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*Article*

# Consumption of Tap Water and Sociodemographic-Associated Characteristics: A Nationwide Cross-Sectional Study

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**Abstract:** Safe water is a global public health concern amid increasing scarcity and pollution. Bottled water production and consumption contribute to these problems. This study examines tap water consumption in Italy, assessing associated sociodemographic factors and related health outcomes such as obesity and self-perceived health status. Data from the Italian National Statistics Institute's "Aspects of daily life" survey (N=45,597) were analyzed. Covariates included education, age, gender, economic status, region, concerns about waste and climate change, consumption of carbonated drinks excluding water, alcohol consumption, consumption of vegetables, consumption of snacks, body mass index, and self-perceived health status. Bivariate analyses and mixed-effect logistic regression models explored the associations. People who drink tap water were 19,674 with a higher prevalence in people aged 45 to 59 old, people with a graduate/post-graduate degree diploma, with optimal economic resources, concerned about waste production and climate change, coming from the North-East regions of Italy. Underweight people showed higher prevalence of TW assumption as well as those who drink less than occasionally carbonated drinks, drink alcohol, consume vegetables more than once a day and snacks less than once a week with a satisfying level perceived health status. Regressions showed that all age classes are less likely to drink tap water than people younger than 20 years old. The category with "inadequate" economic resources is more likely to consume tap water. Low educational classes show a low likelihood of consuming tap water as well as Islands. A concern about waste production and climate change is associated with an increased likelihood of assuming tap water. Tap water consumption was negatively associate with obesity but not with a satisfactory Self-perceived health status. Insights from this study can inform public health strategies.

**Keywords:** safe water; public health; sociodemographic characteristics; environmental health; health outcomes

## 1. Introduction

Drinking safe water is a critical public health element worldwide. Improved water supply and sanitation, and better management of water resources, can boost countries' economic growth and can contribute greatly to poverty reduction [1]. Anyway, in the next future, the availability of safe water could be a worldwide issue. Environmental challenges such as climate change and extreme events, water scarcity, and pollution are increasingly becoming a global concern [2]. Many studies have shown how the production and consumption of bottled water (BW) are contributors to these problem [3,4] s[3,4]. Others have shown how tap water (TW) would be preferable due to the high environmental impact of bottle manufacturing [5]. Moreover, increasing evidence has shown a higher level of exposure to microplastics from BW versus TW [6] Nowadays, in many countries, there is the

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possibility to have access to cheap and safe potable TW, but BW consumption has been increasing globally[7]. Recently there has been a growing interest in investigating possible reasons for preferring TW or BW. Some of them have focused attention on health and safety concerns about TW [8,9], while others on organoleptic properties [10,11]. The European Region has diverse TW consumption patterns between and within countries, with the highest share of TW intake observed in northern Europe. Moreover, different sociodemographic characteristics associated with TW or BW consumption have been investigated, delineating a complex scenario[12]; in particular, gender differences have been highlighted, with women drinking more BW [13–15] since women seem to perceive TW riskier but at the same time, they have more general environmental awareness. Moreover, ethnicity and culture, as well as self-perceived health status and diet choices are among the key drivers of TW and city dwellers tend to drink less TW, with the lowest consumption observed at restaurants and the highest in people's homes [16]. Additionally, research shows that free access to safe and acceptable drinking water may be beneficial in reducing sugary drinks[17].

The aim of this study is to evaluate the consumption of TW and its association with selected sociodemographic- characteristics, self-perceived health status, and body Mass index of consumers at a nationwide level in Italy.

## 2. Materials and Methods

Information on tap and BW consumption has been obtained from the multi-purpose survey on families "Aspects of daily life", carried out by the Italian National Statistics Institute (ISTAT). The survey is carried out on a yearly basis in a representative sample of the Italian population and is part of the integrated system of multipurpose surveys on families aimed at detecting a plurality of behavioral dimensions and segments of daily life. The questionnaire is standardized, and it is administered both in face-to-face mode by trained interviewers and in self-compilation and it has been used in several studies[18], [19]. We analyzed data coming from the 2021 edition of the survey, including 45,597 subjects and 20.000 families. In the specific case, the populations for the current surveys, have been identified by the Italian National Statistics Institute within the set of municipalities which has been divided into two subsets: Municipalities with larger demographic size constitute a separate stratum and are defined as Self-Representative (SR); the remaining municipalities are defined as Non Self-Representative (NSR) and are divided, based on demographic size, into strata of equal breadth. From these strata, the sample municipalities (two for each stratum) were selected with probabilities proportional to their size. For each of the municipalities involved in the survey (SR and NSR), a cluster sampling is carried out: the clusters—the families—are randomly selected from the registry list, and all the members belonging to the actual family are surveyed. The minimum number of sample families for each municipality has been set at 24. The families are selected for each sample municipality from the theoretical sample selected for the Master Sample for each family included in the sample, the characteristics under investigation of all actual members belonging to the same family are recorded. The size of the theoretical sample in terms of families, set at the national level primarily based on cost and operational criteria, is approximately 24,000 families. The number of involved sample municipalities should not exceed 900, to allow for effective control and supervision. The allocation of the sample of families and municipalities, among the various regions, has therefore been calculated by adopting a compromise criterion to ensure both the reliability of estimates at the national level and that of estimates within each of the territorial domains[20] The following variables have been included in the analyses: educational level (graduate/postgraduate degree, high school diploma, middle school diploma, primary school diploma/none), age (<20 years old, 20-44 years old, 45-59 years old, 60-74 years old, ≥75 years old), sex (males/females), economical resources in last 12 months (1 = inadequate, 2 = scarse, 3 = adequate, and 4 = optimal), geographical area of residency (North-West, North-East, Center, South, The Islands), concern about waste production (yes/no), concern about climate change (yes/no), consumption of carbonated drinks excluding water (1=more than 1 L/day, 2=between ½ / 1 L day, 3=less than ½ L, 4=less than occasionally, 5=occasionally, 6= no use), alcohol consumption (1=yes, 0=no), consumption of vegetables (1=more than once a day, 2=once a day, 3=sometimes a week, 4=less

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than once a week, 5=never), consumption of snacks (1=more than once a day, 2=once a day, 3=sometimes a week, 4=less than once a week, 5=never), body mass index (BMI ; 1=underweight, 2=normal, 3 overweight, 4= obese), self-perceived health status(1=satisfactory, 0=not satisfactory). Bivariate analyses were performed to study the association of TW consumption with relevant variables using Chi-square tests. Logistic regression models have been built to adjust for confounders and to evaluate the factors independently associated with TW consumption (1, if TW consumption is present; 0 if not). Regarding health outcomes, we considered self-perceived health status satisfaction level (dichotomized in two levels 1=satisfactory, 0=not satisfactory) and BMI (dichotomized in two 1=obese, 0= not obese). The level of significance was set at 0.05. Analyses have been performed with STATA, version 15 (Stata Corp.).

## 3. Results

Among the selected sample, people who usually drink TW were 19,674 representing the 43.15 (95% confidence interval, CI 42.69-43.60). In terms of prevalence, bivariate analysis (Table 1) has highlighted a higher prevalence of TW consumption in people aged 45 to 59 years old (N=4942, 25.12%, p-value<0.05) with no statistically significant differences among males and females. People with a graduate/post-graduate degree diploma showed the highest prevalence of consumption (N=3111, 48.56%, p-value<0.05) as well as people with optimal economic resources (N=356, 50%, p-value<0.05). Considering concern for environmental issues our sample showed a higher prevalence of people consuming TW among those that were concerned about waste production (N=7963, 44.21%, p-value<0.05) and among those that were concerned about climate change (N=9586, 44.66%, p-value<0.05). Regarding the Geographical Area of Residency, there was a higher prevalence of TW consumption in the North-East regions of Italy (N=5966, 64.98%, p-value<0.05). Underweight people showed higher prevalence of TW assumption (N=509, 46.27% p-value<0.05) as well as those who drink less than occasionally carbonated drinks (N=1932, p-value<0.05), drink alcohol (N=12519, 44.66% p-value<0.05), consume vegetables more than once a day (N=3584, 46.83% p-value<0.05) and snacks less than once a week (N=7265, 45.10%, p-value=0.05). Regarding perceived health status highest prevalence of TW consumption has been shown from those with a satisfying level (N=14323, 44.03% p-value<0.05)

**Table 1.** Distribution of the proportion of people drinking TW according to selected personal characteristics.

| | | N | % of people drinking TW | p |
|---|---|---|---|---|
| **Sex** | Males | 9524 | 43.28 | 0.58 |
| | Females | 10150 | 43.02 | |
| **Age class (years)** | <20 | 3142 | 15.97 | 0.00 |
| | 20-44 | 4577 | 23.26 | |
| | 45-59 | 4942 | 25.12 | |
| | 60-74 | 4298 | 21.85 | |
| | ≥75 | 2715 | 13.80 | |
| **Educational level** | Graduate/Post-Graduate degree | 3111 | 48.56 | 0.00 |
| | High school diploma | 6640 | 43.55 | |
| | Middle school diploma | 4874 | 41.19 | |
| | Primary school diploma/none | 4013 | 41.52 | |
| **Economical resources in last 12 months** | Optimal | 356 | 50.00 | 0.00 |
| | Adequate | 13545 | 43.76 | |
| | Scarse | 5103 | 41.24. | |

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| | | | | |
|---|---|---|---|---|
| | Inadequate | 670 | 42.92 | |
| **Concern about waste production** | No | 11711 | 42.45 | 0.00 |
| | Yes | 7963 | 44.21 | |
| **Concern about climate change** | No | 10088 | 41.8 | 0.00 |
| | Yes | 9586 | 44.66 | |
| **Geographical Area of residency** | North-West | 4712 | 46.21 | 0.00 |
| | North-East | 5966 | 64.98 | |
| | Center | 3649 | 41.63 | |
| | South | 4482 | 35.8 | |
| | The Islands | 857 | 17.45 | |
| **BMI** | Normal | 8571 | 43.94 | 0.00 |
| | Underweight | 509 | 46.27 | |
| | Overweight | 5869 | 42.90 | |
| | Obese | 1974 | 40.66 | |
| **Carbonated drinks consumption (excluding water)** | More than 1L/day | 170 | 40.57 | 0.00 |
| | From 1/2L to 1L/day | 482 | 43.19 | |
| | Less than 1/2L day | 1241 | 40.68 | |
| | Occasionally | 6103 | 41.89 | |
| | Less than occasionally | 1932 | 45.87 | |
| | No/never | 7897 | 44.96 | |
| **Alcohol consumption** | No | 5618 | 40.89 | 0.00 |
| | Yes | 12519 | 44.66 | |
| **Consumption of vegetables** | More than once a day | 3584 | 46.83 | 0.00 |
| | Once a day | 6645 | 44.43 | |
| | Sometimes a week | 6968 | 41.80 | |
| | Less than once a week | 1349 | 39.20 | |
| | Never | 643 | 39.30 | |
| **Consumption of snacks** | More than once a day | 186 | 41.24 | 0.00 |
| | Once a day | 731 | 42.65 | |
| | Sometimes a week | 4276 | 40.71 | |
| | Less than once a week | 7265 | 45.10 | |
| | Never | 6616 | 43.50 | |
| **Self-perceived health status** | Not satisfactory | 3088 | 41.05 | 0.00 |
| | Satisfactory | 14323 | 44.03 | |

Multilevel regression analysis (Table 2) confirmed that there are no statistically significant differences between males and females in terms of the likelihood of drinking TW (females OR=0.98, C.I. 0.94-1.03). All age classes from 20 to 74 years old are less likely to drink TW than people younger than 20 years old but only one class reached statistical significance (20-44 OR=0.75, C.I. 0.64-0.88). Regarding economic resources, there is an increasing trend of TW consumption but none of the several different categories reached statistical significance. On the other hand, our model highlights also how the level of schooling may influence TW assumption. Compared to the highest level of education (Graduate/Post-graduate) other educational classes show a low likelihood of consuming TW with a statical significance level (High School diploma OR= 0.8, C.I. 0.75-0.85, Middle School Diploma OR=0.72, C.I. 0.67-0.78, Elementary school diploma/none OR=0.7, C.I. 0.64-0.77). About the Geographical Area of residence, we did observe statical significant differences among different regions with increased consumption in Northwest (baseline) and North-East (OR=2.17, C.I.= 2.04-2.32) and less consumption in Center (OR=0.85, C.I.=0.79-0.9), South (OR=0.69, C.I.=0.65-0.74) and The Islands (OR 0.25, C.I.=0.23-0.28). In our model, we considered also some variables associated with attention to environmental issues. A concern about waste production was associated with an

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increased likelihood of assuming TW (OR=1.09, C.I.=1.04-1.14). A similar trend of likelihood has been shown for concern for climate change but is not statistically significant (OR=1.03, C.I.=0.99-1.08).

**Table 2.** Factors associated to TW consumption at logistic regression analysis.

| Variables | | OR | CI 95% | p-value |
|---|---|---|---|---|
| **Sex** | Males | 1 | | |
| | Females | 0.98 | 0.94-1.03 | 0.17 |
| **Age** | <20 | 1 | | |
| | 20-44 | 0.75 | 0.64-0.88 | 0.00 |
| | 45-59 | 0.89 | 0.74-1 | 0.05 |
| | 60-74 | 0.91 | 0.74-1.02 | 0.08 |
| | ≥75 | 0.97 | 0.82-1.14 | 0.70 |
| **Educational level** | Graduate/Post-graduate degree | 1 | | |
| | High School diploma | 0.8 | 0.75-0.85 | 0.00 |
| | Middle school diploma | 0.72 | 0.67-0.78 | 0.00 |
| | Primary school diploma/none | 0.70 | 0.64-0.77 | 0.00 |
| **Economical resources in last 12 months** | Optimal | 1 | | |
| | Adequate | 0.98 | 0.82-1.18 | 0.88 |
| | Scarce | 0.99 | 0.82-1.18 | 0.88 |
| | Inadequate | 1.13 | 0.91-1.4 | 0.26 |
| **Concern about waste production** | No | 1 | | |
| | Yes | 1.09 | 1.04-1.14 | 0.00 |
| **Concern about climate change** | No | 1 | | |
| | Yes | 1.03 | 0.99-1.08 | 0.18 |
| **Geographical Area of residency** | North-West | 1 | | |
| | North-East | 2.17 | 2.04-2.32 | 0.00 |
| | Center | 0.85 | 0.79-0.9 | 0.00 |
| | South | 0.69 | 0.65-0.74 | 0.00 |
| | The Islands | 0.25 | 0.23-0.28 | 0.00 |
| **BMI** | Normal | 1 | | |
| | Underweight | 0.95 | 0.83-1.08 | 0.42 |
| | Overweight | 0.95 | 0.83-1.08 | 0.44 |
| | Obese | 0.89 | 0.77-1.03 | 0.12 |
| **Carbonated drinks consumption (excluding water)** | More than 1L/day | 1 | | |
| | From 1/2L to 1L/day | 1.03 | 0.79-1.35 | 0.82 |
| | Less than 1/2L day | 1.01 | 0.78-1.,29 | 0.96 |
| | Occasionally | 0.99 | 0.78-1.26 | 0.96 |
| | Less than occasionally | 1.16 | 0.91-1.48 | 0.24 |
| **Alcohol consumption** | No | 1 | | |
| | Yes | 1.12 | 1.06-1.17 | 0.00 |
| **Consumption of vegetables** | More than once a day | 1 | | |
| | Once a day | 1.00 | 0.94-1.06 | 0.91 |
| | Sometimes a week | 0.99 | 0.93-1.06 | 0.79 |
| | Less than once a week | 0.97 | 0.88-1.07 | 0.56 |
| | Never | 0.99 | 0.85-1.14 | 0.88 |
| **Consumption of snacks** | More than once a day | 1 | | |
| | Once a day | 1.13 | 0.85-1.52 | 0.4 |

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| | | | |
|---|---|---|---|
| Sometimes a week | 0.94 | 0.72-1.22 | 0.63 |
| Less than once a week | 1.03 | 0.79-1.34 | 0.84 |
| Never | 0.99 | 0.76-1.29 | 0.92 |

We then performed a multilevel regression analysis with perceived health status as the main outcome (Table 3) and possible variables that were independently associated: consumption of tap water showed no statistically significant association (OR=0.93, C.I. 0.99-1.12) with satisfying perceived health status. This perception showed a decreasing trend of likelihood with age increase, and it reached statistical significance all among different age classes (20-44, OR=0.65, C.I. 0.49-0.87; 45-59, OR=0.34, C.I. 0.25-0.45; 60-74, OR=0.21, C.I. 0.16-0.28; ≥75 OR=0.12, C.I. 0.09-0.16). The same decreasing trend has been found regarding lower levels of education but only people with middle school diploma (OR=0.89, C.I. 0.81-0.98) and with elementary school diploma/none diploma (OR=0.66, C.I. 0.59-0.74) reached statistical significance. A low likelihood of a satisfying perceived health status has been found also with a decreasing availability of economic resources in the last 12 months, particularly for people who declared few resources (OR=0.51, C.I. 0.39-0.66) and insufficient (OR=0.33, C.I. =0.25-0.44). Again, self-perceived health status was worse in Central, Southern and island regions (OR=0.87, C.I. 0.8-0.95; OR=0.8, C.I. 0.74-0.87; OR=0.74, C.I: =0.67-0.82), as well as in underweight people (OR=0.69, C.I. 0.58-0.82), overweight (OR=0.91, C.I. 0.86-0.97) and obese people (OR=0.61 C.I. 0.56-0.66) with respect to normal weight subjects. Regarding consumption of carbonated drinks (excluding water) compared to those who declared to consume more than 1 liter per day, all other subjects showed a positive association trend with perceived health status that reached statical significance for people who declared a consumption from 1/2L to 1L/day (OR=1.41, C.I. 1.01-1.96) and an occasional consumption (OR=1.41, C.I. 1.06-1.87); as well, the presence of alcohol consumption was found to be positively associated with perceived health status (OR=1.33, C.I. 1.25-1.42). Considering the assumption of vegetables and consumption of snacks the likelihood of association with a satisfying perceived health status showed opposite trends since the lower the assumption of vegetables the lowest odds of association and this resulted to be significant for "less than once a week" (OR=0.77, C.I. 0.68-0.88) and "never" (OR=0.71, C.I. 0.6-0.86), while the lower the consumption of snacks, compared with those who declare consumption "more than once a day", the highest odds of associations with a statistical significance all among classes of assumption ("Once a day" OR=1.,46 C.I. 1.04-2.07; "Sometimes a week" OR=1.,91 C.I. 1.4-2.59; Less than once a week OR=1.,93 C.I. 1.43-2.63; Never OR=1.,84 C.I. 1.35-2.5).

**Table 3.** Factors associated with a satisfactory Self-perceived health status at logistic regression analysis.

| Variables | | OR | 95% CI | p-value |
|---|---|---|---|---|
| **Tap Water consumption** | No | 1 | | |
| | Yes | 1.05 | 0.99-1.12 | 0.07 |
| **Sex** | Males | 1 | | |
| | Females | 0.84 | 0.79-0.89 | 0.00 |
| **Age** | <20 | 1 | | |
| | 20-44 | 0.65 | 0.49-0.87 | 0.00 |
| | 45-59 | 0.34 | 0.25-0.45 | 0.00 |
| | 60-74 | 0.21 | 0.16-0.28 | 0.00 |
| | ≥75 | 0.12 | 0.09-0.16 | 0.00 |
| **Educational level** | Graduate/Post-graduate degree | 1 | | |
| | High School diploma | 0.95 | 0.87-1.05 | 0,3 |
| | Middle school diploma | 0.89 | 0.81-0.98 | 0,02 |
| | Elementary school diploma/none | 0.66 | 0.59-0.74 | 0.00 |

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| | | | | |
|---|---|---|---|---|
| **Economical resources in last 12 months** | Optimal | 1 | | |
| | Adequate | 1.02 | 0.79-1.32 | 0,87 |
| | Scarse | 0.51 | 0.39-0.66 | 0.00 |
| | Inadequate | 0.33 | 0.25-0.44 | 0.00 |
| **Concern about waste production** | No | 1 | | |
| | Yes | 1.07 | 1.01-1.13 | 0,02 |
| **Concern about climate change** | No | 1 | | |
| | Yes | 1.02 | 0.97-1.08 | 0,42 |
| **Geographical Area of residency** | North-West | 1 | | |
| | North-East | 1.04 | 0.95-1.13 | 0,41 |
| | Center | 0.87 | 0.8-0.95 | 0.00 |
| | South | 0.8 | 0.74-0.87 | 0.00 |
| | Islands | 0.74 | 0.67-0.82 | 0.00 |
| **BMI** | Normal | 1 | | |
| | Underweight | 0.69 | 0.58-0.82 | 0.00 |
| | Overweight | 0.91 | 0.86-0.97 | 0,01 |
| | Obese | 0.61 | 0.56-0.66 | 0.00 |
| **Carbonated drinks consumption (excluding water)** | More than 1L/day | 1 | | |
| | From 1/2L to 1L/day | 1.41 | 1.01-1.96 | 0,04 |
| | Less than 1/2L day | 1.35 | 1-1.83 | 0,05 |
| | Occasionally | 1.41 | 1.06-1.87 | 0,02 |
| | Less than occasionally | 1.32 | 0.98-1.77 | 0,06 |
| | No | 1.25 | 0.94-1.67 | 0,12 |
| **Alcohol consumption** | No | 1 | | |
| | Yes | 1.33 | 1.25-1.42 | 0.00 |
| **Consumption of vegetables** | More than once a day | 1 | | |
| | Once a day | 0.98 | 0.9-1.06 | 0,57 |
| | Sometimes a week | 0.93 | 0.85-1 | 0,06 |
| | Less than once a week | 0.77 | 0.68-0.88 | 0 |
| | Never | 0.71 | 0.6-0.86 | 0 |
| **Consumption of snacks** | More than once a day | 1 | | |
| | Once a day | 1.46 | 1.04-2.07 | 0,03 |
| | Sometimes a week | 1.91 | 1.4-2.59 | 0.00 |
| | Less than once a week | 1.93 | 1.43-2.63 | 0.00 |
| | Never | 1.84 | 1.35-2.5 | 0.00 |

We then performed a multilevel regression analysis with obesity as the main outcome (Table 4) and possible variables that were independently associated: consumption of TW showed a statistically significant low likelihood association (OR=1.05, C.I. 0.86-0.99) of being obese. The obese status also showed an increasing trend of likelihood with aging, and it reached statistical significance among all different age classes (20-44 years, OR=1.71, C.I. 1.15-2.54; 45-59, OR=2.31, C.I. 1.56-3.42; 60-74, OR=2.64, C.I. 1.77-3.91; ≥75 OR=1.93, C.I. 1.28-2.9). The same trend has been found regarding lower levels of education statistically significant for high school diplomas (OR=1.39, C.I. 1.23-1.57), middle school diplomas (OR=1.5, C.I. 1.32-1.7), and elementary school diploma/none diploma (OR=1.69, C.I. 1.46-1.95). A low likelihood of satisfaction with self-perceived health status has been found also with a decreasing availability of economic resources in the last 12 months, particularly for people who declared few resources (OR=0.51, C.I. 0.39-0.66) and insufficient (OR=0.33, C.I. =0.25-0.44). An increasing trend of association for being obese in southern parts of Italy, compared to northern ones, has been found but only the south geographical area reached a statically significant association (OR=1.14, C.I. 1.04-1.26). A satisfying perceived health status was negatively associated with the

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likelihood of being obese (OR=0.68, C.I. 0.62-0.73) as well as alcohol consumption (OR=0.89, C.I. 0.82-0.96). Regarding consumption of carbonated drinks (excluding water) compared to those who declared to consume more than 1 liter per day, all other subjects showed a negative association trend with being obese but none of the classes reached statical significance. Considering the assumption of vegetables and consumption of snacks the likelihood of association with being obese showed opposite trends since the lower the assumption of vegetables the highest odds of association, while the lower the consumption of snacks, compared with those who declare consumption "more than once a day", the lowest odds of associations. However, the association for vegetables and snacks did not reach statistical significance for any of the classes of consumption.

**Table 4.** Factors associated with obese BMI at logistic regression analysis.

| Variables | | OR | CI 95% | p-value |
|---|---|---|---|---|
| **Tap Water consumption** | No | 1 | | |
| | Yes | 0.93 | 0.86-0.99 | 0.03 |
| **Sex** | Males | 1 | | |
| | Females | 1.07 | 1.00 -1.16 | 0.05 |
| **Age** | <20 | 1 | | |
| | 20-44 | 1.71 | 1.15-2.54 | 0.01 |
| | 45-59 | 2.31 | 1.56-3.42 | 0.00 |
| | 60-74 | 2.64 | 1.77-3.91 | 0.00 |
| | ≥75 | 1.93 | 1.28-2.9 | 0.01 |
| **Educational level** | Graduate/Post-graduate | | | |
| | High School diploma | 1.39 | 1.23-1.57 | 0.00 |
| | Middle school diploma | 1.5 | 1.32-1.7 | 0.00 |
| | Primary school diploma/none | 1.69 | 1.46-1.95 | 0.00 |
| **Economical resources in last 12 months** | Optimal | 1 | | |
| | Adequeate | 0.91 | 0.67-1.24 | 0.57 |
| | Scarse | 1.02 | 0.75-1.4 | 0.9 |
| | Inadequate | 1.03 | 0.73-1.47 | 0.84 |
| **Concern about waste production** | No | 1 | | |
| | Yes | 1.04 | 0.97-1.12 | 0.24 |
| **Concern about climate change** | No | 1 | | |
| | Yes | 1.01 | 0.94-1.08 | 0.77 |
| **Geographical Area of residence** | North-West | 1 | | |
| | North-East | 1.06 | 0-95-1.18 | 0.28 |
| | Center | 0.97 | 0.87-1.08 | 0.56 |
| | South | 1.14 | 1.04-1.26 | 0.01 |
| | The Islands | 1.07 | 0.94-1.22 | 0.285 |
| **Carbonated drinks consumption (excluding water)** | More than 1L/day | 1 | | |
| | From 1/2L to 1L/day | 0.81 | 0.55 - 1.2 | 0.29 |
| | Less than 1/2L day | 0.93 | 0.66- 1.32 | 0.69 |
| | Occasionally | 0.91 | 0.65 -1.27 | 0.57 |
| | Less than occasionally | 0.73 | 0.52-1.04 | 0.08 |
| | No | 0.75 | 0.54-1.06 | 0.103 |
| **Alcohol consumption** | No | 1 | | |
| | Yes | 0.89 | 0.82-0.96 | 0.00 |
| **Consumption of vegetables** | More than once a day | 1 | | |
| | Once a day | 0.97 | 0.87-1.07 | 0.5 |

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| | | | | |
|---|---|---|---|---|
| | Sometimes a week | 0.95 | 0.86-1.05 | 0.3 |
| | Less than once a week | 1.01 | 0.87-1.18 | 0.88 |
| | Never | 1.17 | 0.93-1.47 | 0.18 |
| **Consumption of snacks** | More than once a day | 1 | | |
| | Once a day | 1.2 | 0.76-1.88 | 0.43 |
| | Sometimes a week | 1.02 | 0.68-1.54 | 0.92 |
| | Less than once a week | 1.01 | 0.67-1.51 | 0.98 |
| | Never | 0.93 | 0.61-1.39 | 0.71 |
| **Self-perceived health status** | Satisfactory | 1 | | |
| | Not satisfactory | 0.68 | 0.62-0.73 | 0.00 |

## 4. Discussion

Safe drinking water represents a worldwide major concern because of several factors such as pollution and climate change that are heavily impacting human health all around the globe, in particular, among residents of developing countries. Impacts on surface water and groundwater resources and water-related illnesses are increasing, especially under changing climate scenarios such as diversity in rainfall patterns, increasing temperature, flash floods, severe droughts, heat waves, and heavy precipitation [21]. Recently, it has been shown a link between health and environmental impacts and drinking water choices, since it has been estimated that the environmental impact of BW is 1400-3500 higher than TW[22]. On the other hand, BW consumption has sharply increased in the last years worldwide [23] and interestingly the recent increase in BW use globally has been driven by an increase in demand in low- and middle-income countries (LMICs), despite parallel increases in access to piped water in some countries [24]. To better understand these trends, it's extremely important to study possible variables associated with increased trap water consumption that can allow policy decision-makers to take adequate actions. Our study fits in this contest since we investigated several demographic and socioeconomic variables that can be associated with increased consumption of TW. Unlike other studies[13,14] our regression model does not observe a statistically significant association of TW consumption with sex; on the other hand, regarding age, the younger the age classes were less likely TW consumers, in particular people aged 20-44 years old. This result agrees with other studies [12]. Interestingly, lower levels of schooling compared to graduate/post-graduate level, showed a reduced frequency of TW consumption and this is partially in disagreement with other findings [25]. It is possible that in our country, people with higher levels of schooling have an increased awareness about the safety and importance of consuming TW also for environmental issues, as testified by our result in terms of the presence of concern about waste production since we found a statistically significant association of increased likelihood of TW consumption for this variable. So, generally speaking, an increased level of knowledge may be associated with increased awareness and environmentally friendly behaviors. It must be highlighted that concern for climate change showed a similar trend, but it did not reach statistical significance in terms of association of TW assumption, indicating a complex scenario in terms of knowledge of environmental issues by the general population. An important consideration regards the Geographical area of residency: in the regression model we observed a statistically significant difference among different geographical areas and we found a decreasing trend of TW consumption from North to South, particularly evident on the Islands where there is the lowest likelihood of TW consumption. This result may be explained by the lower presence of natural water sources between the Northern and the Southern parts of Italy, especially for islands like Sicily and Sardinia where water is particularly scarce(Fresh Water Resources - Italy - Climatechangepost.Com).

Looking at health outcomes we focused on the perceived health status declared by subjects and we studied possible association with a positive attitude and consumption of TW together with other variables included in the logistic model. Even if TW assumption showed an increased likelihood of association with a satisfying perceived health status, the association did not reach statistical significance. On the other hand, other variables showed a coherent association in agreement also with

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studies conducted by others since the likelihood of perceiving a satisfying health status decreases with age[27], with underweight or overweight/obese BMI classes[28], with lower availability of economic resources[29] and lower levels of education[30], [31]. Moreover, we found a worsening perception of own health status from North to south as found by others[32], [33]. Also, consumption of snacks and consumption of vegetables showed interesting trends with a low likelihood of a satisfying perceived health status associated with lowering the assumption of vegetables that reached statical significance for the lowest ones identified as "less than once a week" and "never". Regarding the consumption of snacks, we found that the lowest classes of assumption of this type of food were associated with an increased likelihood of perceived satisfying health status that resulted to be statistically significant all among the several classes compared to the baseline of subjects who declared a consumption of more than "once a day". Both results are in accordance with other studies[34], [35]. Regarding others liquid intake besides TW, a decreasing consumption of carbonated drinks, compared to those who declared an assumption of more than 1L/day, showed a positively associated trend to an increased likelihood of a satisfying perceived health status, resulting particularly significant for the "occasionally" class of consumption in agreement with other works that found an association with depression and low perceived health status [36], [37]. Taken together, these considerations may allow us to speculate that the model proposed describes quite accurately the reality of variables independently associated with a satisfying perceived health level including consumption of TW that showed a positive likelihood of association even if not statically significant.

Looking at BMI we found that consumption of TW showed a possible protective effect for being obese. This could be explained by the fact that individuals who prefer to consume TW are more likely to have both a healthier lifestyle and lower consumption of refined, carbonated, and sugary beverages[17], [38] which are responsible for weight gain[39], cardiovascular issues[40], diabetes[41] and overall poorer glycemic control[42]. Also, this model showed coherent associations with other independent variables that have been confirmed by other studies since we found an increased likelihood of being obese with aging[43], [44], with lower educational level[44], [45], and for those subjects with a geographical area of residency in the southern parts of Italy[46].

To our knowledge, this is the first study in Italy, to take into consideration the consumption of TW and possible sociodemographic variables associated and health outcomes such as perceived health status and BMI. Moreover, our data cover a nationwide sample of thousands of subjects, and interviews and data collection are conducted under rigorous methodological methods since they have been carried out by ISTAT-trained personnel.

Nevertheless, some limitations should be acknowledged. Given the nature of this study, as a prevalence study rather than a longitudinal one, certain details regarding individuals' dietary habits might lack precision. This is testified, for example, by the absence of the exact amount of TW consumption that could have been more informative about water attitudes. Also, we did not have specific information on possible specific pathological conditions, that could have been associated with the assumption of TW, but only aggregated variables like the perceived health status that we used in our models. Moreover, all data must be considered declarative generating a possible declarative or recall bias in our sample. Lastly, it's important to note that the official language of ISTAT, the government institution conducting the survey, is Italian. The survey administration was not declared in other languages, which may have resulted in a selection bias. This bias could have excluded individuals, even residents in Italy, who did not fully understand the Italian language.

## 5. Conclusions

Taken together, our data show very informative results that can be very useful in terms of public health. For example, increasing education about the importance of TW consumption may improve this aspect among those lower educated people who don't drink TW maybe for misleading beliefs about its safety and at the same time increase a probable low self-awareness about the importance of plastic-free water consumption for the environmental issues that are related to BW production and distribution. Moreover, the increasing number of people accessing safe TW can be considered as a "One Health" approach since through the administration of a fundament health element and right

such as drinkable free water, a nation can obtain important results on other several aspects like environmental issues, economic and social equality. TW water can also influence health outcomes both perceived and objective ones, and more studies are needed to explore this possible correlation that may help health policymakers to better design health promotion campaigns and prevention strategies aimed at reducing health inequalities that may be obtained also through a promotion of TW consumption.

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**Informed Consent Statement:** Informed consent was obtained from all subjects involved in the study.

**Data Availability Statement:** The data undergo anonymization and aggregation by ISTAT and are subsequently made publicly accessible for research purposes at the following link:. https://www.istat.it/it/archivio/129956

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## References

1. WHO, "Drinking-water." Accessed: Jun. 05, 2023. [Online]. Available: https://www.who.int/news-room/fact-sheets/detail/drinking-water
2. A. du Plessis, "Current and Future Water Scarcity and Stress," *Springer Water*, pp. 13–25, 2019, doi: 10.1007/978-3-030-03186-2_2/COVER.
3. M. Cole, P. Lindeque, C. Halsband, and T. S. Galloway, "Microplastics as contaminants in the marine environment: A review," *Mar Pollut Bull*, vol. 62, no. 12, pp. 2588–2597, Dec. 2011, doi: 10.1016/J.MARPOLBUL.2011.09.025.
4. C. M. Free, O. P. Jensen, S. A. Mason, M. Eriksen, N. J. Williamson, and B. Boldgiv, "High-levels of microplastic pollution in a large, remote, mountain lake," *Mar Pollut Bull*, vol. 85, no. 1, pp. 156–163, Aug. 2014, doi: 10.1016/J.MARPOLBUL.2014.06.001.
5. N. Horowitz, J. Frago, and D. Mu, "Life cycle assessment of bottled water: A case study of Green2O products," *Waste Management*, vol. 76, pp. 734–743, Jun. 2018, doi: 10.1016/J.WASMAN.2018.02.043.
6. E. Danopoulos, M. Twiddy, and J. M. Rotchell, "Microplastic contamination of drinking water: A systematic review," *PLoS One*, vol. 15, no. 7, p. e0236838, Jul. 2020, doi: 10.1371/JOURNAL.PONE.0236838.
7. Arnold Emily and Larsen Janet, "Plan B Updates - 51: Bottled Water - Pouring Resources Down the Drain | EPI." Accessed: Jun. 06, 2023. [Online]. Available: https://www.earth-policy.org/plan_b_updates/2006/update51
8. R. Geerts *et al.*, "Bottle or tap? Toward an integrated approach to water type consumption," 2020, doi: 10.1016/j.watres.2020.115578.
9. L. J. Debbeler, M. Gamp, M. Blumenschein, D. Keim, and B. Renner, "Polarized but illusory beliefs about tap and bottled water: A product- and consumer-oriented survey and blind tasting experiment," *Science of The Total Environment*, vol. 643, pp. 1400–1410, Dec. 2018, doi: 10.1016/J.SCITOTENV.2018.06.190.
10. P. W. Ballantine, L. K. Ozanne, and R. Bayfield, "Why Buy Free? Exploring Perceptions of Bottled Water Consumption and Its Environmental Consequences," *Sustainability 2019, Vol. 11, Page 757*, vol. 11, no. 3, p. 757, Feb. 2019, doi: 10.3390/SU11030757.
11. M. F. Doria, "Bottled water versus tap water: understanding consumers' preferences," *J Water Health*, vol. 4, no. 2, pp. 271–276, Jun. 2006, doi: 10.2166/WH.2006.0023.
12. A. Y. Rosinger and S. L. Young, "In-Home Tap Water Consumption Trends Changed Among U.S. Children, but Not Adults, Between 2007 and 2016," *Water Resour Res*, vol. 56, no. 7, p. e2020WR027657, Jul. 2020, doi: 10.1029/2020WR027657.
13. A. Saylor, L. S. Prokopy, and S. Amberg, "What's wrong with the tap? Examining perceptions of tap water and bottled water at Purdue University," *Environ Manage*, vol. 48, no. 3, pp. 588–601, Sep. 2011, doi: 10.1007/S00267-011-9692-6/TABLES/6.

14. E. C. Anadu and A. K. Harding, "Risk Perception and Bottled Water Use," *J Am Water Works Assoc*, vol. 92, no. 11, pp. 82–92, Nov. 2000, doi: 10.1002/J.1551-8833.2000.TB09051.X.
15. O. S. Juba and V. I. Tanyanyiwa, "Perceptions on the use of bottled water in restaurants in Harare's Central Business District (CBD)," *Physics and Chemistry of the Earth, Parts A/B/C*, vol. 105, pp. 239–246, Jun. 2018, doi: 10.1016/J.PCE.2017.12.003.
16. WHO, "Increased drinking-water consumption brings gains for health and the environment." Accessed: Dec. 06, 2023. [Online]. Available: https://www.who.int/europe/news/item/19-03-2020-increased-drinking-water-consumption-brings-gains-for-health-and-the-environment
17. G. D. Moreno *et al.*, "A cluster-randomized controlled trial of an elementary school drinking water access and promotion intervention: Rationale, study design, and protocol," *Contemp Clin Trials*, vol. 101, p. 106255, Feb. 2021, doi: 10.1016/J.CCT.2020.106255.
18. J. Dolcini, E. Ponzio, A. Campanati, M. M. D'Errico, and P. Barbadoro, "Gender, Socioeconomic and Health Characteristics Associated to Dermatological visits in Italy: secondary Analysis of a National Cross-Sectional Survey," *Dermatology*, pp. 1–6, Sep. 2023, doi: 10.1159/000534223.
19. J. Dolcini, E. Ponzio, M. M. D'Errico, and P. Barbadoro, "Socioeconomic differences in dietary habits in Italy before and during COVID-19 pandemic: secondary analysis of a nationwide cross-sectional study," *BMC Public Health*, vol. 24, no. 1, pp. 1–10, Dec. 2024, doi: 10.1186/S12889-023-17530-6/FIGURES/4.
20. "Aspects of daily life: public use micro.stat files." Accessed: Oct. 31, 2023. [Online]. Available: https://www.istat.it/en/archivio/129959
21. T. Ahmed, M. Zounemat-Kermani, and M. Scholz, "Climate Change, Water Quality and Water-Related Challenges: A Review with Focus on Pakistan," *International Journal of Environmental Research and Public Health 2020, Vol. 17, Page 8518*, vol. 17, no. 22, p. 8518, Nov. 2020, doi: 10.3390/IJERPH17228518.
22. C. M. Villanueva, M. Garfí, C. Milà, S. Olmos, I. Ferrer, and C. Tonne, "Health and environmental impacts of drinking water choices in Barcelona, Spain: A modelling study," *Science of The Total Environment*, vol. 795, p. 148884, Nov. 2021, doi: 10.1016/J.SCITOTENV.2021.148884.
23. J. G. Rodwan, "Bottled water 2017," *bottledwater.org JGJ Rodwan Staying Strong: US and International Developments and Statistics, 2017•bottledwater.org*, 2018, Accessed: Aug. 02, 2023. [Online]. Available: https://www.bottledwater.org/wp-content/uploads/2020/03/BMC2016_BWR_StatsArticle.pdf
24. A. Cohen and I. Ray, "The global risks of increasing reliance on bottled water," *Nature Sustainability 2018 1:7*, vol. 1, no. 7, pp. 327–329, Jul. 2018, doi: 10.1038/s41893-018-0098-9.
25. K. K. Kuok and P. C. Chiu, "Indigenous drinking-water consumption pattern of residents in Kuching city: results of a pilot study," *Journal of Water, Sanitation and Hygiene for Development*, vol. 8, no. 4, pp. 817–824, Dec. 2018, doi: 10.2166/WASHDEV.2018.004.
26. "Fresh water resources - Italy - Climatechangepost.com." Accessed: Aug. 02, 2023. [Online]. Available: https://www.climatechangepost.com/italy/fresh-water-resources/
27. C. Giacomozzi *et al.*, "The Perceived Health Status from Young Adults to Elderly: Results of the MEHM Questionnaire within the CUORE Project Survey 2008–2012," *International Journal of Environmental Research and Public Health 2020, Vol. 17, Page 6160*, vol. 17, no. 17, p. 6160, Aug. 2020, doi: 10.3390/IJERPH17176160.
28. J. Narciso and N. Croome, "How does body mass index impact self-perceived health? A pan-European analysis of the European Health Interview Survey Wave 2," *BMJ Nutr Prev Health*, vol. 5, no. 2, p. 235, Oct. 2022, doi: 10.1136/BMJNPH-2022-000439.
29. C. Cialani and R. Mortazavi, "The effect of objective income and perceived economic resources on self-rated health," *Int J Equity Health*, vol. 19, no. 1, pp. 1–12, Dec. 2020, doi: 10.1186/S12939-020-01304-2/TABLES/5.
30. T. Faresjö and M. Rahmqvist, "Educational level is a crucial factor for good perceived health in the local community," *https://doi.org/10.1177/1403494810374676*, vol. 38, no. 6, pp. 605–610, Jul. 2010, doi: 10.1177/1403494810374676.
31. A. N. Shaaban, M. R. O. Martins, and B. Peleteiro, "Factors associated with self-perceived health status in Portugal: Results from the National Health Survey 2014," *Front Public Health*, vol. 10, p. 879432, Sep. 2022, doi: 10.3389/FPUBH.2022.879432/BIBTEX.
32. F. Toth, "How health care regionalisation in Italy is widening the North–South gap," *Health Econ Policy Law*, vol. 9, no. 3, pp. 231–249, 2014, doi: 10.1017/S1744133114000012.
33. S. Bruzzi, E. Ivaldi, and M. Santagata, "Measuring Regional Performance in the Italian NHS: Are Disparities Decreasing?," *Soc Indic Res*, vol. 159, no. 3, pp. 1057–1084, Feb. 2022, doi: 10.1007/S11205-021-02775-8/TABLES/9.
34. E. Hrezova, M. Bobak, N. Capkova, D. Stefler, and H. Pikhart, "Low fruit and vegetable intake is associated with poor self-rated health in the Czech part of the HAPIEE study," *https://doi.org/10.1177/02601060211069209*, vol. 29, no. 2, pp. 269–276, Dec. 2021, doi: 10.1177/02601060211069209.

35. D. K. Goodwin, L. L. Knol, J. M. Eddy, E. C. Fitzhugh, O. W. Kendrick, and R. E. Donahue, "The Relationship between Self-Rated Health Status and the Overall Quality of Dietary Intake of US Adolescents," *J Am Diet Assoc*, vol. 106, no. 9, pp. 1450–1453, Sep. 2006, doi: 10.1016/j.jada.2006.06.011.
36. J. M. Kim and E. Lee, "Association between Soft-Drink Intake and Obesity, Depression, and Subjective Health Status of Male and Female Adults," *Int J Environ Res Public Health*, vol. 18, no. 19, p. 10415, Oct. 2021, doi: 10.3390/IJERPH181910415.
37. L. Lien, N. Lien, S. Heyerdahl, M. Thoresen, and E. Bjertness, "Consumption of Soft Drinks and Hyperactivity, Mental Distress, and Conduct Problems Among Adolescents in Oslo, Norway," *https://doi.org/10.2105/AJPH.2004.059477*, vol. 96, no. 10, pp. 1815–1820, Oct. 2011, doi: 10.2105/AJPH.2004.059477.
38. A. C. Reese *et al.*, "Use of a Water Filter at Home Reduces Sugary Drink Consumption among Parents and Toddlers in Predominantly Hispanic Community: Results From the Water Up!@ Home Intervention Trial," *J Acad Nutr Diet*, vol. 123, no. 1, p. 41, Jan. 2023, doi: 10.1016/J.JAND.2022.06.006.
39. R. González-Morales *et al.*, "Soft drink intake is associated with weight gain, regardless of physical activity levels: The health workers cohort study," *International Journal of Behavioral Nutrition and Physical Activity*, vol. 17, no. 1, pp. 1–10, May 2020, doi: 10.1186/S12966-020-00963-2/FIGURES/1.
40. A. Narain, C. S. Kwok, and M. A. Mamas, "Soft drinks and sweetened beverages and the risk of cardiovascular disease and mortality: a systematic review and meta-analysis," *Int J Clin Pract*, vol. 70, no. 10, pp. 791–805, Oct. 2016, doi: 10.1111/IJCP.12841.
41. L. Torres-Ibarra *et al.*, "Regular consumption of soft drinks is associated with type 2 diabetes incidence in Mexican adults: findings from a prospective cohort study," *Nutr J*, vol. 19, no. 1, pp. 1–10, Dec. 2020, doi: 10.1186/S12937-020-00642-9/TABLES/3.
42. M. M. de Moraes, M. F. F. Mediano, R. A. G. de Souza, A. S. Moura, G. V. da Veiga, and R. Sichieri, "Discouraging soft drink consumption reduces blood glucose and cholesterol of Brazilian elementary students: Secondary analysis of a randomized controlled trial," *Prev Med (Baltim)*, vol. 100, pp. 223–228, Jul. 2017, doi: 10.1016/J.YPMED.2017.04.035.
43. Craig M. Hales, Margaret D. Carroll, Cheryl D. Fryar, and Cynthia L. Ogden, "NCHS Data Brief ■ No. 360 ■ February 2020." Accessed: Jan. 19, 2024. [Online]. Available: https://www.cdc.gov/nchs/products/databriefs/db360.htm
44. C. Donfrancesco *et al.*, "Trends of overweight, obesity and anthropometric measurements among the adult population in Italy: The CUORE Project health examination surveys 1998, 2008, and 2018," *PLoS One*, vol. 17, no. 3, Mar. 2022, doi: 10.1371/JOURNAL.PONE.0264778.
45. C. A. Monteiro, W. L. Conde, and B. M. Popkin, "Independent Effects of Income and Education on the Risk of Obesity in the Brazilian Adult Population," *J Nutr*, vol. 131, no. 3, pp. 881S-886S, Mar. 2001, doi: 10.1093/JN/131.3.881S.
46. S. Gallus *et al.*, "Overweight and obesity prevalence and determinants in Italy: An update to 2010," *Eur J Nutr*, vol. 52, no. 2, pp. 677–685, Mar. 2013, doi: 10.1007/S00394-012-0372-Y/TABLES/3.