Intakes and sources of total and added sugars among 4 to 13-year-old children in China, Mexico and the United States

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Summary

Background: Intakes of dietary sugars is a global concern, and many national and international organizations have set targets to limit consumption. However, it is unclear to what extent intakes of total and added sugars vary between geographies.

Objectives: The aim of this study was to assess the differences in intakes of total and added sugars in 4 to 13-year-old children in China, Mexico and the United States. The secondary aim was to identify main sources of total and added sugars in the diets of these children.

Methods: Secondary data analysis was conducted using the 2011 China Health and Nutrition Survey, 2012 Mexican National Health and Nutrition Survey, and 2009–2012 US National Health and Nutrition Examination Surveys. Total and added sugar intakes were calculated using the US Food Patterns Equivalents Database.

Results: Mean intakes of total and added sugars were 26 and 9 g d⁻¹ among Chinese children, 92 and 55 g d⁻¹ among Mexican children, and 124 and 76 g d⁻¹ among US children, respectively. The top food sources of total sugars were fruits among Chinese children, and sugar-sweetened beverages and milk-based beverages among Mexican and US children.

Conclusions: These data highlight the heterogeneity of food patterns worldwide and the need for adapted country-specific public health recommendations on sugars.

Keywords: Beverages, children, dietary intake, sugars.

Introduction

Culture and geography shape availability of foods, traditions, attitudes and preferences towards foods (1), which partly explain differences in nutrient intakes and the sources of nutrients across geographies. In the case of dietary sugars, several national and international recommendations on intakes of dietary sugars have been recently issued. There is a general global consensus that excess dietary sugar intakes may lead to excess weight gain and play a role in the development of non-communicable diseases and should, therefore, be decreased (2). However, definitions and targets for recommendations differ broadly between organizations at both the national and international levels (3). While the World Health Organization (WHO) recommends to decrease free sugars to less than 10% total energy intake (TEI) with a preference to go as low as 5%, other recommendations range from 4.4% to 10% TEI with an upper limit of 25% TEI (3). Finally, some countries are advocating for a general reduction of sources of total and added sugars, without providing a specific threshold (3).

Comparing intakes of nutrients such as dietary sugars across geographies may allow us to learn more about drivers of non-communicable diseases at a national and international level, and also about the complexities that arise due to differing dietary recommendations.

To our knowledge, there is no study to date examining dietary sugar intakes and their food sources across geographical regions using comparable methodology (4). To better understand the differences in food consumption patterns among 4
to 13-year-old children in different parts of the world, we conducted secondary data analysis from existing dietary surveys in China, Mexico and the United States in the frame of the Kids Nutrition and Health Study (KNHS) (5). The primary aim of this analysis was to assess the differences in intakes of total and added sugars in children in these countries. The secondary aim was to identify the main sources of total and added sugars.

Methods

Study population

Subjects for this study came from the 2011 China Health and Nutrition Survey (CHNS), 2012 Mexican National Health and Nutrition Survey (ENSANUT; Encuesta Nacional de Salud y Nutrición) and 2009–2012 What We Eat in America National Health and Nutrition Examination Surveys (NHANES). Secondary data analysis was carried out among 4 to 13-year-old children; 1460 from CHNS, 3980 from ENSANUT and 3647 from NHANES.

The 2011 CHNS selected participants from nine provinces and three mega cities using a multistage random cluster design from its longitudinal household-based cohort (6). With 27 447 individuals surveyed in 2011, the CHNS represents 47% of China’s population, mirroring national age, gender and education profiles (6). ENSANUT is a cross-sectional probabilistic population-based survey which uses a multistage and stratified sampling to represent the Mexican population. A total of 50 528 Mexican households were surveyed between 2011 and 2012, with a response rate of 87%, from 32 federal entities (7). The NHANES uses a multistage stratified area probability sample of non-institutionalized individuals, and examines a sample, weighted to be nationally representative, of about 5000 persons each year. Data from the 2009–2010 and 2011–2012 NHANES cycles were combined for this analysis (8,9).

Dietary intake assessment

The CHNS, ENSANUT and NHANES used the 24-h recall method to collect dietary intake information. For the CHNS, dietary intake was collected from three consecutive 24-h recalls during randomly allocated home visits from Monday to Sunday (10). For children <12 years old in CHNS, the person responsible for food preparation and feeding was used as a proxy for the children's food consumption. Conversely, children ≥12 years old reported food consumption at home or away from home themselves. Household food inventory and in-house weighing approach were used to provide complementary information to estimate food consumption. For ENSANUT, a single 24-h recall was administered on a random sub-sample of the surveyed population via the USDA’s Automated Multiple-Pass Method (AMPM), which has been adapted to the Mexican context (11). The primary caregiver (usually the mother) reported the type and amount of foods and beverages consumed by the child while at home. In addition, children reported what they consumed away from home (i.e. while at school). In NHANES, dietary intakes were obtained from the Day 1 interviewer administering 24-h dietary recalls also using the USDA’s AMPM (12). Parents or caregivers of children younger than 5 years old responded to the survey on their behalf. Children 6–11 years old were assisted by a parent or caregiver, while children ≥12 years old completed the dietary interview on their own.

In CHNS, food intake was converted into energy intake using the 2002 Chinese Food Composition Table (FCT) which contains approximately 2500 foods (13). Average intakes of the three consecutive 24-h recalls were calculated. To capture energy intake in ENSANUT, the most recent FCT from Mexico was used which was based on a combination of pre-existing Mexican FCTs (making up 67% of foods) (11) and the FCT from USDA's Food and Nutrient Database for Dietary Studies (FNDDS) (14) (making up 33% of foods). For NHANES, dietary intake data were converted to nutrient values using the USDA FNDDS (14). To calculate total and added sugar intakes in CHNS, ENSANUT (total and added sugars were neither available in the Chinese FCT nor in the Mexican FCT) and NHANES, each food was linked to the US Department of Agriculture’s National Nutrient Database for Standard Reference (14), and then further linked to the MyPyramid Equivalents Database (15). Teaspoon equivalents in the Food Patterns Equivalents Database were converted to grams with the use of the ratio 4.2 g teaspoon⁻¹.

Food groupings

The food/beverage groups (hereafter labelled food groups) used in this study have been previously published (16). We made a few modifications as follows: (i) separating unsweetened from sweetened milks and milk-based beverages. Unsweetened milk-based beverages include unsweetened cow’s milk (plain milk and other dairy drinks) and unsweetened animal and plant-based milks such as soy milk. Sweetened milk-based beverages include sweetened cow’s milk.
Obesity Pediatric (1400 kcal d\textsuperscript{-1}) for energy intake (kcal d\textsuperscript{-1}).

There were differences in educational outcomes of the primary caregiver, with almost 58% of US caregivers having more than a high school education compared to 21% in China, and only 6% in Mexico.

Among 9092 children in China, Mexico and the United States, mean age was similar at around 8 years old (Table 1). The percentage of male to female children was equal in Mexico and the United States; in China, there was a slightly higher proportion of male children. There were differences in educational outcomes of the primary caregiver, with almost 58% of US caregivers having more than a high school education compared with 21% in China, and only 6% in Mexico.

US and Mexican children showed higher daily mean energy intake (\textasciitilde1900 kcal d\textsuperscript{-1}) than Chinese children (\textasciitilde1400 kcal d\textsuperscript{-1}) (Fig. 1). US children had the highest mean total and added sugar consumption (124 and 76 g d\textsuperscript{-1}, respectively) followed closely by Mexico (92 and 55 g d\textsuperscript{-1}, respectively). Mean total and added sugars among US and Mexican children were more than three times higher compared to Chinese children (26 and 9 g d\textsuperscript{-1}, respectively, \(p < 0.05\)). The percentage contribution of added sugars to energy intake also differed widely between countries: while added sugars contributed to less than 3% to total daily energy in Chinese children, it contributed to 12% among Mexican and 16% among US children (\(p < 0.05\)).

The top 10 food sources made up 81% of total sugar intakes in China, 75% in Mexico and 72% in the United States (Table 2A). While this list was topped by fruits and vegetables (solid foods) in China, beverages (fruit drinks, soft drinks and milk-based beverages) were the highest contributors to total sugars consumption in Mexico and the United States. All sugar-sweetened beverages (SSBs) contributed to 43% of total sugar intakes in Mexico, 28% in the United States, while only 7% in China.

The top 10 food sources contributed to 88% of added sugar intakes in China, 85% in Mexico and 79% in the United States (Table 2B). For Mexican and US children, the top 10 food sources of added sugars were similar to those for total sugars with soft drinks, fruit drinks and sweetened milk-based beverages, at the top of the lists. Among Chinese children, all solid foods – such as rolls and buns and cakes and pies – contributed to 84% of added sugar intakes. Overall, sweets and sweetened beverages were the primary contributors to added sugars in China (61%), Mexico (74%) and the United States (72%).

Discussion

In this study, large differences were observed in both absolute and relative intakes of total and added sugars among children in China, Mexico and the United States. Compared to Chinese children, mean intakes of added sugars were 6 and 8 times higher among Mexican and US children, respectively. Moreover, added sugars represented only one third of total sugar intakes in Chinese children, while accounting for almost two third of total sugars in Mexican and US children. Differences in food sources of sugars explained these findings. While the main source of total sugars in China were fruits and vegetables (naturally-occurring sugars), beverages (added sugars) contributed around 31% and 43% to total sugar intakes in Mexican and US children.

Recent surveys have observed a stable decline in added sugars consumption in the United States over the past decade (4,17). Despite such reports, we found that consumption of both total and added sugars in the United States remains high, with mean...
Few data are available on intakes of sugars among children worldwide. Compared with Australian children, absolute intakes of added sugars (50 g d\(^{-1}\) for 4–8 years and 68 g d\(^{-1}\) for 9–13 years) and relative energy contribution (12% for 4–8 years and 13% for 9–13 years) were similar to those of Mexican children, but lower than those of US children (18). Comparing the results with...
other countries in Latin America, mean absolute intakes of added sugars among 10 to 19-year-old Brazilians (about 68 g) and 10 to 16-year-old (87 g and 15% TEI) Ecuadorians were closer to intakes among US children (19,20). In contrast, sugar consumption in China remained below these levels, despite social and economic transition and diets being more and more Westernized (21).

The food preference plays an important role in sugar intakes, and the relative low added sugar intakes among Chinese children might be due to the regional food culture. A recent study reported a low consumption of total sugars and SSBs in Korean children and adolescents as compared to western countries (22). We found in this study that while soft drinks and fruit drinks were the top sources of added sugars in both Mexico and United States, these were not among the top 3 food sources in Chinese children. In addition, it has been reported that packaged processed foods contribute to a lower percent of all calories in China, compared to Mexico and the United States (30%, 58% and 75%, respectively) (23). Packaged processed food in general, and SSB in particular, are the main sources of added sugars: indeed, a 350-mL serving of SSB can provide as much as 33 g of added sugars. Such differences in packaged food consumption may likely explain the lower added sugars consumption in China.

Our data show that the added sugars contribution represented 12% and 16% of TEIs in Mexico and the United States, respectively. This ratio was obtained by using the energy intake calculated from the participant’s 24-h dietary recall (1847 kcal in Mexico and 1905 kcal in the United States) and is above the recommended threshold as well. Therefore, if one would take this recommended energy intake value, the percent contribution of added sugars would be even higher, which represents a further risk of calorie displacement.

Different food sources contributed to total and added sugar intakes between countries. In China, the main source of sugars was from naturally-occurring sources, such as fruits and vegetables. In contrast, in both Mexico and the United States, the main contributors to sugar intakes were added sugars present in beverages, such as SSBs (soft drinks and fruit drinks) and sweetened milk-based beverages. These results highlight the cultural differences in food choices. Previous research has also observed the excessive contribution of SSBs in the United States (17) and Mexico (25). Indeed, in Mexico, some traditional dishes are commonly consumed with a sweetened beverage such as a soda (26) rather than plain water. Second, while bakery products were common sources of total and added sugars across the three countries, the type of the bakery products differed. In China, these were mainly rolls and buns, cakes and pies; in Mexico, these were mostly cookies and sweetened breads (pan dulce); and in the United States these were mainly ice cream and frozen dairy desserts, candy, cookies and brownies, and RTE cereal (mostly high sugars RTE cereal (>21.2 g/100 g)).

While these foods are typically consumed at snacking occasions or breakfast, their history of consumption varies between countries: in the United States, brownies, cookies and candies have been consumed for a long time and their consumption is embedded in the local culture. Similarly, in Mexico, bread was introduced by the Spaniards, and sweetened breads (pan dulce) are part of the every day diet (16). Finally, the introduction of sweet pastries is more recent in China; those may be consumed at the expense of traditional diets which comprise whole grains,
legumes and vegetables, a reflection of the nutrition transition (27). This potentially rapid change in eating habits highlights the need to monitor the changes in intake of sweet bakery products with time in China.

The data presented in this paper highlight the heterogeneity of food patterns worldwide, and the need for adapted country-specific public health recommendations. One example is to encourage caregivers and children to limit consumption of SSBs and to make water and low-fat milk the preferred beverage choices (28,29). Our data suggest that while such measure is of prime importance in the United States and Mexico, its impact may be more moderate in countries such as China, where SSBs contribute to only a minor proportion of sugar intakes. However, even with relatively low sugar intake, an association was found between the cardiometabolic risk factors and sugar consumption in Chinese children (30).

### Table 2A

**Top 10 food sources of total sugar intakes among 4 to 13-year-old children in China, Mexico and the United States**

| Country   | Rank | Food/beverage groups                      | % of total intake | Mean (g) |
|-----------|------|-------------------------------------------|-------------------|----------|
| China     | 1    | Fruits                                    | 25.8              | 6.8      |
|           | 2    | Vegetables \(^a\)                        | 16.4              | 4.3      |
|           | 3    | Rolls and buns                            | 10.5              | 2.8      |
|           | 4    | Unsweetened milk-based beverages \(^b\)   | 9.0               | 2.4      |
|           | 5    | Cakes and pies                            | 7.7               | 2.0      |
|           | 6    | Sweetened milk-based beverages \(^c\)     | 4.2               | 1.1      |
|           | 7    | Soft drink and fruit drinks               | 2.2               | 0.6      |
|           | 8    | Olives, pickles, pickled vegetables      | 1.9               | 0.5      |
|           | 9    | Yogurt                                    | 1.9               | 0.5      |
|           | 10   | Candy                                     | 1.8               | 0.5      |
|           |      | **Top 10**                                | **81% of total intake** |
| Mexico    | 1    | Fruit drinks \(^d\)                      | 14.8              | 13.7     |
|           | 2    | Soft drinks                               | 11.7              | 10.8     |
|           | 3    | Sweetened milk-based beverages \(^c\)     | 9.7               | 8.9      |
|           | 4    | Fruits                                    | 9.7               | 8.9      |
|           | 5    | Sweetened tea and coffee                  | 7.1               | 6.5      |
|           | 6    | Unsweetened milk-based beverages \(^b\)   | 6.2               | 5.7      |
|           | 7    | Cookies                                   | 4.6               | 4.3      |
|           | 8    | RTE cereal                                 | 4.4               | 4.1      |
|           | 9    | Yogurt                                    | 3.6               | 3.4      |
|           | 10   | Sweetened bread                           | 3.4               | 3.1      |
|           |      | **Top 10**                                | **75% of total intake** |
| United States | 1    | Fruit drinks \(^d\)                      | 10.1              | 12.6     |
|           | 2    | Soft drinks                               | 10.0              | 12.3     |
|           | 3    | Unsweetened milk-based beverages \(^b\)   | 9.1               | 11.3     |
|           | 4    | Fruits                                    | 8.5               | 10.6     |
|           | 5    | Sweetened milk-based beverages \(^c\)     | 7.4               | 9.1      |
|           | 6    | 100% fruit juice                          | 6.9               | 8.6      |
|           | 7    | Ice cream and frozen dairy desserts \(^e\)| 6.0               | 7.5      |
|           | 8    | Candy                                     | 5.6               | 7.0      |
|           | 9    | Cookies and brownies                      | 4.2               | 5.3      |
|           | 10   | RTE cereal                                 | 4.0               | 4.9      |
|           |      | **Top 10**                                | **72% of total intake** |

\(^a\)Includes potatoes (which contribute to 1% of total sugar intakes in China).

\(^b\)Unsweetened milk-based beverages include unsweetened cow’s milk (plain milk and other dairy drinks); and unsweetened animal and plant-based milks such as soy milk.

\(^c\)Sweetened milk-based beverages include sweetened cow’s milk (flavoured milk, milkshakes, other sweetened dairy drinks); and sweetened animal and plant-based milks such as soy milk.

\(^d\)Fruit drinks include fruit-flavoured drinks and other fruit-based drinks such as aguas frescas (beverage consisting of fruits, flowers or seeds with water and sugar).

\(^e\)Includes frozen yogurt, gelatins, ices, sorbets and puddings.
Another way to reduce sugar intakes involves product reformulation by food manufacturers. Our data highlight the need to carefully select the targeted food groups in reformulation strategies, which should be country specific in order to be relevant and impactful. In China, where added sugars represent only a low proportion of total sugars, product reformulation may not be the preferred primary strategy as it may only reach a limited population.

The biggest limitation in this study was the use of the US Food Patterns Equivalents Database to estimate total and added sugar intakes in China and Mexico. In fact, manufacturers could have different compositions for same product in different countries, possibly due to consumer tastes and preferences. However, a study in Mexico calculated added sugars using an algorithm and found similar mean intakes of added sugars and contribution of added sugars to TEI (25). Another limitation is that some differences in the recall methodologies could partly explain the comparability of the results between countries. The lack of the multiple pass 24-h recall in China could

| Country  | Rank | Food/beverage groups               | % of total intake | Mean (g) |
|----------|------|------------------------------------|-------------------|----------|
| China    | 1    | Rolls and buns                     | 27.4              | 2.5      |
|          | 2    | Cakes and pies                     | 21.4              | 1.9      |
|          | 3    | Sweetened milk-based beverages a  | 9.3               | 0.8      |
|          | 4    | Candy                              | 5.1               | 0.5      |
|          | 5    | Soft drink and fruit drinks        | 5.0               | 0.4      |
|          | 6    | Ice cream and frozen dairy desserts b | 4.7               | 0.4      |
|          | 7    | Olives, pickles, pickled vegetables | 4.3               | 0.4      |
|          | 8    | Crackers                           | 4.1               | 0.4      |
|          | 9    | Quick breads and bread products    | 3.5               | 0.3      |
|          | 10   | Yeast breads                       | 3.5               | 0.3      |
| Mexico   | 1    | Soft drinks                        | 19.0              | 10.8     |
|          | 2    | Fruit drinks                       | 17.2              | 9.7      |
|          | 3    | Sweetened milk-based beverages a  | 9.9               | 5.6      |
|          | 4    | Cookies                            | 8.7               | 5.0      |
|          | 5    | Sweetened tea and coffee           | 7.1               | 4.0      |
|          | 6    | Sweetened bread                    | 6.0               | 3.4      |
|          | 7    | Yogurt                             | 4.7               | 2.7      |
|          | 8    | RTE cereal                         | 4.4               | 2.5      |
|          | 9    | Candy                              | 4.2               | 2.4      |
|          | 10   | Cakes                              | 3.5               | 2.0      |
| United States | 1    | Soft drinks                        | 16.3              | 12.3     |
|           | 2    | Fruit drinks                       | 14.7              | 11.1     |
|           | 3    | Ice cream and frozen dairy desserts b | 8.1               | 6.1      |
|           | 4    | Candy                              | 7.2               | 5.5      |
|           | 5    | Cookies and brownies               | 6.7               | 5.1      |
|           | 6    | Sweetened milk-based beverages a  | 6.5               | 4.9      |
|           | 7    | RTE cereal                         | 6.2               | 4.7      |
|           | 8    | Jams, syrups, toppings and honey   | 5.3               | 4.0      |
|           | 9    | Cakes and pies                     | 4.7               | 3.6      |
|           | 10   | Sweetened tea and coffee           | 3.7               | 2.8      |

| Mexico   | 1    | Soft drinks                        | 19.0              | 10.8     |
|          | 2    | Fruit drinks                       | 17.2              | 9.7      |
|          | 3    | Sweetened milk-based beverages a  | 9.9               | 5.6      |
|          | 4    | Cookies                            | 8.7               | 5.0      |
|          | 5    | Sweetened tea and coffee           | 7.1               | 4.0      |
|          | 6    | Sweetened bread                    | 6.0               | 3.4      |
|          | 7    | Yogurt                             | 4.7               | 2.7      |
|          | 8    | RTE cereal                         | 4.4               | 2.5      |
|          | 9    | Candy                              | 4.2               | 2.4      |
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|           | 7    | RTE cereal                         | 6.2               | 4.7      |
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|           | 9    | Cakes and pies                     | 4.7               | 3.6      |
|           | 10   | Sweetened tea and coffee           | 3.7               | 2.8      |

aSweetened milk-based beverages include sweetened cow’s milk (flavoured milk, milkshakes, other sweetened dairy drinks); and sweetened animal and plant-based milks such as soy milk.
bIncludes frozen yogurt, gelatins, ices, sorbets and puddings.
lead to underreporting of foods and beverages. However, added sugars used in baking for example, could be captured using the household food inventory in China. Another methodological limitation is that the US FCT contains much more food items than the Chinese and Mexican ones. This could lead to more extensive reporting of foods and beverages in the United States and thus explain the higher total and added sugar intakes observed. However, while absolute intakes (g d⁻¹ of total and added sugars) could be impacted by misreporting due to different methodologies across countries, using relative measures (percent of energy from total and added sugars) would make the comparison more even. Strengths of the study include the cross-country comparison using nationally representative surveys, large sample sizes and use of validated 24-h recalls to estimate food intake. Also, we were able to compare the food sources of sugar intakes across countries, identifying cultural preferences.

In summary, our analysis revealed large differences in sources and intakes of total and added sugars between countries, highlighting the cultural specificities of food choice. Sugar intakes were substantially lower among Chinese children compared to Mexican and US children. Moreover, added sugars represented only a small proportion of total sugar intakes in Chinese children, while accounting for almost two thirds of total sugars in Mexican and US children. These data highlight (i) the value to translate overall recommendations to absolute intake ranges that are age group and sex specific, and (ii) the need for adapted and relevant country-specific public health initiatives in order to be most impactful.

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Conflict of Interest
All authors were employed at the Nestlé Research Center at the time this work was performed. BNSK is currently at the State University of New York at Buffalo.

Author contributions
MCA and KAL designed the research question and study design. All authors contributed to data interpretation. MCA, BNSK and KAL wrote the first draft of the manuscript. All authors reviewed, edited and had final approval of the manuscript.

References
1. Atkins P, Bowler I. Food in Society: Economy, Culture, Geography. : Routledge, 2016.
2. Te Morenga L, Mallard S, Mann J. Dietary sugars and body weight: systematic review and meta-analyses of randomised controlled trials and cohort studies. BMJ 2013; 346.
3. Rippe JM, Sievenpiper JL, Le KA, White JS, Clemens R, Angelopoulos TJ. What is the appropriate upper limit for added sugars consumption? Nutr Rev 2017; 75: 18–36.
4. Wittekind A, Walton J. Worldwide trends in dietary sugars intakes. Nutr Res Rev 2014; 27: 330–345.
5. Nestlé. Children’s Nutrition Knowledge Leadership. Our Commitment: Build Knowledge Leadership in Children’s Nutrition, Vol. 2016. Nestlé: Vevey, Switzerland, 2015.
6. Zhang B, Zhai FY, Du SF, Popkin BM. The China Health and Nutrition Survey, 1989–2011. Obesity reviews: an official journal of the International Association for the Study of Obesity 2014; 15: 2–7.
7. Romero-Martínez M, Shamah-Leyv T, Franco-Núñez A, et al. Encuesta Nacional de Salud y Nutrición 2012: diseño y cobertura. [National Health and Nutrition Survey 2012: design and coverage]. Salud Pública de Mexico 2013; 55: S332–S340.
8. Johnson CL, Paulose-Ram R, Ogden CL, et al. National Health and Nutrition Examination Survey: analytic guidelines, 1999–2010. Vital and Health Statistics 2013: 2.
9. Centers for Disease Control and Prevention, Division of Health and Nutrition Examination Surveys. National Health and Nutrition Examination Survey: Analytic Guidelines, 2011–2012.2013.
10. Zhai F, Guo X, Popkin BM, et al. Evaluation of the 24-hour individual recall method in China. Food Nutr Bull 1996; 17: 154–161.
11. López-Olmedo N, Carriquiry AL, Rodríguez-Ramírez S, et al. Usual intake of added sugars and saturated fats is high while dietary fiber is low in the Mexican population. J Nutr 2016; 46: 1856S–1865S.
12. Blanton CA, Moshtagh AJ, Baer DJ, Kretch MJ. The USDA Automated Multiple-Pass Method accurately estimates group total energy and nutrient intake. J Nutr 2006; 136: 2594–2599.
13. Yang Y, Wang G, Pan X. China Food Composition 2002, Vol. 136. Peking University Medical Press: Beijing, 2002.
14. United States Department of Agriculture, Agricultural Research Service. USDA National Nutrient Database for Standard Reference. Nutrient Data Laboratory Home Page. Vol 2016.
15. Brownman SA, Friday JE, Moshfegh AJ. MyPyramid Equivalents Database, 2.0 for USDA Survey Foods, 2003–2004. Beltsville, MD: Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, US Department of Agriculture; available at http://www.ars.usda.gov/ba/bhnrc/fsrg; 2008.
16. Taillie LS, Afeiche MC, Eldridge AL, Popkin BM. Increased snacking and eating occasions are associated with higher energy intake among Mexican children aged 2–13 years. *J Nutr* 2015; 145: 2570–2577.
17. Slining MM, Popkin BM. Trends in intakes and sources of solid fats and added sugars among U.S. children and adolescents: 1994–2010. *Pediatr Obes* 2013; 8: 307–324.
18. Lei L, Rangan A, Flood VM, Louie JCY. Dietary intake and food sources of added sugars in the Australian population. *Br J Nutr* 2016; 115: 868–877.
19. Colucci AC, Cesar CL, Marchioni DM, Fisberg RM. Factors associated with added sugars intakes among adolescents living in São Paulo, Brazil. *J Am Coll Nutr* 2012; 31: 259–267.
20. Ochoa-Avilés A, Verstraeten R, Lachat C, *et al.* Dietary intake practices associated with cardiovascular risk in urban and rural Ecuadorian adolescents: a cross-sectional study. *BMC Public Health* 2014; 14: 1–11.
21. Piernas C, Wang D, Du S, *et al.* The double burden of under- and overnutrition and nutrient adequacy among Chinese preschool and school-aged children in 2009–2011. *Eur J Clin Nutr* 2015; 69: 1323–1329.
22. Ha K, Chung S, Lee H-S, *et al.* Association of dietary sugars and sugar-sweetened beverage intake with obesity in Korean children and adolescents. *Forum Nutr* 2016; 8: 31.
23. Popkin BM. Nutrition, agriculture and the global food system in low and middle income countries. *Food Policy* 2014; 47: 91–96.
24. European Food Safety Authority, Panel on Dietetic Products Nutrition and Allergies. Draft of the scientific opinion on dietary reference values for energy. *EFSA J* 2013;11:3005.
25. Sánchez-Pimienta TG, Batis C, Lutter CK, Rivera JA. Sugar-sweetened beverages are the main sources of added sugars intakes in the Mexican population. *J Nutr* 2016; 146: 1888S–1896S.
26. Azevedo SA. Putting taxes into the diet equation. *Bull World Health Organ* 2016; 94: 239–240.
27. Popkin BM, Adair LS, Ng SW. Global nutrition transition and the pandemic of obesity in developing countries. *Nutr Rev* 2012; 70: 3–21.
28. Secretaría de Salud. NORMA Oficial Mexicana NOM-043-SSA2-2012. Servicios básicos de salud. Promoción y educación para la salud en materia alimentaria. Criterios para brindar orientación. México. [Official Mexican Standard. Basic health services. Health and food promotion and education. Criteria to provide guidance.] (in Spanish): Diario Oficial de la Federación 2013:24–48.
29. Duffey KJ, Poti J. Modeling the effect of replacing sugar-sweetened beverage consumption with water on energy intake, HBI score, and obesity prevalence. *Forum Nutr* 2016; 8.
30. Piernas C, Wang D, Du S, *et al.* Obesity, non-communicable disease (NCD) risk factors and dietary factors among Chinese school-aged children. *Asia Pac J Clin Nutr* 2016; 25: 826–840.