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ORIGINAL ARTICLE

Towards a sustainable use of shower water: Habits and explanatory factors in southern Spain

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Abstract

One of the targets of Sustainable Development Goal 6 is the efficient use of water resources in all sectors in order to tackle water shortages. In the home, showering is one of the main water consuming activities. How can people make more sustainable use of shower water? To answer this question, this research analyses showering habits and explanatory factors of shower use. The study is carried out with data from 945 students of the University of Granada, Spain. Significant differences are observed in shower use during the summer and winter months: the average duration is 8.8 and 11.6 min, respectively, and the frequency is greater in summer (with an average frequency of eight showers per week). Determinants of different shower water use include gender, ideology, pro-environmental actions, inherent values, and connectedness to nature, among others. Those variables relate differently to duration and frequency of showers, according to the season, thus highlighting the importance of seasonality. The results show that there is room to achieve a more sustainable use of the shower, in terms of frequency and duration, through awareness measures that are tailored to groups that make a less sustainable use of showers. The main recommendation is that awareness campaigns should be designed on the basis of the user profile as well as the season.

Keywords Water consumption · Showers · Pro-environmental actions · Water efficiency

Introduction

It is estimated that 53 countries have severe levels of water stress (United Nations 2018). In addition, around four billion people suffer from severe water scarcity for at least one month a year (Mekonnen and Hoekstra 2016). Due to climate change, the situation is expected to worsen, with already dry regions becoming even drier (United Nations 2019). Consequently, UN sustainable agenda (SDGs) sets a variety of targets to address water scarcity in several ways. Among the targets, SDG 6 aims to achieve a more efficient use of water resources in all sectors, whereas SDG 12 pursues a sustainable management and efficient use of natural resources, including water (United Nations 2015).

Looking at the different end-uses of residential water, there is significant potential for water savings in personal hygiene (Makki et al. 2013; Wong et al. 2019). Shower/bath end-use consumption often represents the highest share of indoor demand in residential households, accounting for between 25 to 40% of the total (Mazzoni et al. 2022). This has been shown in the case of Australia (Willis et al. 2013; Makki et al. 2015), the United States (Water Research Foundation 2016), the United Kingdom (Energy Saving Trust 2015), the Netherlands (Vewin 2012), Spain (Domene and Saurí 2006), Portugal (Vieira et al. 2018) and Brazil (Marinoski et al. 2014).

Regarding personal hygiene habits, showering is the most widespread practice. Using a representative sample of ten OECD countries, Grafton et al. (2011) found that 85% of respondents tended to take showers rather than baths. In the report on water consumption in English households by Pullinger et al. (2013), 50% of respondents reported never taking a bath, while only 17% reported never taking a shower. In just one generation, there has been a shift from weekly bathing to daily or twice-daily

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showering (Hand et al. 2005; Shove and Walker 2010). Although showering is generally seen as a more sustainable use of water resources, the adoption of daily showering as a regular practice may result in more water consumption than was originally consumed by (less than daily) bathing (Critchley and Phipps 2007). On average, the water consumed in two or three showers can be equivalent to that of one bath (United States Environmental Protection Agency 2017), although consumption could be higher in the case of long showers without an efficient showerhead (González-Gómez et al. 2022).

Water consumption in the shower is determined by technology and individual behaviour. The use of efficient showerheads allows massive water savings (Sadi et al. 2022; Watson 2017). However, efficient technologies do not always achieve the expected savings, as their use can serve to justify a greater resource use, leading to a rebound effect (Freire-González 2019). Given the importance of individual habits in resource conservation, there is a clear need to promote more sustainable showering behaviour.

Much research has been conducted focusing on household water end-uses (for a review see Koop et al. 2019; Roshan and Kumar 2020). Additionally, several studies look at the determinants of these uses, mainly emphasizing demographic and environmental factors (Willis et al. 2013; Makki et al. 2015; Vieira et al. 2018). However, there are fewer studies that specifically analyse personal habits and behaviour in the shower (see Gram-Hanssen 2007; Gram-Hanssen et al. 2020; Makki et al. 2013; Ableitner et al. 2016; Hannibal et al. 2019). Although these studies provide valuable insight into showering behaviour patterns, they often do not consider different aspects of showering habits (e.g., Hannibal et al. 2019), or the set of explanatory factors they consider is limited, usually restricted to socio-demographic characteristics (e.g., Makki et al. 2013). In this regard, Ableitner et al. (2016) pointed to the need for future research to identify new factors that may further explain showering behaviour. A more comprehensive study of shower patterns is therefore lacking in the literature.

This study aims to analyse different facets of showering behaviour and investigate the various factors that may determine it, in order to identify whether a more sustainable use of showers is possible and to provide useful information for the design of policies. Specifically, it analyses the behaviour of university students in southern Spain, an area suffering from high water stress. This population segment is of particular interest for water conservation in the context of personal hygiene. Previous research has indicated that young adults tend to use more water in the shower and are also reluctant to change their habits (Stanes et al. 2015; Lindsay and Supski 2017). Efforts need to be made to understand their behaviour and the factors that influence it in order to develop successful messages and actions that promote water conservation.

With respect to previous research, several contributions are made. Firstly, this study delves further into showering habits by considering the duration and frequency of showering differentiated for the summer and winter months. This seasonal distinction was included because changes in weather tend to influence users' showering behaviour (Rathnayaka et al. 2015, 2017; Smit and de Bruyn 2022). Secondly, this research extends the evidence on the determinants of shower use by including, in addition to socioeconomic characteristics, environmental and psychological variables that had not been considered before. Thirdly, this is the first research to analyse determinants of shower water end-use in Spain. Consumer behaviour may differ both within and between countries (Shahmohammadi et al. 2019). Thus, regional analysis is needed to pinpoint potential savings in showering and to design more effective targeted conservation campaigns that consider region-specific water use patterns.

Literature review

A review of factors that might explain individuals' behaviour regarding shower frequency and duration is presented below. It mainly addresses water consumption in the shower, which is the main topic of the research. However, general household water use is also considered because it can be useful for gaining a better understanding of the dynamics underlying the sustainable use of water in the shower.

Socioeconomic factors

The water conservation literature has traditionally focused on a set of socioeconomic factors, such as gender, age, income, family status, occupation, relationships, or ideology. It is generally held that young people and women take more care of their grooming (Shan et al. 2015). Watson (2017) reported that young women see a daily shower as crucial to start the day. Older people tend to exhibit more water-saving behaviours, which may be due to past life experiences, housing ownership or different lifestyles (Gilg and Barr 2006). Makki et al. (2013) found that females, children and teenagers were related to greater shower water consumption. Ableitner et al. (2016) also found that young people used more water for showering.

Education level may also be a predictor of water use, although the evidence is ambiguous. For other household water uses, Gilg and Barr (2006) and Lam (2006) found that households with higher education levels show more intention to conserve water. However, De Oliver (1999) and Gregory and Di Leo (2003) revealed that households with

lower education levels engage in more water conservation behaviours. On the contrary, Fielding et al. (2012) found no significance in the relationship between educational level and water saving. For specific water use in the shower, evidence is very scarce, although there is some research suggesting that educational level is positively correlated with water consumption in the shower (Makki et al. 2013).

The household size may play a role in determining shower water use. Willis et al. (2013) found a decrease in per capita consumption as family size increases. According to Linkola et al. (2013), single-person households register the highest frequency of showering and highest level of shower water consumption. In addition, income seems to have a significant effect on shower water consumption. Previous studies have indicated that per capita consumption rises as household income increases (Willis et al. 2013; Roshan and Kumar 2020). Makki et al. (2015) showed that well-off households tend to shower more frequently, while lower-income families tend to make more sustainable use of water to reduce their water bill (Hannibal et al. 2019). However, other studies did not find income to be a significant variable (Loh and Coghlan 2003; Willis et al. 2011).

Gram-Hanssen et al. (2020) identified occupation as a factor that may influence shower routines. In Beal et al. (2012) and Beal and Stewart (2011), higher shower use explains why more water is consumed in dwellings with working residents versus dwellings with retired residents. Being sociable emerges as a key determinant of shower water use. Those who have greater contact and proximity to other people will tend to shower more, as Makki et al. (2013) demonstrated.

Ideology is also considered a predictor of water conservation and pro-environmental behaviours (Liu et al. 2014). According to these authors, political (left) liberals tend to care more about the environment. Using a sample of Americans, Hannibal et al. (2019) found that more conservative people would be less willing to change their habits and take shorter showers in case of drought.

As this section shows, the literature has pointed to a large number of socioeconomic factors as predictors of water use in the shower, although in some cases the evidence is ambiguous. Furthermore, the effect of these factors on frequency and duration of showering, and whether their effect is the same in different seasons, has not been analysed in a differentiated way, so this study aims to provide some evidence by conducting a more in-depth study of showering habits.

Environmental and psychological factors

The research analysing the connection between shower water use and socioeconomic factors is more abundant. There are some studies involving environmental and psychological variables that are not empirically focused on the use of water in the shower, but which can nevertheless offer a better understanding of shower water consumption. People having intrinsic life aspirations rather than extrinsic ones generally tend to behave more pro-environmentally (see Kasser 2017, for a review). Intrinsic life aspirations are related to personal growth and connection with community, while extrinsic aspirations relate to money, image, and status (Kasser and Ryan 1996). Being excessively concerned with self-image or status could lead to greater use of beauty and body care products and spending more time than average in the shower.

Other features are related to the environment and psychology, such as people's feeling of connection with nature, which is also positively related to greater pro-environmental behaviour (Mayer and Frantz 2004; Geng et al. 2015). Previous findings indicate that feeling connected to nature and spending time in nature is associated with adopting pro-environmental water consumption habits (Ibáñez-Rueda et al. 2022). Similarly, Smit and de Bruyn (2022) found in their study that nature-based tourists consume less shower water and shower for shorter compared to the general public.

In general, attitudes towards environmental issues are considered predictors of water conservation behaviour (Willis et al. 2011; Ableitner et al. 2016). However, the relationship is not entirely obvious as, according to the Theory of Planned Behaviour, intentions do not always produce behavioural changes (Ajzen 2011). Positive attitudes towards water conservation do not necessarily lead to water-saving practices (Jensen 2008; Dolnicar and Hurlimann 2015). The dissociation between declared attitudes and sustainable use of water can be explained through individual resistance to the sacrifice associated with putting into practice pro-environmental attitudes (Ananga et al. 2019), or may simply be because behaviour is not always rational and can be guided by automatic routines (Steg and Vlek 2009).

On the other hand, it is not clear whether people who develop pro-environmental behaviours in other areas also use water sustainably, as there could be a positive or negative spillover effect from pro-environmental behaviour (Maki et al. 2019). Gilg and Barr (2006) provided evidence of the greater probability of water-saving attitudes in people who are committed to energy conservation, green consumerism and management of domestic waste. In contrast, Geng et al. (2016) found that purchasing green products can undermine commitment to water conservation, due to the phenomenon of moral licensing.

Finally, there is a private component in the act of showering, related to the search for personal wellness (Lupton and Miller 1992; Quitzau and Røpke 2009). Showering may be used as a relaxation activity instead of simply for hygiene purposes (Willis et al. 2011). People with depressive tendencies, anxiety or lack of intrinsic motivation may find showering a way to achieve well-being; indeed, Lindsay and Supski (2017) argued that showering has therapeutic value as a tool for calming daily tensions. Cold shower sessions even seem

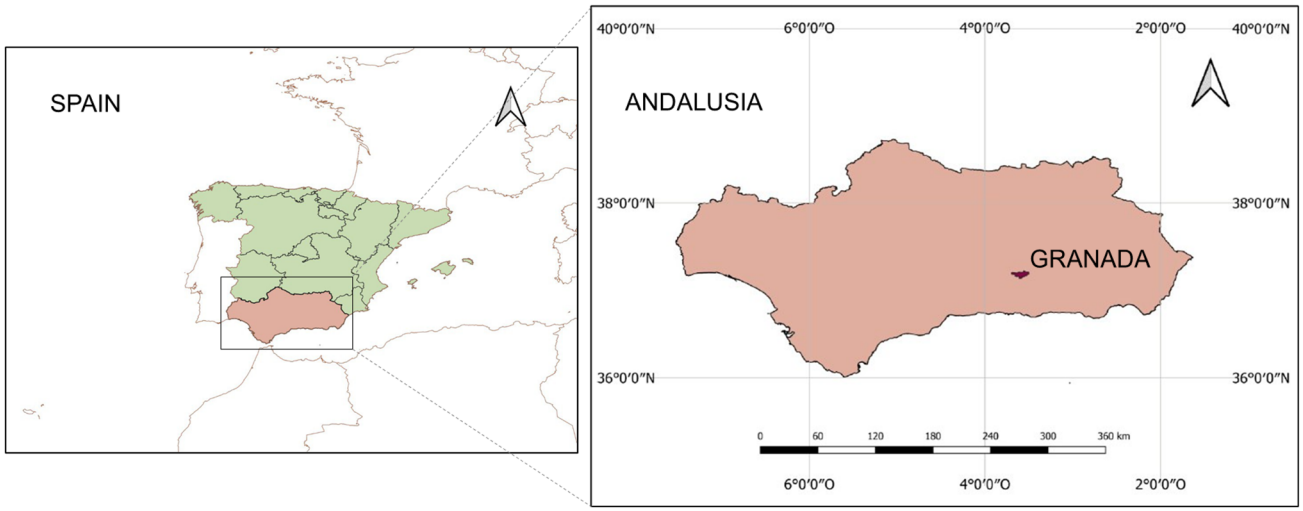

Fig. 1 Location map of the study area

to have anti-depressive effects (Shevchuk 2008). The search for wellness through showering may be especially common in people who suffer from stress episodes and have very demanding jobs (Quitzau and Røpke 2008).

To date, there is little empirical evidence on the relationship of water consumption in the shower with the environmental and psychological variables reviewed in this section–namely, one's relationship with nature, pro-environmental performance, life aspirations, and feelings of stress and insecurity–so this study aims to shed some light on this issue.

Material and methods

Study area and fieldwork

The research uses data from a questionnaire administered to students of the University of Granada. As shown in Fig. 1, the city of Granada is located in Andalusia, a semi-arid region in southern Spain facing severe water stress (World Resources Institute 2019). The study area experiences dry summers (National Geographic Institute 2019), and to cope with water scarcity during this season, certain measures, such as banning specific water uses and restricting supply at specific times, are implemented by municipalities. The year 2019, when the fieldwork was conducted, and the previous year were very warm, with August 2018 being one of the hottest months on record (State Meteorological Agency 2019). The results of this research have implications for regions with similar conditions to the study area that also grapple with severe water stress. Moreover, southern Spain presents an interesting research scenario because this region is already experiencing weather events such as prolonged heat waves, which are expected to occur in many other regions as a result of climate change (IPCC 2021).

The questionnaire was given mostly to young people, who make up the bulk of the student body.[1] According to United Nations General Assembly Resolution 70/1, this age group should play an important role in contributing to the implementation of SDG. Given the forecasts of water scarcity in the coming years, young people are expected to make the greatest efforts to change their habits to achieve a more sustainable use of water resources. In addition, young adults have been identified as high water users due to lifestyle aspirations and heightened body image concerns (Simpson et al. 2019). Previous research has not only indicated that young people consume more water in the shower but has also established that they are unwilling to limit the length and frequency of their showers (Lindsay and Supski 2017). On the other hand, it has also been suggested that a higher level of education may be associated with higher water consumption in the shower (Makki et al. 2013). University students are therefore an interesting group to study when it comes to achieving water savings. Moreover, it should be borne in mind that the target segment of this research represents a large group of society: more than half of the Spanish population between 18 and 34 years of age is in or has completed higher education (Ministry of Education and Vocational Training 2020).

The fieldwork was undertaken during the months of March and April 2019. Questionnaires were delivered to 1283 students from different faculties and disciplines. A research team visited classrooms and provided students with

[1] The majority of the sample is made up of students between 18 and 25 years old (95.66%), with only four participants over 35 years old.

Table 1 Description of the independent variables and their expected effect on the dependent variables

Variable	Description	Hypotheses
Socieconomics		
Gender	Equals 1 if the respondent is female	+
Age	Years as specified by respondents	−
Ideology	Political orientation. (1 to 10: 1 is extreme left – 10 is extreme right)	+
Household	Number of members of the household	−
Income	Natural logarithm of household income per capita	+
Single	Equals 1 if the individual is not in a stable relationship	+
Work	Equals 1 if the respondent works, besides studying	+
Rel_friends	Frequency in touch with friends (1 to 5: 1 never -5 every day or almost every day)	+
Rel_relatives	Frequency in touch with relatives (1 to 5: 1 never -5 every day or almost every day)	+
Psychological		
Anxious	Degree to which the respondent feels anxious (1 to 5: 1 nothing or very slightly, and 5 extremely)	+*
Insecure	Degree to which the respondent feels insecure (1 to 5: 1 nothing or very slightly, and 5 extremely)	+*
Environmental/Psychological		
Aspirations	Index capturing the intrinsic-extrinsic nature of goals (explanation in the text)	−*
ControlTime	Degree of control of the time spent in the shower (0 no control, 1 sometimes control, 2 control very often)	−*
PEBs_water	Indicator of water efficiency (explanation in the text)	−*
PEBs	Indicator of pro-environmental behaviours (explanation in the text)	−*
Freqnat	Frequency on visiting nature (1 never, 2 less than once a month, 3 once a month, 4 many times a month, 5 once a week, 6 many times a week, 7 everyday)	−*
Connectnat	Indicator on nature connectedness (explanation in the text)	−*
StudyEnv	Equals 1 if the respondent studies Environmental Sciences	−*

An * indicates that there is no previous evidence on the relationship of this variable with water shower use, and the hypothesis is based on water use in general or the intuition of the authors

the questionnaire, which was accessible online via Qualtrics. By collecting data anonymously and through self-administered questionnaires, potential social desirability biases in self-reported information are limited (Kormos and Gifford 2014). After deleting 329 missing values, 4 observations because they correspond to people who take baths rather than showers, and 5 observations that were incongruous, the final sample was left with 945 observations.

The sample used in this study is a selected sample chosen by convenience. A variety of faculties were chosen to conduct the survey in order to be representative of a range of disciplines, from the social sciences to the hard sciences. Specifically, students from Political Science, Sociology, Social Work, Education, Economics, Medicine, Environmental Sciences, Computer Science and Engineering participated in the study. The composition of the sample is descriptive of the student body of the University of Granada in terms of age and gender distribution (University of Granada 2019). Below, Table 3 shows the composition of the sample.

Variables and hypotheses

Self-reports were used to determine showering habits, as they are a valid measure of actual behaviour (Kormos and Gifford 2014). Indeed, previous evidence has shown that self-reported water use is related to actual water consumption (Fielding et al. 2012). The questionnaire contained two key questions: firstly, participants were asked how many showers they took per week; and secondly, how long, in minutes, these showers lasted (for a complete list of questions, see Supplementary Data 1). Open-response questions with specified units of measurement allow for more accurate and objective answers about participants' behaviour (Kormos and Gifford 2014). In both questions, they had to give a separate answer for two different seasons. Four dependent variables were used–time_winter, time_summer, number_winter, and number_summer–because climatic differences throughout the year can be a determining factor in water use, especially in shower duration and frequency (Rathnayaka et al. 2015, 2017).

A number of variables were employed to determine the shower habits profile of each participant. These variables were categorized into three groups: socioeconomic, psychological and environmental/psychological. A comprehensive list of the variables used, along with an explanation of the indices' construction, is presented below. In addition, Table 1 describes the variables and includes a column with the direction of the expected effect of each variable on the

dependent variables. The same direction was expected for all dependent variables, although with different degrees of strength. Due to the lack of evidence from previous research, it is not possible to predict the strength of these relationships. Information on the justification for the hypotheses can be found in the literature review, although some hypotheses are novel, as to the authors' knowledge there is no previous empirical evidence relating some of the variables with shower water use. Whenever this is the case, an asterisk marks the expected direction, which is based on literature on water use in general, or the intuition of the authors.

The variables shown in Table 1 are self-explanatory, except for some indexes that require additional explanation. The aspiration index (*Aspirations)* comprises a set of 14 questions on personal goals (Kasser and Ryan 1996). Using a 5-point Likert scale (from strongly disagree to strongly agree), respondents indicated their opinions on the importance of extrinsic goals, related to fame, wealth and image (e.g., "having fashionable clothes and hair") and intrinsic goals, related to personal growth, affiliation and community involvement (e.g., "helping to make the world a better place") (Kasser and Ryan 1996). The aspiration index was calculated by subtracting the average score for the extrinsic goal questions from the average score for the intrinsic ones.

The variable *PEBs_water* is an index that captures how efficiently respondents use water outside the shower. They answered questions such as "do you turn off the tap while you're brushing your teeth?". The possible answers were yes, sometimes, or no. An index was constructed by averaging the response to seven questions of this kind. The index *PEBs* is an indicator comprising 16 pro-environmental behaviours that do not involve direct use of water, such as "separating the garbage (e.g. paper, plastic, glass)". Individuals rated them using a 5-point Likert scale from never to always.

The last index included is the connectedness to nature scale (Mayer and Frantz 2004), which comprises 14 items such as "I often feel part of the web of life". People replied to the items with a 5-point Likert scale, from strongly disagree to strongly agree. The connectedness to nature scale was calculated by averaging the score of all items (*Connectnat)*.

Empirical strategy

The analysis of the data was carried out in two stages. The first stage analysed respondents' shower habits, distinguishing between frequency and shower duration. Besides, differences between summer and winter months were examined. This stage was an eminently descriptive analysis, focusing on the dependent variables.

In a second stage, estimations were performed using Ordinary Least Squares (OLS) to test the expected relationships between the dependent variables and the set of independent variables listed in Table 1. The application of OLS to estimate the regression coefficients is an appropriate choice because the dependent variables are quantitative and can be treated as continuous. Estimations were performed with errors robust to heteroskedasticity. The estimated model can be summarized as follows:

$$\text{DEPENDENT}_j = \alpha + \beta_1 S_i + \beta_2 P_i + \beta_3 EP_i + \varepsilon_i$$

where $DEPENDENT_j$ takes four different values (j = 1,…,4) for the frequency of showers per week and the average duration of the shower, in both summer and winter, by individual i ($i = 1,\ldots,945$). S_i is the set of socioeconomic variables, P_i represents a set of variables of individual i's psychological characteristics, and EP_i is the set of environmental/psychological variables. Finally, ε_i is the error term. Four models were estimated, one for each dependent variable. Additionally, models were replicated in the presence of correlation among the independent variables, in order to check whether this correlation conditioned the significance of the coefficients. The analysis was carried out using Stata15 software.

Figure 2 illustrates the main points of the methodology used to develop the present study, from the design of the questionnaire to the analysis of the data.

Results

Habits related to shower use

Table 2 indicates that time spent in the shower in summer and winter is positively correlated, according to a Pearson test (significant at 1%). The findings are analogous for the number of weekly showers in both seasons. However, the correlation is not perfect (0.762 for time and 0.650 for number), pointing to seasonal differences. Furthermore, the correlation between duration and number of showers within or between seasons is negligible. This suggests that a greater (smaller) number of showers may not translate into more (less) time spent in showers.

Regarding showering habits, on average, people in the sample shower around once per day (see Table 3 below for descriptive statistics). With regard to seasonal differences, the average shower frequency is slightly higher in summer. A *t* test indicates that those differences are significant (t = 22.67, p = 0.000); the histograms and Kernel density of the shower frequency are shown in Fig. 3.

The average shower duration is 11.6 min in winter and 8.8 min in summer. A test for equality of means indicates that the seasonal means are statistically different (t = 20.76, p = 0.000). Figure 4 depicts the kernel density of the time spent showering in summer and winter. To gain a better understanding of this variable, Fig. 5 shows the time respondents spend showering, distinguishing by season,

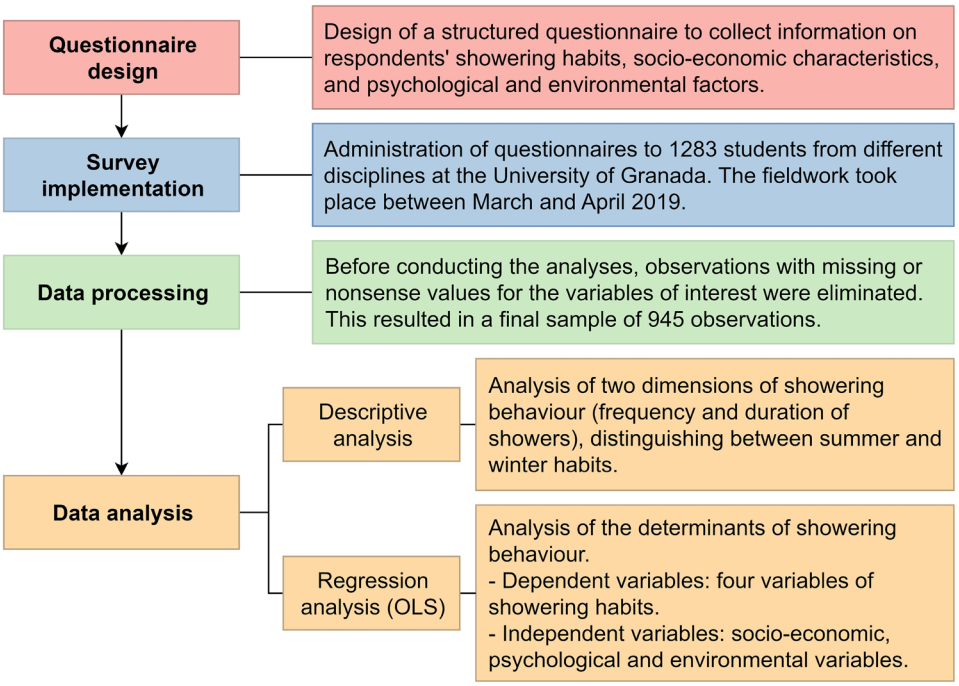

Fig. 2 Flowchart of the study methodology

Table 2 Correlation matrix of time and number of showers

	Time_summer	Time_winter	Number_summer	Number_winter
Time_summer	1			
Time_winter	0.762	1		
	(0.000)			
Number_summer	0.065	0.066	1	
	(0.047)	(0.042)		
Number_winter	0.059	0.045	0.650	1
	(0.069)	(0.167)	(0.000)	

p-values between brackets

grouping the times in 5-min intervals. According to this figure, it is more common to spend over 20 min in the shower in winter than in summer.

Determinants of shower frequency and duration

Descriptive statistics of the dependent and independent variables are presented in Table 3. Around 60% of the sample are female students, the average age is 20 years old, the average household size is 3.5, and about 25% work in addition to studying. Only 2% of the sample study environmental sciences.

Table 4 shows the correlations between the environmental variables and the aspiration index, which are found in the literature to be positively associated with pro-environmental orientation ("Literature review"). A positive relationship is observed for all variables, suggesting that the key independent variables are quite interrelated, although they conceptually measure different phenomena.

The results of the estimations are shown in Table 5 for the time spent in the shower and in Table 6 for the number of weekly showers. The high correlations presented in Table 4 may condition the results, as there could be a problem of multicollinearity. Even though the variance inflation factor results suggest this is not the case (the highest value is 1.43 for pro-environmental behaviour), alternative models are estimated in which the variables from Table 4 are isolated. By isolating those variables, some of the variables that were not significant in the full model become significant (Tables 5 and 6 only present those models that show a change in the significance of the variable with respect to the full model).

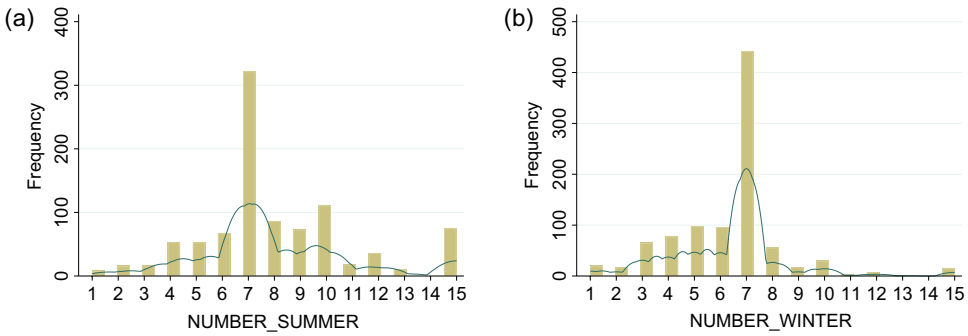

Fig. 3 Histogram of number of showers per week, in summer (**a**) and winter (**b**)

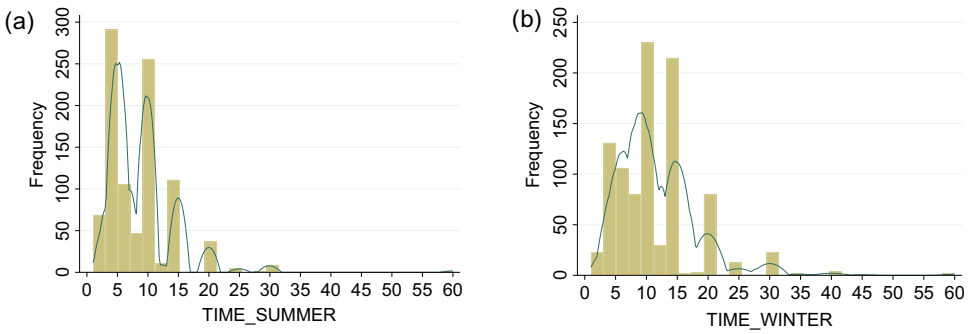

Fig. 4 Histogram of time per shower (in minutes), in summer (**a**) and winter (**b**)

Table 3 Descriptive statistics of the variables

Variable	Mean/%	Std. Dev	Min	Max
Socieconomics				
Time_summer	8.806	5.462	1	60
Time_winter	11.690	6.556	1	60
Number_summer	8.015	2.999	1	15
Number_winter	6.325	2.197	1	15
Gender	0.620		0	1
Age	20.692	2.870	18	54
I deology	4.385	1.856	1	10
Household	3.507	1.227	1	10
Income	6.211	0.776	3.219	8.294
Single	0.639		0	1
Work	0.251		0	1
Rel_friends	4.307	0.819	1	5
Rel_relatives	3.260	1.034	1	5
Psychological				
Anxious	3.051	1.236	1	5
Insecure	2.602	1.263	1	5
Environmental/Psychological				
Aspirations	17.80	5.094	− 2	33
ControlTime	1.329	0.788	0	2
PEBs_water	1.278	0.332	0	2
PEBs	2.927	0.644	1	4.867
Freqnat	3.749	1.373	1	7
Connectnat	3.326	0.646	1.357	5
StudyEnv	0.020		0	1

Socioeconomic factors

Gender was found to be the most clear-cut socioeconomic variable, with women showering more frequently and for longer durations than men do, and these relationships were highly significant, except for the number of showers taken during winter. Age was also found to be a significant factor, though the results were mixed, with older individuals taking more showers in the summer but shorter showers in the winter. Ideology emerged as another important explanatory factor, although not significant in the full models,[2] alternative models suggested that people with a left-wing ideology are more sustainable in terms of duration and number of showers in both seasons. Social contact was also found to be related to less sustainable habits, with people who have more interaction with their family showering more frequently in both seasons. Moreover, weakly significant relationships were observed between the number of showers and interactions with friends, as well as between the duration of showers in summer and interactions with relatives. There was some weak evidence that singles showered more often and for longer durations in the summer, while household income did not seem to be a relevant factor in explaining showering

[2] This could be because of the correlation of this variable with most of the environmental variables. The ideology variable correlates significantly and negatively with all variables from table 4, except for the frequency of visits to nature, which is nonsignificant.

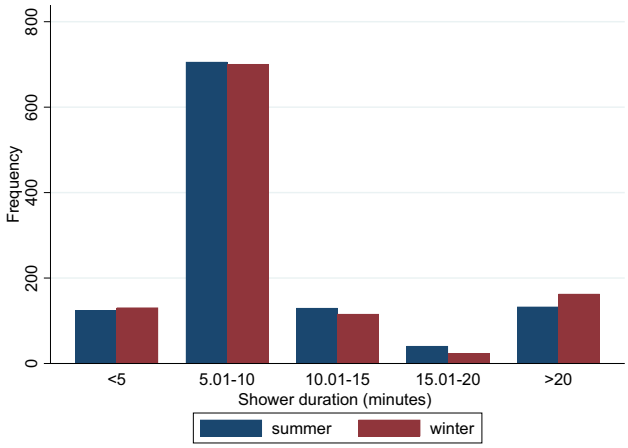

Fig. 5 Time in the shower grouped in 5 min intervals, in summer and winter

habits; there is only a weak relationship in the alternative models of number of showers in winter. Size, as well as employment status, were non-significant in all models.

Psychological factors

With respect to the psychological variables, showering behaviour was associated with both insecurity and anxiety. Insecure individuals tend to take fewer showers in winter but have longer shower durations across both seasons. Meanwhile, individuals with higher levels of anxiety tend to take more showers in winter.

Environmental/Psychological factors

In general, the set of environmental/psychological variables were found to be significant determinants of showering habits. People with higher intrinsic values spend less time in the shower in both seasons, and shower less often in winter. Individuals who control their time when showering to avoid spending too much time in the shower effectively manage to spend significantly less time. Although they reduce their number of showers as well, the significance of this relationship is weaker.

People who have efficient habits in other water uses, also tend to make sustainable use of the shower. Similarly, adopting other pro-environmental behaviours is related to more efficient showering practices in terms of frequency and duration in both seasons. It is also found that more frequent visits to nature are related to more efficient use of shower water in terms of duration, but the frequency of showers is higher in summer. Finally, feeling connected to nature and studying environmental issues is related to fewer and shorter showers in both seasons.

Discussion and policy implications

Awareness-raising campaigns are an effective measure to promote sustainable water use for residential purposes (Katz et al. 2016; Cominola et al. 2021). However, González-Gomez et al. (2022) show that there is a need to generalize awareness campaigns to make more efficient use of the shower. In this research, showering behaviour has been analysed to identify whether there is room for more sustainable shower use and provide well-informed users-profile to design effective public policies that promote sustainable water use for personal hygiene.

Based on the results of the descriptive analysis, changing showering habits could have a significant impact on water conservation without undermining personal hygiene.

Table 4 Correlation matrix of key environmental and psychological variables

	Aspirations	ControlTime	PEBs_water	PEBs	Freqnat	Connectnat	StudyEnv
Aspirations	1						
Control time	0.200	1					
	(0.000)						
PEBs_water	0.215	0.319	1				
	(0.000)	(0.000)					
PEBs	0.313	0.244	0.384	1			
	(0.000)	(0.000)	(0.000)				
Freqnat	0.127	0.111	0.169	0.227	1		
	(0.000)	(0.001)	(0.000)	(0.000)			
Connectnat	0.384	0.188	0.211	0.336	0.282	1	
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)		
StudyEnv	0.058	0.074	0.122	0.158	0.087	0.105	1
	(0.078)	(0.023)	(0.000)	(0.000)	(0.008)	(0.001)	

p-values between brackets

Table 5 Estimations for time spent in showers in summer and winter

	Summer			Winter			
	(1)	(2)	(3)	(1)	(2)	(3)	(4)
Gender	1.309***	1.231***	1.231***	2.899***	2.935***	2.888***	2.721***
	(0.400)	(0.380)	(0.399)	(0.408)	(0.415)	(0.420)	(0.417)
Age	– 0.0309	– 0.0406	– 0.0298	– 0.168***	– 0.164***	– 0.158**	– 0.168***
	(0.067)	(0.070)	(0.070)	(0.060)	(0.063)	(0.064)	(0.064)
Ideology	0.0364	0.122	0.185**	0.152	0.249**	0.335***	0.358***
	(0.091)	(0.097)	(0.094)	(0.113)	(0.120)	(0.126)	(0.126)
Household	0.127	0.132	0.113	0.141	0.141	0.126	0.138
	(0.149)	(0.158)	(0.159)	(0.164)	(0.172)	(0.176)	(0.174)
Income	– 0.341	– 0.246	– 0.237	– 0.098	0.0149	0.0327	0.0221
	(0.248)	(0.252)	(0.257)	(0.282)	(0.298)	(0.301)	(0.301)
Single	0.409	0.721**	0.732**	0.142	0.546	0.56	0.566
	(0.324)	(0.343)	(0.345)	(0.394)	(0.420)	(0.425)	(0.425)
Work	0.0123	– 0.2	– 0.175	0.305	0.063	0.0479	– 0.0578
	(0.363)	(0.380)	(0.375)	(0.457)	(0.475)	(0.484)	(0.476)
Rel_friends	0.00176	– 0.0513	– 0.0775	0.163	0.15	0.109	0.102
	(0.206)	(0.220)	(0.221)	(0.271)	(0.291)	(0.293)	(0.292)
Rel_relatives	0.390*	0.321	0.360*	0.114	0.0714	0.105	0.0701
	(0.205)	(0.203)	(0.205)	(0.214)	(0.221)	(0.223)	(0.224)
Anxious	– 0.102	– 0.0669	– 0.113	– 0.175	– 0.126	– 0.178	– 0.183
	(0.145)	(0.149)	(0.150)	(0.188)	(0.200)	(0.198)	(0.199)
Insecure	0.167	0.330**	0.323**	0.415**	0.628***	0.628***	0.649***
	(0.157)	(0.158)	(0.162)	(0.190)	(0.205)	(0.209)	(0.207)
Aspirations	– 0.106***			– 0.0755*			
	(0.035)			(0.041)			
ControlTime	– 1.544***			– 2.629***			
	(0.244)			(0.295)			
PEBs_water	– 1.003**			– 1.202**			
	(0.485)			(0.546)			
PEBs	– 0.21	– 1.186***		– 0.21	– 1.348***		
	(0.299)	(0.264)		(0.341)	(0.335)		
Freqnat	– 0.353**			– 0.288*			
	(0.159)			(0.171)			
Connectnat	0.161		– 0.778***	0.426		– 0.624*	
	(0.352)		(0.297)	(0.379)		(0.363)	
StudyEnv	– 1.113*			– 0.882			– 2.395**
	(0.579)			(0.883)			(1.017)
Constant	15.13***	10.99***	9.752***	17.69***	13.04***	10.86***	9.181***
	(3.066)	(2.718)	(3.224)	(3.002)	(2.935)	(3.177)	(2.926)
R-squared	0.132	0.054	0.044	0.21	0.097	0.084	0.084

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

(1) is the full model. (2), (3) and (4) are alternative models in which highly correlated environmental and psychological variables are isolated

Dermatologists suggest that a few showers per week are enough to maintain personal hygiene (Shmerling 2019), but daily showering has become a common behaviour due to social norms (Shove and Walker 2010). The study found that almost half of the participants reported showering daily or more frequently, with higher shower frequency reported during the summer season. The frequency of showers observed in this study is consistent with that reported in other research and countries. For example, in Binks et al. (2016) the shower frequency is between 0.9 and 1.8 per day. In England, Abu-Bakar et al. (2023) found that 55% of

Table 6 Estimations for number of showers in summer and winter

	Summer				Winter			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Gender	0.592***	0.446**	0.507**	0.420**	0.0862	0.0486	– 0.0462	– 0.00386
	(0.206)	(0.198)	(0.199)	(0.198)	(0.150)	(0.149)	(0.146)	(0.147)
Age	0.0940***	0.0825**	0.0864**	0.0857**	– 0.0155	– 0.024	– 0.028	– 0.0252
	(0.036)	(0.036)	(0.036)	(0.037)	(0.024)	(0.024)	(0.024)	(0.024)
Ideology	0.0335	0.117**	0.119**	0.123**	0.0499	0.0954**	0.114***	0.118***
	(0.055)	(0.056)	(0.055)	(0.055)	(0.039)	(0.038)	(0.039)	(0.038)
Household	– 0.0854	– 0.0795	– 0.079	– 0.0798	– 0.0979	– 0.0914	– 0.0911	– 0.0907
	(0.086)	(0.087)	(0.088)	(0.087)	(0.062)	(0.063)	(0.063)	(0.063)
Income	0.133	0.166	0.156	0.159	0.146	0.172*	0.177*	0.172*
	(0.136)	(0.136)	(0.137)	(0.136)	(0.101)	(0.101)	(0.101)	(0.101)
Single	0.431**	0.403*	0.408**	0.429**	0.162	0.155	0.166	0.174
	(0.204)	(0.205)	(0.205)	(0.204)	(0.147)	(0.150)	(0.149)	(0.149)
Work	0.125	0.0477	0.0573	0.0246	– 0.0237	– 0.104	– 0.091	– 0.0881
	(0.242)	(0.241)	(0.241)	(0.239)	(0.179)	(0.178)	(0.179)	(0.179)
Rel_friends	0.216*	0.178	0.182	0.187	0.175*	0.151	0.133	0.136
	(0.119)	(0.124)	(0.124)	(0.124)	(0.091)	(0.093)	(0.094)	(0.094)
Rel_relatives	0.263***	0.279***	0.286***	0.276***	0.135*	0.135*	0.131*	0.136*
	(0.097)	(0.098)	(0.099)	(0.099)	(0.071)	(0.072)	(0.072)	(0.072)
Anxious	0.127	0.0999	0.104	0.0985	0.197***	0.184***	0.185***	0.188***
	(0.084)	(0.086)	(0.086)	(0.086)	(0.059)	(0.060)	(0.060)	(0.060)
Insecure	– 0.0406	– 0.0467	– 0.0484	– 0.0312	– 0.138**	– 0.128**	– 0.134**	– 0.132**
	(0.084)	(0.086)	(0.086)	(0.086)	(0.059)	(0.060)	(0.060)	(0.060)
Aspirations	0.0166				– 0.0164	– 0.044***		
	(0.022)				(0.017)	(0.017)		
ControlTime	– 0.0581	– 0.231*			– 0.065		– 0.198**	
	(0.132)	(0.129)			(0.099)		(0.097)	
PEBs_water	– 0.067		– 0.728**		– 0.0178			– 0.504**
	(0.303)		(0.283)		(0.228)			(0.215)
PEBs	– 0.889***				– 0.423***			
	(0.176)				(0.130)			
Freqnat	0.134*				0.0374			
	(0.075)				(0.056)			
Connectnat	– 0.350*				– 0.310**			
	(0.184)				(0.140)			
StudyEnv	– 0.643			– 1.266**	– 0.840*			
	(0.556)			(0.627)	(0.431)			
Constant	5.793***	2.943**	3.447**	2.558*	6.832***	5.017***	4.609***	4.877***
	(1.598)	(1.475)	(1.506)	(1.434)	(1.172)	(1.071)	(1.036)	(1.072)
R-squared	0.086	0.045	0.048	0.045	0.087	0.057	0.053	0.053

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

(1) is the full model. (2), (3) and (4) are alternative models in which highly correlated environmental and psychological variables are isolated

households surveyed used the shower once a day, 34% twice, and 11% three times or more daily.

Water can be saved not only by reducing frequency but also by limiting the time spent in the shower. UN recommends showering for no longer than five minutes to save water (United Nations 2020a, b). However, most of the participants significantly exceed this recommendation, particularly in winter. Moreover, the mean values and frequency distribution indicate that showering durations among participants were higher than those reported in most literature for the general population. For instance, Ableitner et al. (2016) reported an average shower time of just over four minutes for

a sample of Swiss households, while in the UK and the US, the average shower time was around seven minutes (Energy Saving Trust 2015; Water Research Foundation 2016). Binks et al. (2016) reported a duration of between 4.4 and 11 min, and Ananga et al. (2019) found that 66% of households in Ada, Oklahoma, took showers lasting five minutes or less. In contrast, shower durations in this study are similar to those reported in other studies on young adults, which were around 10–12 min (Simpson et al. 2019). Therefore, these findings support previous research suggesting that young people tend to shower longer (Stanes et al. 2015; Ableitner et al. 2016).

The difference in showering habits between seasons is consistent with the findings of previous studies on the effect of weather conditions on showering behaviour (Rathnayaka et al. 2017; Smit & Bruyn 2022). The higher shower frequency in summer can be explained by the high temperatures reached in southern Spain during this season, an explanation that becomes even stronger considering the above-average temperatures of summer 2018 (State Meteorological Agency 2019). On the other hand, the longer shower time in winter may be to get warm. This is consistent with research by Wong et al. (2016), who found that when the outside temperature dropped by 6 ºC, shower duration was 10% longer.

Regarding the personal factors influencing showering behaviour, the regression analyses generally confirm most of the hypotheses put forward. However, there are again differences between the seasons and between the two aspects of behaviour considered.

In terms of socio-economic factors, gender is a very important determinant of showering habits. These results are in line with previous studies indicating that women consume more water in the shower (Makki et al. 2013). As a novelty, this study suggests that this higher consumption is mainly due to longer showers, with the time difference being greater in winter. The findings on the ideology variable are also in line with previous studies, which point to left-wing ideology as a factor favouring water conservation (Hannibal et al. 2019). Furthermore, the idea of showering before socialising as a standard practice is supported (Gram-Hanssen et al. 2020), as more contact with friends and family is associated with a higher frequency of showering.

However, contrary to expectations, income level and being single do not seem to have much influence on showering habits, with only some weak positive relationships found for these factors. No significant association is found for the variables number of people in the household and employment. The fact that the expectations for these variables are not confirmed is probably due to the composition of the sample. The participants are students who go to class and interact with other people daily, so the fact that they also have a job may not make a difference. Regarding household composition, about half of the respondents lived away from home during the academic year, which may explain why this variable is not significant in this context. The fact that the sample consists of university students may also explain the unexpected results regarding age. Older age is positively associated with the number of showers in summer and negatively associated with the duration of showers in winter. However, when considering this result, it should be noted that the age range of the participants is very limited.

The results partially support the hypotheses on psychological variables. Being insecure is associated with a lower frequency of showering in winter and a longer duration of showering regardless of the season. The most insecure people probably shower less often because they avoid contact with other people, but they may spend more time in the shower if they find it as a means of escape, or to pay close attention to their personal hygiene before meeting other people. While being anxious is significantly and positively associated with the number of showers per week. The difference in behaviour is more evident in the winter months, when people may be under more stress for a variety of reasons, such as their studies or work, lack of daylight, and limited outdoor activities. Showering may be considered as an option to reduce anxiety (Shevchuk 2008).

Environmental variables emerge as significant explanatory factors, generally associated with more sustainable habits in terms of frequency and duration of showering. The exception is contact with nature, which, although associated with shorter showering time in both seasons, is positively related to showering frequency in summer, which may be explained by the climatic factor. People who spend more time in nature may need more showers in summer because the outdoor activity makes them sweat.

Higher intrinsic values are associated with shorter showers throughout the year and fewer showers in winter. It is probably the case that people who are more concerned about their image take time in the shower to apply more personal care. Unsustainable showering habits, such as prolonged showering, have previously been linked to notions of beauty, image and body care (Watson 2017). Pro-environmental behaviour variables, both related to water use and not, are associated with more sustainable showering habits in both dimensions and seasons. Therefore, it appears that shower habits are not affected by the moral licensing effect (Tiefenbeck et al. 2013; Gholamzadehmir et al. 2019), but that participants show consistency in their behaviour, suggesting that people take action to protect the environment in multiple dimensions. Similarly, connectedness to nature and studying environmental science seem to encourage sustainable shower habits. As with pro-environmental behaviour in other areas (Mackay and Schmitt 2019; Alcock et al. 2020), a close relationship with nature encourages sustainable showering habits.

The existence of specific profiles who are less efficient in their showering habits is a key finding of this research

with implications for the design of policies aimed at water conservation. Awareness campaigns on shower conservation should specifically target these profiles. Taking into account the significance of the gender variable, shower conservation campaigns could be gender-differentiated to make them more appealing to women. Furthermore, based on the results of the psychological variables, an important message to convey is that showering should be avoided as a way of de-stressing or enhancing well-being. There is evidence that those who make more sustainable use of water resources have greater personal well-being (Chenoweth et al. 2016; Ibáñez-Rueda et al. 2023).

The use of showering as a form of self-care and image maintenance is often associated with unsustainable showering habits (Quitzau and Røpke 2008; Watson 2017). Therefore, educational values that guide people towards intrinsic goals rather than materialistic values could contribute to efficient shower water use. Finally, given the strong influence of environmental variables on sustainable water use, encouraging people to visit nature through educational initiatives that show the benefits of nature visits and incorporate nature values could be part of a policy aimed at reducing shower water use. In addition, encouraging people to be environmentally friendly in other aspects of their lives may also help to reduce shower water use, as there appears to be a positive spillover effect (Truelove et al. 2014).

Limitations and future research

Before concluding, some limitations of this research need to be considered. The study is conducted with a focus on a specific target group of university students. The results of the study refer to this specific segment and caution should be exercised before extrapolating them to the general population. It should be borne in mind that many students live away from home during the academic year (in shared flats, halls of residence, single rooms, etc.), which could have an impact on showering habits. In addition, the sample consists almost entirely of young people, so the results would probably be different if other age groups were included. It would be desirable to carry out similar studies with larger samples in order to better capture the possible effect of variables such as age, employment status or different levels of education.

For more insight into the causes of (un)sustainable shower use, extended personal interviews should be considered. Moreover, future research endeavours could benefit from employing direct measurements of shower water consumption, allowing for more precise estimations and accurate correlations with the proposed factors. Finally, given the influence of cultural context on water consumption patterns (Smith and Ali 2006), it would be advisable to conduct studies focusing on other geographical areas. Although habits and explanatory factors identified here could be valid for university students in other Western countries, the generalisability of the results remains to be determined.

Conclusion

Ensuring the availability of water resources requires both supply-side and demand-side measures. In terms of demand management, aligning conservation measures with existing water consumption behaviours is key to their effectiveness (March et al. 2015). This study focuses on showering habits, as this is often the most water-intensive activity within households. The main novelty of the study lies in the detailed analysis of showering habits, considering both the frequency and duration of showering seasonally (winter and summer). In addition, a wide range of factors that may affect showering behaviour are considered, including socio-economic characteristics as well as environmental and psychological factors.

The first conclusion based on respondents' number of showers and time spent in the shower is that a substantial part of the sample can make more sustainable use of the shower. There is a need to raise awareness about the benefits of reducing the frequency and duration of showers, without sacrificing personal hygiene. One benefit is personal–reducing damage to the skin–and the other is for the public good–saving water.

Secondly, the investigation reveals discernible disparities in showering habits between winter and summer, in terms of not only frequency but also duration. Individuals tend to spend more time showering during winter, whereas showering frequency tends to be more pronounced in summer. Consequently, policy formulations necessitate careful consideration of these seasonal variations in showering behaviour.

Lastly, the research highlights the existence of factors that determine people's showering behaviour, including gender, ideology, social relations, psychological factors, pro-environmental behaviour and relationship with nature. The relationships between these factors and showering behaviour exhibit a heterogeneous pattern, contingent upon the specific aspect of behaviour and the season under investigation. A profound comprehension of these factors and their relation to season facilitates the tailoring of recommendations to specific target populations, and the formulation of targeted awareness campaigns with heightened efficacy.

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Data availability The data that support the findings of this study are openly available in Zenodo at http://doi.org/10.5281/zenodo.6788781.

Declarations

Conflict of interest On behalf of all authors, the corresponding author states that there is no conflict of interest.

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