF value before the COVID-19 pandemic was 11,419 L/day, between the ages of 31–40, 5001–7000 TL income group, and a postgraduate education level woman. Again, it was determined that the lowest WF value before the COVID-19 pandemic period was 704 L/day, with a postgraduate education level woman in the income group of 3001–4000 TL between the ages of 26–30. Although the monthly clothing expenditure and weekly meat consumption of the person with the highest footprint were higher, it was observed that the individual with the lowest WF value did not consume meat and the clothing expenditure was lower than the individual with the highest footprint. During the COVID-19 pandemic, the highest WF value (14,941 L/day) among the individuals participating in the survey within the scope of this study belongs to a university graduate woman, between the ages of 31–40, in the 5001–7000 TL income group. The lowest WF (1073 L/day) detected within the scope of this study during the COVID-19 pandemic belongs to a postgraduate woman in the 26–30 age group with an income of 3001–4000 TL. It was observed that the individual with the lowest WF during the COVID-19 pandemic did not consume meat, similar to the results before the COVID-19 pandemic, and the monthly clothing expenditure was lower than the individual with the highest WF.

As it is seen that in Fig. 2, when the change in the WF values of the individuals participating in the study were examined regardless of their socioeconomic levels, age and gender, it is observed that WF values of 57.14% of individuals increased, WF values of 26.37% of individuals decreased, and WF values of 16.48% of individuals remained unchanged.

It was seen that 58.2% of the individuals participating in the study were women and 41.8% were men. 56% of the participants are university graduates, 19.8% of them are post-graduates, 16.5% are senior high school graduates, 4.4% of them are junior high

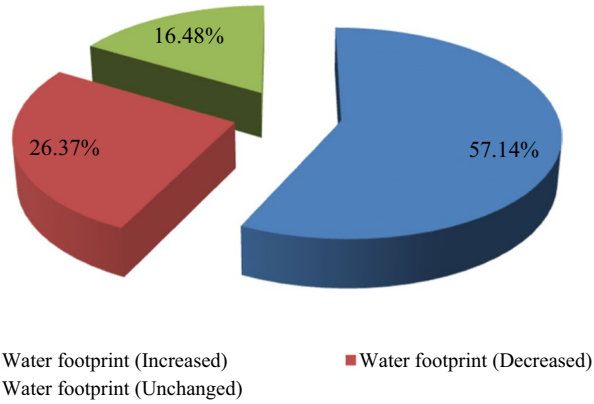


Fig. 2 Change in WF values of individuals during COVID-19 Pandemic when compared with the period before COVID-19 pandemic

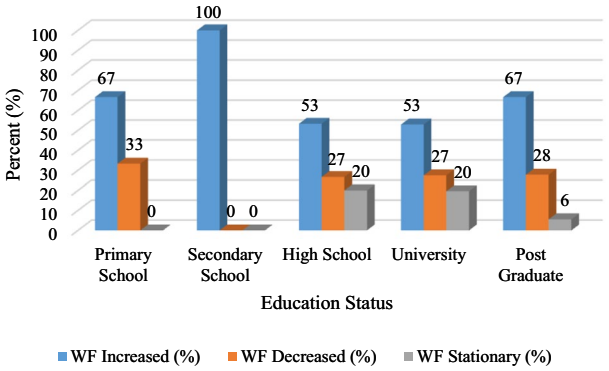


Fig. 3 Change in WF values of individuals during COVID-19 pandemic with respect to the period before COVID-19 pandemic depending on their education status

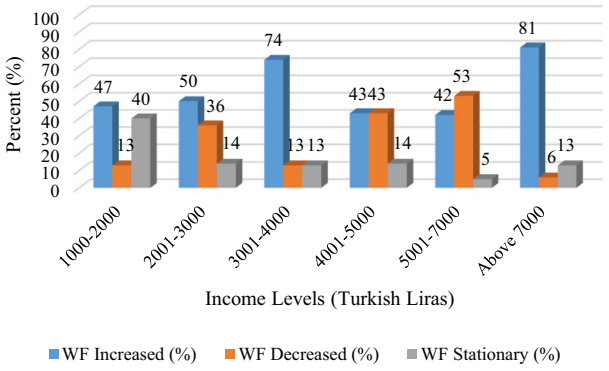


Fig. 4 Change in WF values of individuals during COVID-19 pandemic with respect to the period before COVID-19 pandemic depending on their Income levels

school graduates and 3.3% are primary school graduates. About 52.8% of the participants are under the age of 30 and 47.2% are over the age of 30.

Percentile change in WF values of individuals during COVID-19 pandemic with respect to the period before COVID-19 pandemic with respect to their education status is presented in Fig. 2. When Fig. 2 is examined, it is seen that for all education levels, percentages of participants whose WF values have increased during COVID-19 pandemic period were higher than percentages of participants whose WFs decreased or remained fixed. It is observed that WF values of all the junior high school graduate participants (100%) increased during COVID-19 pandemic period (Fig. 3). When the consumption habits of secondary school graduates are examined, it has been observed that the frequency of weekly showering, weekly laundry washing frequency, weekly dishwashing frequency of all secondary school graduates participating in the survey increased, and also the tea/coffee consumption and kitchen expenses of all of them increased during the COVID-19 period.

The change of WF values according to the income levels of the participants during the COVID-19 pandemic compared to before the COVID-19 pandemic is presented in Fig. 4. It was observed that the WF of 81% of individuals with a monthly income of 7000 TL and above increased compared to before the COVID-19 pandemic (Fig. 4). When the consumption habits of the survey participants whose income is over 7000 TL are examined, it has been seen that the weekly shower frequency and weekly laundry

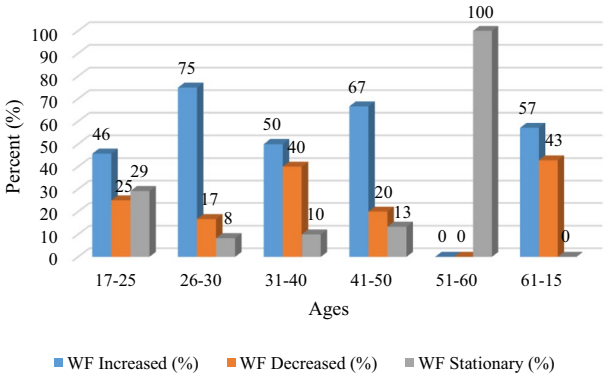


Fig. 5 Change in WF values of individuals during COVID-19 pandemic with respect to the period before COVID-19 pandemic depending on their ages

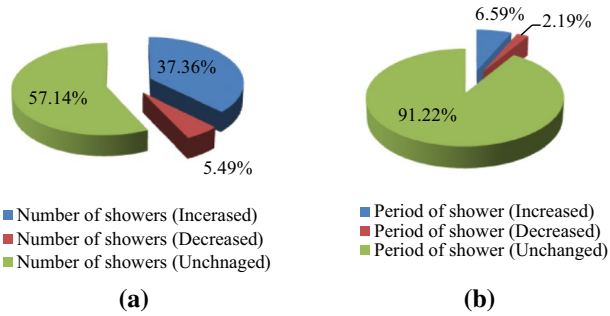


Fig. 6 Change in number of weekly showers **a** and period of shower **b** taken during COVID-19 pandemic with respect to the period before COVID-19 pandemic

frequency of these participants have increased in general, and their monthly kitchen expenses and daily tea/coffee consumption have also increased during the COVID-19 period.

Figure 5 shows the change in WF values before the COVID-19 pandemic during the COVID-19 pandemic, depending on the age groups of the participants. It is observed that the WF values of individuals generally tend to increase for all age groups except the age range 51–60. When the change in the WF values of the respondents according to the age groups was examined, it was observed that the WF values of 75% of the individuals aged 26–30 increased during the COVID-19 pandemic compared to before the COVID-19 pandemic (Fig. 5). It can be said that the increase in the number of showers taken weekly, the increase in the monthly kitchen expenses and the increase in the usage times of the kitchen faucets are the consumption habits that contribute to the increase in the WF during the COVID-19 pandemic in the 26–30 age group.

Within the scope of the study, during the pandemic, changes in the habits of individuals that contribute to the WF values in their daily lives were examined. In this context, the change in the number of showers taken in a week is given in Fig. 6a.

When Fig. 6a is examined, it is seen that number of showers taken in a week has increased for 37.36% of participants and that number of showers taken has not changed for 57.14% of participants. When period of shower taking was examined, it is seen that period of shower taking during COVID-19 has increased for only 6.59% of participants and that shower taking period of 2.19% of participants has shortened and shower taking

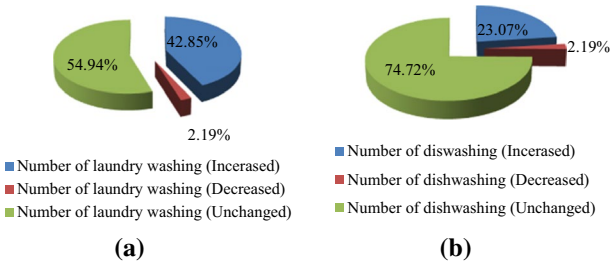


Fig. 7 Change in number of laundry washing **a** and dish washing **b** in a week by the participants during COVID-19 pandemic with respect to the period before COVID-19 pandemic

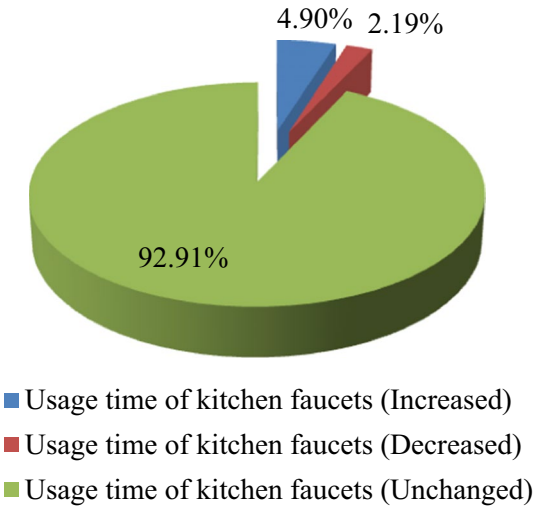


Fig. 8 Change in daily usage time of kitchen faucets by participants during COVID-19 pandemic with respect to the period before COVID-19 pandemic

period of 91.22% of participants has not changed during COVID-19 pandemic period with respect to the period prior to COVID-19 pandemic (Fig. 6b).

In Fig. 7a, it is seen that number of weekly laundry washing of 54.94% of participants did not change during pandemic period. Change in number of weekly dish washing of participants is given in Fig. 7b. It was observed that number of weekly dishwashing of 74.72% of the participants did not change during the pandemic. When the usage time of kitchen faucets during the day is examined, it was seen that usage of kitchen faucets during the day has remained unchanged for 92.91% of participants during COVID-19 pandemic when compared with the period before COVID-19 period (Fig. 8).

Monthly car washing numbers during COVID-19 pandemic with respect to the period before COVID-19 pandemic are presented in Fig. 9. When Fig. 8 is examined, it is seen that car washing numbers of 47.83% of participants having cars did not change during pandemic period.

In Fig. 10, change in monthly kitchen expenses of participants during pandemic is given. It is seen that during pandemic period, kitchen expenses of 46% of participants increased, while kitchen expenses of 46.15% of participants remained fixed (Fig. 10). Change in monthly meat consumptions of participants is given in Fig. 11. When Fig. 11 is examined, it is seen that monthly red meat consumption of 69.23% of participants did not change during pandemic period. Change in daily tea/coffee consumption of participants during pandemic period is given in Fig. 12. While it is seen that tea/

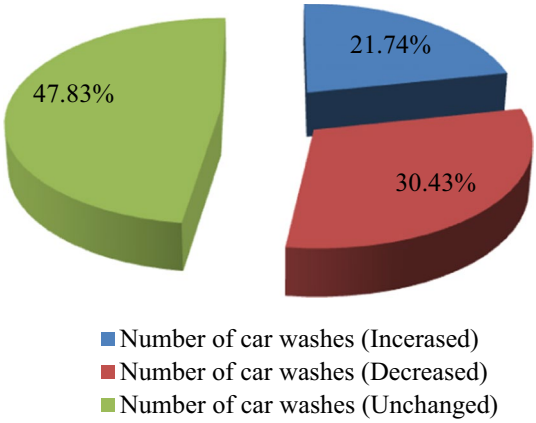


Fig. 9 Change in number of monthly car washes during COVID-19 pandemic with respect to the period before COVID-19 pandemic

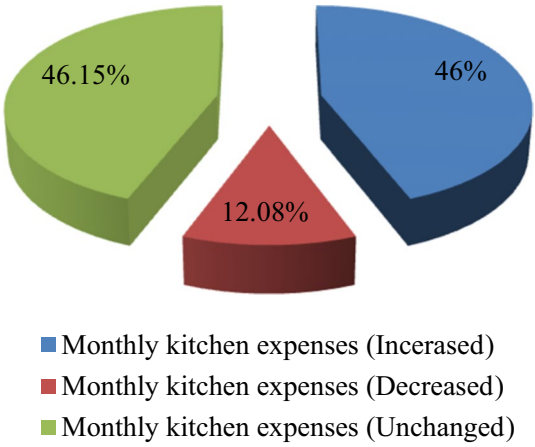


Fig. 10 Change in monthly kitchen expenses of participants during COVID-19 pandemic with respect to the period before COVID-19 pandemic

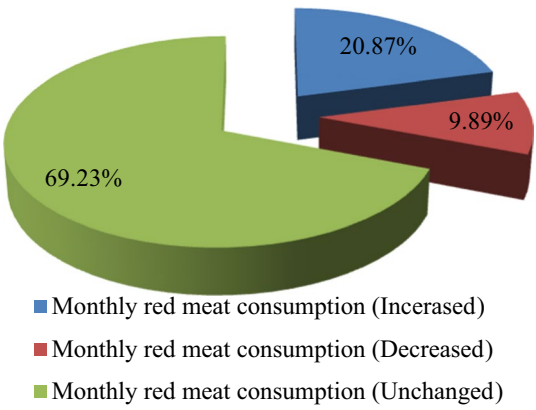


Fig. 11 Change in monthly red meat consumption of participants during COVID-19 pandemic with respect to the period before COVID-19 pandemic

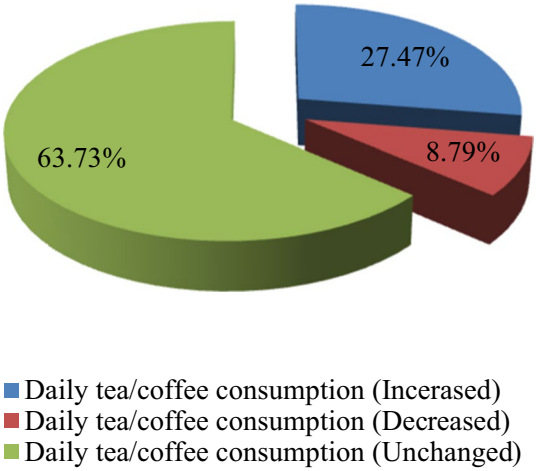


Fig. 12 Change in daily tea/coffee consumption of participants during COVID-19 pandemic with respect to the period before COVID-19 pandemic

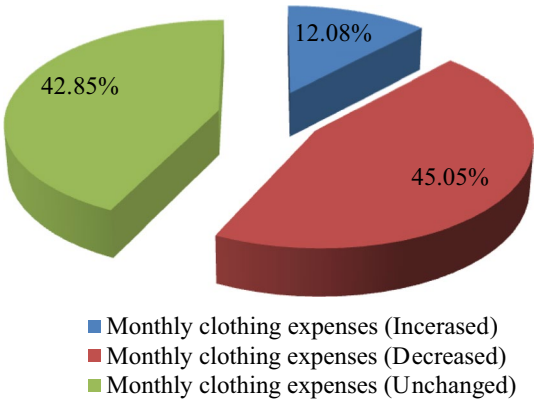


Fig. 13 Change in monthly clothing expenses of participants during COVID-19 pandemic with respect to the period before COVID-19 pandemic

coffee consumption of 63.73% of participants remained unchanged (Fig. 12). Change in monthly clothing expenditures of participants during pandemic period is given in Fig. 13. It is observed that monthly clothing expenditure of 45.05% of participants decreased (Fig. 13).

During the COVID-19 pandemic, it is thought that the frequency of showering and period of shower of people increased compared to before the COVID-19 pandemic, especially during the pandemic period, to pay attention to hygienic conditions in people who continue to work. It is thought that the increase in the frequency of dishwashing and monthly kitchen expenses during the COVID-19 pandemic compared to before the COVID-19 pandemic is due to both the increase in the time they spend at home due to the closure of schools and some workplaces, and the fact that people prefer to prepare and eat food at home due to hygiene. The reason for the decrease in monthly expenditure on clothing is thought to be due to the fact that people spend time at home due to pandemic conditions.

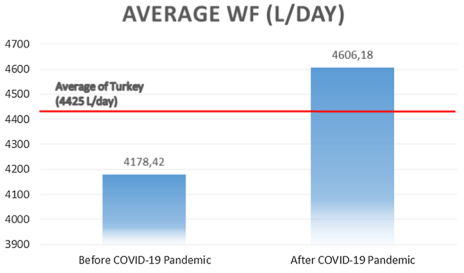
3.1 Statistical analysis results

Data obtained from the answers given by participants to questionnaire questions have been statistically analyzed with SPSS application.

The WF values before the COVID-19 pandemic and during the COVID-19 pandemic were compared, and it was seen that the WF values of the two periods were different. Accordingly, it was observed that water consumption increased during the COVID-19 pandemic ($p < 0.05$). However, average value of WF parameter for Turkey was 4425 L/day per capita. According to the test, it was seen that there was not a statistically meaningful difference between increase in WF of individuals participating in the questionnaire during COVID-19 pandemic and average value for Turkey ($p > 0.05$) (Fig. 14).

According to the results of Mann–Whitney U test performed to compare the WF levels of men and women before COVID-19 pandemic, no significant difference was observed between the group averages. ($p > 0.05$). A similar situation is seen in relation to WF levels during COVID-19 pandemic ($p > 0.05$). As a result of statistical evaluation being made, it was seen that there was not a statistically meaningful difference between women and men, as WF values before COVID-19 pandemic and during COVID-19 pandemic were examined (Fig. 15). When the average WF values of men and women given in Fig. 15a are examined, it is seen that the average WF values of women are higher than those of men both before the COVID-19 pandemic and during the COVID-19 pandemic. However, there is not a big difference between these values. When the answers given by the participants to the survey questions were examined, it was seen that the monthly clothing expenses of the female participants were generally higher than the men's. Therefore, it can be said that the average WF of women is slightly higher than the average WF of men.

Change in WF values of participants before and during COVID-19 pandemic and change in values relating with their consumption habits have been calculated and compared. Results are given in Table 3. When the relationship between the change of WF values before and during the COVID-19 pandemic and weekly shower numbers, weekly



(a)

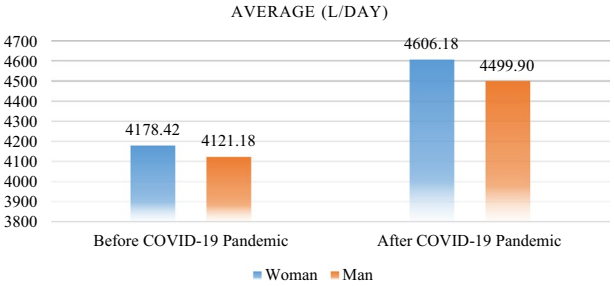
Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The median of WF Before COVID-19 equals 4.425.	One-Sample Wilcoxon Signed Rank Test	,054	Retain the null hypothesis.
2	The median of WF After COVID-19 equals 4.425.	One-Sample Wilcoxon Signed Rank Test	,315	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

(b)

Fig. 14 Change in the average WF value of the participants during the COVID-19 pandemic compared to the period before the COVID-19 pandemic (**a**) and comparison with the average value of Turkey (**b**)



(a)

Test Statistics[a]

	Water footprint before COVID-19	Water footprint after COVID-19
Mann-Whitney U	975,000	946,000
Wilcoxon W	1716,000	1687,000
Z	-,258	-,491
Asymp. Sig. (2-tailed)	,797	,623

a. Grouping Variable: Gender

(b)

Fig. 15 Comparison of the WF averages of the participants before and during the COVID-19 pandemic by gender (**a**) and group averages (**b**)

Table 3 Relationship of change in WF values of participants during COVID-19 pandemic with respect to the period before COVID-19 pandemic, with the consumption habits of participants

Consumption Habits	Spearman rank correlation coefficient ρ_s	p
Number of showers per week	0.302	0.004
Number of weekly laundry washes	0.472	0.000
Number of dish washes per week	0.153	0.147
Monthly kitchen expenses	0.533	0.000
Monthly clothing expenses	0.174	0.102
Daily tea/coffee consumption	0.242	0.021
Weekly red meat consumption	0.711	0.000
Kitchen faucet daily usage time	0.198	0.060
Period of shower	0.062	0.561

laundry washing numbers, and monthly kitchen expenses of the participants is examined, it was seen that it was statistically meaningful, coefficients were interpretable coefficients, there was a positive and medium level relationship between the variables according to the coefficients ($p < 0.05$).

When the change in WF values of participants before and during COVID-19 pandemic and changes in weekly dish washing numbers, usage time of kitchen faucets, shower periods and monthly clothing expenses are compared (Table 3), it was seen that it was not statistically meaningful and that the coefficient was not an interpretable coefficient ($p > 0.05$).

Change in WF values of participants before and during COVID-19 pandemic and change in daily tea/coffee consumption of participants are compared (Table 3), and it can be stated that it is statistically meaningful and that there is a negative and medium level relationship between the variables according to the coefficient ($p < 0.05$).

Change in WF values of participants before and during COVID-19 pandemic and change in the amounts of red meat consumption of participants have been calculated and compared (Table 3). It is statistically meaningful, and there is a positive and strong level relationship between variables as per the coefficient ($p < 0.05$).

According to Kruskal–Wallis Test, it is seen that the WF change does not differ with the age groups, the education level and the income level ($p > 0.05$) (Table 4).

4 Conclusions

If the water resources are not used in a sustainable way, the probability that we will be confronted with water scarcity in the coming years is quite high. WF is a measure of water amount we consume. It has been foreseen that due to COVID-19 pandemic, many people could have made changes in their daily life styles and in their activities causing for water consumption as relating with this and this study has been conducted with the aim to determine this particular. When the results obtained from this study were examined, it was seen that the duration of showers and the number of showers taken by the participants, the number of weekly washing dishes and the duration of usage of kitchen faucets during the day have not changed much during COVID-19 pandemic when compared with the period before COVID-19 pandemic. However, it was observed that number of monthly car washes of participants and their monthly clothing expenses revealed a tendency to decrease during pandemic period when compared with the period before COVID-19 pandemic. During pandemic period, it was observed that kitchen expenses of majority of participants have increased. As a result of statistical evaluation, it was seen that there was a meaningful correlation between the change in WF values of participants before and during COVID-19 pandemic and number of weekly showers, weekly number of laundry washing, and monthly kitchen expenditures. Between education level and change in WF values, a highly meaningful relationship has not been seen. A meaningful relationship was also not seen between economical income and change in WF values. Although it was observed that WF increased during COVID-19 pandemic, it can be stated that this increase is not much higher than average value for Turkey.

While the average WF values of the participants were below the average WF of Turkey (4425 L/day) before the COVID-19 pandemic (4178.42 L/day), this value was above the Turkey average during the COVID-19 pandemic (4606.18 L/day). Despite the fact that water consumption has increased in many items, the fact that the participants reduced their clothing expenditures during the pandemic process and changed the frequency of car washing prevented the average WF value from increasing too much. In addition, the fact that red meat consumption has not increased in general despite the increase in kitchen expenses can be interpreted as another parameter that prevents the increase in the average WF.

As a result of the statistical analyses, it was determined that the change in the WF values of the individuals participating in this study during the COVID-19 pandemic compared

Table 4 WF change according to Kruskal–Wallis Test results

Groups	*p*
Age	0.311
Education level	0.329
Income level	0.202

to before the COVID-19 pandemic does not depend on the age groups, education level, income level and gender of the individuals.

It is strongly recommended that countries conduct an environmental impact assessment to investigate how much environmental components have been affected by the COVID-19 pandemic. It is thought that this approach can help reduce the negative effects of future crises. It can be said that this study is a preliminary research on the effect of the COVID-19 pandemic on the WF on a country basis. It is thought that this study will be beneficial in terms of ensuring the sustainable use of water during the next possible pandemics. However, for this, water consumption values before and during the COVID-19 pandemic should be evaluated together with other studies that will examine the change.

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Authors and Affiliations

Emine Elmaslar Özbaş[1] · Özcan Akın[2] · Sinan Güneysu[1] · H. Kurtuluş Özcan[1] · Atakan Öngen[1]

Emine Elmaslar Özbaş
elmaslar@iuc.edu.tr

Özcan Akın
ozcanakin@duzce.edu.tr

H. Kurtuluş Özcan
hkozcan@iuc.edu.tr

Atakan Öngen
aongen@iuc.edu.tr

[1] Environmental Engineering Department, Engineering Faculty, Istanbul University-Cerrahpaşa, Avcilar, 34320 Istanbul, Turkey

[2] Department of Watershed Management, Faculty of Forestry, Düzce University, 81620 Düzce, Turkey