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Fluid intake in Mexican adults; a cross-sectional study

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Abstract

Introduction: **An adequate hydration is critical for a series of body functions, including proper regulation of core body temperature, elimination of waste metabolites by the kidney and maintenance of normal physical and cognitive functions. Some institutions have set recommendations for adequate intake of water, but these recommendations vary widely.**

Objective: **To estimate the usual daily consumption of fluids (water and all other beverages) by a selective sample of Mexican population.**

Methods: Cross-sectional sample of 1,492 male and female adults between 18-65 years of age, drawn from 16 cities throughout Mexico. Self-reported fluid intake data collected over a 7-day consecutive period, recording intake of water, milk and derivatives, hot beverages, sugar sweetened beverages (SSB), alcoholic beverages and others.

Results: **We found that 87.5% of adult males and 65.4% of adult females reported drinking below their recommended daily fluid intake (3 L for males and 2 L for females), and in 80% of the population SSB, not including hot beverages or milk and derivatives, accounted for a larger amount and proportion of fluid intake than plain water. Sixty-five percent of adult males and 66% of adult females consumed more than 10% of their estimated daily caloric intake from fluids. Fluid intake did not differ significantly by gender, but showed a declining trend with age.**

Conclusion: **Our findings may have important implications for policy recommendations, as part of comprehensive strategies to promote the adoption of healthy life styles, in this case, promoting consumption of plain water while discouraging excessive consumption of caloric beverages.**

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Key words: *Fluid intake. Water. Sugar sweetened beverages. Adults. Mexico.*

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INGESTA DE LÍQUIDOSPOR ADULTOS MEXICANOS; UN ESTUDIO TRANSVERSAL

Resumen

Introducción: **Un adecuada hidratación resulta fundamental para el buen funcionamiento de diversas funciones orgánicas, incluyendo la regulación de la temperatura corporal, la eliminación de metabolitos por los riñones, y el funcionamiento adecuado de diversas funciones físicas y cognitivas. Algunas instituciones han establecido recomendaciones para una ingesta adecuada de agua y otros líquidos, pero estas recomendaciones varían ampliamente.**

Objetivo: **Estimar el consumo diario usual de líquidos (incluyendo agua otras bebidas), en una muestra seleccionada de adultos mexicanos.**

Métodos: **Estudio transversal de 1.492 hombres y mujeres adultas con edades entre 18-65 años, reclutados en 16 ciudades distribuidas a lo largo de todo el país. Se recolectó información auto-reportada sobre la ingesta de líquidos a lo largo de un período consecutivo de 7 días, registrando el consumo de agua, leche y derivados, bebidas calientes, bebidas azucaradas, bebidas alcohólicas, y otras bebidas.**

Resultados: **Encontramos que el 87,5% de los hombres y el 65,4% de las mujeres registraron una ingesta de líquidos por debajo de la recomendación vigente para estos grupos, que es de 3 L/día para hombres y 2 L/día para mujeres. Además, en el 80% de la población participante la ingestión de bebidas azucaradas, no incluyendo la leche y derivados ni las bebidas calientes, fue mayor que la de agua simple. El 65% de los hombres y el 66% de las mujeres consumieron más de la recomendación del 10% de energía correspondiente a su requerimiento calórico estimado a partir de bebidas. La ingestión de líquidos no mostró diferencias estadísticamente significativas de acuerdo al género, pero mostró una tendencia significativa a declinar con la edad.**

Conclusión: **Nuestros resultados tiene importancia para orientar políticas publicas como parte de recomendaciones integrales que promuevan la adopción de estilos saludables de vida, particularmente en lo que concierne a fomentar el consumo de agua simple y a desaconsejar el consumo exagerado de bebidas con contenido calórico.**

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Palabras clave: *Ingesta de líquidos. Agua. Bebidas azucaradas. México.*

Introduction

An adequate hydration is critical for a series of body functions, including proper regulation of core body temperature, elimination of waste metabolites by the kidney and maintenance of normal physical and cognitive functions[1-3]. Some institutions have set an adequate intake (AI) for total water intake (water from food and from fluids), but these recommendations vary widely. For example, the European Food Safety Agency[4] set the AI for total water intake at 2.5 L/day for men older than 14 years and 2 L/d for women older than 14 years[4], while AI for total water intake set by the Institute of Medicine (IOM) of the United States of America is 3.7 L/day for men and 2.7 L/day for women[5]. In Mexico, a panel of experts convened by the Ministry of Health recommends to consume 0.75-2 L (6-8 glasses) of water per day. As for other fluids, the panel specifically recommends that consumption of higher energy content beverages, mainly coming from sugar-sweetened beverages (SSB), should be discouraged[6]. This group laid specific emphasis on the promotion of consumption of water and low-calorie beverages, strongly arguing against consumption of high-energy beverages, and in general terms followed the recommendation for total fluid intake set forth by IOM[5]. The differences in recommendations may, in part, be due to the wide individual variation found in response to hydration needs, as fluid loss is affected by environmental factors such as ambient temperature and humidity, as well as individual factors, such as age, body size and level of physical exercise[2].

Even though AI for total water has seen set, methods to estimate daily ingestion and adequacy of water and other fluids at a population level remain elusive in the literature. A wide-extended practice that nutritionists and public health specialists have resorted to, is accounting for ingestion of fluids as part of dietary intake methods, commonly the 24-hour intake recall. While this –and other– methods have estimated that approximately 20% of total water intake comes from food, while the remaining 80% comes from fluids[7], it has also become evident that 24-hr recall methods greatly underestimate fluid intake, by as much as 0.5 L/day[8]. Recently, a fluid-specific dairy has been proposed, to collect information about fluid consumption over a 24-hour period over a 7-consecutive day span, supported by photographs or drawings of commonly used recipients of different sizes for fluids[8,9]. A proper assessment of the intake of water and other beverages is important from a public health point of view for many reasons, including the need to promote adoption of healthy life styles in order to counter the growing epidemics of chronic diseases, many of which are related to unhealthy habits of consumption of different foods and beverages[6,10-13].

The objective of this paper was to estimate the usual daily consumption of fluids (water and all other beverages) by a selective sample of Mexican population. Evaluating the quantity of fluid intake and understanding the contribution of each fluid type to total fluid intake is critically needed in order to draw conclusions about the adequacy of drinking habits. This information may help to shape up public health policies and programs oriented to the promotion of the adoption of healthy life-styles.

Methods

A cross-sectional study was carried out between the months of april and may, 2012, when the average ambient temperature in the country is around 18°C. The quota based sample was drawn from 16 cities throughout Mexico, including Chihuahua, Culiacan, Guadalajara, Hermosillo, Leon, Merida, Monterrey, Morelia, Oaxaca, Puebla, Queretaro, San Luis Potosi, Tijuana, Toluca, Mexico City and surrounding peri-urban area, and Veracruz. Quotas were set in term of age, gender, region and socio-economical levels, to allow us to identify mean fluid consumption with a confidence level of 95%, based on previous studies[14,15]. Houses to be visited were chosen at random based on the sampling frame provided by the Mexican National Institute of Geography. Inclusion criteria were defined as a healthy, male or female consenting adult, between the ages of 18-65 years old, who could read and write, and had been a regular resident of the area for the past year. Exclusion criteria included being under any kind of diet or medical treatment that may affect or modify his/her eating or drinking habits. Elimination criteria included a mean reported fluid intake below 0.4 L/day or above 6 L/day.

To register daily ingestion of water and any other fluid throughout the day the study resorted to a fluid specific intake dairy that had been previously used in similar populations (i.e., literate, Spanish-speaking adults)[15]. Participants were asked to record in the diary what type of beverage they consumed, in what size of container, what amount was consumed, and the time of day when consumption took place. Data recording went on for 7 consecutive days. To increase reporting accuracy of the consumed volume of fluids, the dairy was supported by a photographic booklet illustrating commonly used drinking containers and their volume. Upon recruitment and oral consent, a study interviewer explained how to fill in the diary, and went over the first day of beverage intake with the study participant to familiarize him/her with data entry. Interviewers visited the house again half-way through the study, to address any questions participants may have about how to register the information, and again at the end of the 7-day period, to collect the dairies and thank participants for their participation. No monetary incentive was offered for taking part in the study. Throughout the study there was a telephone hot-line available to address any question participants may have.

The beverages consumed were grouped into six broad categories: water, milk and derivatives, hot be-

verages, sugar sweetened beverages (SSB), alcoholic beverages and others. The specific beverages under each category are listed in table I. Total fluid intake was defined as the sum of these 6 categories. To calculate the proportion of participants having an inadequate fluid intake, total fluid intake provided by beverages of each subject was compared to the fluid recommendations in Mexico, based on recommendations of a group of expert nutritionists[16]. Table I also indicates which fluids were taken into consideration to calculate energy intake from added sugar coming from fluids. Information regarding the energy content of fluids was extracted from Mexican food composition tables[17]. Additions (by hand) to each beverage (e.g. sugar, honey) were not taken into account. To be able to calculate the proportion of participants consuming ≥ 10% of the energy requirements as free sugars,[13] associated with fluid intake, the assumption had to be made that men and women have on average a daily energy intake of respectively 2400 kcal/day and 1800 kcal/day[18].

Individuals who agreed to be part of the study received a detailed information about the study and its objectives, what was expected from them, as well as a disclosure of the study's provisions to preserve confidentiality, risks and benefits, and a clear explanation about their option to participate voluntarily or not in the

Table I
Description and classification of fluids consumed by Mexican adults

Classification of fluids	*Detailed fluid types*	*Fluids considered for analysis of energy intake*
Water	Still water, unflavored sparkling water, tap/filtered/ boiled water	
Milk and derivatives	Packaged (fermented milk, milk (ready-to-drink), flavored milk, yogurt milk), *atole*/*champurrado*, raw milk, powder milk, powder/syrup flavored milk, fruit shake with milk	Packaged (fermented milk, milk (ready-to-drink), flavored milk, yogurt milk), *atole*/*champurrado*, powder/syrup flavored milk, fruit shake with milk
Hot beverages	Coffee, Coffee from coffee maker (e.g.: homemade coffee, dolce gusto, others), powder coffee, vending machine coffee, restaurant/franchise coffee, homemade hot/cold tea (from tea bags), Infusions (herbal)	Coffee, Coffee from coffee maker (e.g.: homemade coffee, dolce gusto, others), vending machine coffee, restaurant/franchise coffee, powder coffee, homemade hot/cold tea (from tea bags)
Sugar sweetened beverages (SSB)	• Regular sweet beverages: flavored packaged water, flavored sparkling water, flavored water slightly fizz, flavored waters made with powder or concentrate/ syrup, fruit shake with water powder, packaged tonic/ quinine water, vitamin/ functional water, electrolyte/ saline solution beverages, sport/isotonic drinks, energetic drinks, nutritional supplement, non carbonated refreshing drinks (e.g.: Frutsi®, Boing®,…), packaged coffee ready-to-drink (canned or boxed coffee), packaged tea, powder food supplement, cola carbonated drinks, flavored carbonated drinks • Juices & derivatives: Packages fruits & vegetables juices (packages juices (fruits or vegetables), packaged orangeade, packages nectars, Eskimos/smoothies), *aguas frescas*, natural fruits & vegetables juices (natural fruit/ vegetable juices, restaurant lemonade/orangeade) • Diet sweet beverages: Packaged light juices, diet/light/zero cola carbonated drinks, diet/light/ zero flavored carbonated drinks	• Regular sweet beverages: flavored packaged water, flavored sparkling water, flavored water slightly fizz, flavored waters made with powder or concentrate/ syrup, fruit shake with water powder, packaged tonic/quinine water, vitamin/functional water, electrolyte/saline solution beverages, sport/isotonic drinks, energetic drinks, nutritional supplement, non carbonated refreshing drinks (e.g.: Frutsi®, Boing®,…), packaged coffee ready-to-drink (canned or boxed coffee), packaged tea, powder food supplement, cola carbonated drinks, flavored carbonated drinks • Juices & derivatives: Packages fruits & vegetables juices (packages juices (fruits or vegetables), packaged orangeade, packages nectars, Eskimos/ smoothies), *aguas frescas*, • Diet sweet beverages: Packaged light juices, diet/light/zero cola carbonated drinks, diet/light/zero flavored carbonated drinks
Alcoholic beverages	Beer, Wine, Aperitifs and digestives straight, packages/canned alcoholic beverages, alcoholic beverages straight (not mixed like vodka, tequila, rum, ….), aperitifs and digestives with other beverages, *clamato*-type, beer/*michelada*	Beer, Wine, Aperitifs and digestives straight, packages/canned alcoholic beverages, alcoholic beverages straight (not mixed like vodka, tequila, rum, ….), aperitifs and digestives with other beverages, *clamato*-type, beer/*michelada*
Other beverages	*Agua de arroz*, Alcohol-free beer, packaged soy drinks	Packaged soy drinks

study. After offering a full-informed description of the study, following the principles of informed consent, participants were asked for their oral approval to participate.

Statistical analysis

Analyses were performed using the SPSS software version 17.0 (SPSS Inc., Chicago, IL). Values of continuous variables are presented as the mean and standard error of mean (SEM) and values of dichotomous variables as percentages. Group comparisons were made using χ^2 tests for categorical variables or Student's t-tests or analysis of variance (ANOVA) as appropriate for the continuous variables. All statistical tests were two-tailed and the significance level was set at $p < 0.05$.

Results

The initial recruited sample consisted of 1,502 participants before applying elimination criteria. Ten participants were removed from the sample because they reported drinking either less than 0.4 L/day or more than 6 L/day, for a final sample size of 1,492 participants. The baseline characteristics of the sample population may be seen in table II.

Mean total fluid consumption of the total population was 1.85 L/day (table III). Figure 1 shows the distribution of mean total fluid intake by gender. Among men, 87.5% of the sample drank less than the recommended 3 L/day of total fluids, while 65.4% of women, drank less than the recommended 2 L/day (16). Moreover, 6% of adults did not report drinking water, while 50% of the sample consumed 0.5 L/day, and 75% of the sample consumed 1 L/day (fig. 2). Thirty-eight percent of the sam-

Table II
Socio-demographic characteristics of study sample

	Total sample n = 1,492	*Males n = 520 (35%)*	*Females n = 972 (65%)*	*P-value*
Age categories, % (n)				< 0.001
18-24 years	22 (335)	26 (137)	20 (198)	
25-35 years	23 (338)	20 (106)	24 (232)	
36-45 years	20 (300)	15 (80)	23 (220)	
46-55 years	19 (280)	21 (109)	18 (171)	
56-65 years	16 (239)	17 (88)	16 (151)	
Socio-Economic Level*, % (n)				< 0.001
ABC+	27 (402)	37 (192)	22 (210)	
C	26 (382)	27 (142)	25 (240)	
D+/D	47 (708)	36 (186)	54 (522)	
Nielsen Regions, % (n)				0.08
Region 1 (Pacific)	16 (234)	17 (86)	15 (148)	
Region 2 (North)	19 (277)	16 (83)	20 (194)	
Region 3 (Central lowlands)	16 (241)	15 (78)	17 (163)	
Region 4 (Central plateau)	17 (253)	18 (95)	16 (158)	
Region 5 (Valle of Mexico)	17 (250)	19 (98)	16 (152)	
Region 6 (Southeast)	16 (237)	15 (80)	16 (157)	

Data expressed as percentage (n).
P values for comparisons between groups were tested by 2.
* The highest level is A.

Table III
Total daily consumption of different types of fluids (ml/day) in all population and stratified by gender

Variables	*All population n = 1,492*	*Males n = 520*	*Females n = 972*	*P-value*
Water	717 (17)	672 (28)	741 (22)	0.059
Milk and derivatives	175 (5)	175 (9)	175 (6)	0.987
Hot beverages	150 (5)	150 (8)	150 (6)	0.803
Sugar sweetened beverages	583 (15)	608 (24)	566 (19)	0.152
Alcoholic beverages	37 (4)	64 (9)	22 (4)	< 0.001
Other beverages	5 (1)	3 (1)	3 (1)	0.788
Total fluid intake	1851 (25)	1847 (41)	1853 (31)	0.899

Data expressed as mean (SEM).
[a] P values for comparisons between gender were tested by student's t-test.

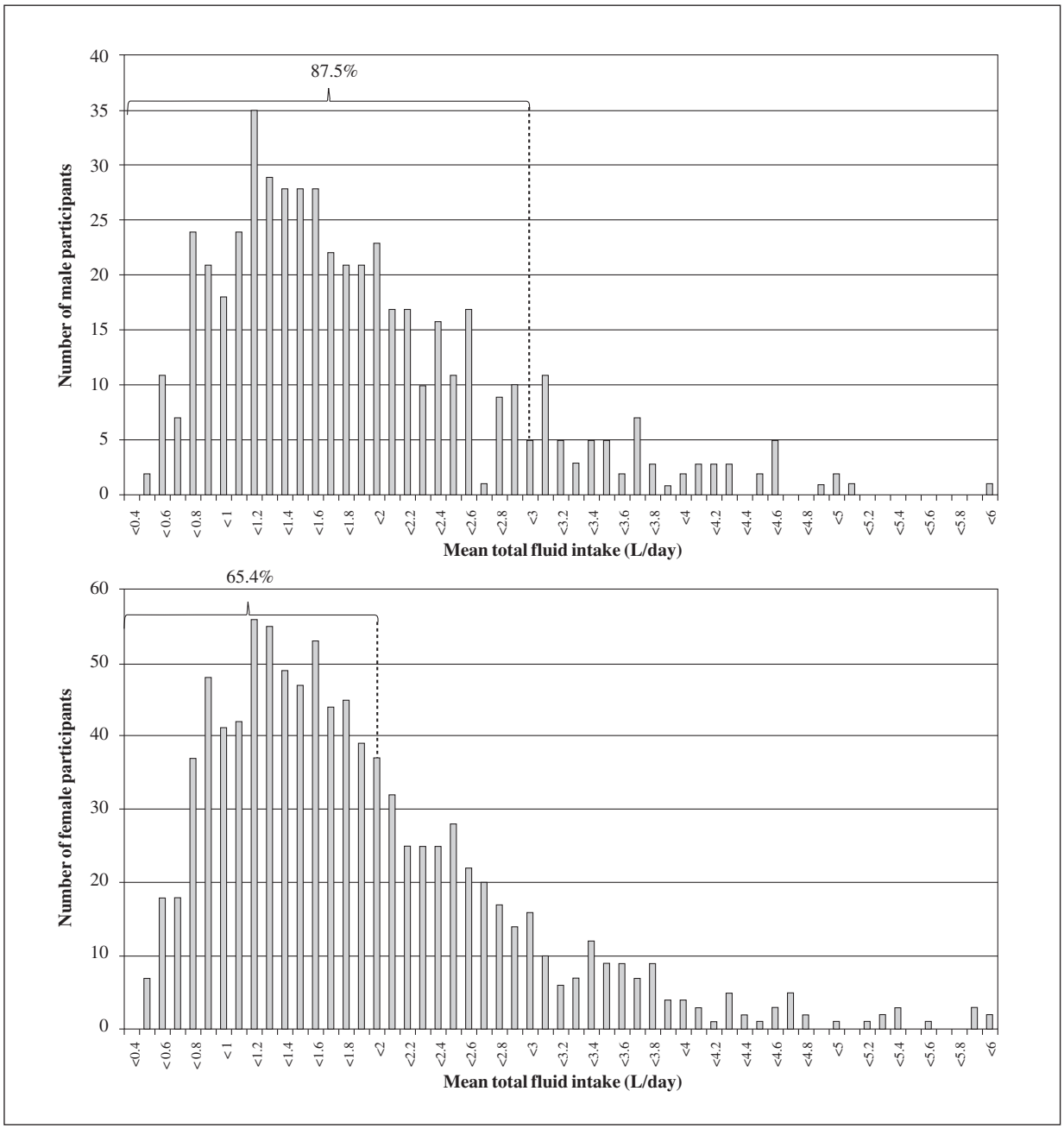

Fig. 1.—Distribution of mean total fluid intake (L/day) by adult male and female participants, indicating the proportion of participants drinking less than the recommendation on total water intake/fluid intake/water intake[16].

ple consumed 0.5 L/day of SSB, and 75.5% consumed 1 L/day. For 80% of the sample the consumed volume of SSB was larger than the volume of water (fig. 2).

There were no statistically significant differences in the mean total fluid intake and the volume of the different fluid type according to gender, with the exception of alcohol, which was consumed more by men (respectively 0.06 *vs* 0.02 L/day; p = 0.001) (table III). Males consumed an average of 0.314 L/day of SSB while females consumed an average of 0.315 L/day.

Table IV shows the mean total fluid intake and the volume of the different fluid types according to age groups. Overall, fluid consumption showed a decreasing trend by age: the highest total fluid intake was reported in the 2 youngest age groups (18-24 years 1.95 L/day; 25-35 years 1.99 L/day; $p < 0.001$ compared to any of the subsequent age groups) and the lowest mean total fluid intake was reported by the oldest age group 56-65 years 1.61 L/day; $p < 0.001$ compared to the 2 youngest groups). Not only the total fluid intake changed with age, also the volume of fluid types consumed was statistically significant different between the age groups. The consumption of hot beverages increased with age, whereas the consumption of SSB decreased (table IV).

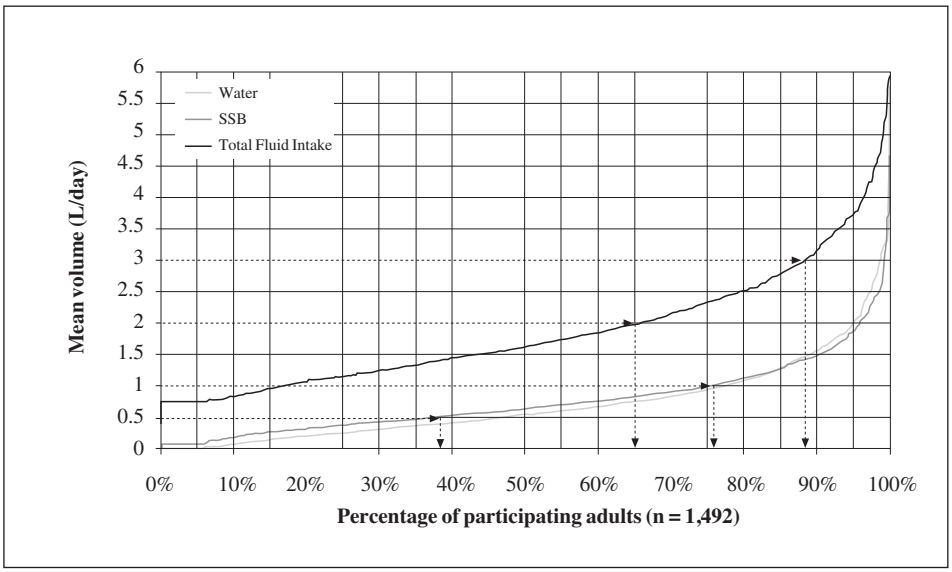

Fig. 2.—Cumulative distribution of total fluid intake, water intake and sugar sweetened beverages intake by participating adults.

Table IV
Total daily consumption of different types of fluids (ml/day) stratified by age range

Variables	*18-35 years (n = 335)*	*25-35 years (n = 338)*	*36-45 years (n = 300)*	*46-55 years (n = 280)*	*56-65 years (n = 239)*	*P value*[a]
Water	697 (35)	794 (40)	715 (38)	721 (42)	632 (36)	0.027
Milk and derivatives	205 (11)	195 (12)	158 (10)	156 (11)	151 (12)	0.017
Hot beverages	103 (9)[b]	129 (9)[d]	148 (10)[f]	180 (12)[c]	212 (16)[c,e,g]	< 0.001
Sugar sweetened beverages	693 (36)[b]	624 (30)[d]	559 (31)	513 (32)[c]	389 (33)[c,e]	< 0.001
Alcoholic beverages	48 (11)	33 (7)	37 (9)	32 (7)	33 (12)	0.003
Other beverages	5 (2)	6 (2)	3 (1)	5 (2)	8 (2)	0.420
Total fluid intake	1948 (55)[b]	1986 (53)[b,d]	1806 (56)[e]	1822 (57)	1612 (53)[c]	< 0.001

Data expressed as mean (SEM). [a]P values for comparisons between groups were tested by bivariate analysis of variance (ANOVA) followed by *post hoc* tests with the Bonferroni correction. P < 0.01 for differences between letters ([b] versus [c]; [d] versus [c]; [f] versus [g]).

The largest contributor to energy intake from fluids was SSB (256 kcal/day or 80-83% of energy intake from fluids), followed by milk and derivatives (men: 37 kcal/day or 12% of energy intake from fluids; women 47 kcal/day or 15% of energy intake from fluids; $p < 0.05$), and hot beverages (14 kcal/day or 5% of energy intake from fluids). In the total population, 81.5% of the participants consumed more than 10% energy from added sugars coming from fluids. Compared to men, a higher percentage of women exceed the recommendation for 10% energy from added sugars (73.6% *versus* 85.7%; $p < 0.001$) (fig. 3).

Discussion

This is the first comprehensive description of habitual fluid intake by a large sample of Mexican adults, including main fluid categories as plain water, milk and derivatives, hot beverages, SSB, alcoholic beverages, and 'others'. The main findings of this paper include that 87.5% of adult males and 65.4% of adult females drink below their recommended daily fluid intake (3 L for males and 2 L for females), and that in 80% of the population SSB, accounted for a larger contribution to total fluid intake than water. This intake brings along a substantial contribution to daily energy intake from SSB, such that 65% of adult males and 66% of adult females exceeded this recommendation. We also found that fluid intake did not differ significantly by gender, but showed a declining trend with age.

There are several methodological strengths supporting our findings. The sample was drawn from different geographic locations, across different ages and socioeconomic strata, both genders, and was large enough to identify the mean fluid consumption by any of these stratification variables with statistical significance. The use of a self-reported fluid-drinking diary kept by study participants for a seven-day consecutive period was supported by an initial supervised one-to-one training period, and data collection was supported throughout the seven day period by a hot-line service to

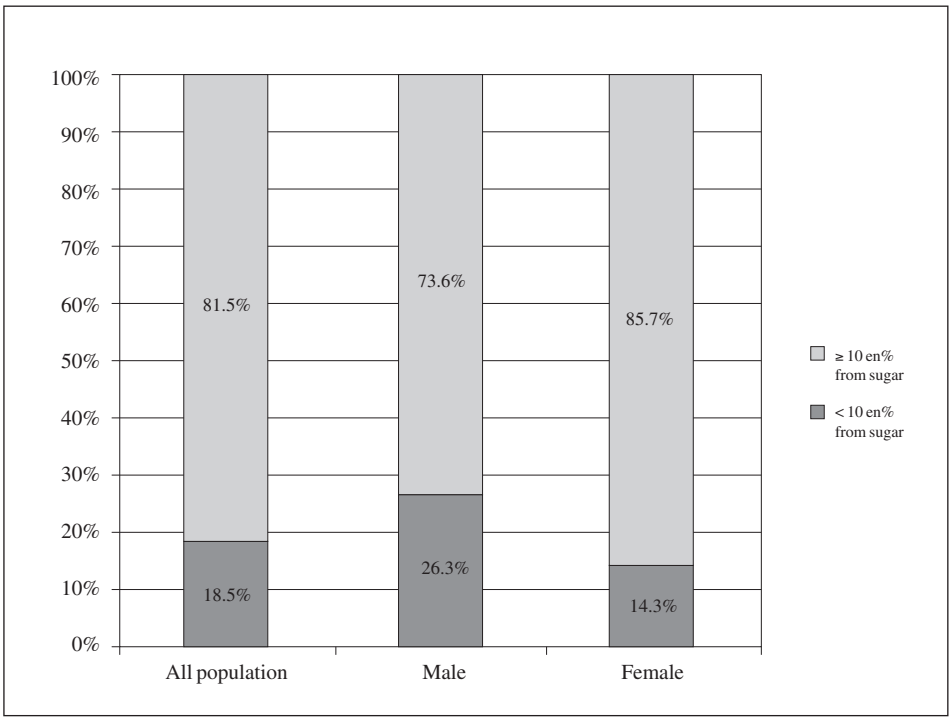

Fig. 3.—Proportion of participants reporting an energy intake from sugar associated to fluid consumption, above or below the recommended 10% of total energy intake[6,13].

address any questions participants may have, plus a mid-term home visit by team staff. This careful data collection method is more likely to capture the habitual ingestion of fluids than other methods used in previously published studies, like the 24-hour recall[8,19].

We do recognize, however, that our study was also subject to several limitations. Different authors have recognized that an accurate registry of drinking habits is difficult in free-living conditions (as opposed to the closed environment provided by laboratory conditions)[20], although we believe that the use of a self-registration fluid-drinking diary may offer a more accurate description of fluid intake[8,19]. The possibility of bias in self-reported data is always present, but the large sample collected, spread across age, socio-economic level and geographic region, greatly reduces the possibility of systematic biases across the whole sample. We did not collect any measure on hydration status, so we can not make any inference regarding the adequacy of fluid intake towards maintenance of hydration status. Therefore, we can only compare reported fluid intake *vs*. fluid intake recommendations. Data on body weight, height and physical activity level was not collected either and therefore we estimated average energy requirements for our population, by gender. Our sample was not a statistically representative sample of adult Mexican population, as we did not have a sampling frame from where to draw our sample. However, we did make an attempt to cover the range of socio-economic and geographic (as a proxy for climate) conditions found throughout the country, stressing that our sample was drawn from 16 major cities distributed widely throughout the country, covering the main geographic regions, i.e., Pacific, North, Central lowlands, Central highland plateau, Valley of Mexico and Southeast. Our study was carried out in the months that represent the transition from the dry to the rainy season (April to May), with an average ambient temperature well in the "comfort zone" of 18°C, the diversity of climate in the country may have provided for warmer and cooler ambient temperatures, which were not accounted for. Also, contextual variables such as availability of specific drinks in the local market, influence of advertising, peer pressure or family preferences for specific types of beverages at home could not be accounted for.

Keeping these strengths and limitations in mind may help to interpret the significance of our data. As mentioned, this is the first comprehensive study about overall fluid consumption in a sample of Mexican adults from throughout the country. Previously, some attempts had been made to characterize water and fluid intake of the population. The Mexican National Institute of Public Health carried out national nutrition surveys in 1999 and 2006 (the latest national nutrition survery in Mexico, conducted in 2012, has not released data on calorie intake nor fluid consumption), and noticed that *per capita* consumption of bottled sodas showed an increasing trend among adults, with over half the population consuming these beverages in the 2006 survey[21,22]. Even though the consumption of milk and other derivatives decreased among the adult population, the overall consumption of SSB increased, to an average 0.155 L/day by 2006[23]. This same survey found that fluid intake provided 22.3% of total caloric intake among the adult population[21]. In our study, conducted in 2012, we found an average consumption of SSB of

0.324 L/day by men and 0.315 L/day by women. Also in the 2006 survey, total fluid intake by the adult population showed an average of 1.721 L/day, with water contributing with 0.889 L/day[6]. In comparison, our study found an average consumption of 1.85 L/day of fluid consumption, with water contributing a mean of 0.711 L/day. As has been noted previously, with our methodology we can not make assumptions about the hydration status of the population. However, it should be noted that, in this sample of adult Mexicans, 65% of women and 88% of men reported consuming less than the daily recommended amount of fluids, and mean fluid consumption tended to decrease with age.

With regards to the consumption of SSB, it was noticeable that only 3% of participating adults reported not consuming this type of beverages. About two out of three adults in our sample (65%) drank more than 0.5 L/day of SSB, and about one out of four (26%) adults consumed more than 1 L/day. The World Health Organization has recommended that no more than 10% of the recommended daily calorie requirement should come from beverages, and the panel of experts convened in Mexico by the Ministry of Health also supports this recommendation[6,13]. On average, a healthy male adult such as those included in our study population should consume no more than 240 kcal/day from fluids, and a healthy female adult should consume no more than 180 kcal/day from fluids[6,13]. In our sample, there were 65% of adult males and 66% of adult females who exceeded this recommendation.

The evidence provided by this study related to drinking practices of an adult population is relevant in order to provide guidance for public health policies that aim to promote healthy drinking practices. Water should suffice to provide for all the hydration needs of a healthy human, so there is no need to complement the recommended daily fluid intake by drinking caloric beverages. In reality, however, different factors contribute to the ingestion of fluids other than water to satisfy thirst or to accompany food intake or even as part of social interaction, including taste, availability, convenience, marketing, peer pressure, cultural practices, etc. However, an excessive ingestion of calories provided by beverages may lead to an excessive increase in caloric intake[24], and there is evidence that physiological mechanisms related to satiety regulation are less effective when calories are provided in fluid form in contrast to calories provided by foods[25]. Some authors dispute the role that calories provided by beverages may have in the onset of overweight and obesity, but a recent systematic review looking into this relationship has found enough evidence to support the recommendation that consumption of SSB should be discouraged as part of the public health interventions aimed at promoting a healthy lifestyle[26]. Along these lines, the World Health Organization has identified the consumption of SSB as a "probable contributor" to the obesity epidemic[13]. Therefore, our findings may have important implications for policy recommendations, as part of comprehensive strategies to curve the obesity epidemic currently affecting Mexico and other developing countries, as well as to promote the adoption of healthy lifestyles that may have an impact on decreasing morbidity and mortality related to chronic diseases such as type-2 diabetes mellitus, stroke, cardiovascular disease and different types of cancer[6,27,28].

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