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## Fluid intake in Spanish children and adolescents; a cross-sectional study

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### Abstract

**Introduction:** Some studies demonstrated that dehydration process is prevalent among young populations and subsequently, a cause of concern. However, the evaluation of the fluid consumption pattern of children and adolescent populations has not been widely assessed.

**Objective:** To evaluate the total fluid intake from different types of beverages in Spanish children and adolescents.

**Methods:** A total of 238 children and adolescents aged 3-17 years were randomly recruited from all Spanish regions. The information about the quantity and quality of daily fluid intake from different types of beverages was collected using a 24 h fluid-specific diary over 7 consecutive days.

**Results:** Fluid intake was < 80% of the EFSA recommendations in 87% of the study population. In our sample, water was the main contributor to fluid intake, followed by milk and derivatives and sweet regular beverages. No differences in consumption patterns were found according to gender. Consumption of hot beverages as well as sweet regular and sweet light beverages increased with age, while milk and milk derivatives consumption decreased.

**Conclusion:** The large majority of our young population did not meet the EFSA recommendations for total water intake. Therefore, an increase in plain water consumption in children and adolescents should be promoted in order to fulfill the fluid needs without increasing calorie intake.

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Key words: Fluid intake. Spain. Beverages. Water. Children. Adolescents.

### INGESTA DE LÍQUIDOS A PARTIR DE BEBIDAS EN NIÑOS Y ADOLESCENTES ESPAÑOLES; ESTUDIO TRANSVERSAL

#### Resumen

**Introducción:** Diversos estudios han mostrado que el proceso de deshidratación tiene lugar en población infantil y adolescente, y por ello, son causa de preocupación. Sin embargo, los patrones de consumo de líquidos en poblaciones infantil y adolescente no han sido estudiados en profundidad.

**Objetivos:** Evaluar la ingesta de líquidos total a partir de distintos tipos de bebidas en niños y adolescentes españoles.

**Métodos:** Un total de 238 niños y adolescentes de entre 3 y 17 años de edad fueron reclutados aleatoriamente en las distintas regiones españolas. La información sobre la cantidad y calidad de la ingesta diaria de líquidos se recogió mediante un registro de 24 horas específico para la evaluación de fluidos durante 7 días consecutivos.

**Results:** La ingesta de líquidos estuvo por debajo del 80% de las recomendaciones de la EFSA en el 87% de la población de estudio. En el presente estudio el agua fue la principal fuente de líquidos, seguida de la leche y derivados y de las bebidas azucaradas. No se encontraron diferencias significativas en los patrones de consumo entre géneros. El consumo de bebidas calientes, bebidas azucaradas y edulcoradas incrementó con la edad, mientras que el consumo de leche y derivados disminuyó.

**Conclusion:** La gran mayoría de nuestra población no cumplió con las recomendaciones de la EFSA sobre la ingesta total de agua. Por ello, se debería promover un aumento en el consumo de agua en niños y adolescentes, para poder satisfacer las necesidades de líquidos sin aumentar la ingesta calórica.

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Palabras clave: Ingesta de líquidos. España. Bebidas. Agua. Niños. Adolescentes.

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## Introduction

Ensuring a good hydration status is essential for adequate body functions. Dehydration is associated with some symptoms linked to mental and physical performance<sup>1</sup>. Fluid needs vary in humans according to several factors. Age, body size and perspiration (affected among other factors by air temperature and intensity of physical exercise) are the main determinants of fluid needs<sup>1</sup>.

Childhood and adolescence are crucial periods of life from a nutritional point of view due to the growth and development<sup>2</sup>. Some studies demonstrated that dehydration process is prevalent among young populations and subsequently, a cause of concern<sup>3,4</sup>. During childhood and adolescence, an appropriate level of hydration can be achieved with a wide range of total water intakes because of homeostatic control mechanisms<sup>1</sup>. This large variability of the population needs complicates the establishment of fluid intake recommendations for the general public.

There are well established dietary requirements intakes for most essential nutrients<sup>5</sup>. In Europe, EFSA established recommendations on total water intake (water coming from food and fluids) based on water balance, i.e. water intake calculated in surveys through dietary recalls, minus the average water losses obtained from urine collection during the next 24 hours<sup>1</sup>. However, the basis to establish the recommendations is often different between organisms. For instance, in US, the method to recommend total water intake is based on the median of a defined population group<sup>6</sup>. The methods used in surveys to estimate total water intake and fluid intake (drinking water and all other beverages) in European children are not comparable and underreporting seems to be frequent<sup>1</sup>. International bodies have set guidelines for total water intake in young populations<sup>1</sup>. In Europe, the EFSA (European Food Safety Agency) panel established the reference values of total water intake for adolescents 14 years and older based in the adults needs. For children and adolescents younger than 14 years, 2,100 ml in boys 9 to 13 years old and 1,900 ml in girls 9 to 13 years old, should be apply, respectively. In children, boys and girls 4 to 8 years old, in boys 9 to 13 years old and in girls 9 to 13 years old, 1,300 mL/day, 1,700 mL/day and 1,520 mL/day, are the reference values established by this panel respectively<sup>1</sup>.

The sources of water are drinking water, other beverages, food moisture and water from substrate oxidation<sup>1</sup>. Fluids represent approximately 80% of total water intake in European diets, and 20% of the water comes from foods<sup>1</sup>. Based on 3 days food diary, in the Dortmund Nutritional and Anthropometric Longitudinally Designed study, the main sources of water intake for boys and girls 4 to 8 years-old were natural mineral water (13.1%), as much as milk (13.0%). For boys 9- to 13-year old, whose total water intake represented a mean of 1801ml/day, milk (9-17%) and natural mineral

water (12-15%) were the most important sources of total water intake. In all these groups, tap water was the least important source of water intake (2.6%, 3.3%, and 3.3%, respectively)<sup>7</sup>. In the Healthy Lifestyle in Europe by Nutrition in Adolescence Cross Sectional Study (HELENACSS), adolescents consumed an average of 1455 ml/day of fluids. Most of the adolescents consumed water (87.9%), representing as well the largest amount of fluid consumed per capita followed by sweet beverages.

Since three decades, the energy intake coming from sweetened beverages increased 135% in children and adolescents, along with the obesity rates (50%)<sup>8</sup>. The association between both observations does not imply a causal relationship. However, it seems to be relevant to evaluate if current levels of fluid consumption other than water, can lead to an excess of energy intake and may have further consequences in long-term health outcomes<sup>9</sup>. In fact, results based on the 2003-2004 National Health and Nutrition Examination Survey data in 3098 children and adolescents 2 to 19 years of age, suggested that replacing all SSBs with water would therefore result in an average net reduction of 235 kcal/d<sup>8</sup>. In this sense, plain water would be the healthiest option for hydration, as increasing water consumption is also proposed as strategy to reduce energy intake<sup>10</sup>.

There is an agreement about the relevance of an appropriate level of fluid intake in terms of health maintenance. However, the actual fluid or total water intake is not often reported in food or nutrient intake studies, whereas fluids should also be considered in dietary intake assessment.

Information on the fluid consumption patterns and their characteristics in young populations is very scarce. The aim of this paper was to investigate the quantity, the quality and the consumption span of the beverages ingested by individuals within the pediatric age range (from 3 to 17 years of age) according to sociodemographic characteristics.

## Methods

### *Design and study population*

The present paper is based on a Spanish cross-sectional study on fluid intake designed to assess all the sources of fluid consumption, from water to different types of beverages, and their association with lifestyle and health. The cross-sectional study took place between March and May 2012, and 1,922 participants were recruited by random selection from an existing Spanish database established for population surveys (all regions were included except Ceuta, Melilla and Canary Islands). This database is considered comparable to the Spanish population in terms of gender, age, region, socioeconomic level and habitat (urban vs rural). For the present study, only children and adoles-

cents 3 to 17 years old were taken into account ( $n = 420$ ). Participants reporting a mean fluid intake less than 0.4 L/day or more than 6 L/day, and those participants with missing data in the fluid intake questionnaire were excluded from the analyses ( $n = 182$ ). Therefore, the effective sample size for the current study was 238 participants (fig. 1).

### Assessment of fluid intake

Fluid intake was assessed using a 24-hours recall during 7 consecutive days. For children and adolescents  $\leq 14$  years old, parents proxy-reported the usual fluid intake. The questionnaire was delivered and explained during a first interview at the participant's home. After seven days, the filled questionnaire was collected and the interviewer checked for completeness. The participants recorded the moment of the fluid intake throughout the day, type, and volume of beverage using standard portion sizes (one standard serving, cup, glass, can, bottle, etc). The addition of sugar in each beverage was also evaluated (number of added tablespoons). There were eleven response categories to the question "moment of the beverage consumption": Just when you wake up, at breakfast, during the morning, just before lunch, at lunch, during the afternoon, just before dinner, at dinner, after dinner, just before going to bed, during the night. The intake of beverages *outside of the meals* was considered in whenever occasion different than breakfast, lunch and dinner.

The questionnaire items on fluids included: water (tap water, filtered tap water, natural mineral water, sparkling natural mineral water, flavoured water, foun-

tain water); hot beverages (coffee, coffee with milk, espresso with a drop of milk, cappuccino, tea, cereals made beverages, and others infusions and hot beverages); milk and milk products (milk, milkshakes, milkshakes with juice, liquid yogurt, other milk drinks); juices (organic juice, bottled juice, nectar, nectar without added sugar, other fruit drinks); sweet beverages regular (carbonated soft drinks (cola, orange, lemon, bitter, tonic water, other flavours), non-carbonated soft drinks (orange, lemon, sports drinks, energy drinks, ice tea regular, other flavours), other sugared soft drinks); sweet beverages light (diet carbonated soft drinks, (cola, orange, lemon, other flavours), diet non-carbonated soft drinks (orange, lemon, diet iced tea) other diet soft drinks); and alcoholic drinks (beer, alcohol-free beer, lemon beer, wine, wine with soda, alcoholic mixed drinks, other alcohol beverages). Fluid intake was defined as the sum of all these categories. The adequacy of fluid intake was based on the EFSA age and gender specific recommendations for total water intake after extracting 20% of the recommendation accounting for water in foods.

### Assessment of other variables and lifestyle factors

Leisure-time physical activity practice for more than thirty minutes was evaluated with a questionnaire, with four possible responses: five times a week or more, between three and four times a week, between one and two times a week and one time every two weeks or less. In addition, variables such as socioeconomic characteristics, region, habitat (urban or rural classification) and parental education level were also evaluated.

### Assessment of body composition

Height in metres (m) and weight in kilograms (kg) were evaluated with a self-reported questionnaire. Body Mass Index (BMI) was calculated (in  $\text{kg/m}^2$ ) and categorized following cut-off points according to the criteria of the International Obesity Task Force<sup>11</sup>.

### Statistical analysis

All the data are presented either as the mean and standard deviation (SD) for continuous variables or numbers and percentages for dichotomous variables. We compared the distribution of the selected characteristics between groups using  $\chi^2$  tests for categorical variables or student's t-tests or analysis of variance (ANOVA) as appropriate for the continuous variables. The Bonferroni post-hoc test was used to correct for multiple comparisons. Analyses were performed using the SPSS software version 20.0 (SPSS Inc, Chicago, IL). All statistical tests were two-tailed and the significance level was set at  $P < 0.05$ .

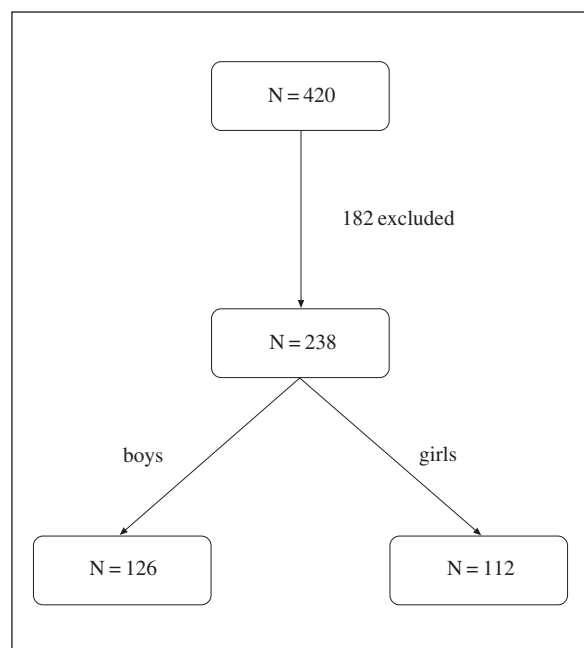


Fig. 1.—Flowchart of the study sample size.

## Results

The baseline characteristics of participants are summarized in table I. A total of 238 participants (126 boys and 112 girls) with a mean age of 9.2 years and recruited from 8 Spanish regions were included. No significant differences were observed in the proportion of individuals for different age categories, region, type of habitat and educational level between the study sample and the total Spanish general population. No gender differences were observed in the prevalence of age categories, region, habitat or socioeconomic level. 24.4% and 11.3% of the total sample was categorized as overweight and obese respectively. No gender differences were found for BMI classification. Most of the study population presented a middle socioeconomic status. The majority of the study population (60.5%) reported at least 3-4 times a week of leisure-time physical activities, being girls more sedentary than boys.

The mean total fluid volume consumed was 1,669 ml per day for whole population, 1,599 ml for girls and 1732 ml for boys (table II). Mean water consumed was 823 ml/day for whole population, 819 ml for girls and 827 ml for boys. Figure 2 shows the percentage of the population according to gender, consuming at least 100% or less of the EFSA recommendations for total water intake (age and gender specific values). 86.6% of the total study population, 87.5% of girls and 85.7% of the boys consumed < 100% of the EFSA recommendations for total water intake.

Table II shows the total daily fluid intake and the amount of each type of consumed beverage according to gender. Girls consumed significantly less sweet regular beverages than boys. No significant differences were observed for total fluid volume, water intake, hot beverages, milk and milk products, juices or sweet light beverages between genders.

**Table I**  
*General characteristics of study population*

<i>Baseline variables</i>	<i>All population (n = 238)</i>	<i>Girls (n = 112)</i>	<i>Boys (n = 126)</i>	<i>P value*</i>
<b>Age, years (mean, SD)</b>	9.17 (4.6)	9.0 (4.5)	9.3 (4.6)	0.57
<b>Age categories, % (n)</b>				0.94
3 to 6 years	36.2 (86)	37.5 (42)	34.9 (44)	
7 to 11 years	29.8 (71)	30.4 (34)	29.4 (37)	
12 to 15 years	23.1 (55)	21.4 (24)	24.6 (31)	
16 to 17 years	10.9 (26)	10.7 (12)	11.1 (14)	
<b>BMI, kg/m<sup>2</sup> (mean, SD)</b>	18.8 (3.9)	18.9 (3.7)	18.7 (4.0)	0.79
<b>BMI classification, % (n)<sup>b</sup></b>				0.17
Under and normal weight	64.3 (153)	63.4 (71)	65.1 (82)	
Overweight	24.4 (58)	28.6 (32)	20.6 (26)	
Obesity	11.3 (27)	8.0 (9)	14.3 (18)	
<b>Region, % (n)</b>				0.96
Region 1 (Catalonia/Aragon)	9.2 (22)	10.7 (12)	7.9 (10)	
Region 2 (east)	13.9 (33)	14.3 (16)	13.5 (17)	
Region 3 (south)	20.6 (49)	18.8 (21)	22.2 (28)	
Region 4 (centre)	8.8 (21)	8.0 (9)	9.5 (12)	
Region 5 (north-centre)	7.1 (17)	8.0 (9)	6.3 (8)	
Region 6 (northwest)	12.2 (29)	10.7 (12)	13.5 (17)	
Barcelona and Madrid	28.1 (67)	29.5 (33)	27.0 (34)	
<b>Habitat, % (n)</b>				0.96
5.000 to 30.000 inhabitants	30.7 (73)	30.4 (34)	31.0 (39)	
30.000 a 200.000 inhabitants	35.7 (85)	36.6 (41)	34.9 (44)	
More than 200.000 inhabitants	33.6 (80)	33.0 (37)	34.1 (43)	
<b>Socioeconomic level, % (n)</b>				0.51
Lower and middle-low	33.6 (80)	34.9 (39)	33.6 (41)	
Middle	43.3 (103)	45.4 (51)	41.3 (52)	
Upper-middle and high	23.1 (55)	19.7 (22)	26.1 (33)	
<b>Leisure-time physical activity, % (n)</b>				0.04
1 time every 2 weeks or less	8.4 (20)	8.0 (9)	8.4 (11)	
1-2 times a week	31.1 (74)	39.3 (44)	23.8 (30)	
3-4 times a week	28.6 (68)	29.5 (33)	27.8 (35)	
5 times a week or more	31.9 (76)	23.2 (26)	39.7 (50)	

Data expressed as mean (SD) or percentage (n). Abbreviations: BMI, body mass index. \*P values for comparisons between groups were tested by student's t-test or  $\chi^2$  as appropriate.

<sup>b</sup> BMI (kg/m<sup>2</sup>) was divided in the following categories: underweight and normal weight, overweight and obesity following age and gender specific cut-off points by Cole et al (2000).

**Table II**  
Total daily consumption of different types of beverages (ml/day) in all population and stratified by gender\*

Variables	All population (n = 238)	Girls (n = 112)	Boys (n = 126)	P value*
<b>Water</b>	823 (556)	819 (576)	827 (541)	0.91
<b>Hot beverages</b>	38 (103)	40 (98)	36 (108)	0.75
<b>Milk and milk products</b>	442 (268)	421 (274)	461 (263)	0.25
<b>Juices</b>	201 (253)	202 (206)	201 (290)	0.97
<b>Sweet regular beverages</b>	120 (250)	89 (160)	148 (306)	0.07
<b>Sweet light beverages</b>	14 (60)	16 (69)	13 (52)	0.67
<b>Alcoholic beverages</b>	-	-	-	-
<b>Total daily liquid volume</b>	1669 (679)	1599 (665)	1732 (688)	0.13

\*Data expressed as mean (SD). \*P values for comparisons between gender were tested by student's t-test.

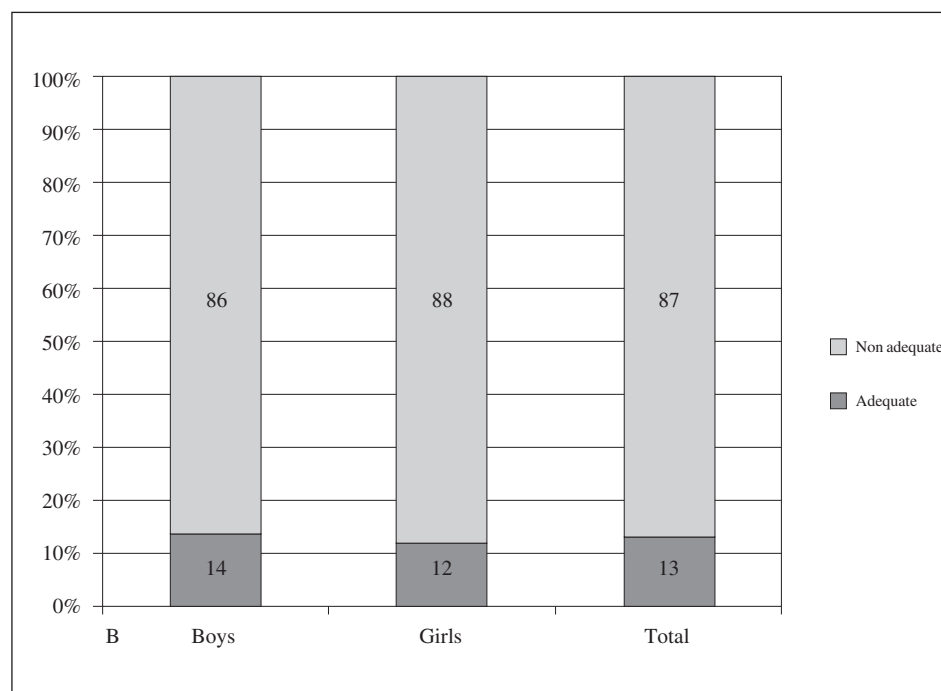


Fig. 2.—Percentage of adequacy to EFSA recommendations for water intake according to gender.

Total daily fluid intake and beverage consumption according to age ranges are shown in table III. Older participants (16-17 years) consumed more hot beverages compared to all other categories ( $p = 0.028$ ). Children corresponding to the younger age groups (3-6 and 7-11 years) consumed more milk and milk products ( $p < 0.001$ ) and less sweet regular ( $p < 0.001$ ) and light beverages ( $p = 0.023$ ) compared to the older categories. No significant differences were found for water and juices intake between age categories.

The total daily intake of different types of beverages and its consumption moment (during the main meals/outside the main meals) are described in table IV. For both genders, fluid intake was significantly higher during the main meals. The consumption of water and sweet regular beverages was significantly higher during the main meals compared with outside

the main meals. Juices consumption was significantly higher outside the main meals for both genders. In relation to milk and milk products and sweet light beverages intake, no significant differences between the moments of consumption were observed.

When stratified by BMI, no differences in total fluid consumption or main beverage groups were found between normal weight, overweight and obese participants (data not shown).

## Discussion

The results of this cross-sectional study provide important information about the fluid intake in a sample of Spanish children and adolescents. Following the European Food Safety Authority reference values



**Table III**  
Total daily consumption of different types of beverages (ml/day) stratified by age range\*

Variables	3-6 years (n = 86)	7-11 years (n = 71)	12-15 years (n = 55)	16-19 years (n = 26)	P value <sup>a</sup>
<b>Water</b>	737 (508) <sup>a</sup>	800 (557) <sup>a</sup>	905 (570) <sup>a</sup>	999 (643) <sup>a</sup>	0.113
<b>Hot beverages</b>	30 (95) <sup>a</sup>	26 (70) <sup>a</sup>	41 (115) <sup>a</sup>	93 (156) <sup>b</sup>	0.028
<b>Milk and milk products</b>	538 (267) <sup>a</sup>	452 (243) <sup>a</sup>	376 (266) <sup>b</sup>	246 (214) <sup>c</sup>	<0.001
<b>Juices</b>	212 (296) <sup>a</sup>	194 (188) <sup>a</sup>	225 (293) <sup>a</sup>	136 (152) <sup>a</sup>	0.499
<b>Sweet regular beverages</b>	39 (107) <sup>a</sup>	103 (155) <sup>a</sup>	212 (380) <sup>b</sup>	248 (340) <sup>b</sup>	<0.001
<b>Sweet light beverages</b>	5 (36) <sup>a</sup>	5 (22) <sup>a</sup>	30 (89) <sup>b</sup>	38 (103) <sup>c</sup>	0.010
<b>Alcoholic beverages</b>	—	—	—	26 (75)	—
<b>Total daily liquid volume</b>	1571 (681) <sup>a</sup>	1602 (589) <sup>a</sup>	1828 (726) <sup>a</sup>	1844 (748) <sup>a</sup>	0.066

\*Data expressed as mean (SD).

<sup>a</sup>P values for comparisons between groups were tested by bivariate analysis of variance (ANOVA) followed by post hoc tests with the Bonferroni correction.

P < 0.05 for differences between letters (<sup>a</sup> versus <sup>b</sup> and <sup>b</sup> versus <sup>c</sup>).

**Table IV**  
Total daily intake of different types of beverages (ml/day) by moment of consumption\*

	All population (n = 238)			Girls (n = 112)			Boys (n = 126)		
	During the meal	Outside the meal	P value <sup>a</sup>	During the meal	Outside the meal	P value <sup>a</sup>	During the meal	Outside the meal	P value <sup>a</sup>
<b>Water</b>	470 (328)	353 (393)	<0.001	473 (322)	345 (386)	0.002	467 (335)	359 (400)	0.017
<b>Hot beverages</b>	23 (66)	14 (59)	<0.001	26 (67)	14 (50)	0.067	21 (64)	14 (66)	0.323
<b>Milk and milk products</b>	230 (167)	212 (214)	0.306	213 (169)	208 (220)	0.861	246 (165)	215 (209)	0.208
<b>Juices</b>	66 (146)	135 (190)	<0.001	60 (149)	141 (137)	<0.001	71 (144)	129 (227)	0.010
<b>Sweet regular beverages</b>	85 (179)	35 (122)	<0.001	65 (151)	23 (56)	0.007	102 (200)	46 (159)	0.002
<b>Sweet light beverages</b>	7 (40)	7 (37)	0.996	8 (53)	7 (44)	0.858	6 (25)	7 (30)	0.578
<b>Alcoholic beverages</b>	—	—	—	—	—	—	—	—	—
<b>Total daily liquid volume</b>	894 (343)	775 (500)	<0.001	849 (334)	749 (451)	0.017	934 (347)	798 (541)	0.011

\*Data expressed as mean (SD). <sup>a</sup>P values for comparisons between during and outside the meal were tested by student's t-test.

for total water intake for these age categories, around 87% of the total study population did not meet water intake EFSA recommendations, which suggests the need of a careful monitoring of total water intake of these populations in the coming years.

No large differences in fluid consumption according to gender were found. Gender differences in sweet regular beverages were close to being significant (being girls those who consumed less), in agreement with previous studies<sup>10,12</sup>. One possible explanation for this could be the fact that female adolescents are often more worried by their energy intake than boys<sup>13</sup>.

The first observation regarding age in our study was that total daily fluid intake increased with age, as also observed in a French survey<sup>14</sup>. A plausible explanation for this finding are the physiological variables (body size<sup>15</sup>, less effective thermoregulators, underdeveloped sweating and skin blood flow mechanisms, and other factors)<sup>16</sup>. The youngest children consumed also more milk and milk products compared to other age categories and less sweet regular beverages. It might be explained by the high influence of their families<sup>17</sup>, still present in these periods of life, which considerably decrease during adolescence. 12 to 15 years old adolescents consumed significantly less hot beverages than

16 to 17 years old adolescents did. Plain water represented around 50% of all the consumed fluids in all the study groups. These trends were also observed in the mentioned French survey<sup>14</sup>.

The prevalence of overweight and obesity in our population group was 23.5% and 10.3% respectively, slightly lower in comparison to the reported prevalence in a very recent Spanish study (26% and 12.6%)<sup>18</sup>. However, BMI was not related to total fluid consumption or to main beverage group distribution, in line with results obtained in other studies<sup>19,20</sup>. Nevertheless there is mounting evidence about a significant negative association between water consumption and energy intake<sup>21</sup>. As our population group is within the most affected by the obesity pandemic, increasing plain calorie-free water consumption should be a recommendation.

EFSA recommendations for total water intake (including water from all beverages and moisture content of foods) are higher than the current mean values obtained in this study for both boys and girls<sup>1</sup>. In this study, data on water coming from foods was not available. For this reason, we extracted 20% of the current recommendations to calculate the percentage of children and adolescents who did not meet the

recommendations, as this is the amount of water which is accepted to correspond to the water coming from foods<sup>1</sup>. The percentage of population who did not meet EFSA recommendations, was higher compared to the HELENA study<sup>22</sup> (85.7% of males and 87.5% of the females against 69.4% of males and 64.4% of females).

Considering our sample, the main contributor to the total fluid intake was plain water, followed by milk and milk products, juices, sweet regular beverages, hot beverages, sweet light beverages and alcohol. Splitting the analyses by gender, the results were similar for girls and for boys, only differing in the order of the two last types of beverages. This order of contributors is equal for 3-6 and 7-11 year old children and 12-15 years old adolescents. For 16-17 years old adolescents, sweet regular beverages represented the second group instead of milk and milk products, being juices the fourth group. In the French survey<sup>14</sup>, the list and the order of the contributors was almost the same (although regular and light sweet beverages were assessed together due to the low proportion of children consuming light sweet beverages). Water represented about one-half of daily fluid intakes for boys and girls, according to what was already described for these population groups in a similar French study<sup>14</sup>. Percentages were also similar in the case of milk and milk products and sweet regular beverages between the two studies. However, in a Brazilian study<sup>23</sup> performed in the same population groups, total daily fluid volume was higher on average, representing plain water a third of the total volume.

In our study, most beverages were ingested during main meals, and this was also observed in a previous Brazilian study<sup>23</sup>. Plain water was the main fluid consumed during main meals. However, American children of all ages were reported to more likely consume other beverages rather than plain water during main meals<sup>24</sup>.

The present study is subject to some limitations. They are mainly related with intrinsic aspects of sampling. As the participants were recruited as being part of a database, only individuals having telephone number were included. Therefore, very low socioeconomic groups could be underrepresented. The most important strength is that this quota-based sample method is recognized as the best method to evaluate intakes in a representative sample<sup>25</sup>. Moreover, using 7 days-records to register the fluid consumption could be considered as an important strength (collecting data from both weekend and weekdays).

## Conclusions

This study shows valuable data on fluid intake in Spanish children and adolescents. From a public health point of view, the most important obtained data is the very high percentage of this young population who did not meet the EFSA recommendations for total water intake. In our sample, water was the main contributor

to total fluid intake, followed by milk and derivatives and sweet regular beverages. No differences in consumption patterns were found according to gender. Consumption of hot beverages as well as sweet regular and sweet light beverages increased with age, while milk and milk derivatives consumption decreased.

The recommendation generated from these results should be the increase in plain water consumption in these populations, as a number of studies have demonstrated that drinking water can improve cognitive functions, and consuming water instead of sugar-sweetened beverages with added sugar, can also prevent dental caries and may avoid the excess of weight gain<sup>26</sup>.

Future research should observe longitudinal changes in different characterized populations (by socioeconomic status, level of physical activity, general diet quality index...) to determine whether the long-term contribution of beverages and the consumption time could impact health from the early stages of life.

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The data about beverage intake were collected by TNS.

## Conflict of interests

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