Certain Selected Sugar-Sweetened Beverages and Metabolic Syndrome

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The objective of this cross-sectional study of 735 adults 32 to 38 years old born in Limache Hospital in the Valparaiso region of Chile was to analyze the relationship between consumption of certain sugar-sweetened beverages (SBs) and metabolic syndrome (MS). The association with sweetened soft drinks (SDs) as part of SBs was also studied. No relationship was observed between total consumption of SBs and MS; 89% of the adults consumed SBs, with a daily median of 179 mL. However, consumption of greater than 400 mL SBs per day was associated with 1 component of MS: a high waist circumference (odds ratio [OR], 2.17; 95% confidence interval [CI], 1.16–2.51). The median consumption of SDs was 163 mL (p25–75 = 71.4–386). An association between SD consumption and MS was found. Consumption of less than 200 mL had an OR of 1.59 (95% CI, 1.01–2.51); between 200 and 400 mL, an OR of 2.06 (95% CI, 1.20–2.51); and greater than 400 mL, an OR of 2.07 (95% CI, 1.18–3.63), compared with those who did not consume them. Although there was no association between SB intake and MS, consuming SBs in high quantities (>400 mL/d) was associated with increased waist circumference. Greater consumption of SDs was associated with MS. Nutr Today. 2018;53(6):300–305

The prevalence of metabolic syndrome (MS) is rising in many countries.[1–4] In Chile, the latest Health Survey revealed a prevalence of 35.3% among adults.[5] Metabolic syndrome (MS) is a risk factor for cardiovascular disease.[6] The MS risk factors are a large waistline (abdominal obesity), high triglyceride level, low high-density lipoprotein (HDL) cholesterol level, high blood pressure, high fasting blood sugar, or medicine treatment for any of these factors. Some of the controllable causes for MS are being overweight, obesity, inactive lifestyle, and insulin resistance, and the main causes that cannot be controlled are age and genetics.[7]

High consumption of sugar-sweetened beverages (SBs) is associated to MS.[8] Sugar-sweetened beverages are defined in various ways. In this study, only certain sweetened beverages were studied: soft drinks (SDs), juice drinks, and processed powdered juices, but not juices squeezed or blender iced from whole fruits at home, sweetened coffee, or sweetened tea. Among the many possible causes of MS, obesity is the main one, which can result from excessive energy intake, sugars, and various types of sugars (sucrose and high fructose corn syrup), but there is much controversy about their relative importance, and more studies are needed.[9–11] Although a wide variety of foods contain simple sugars, SB consumption has increased substantially in Chile during recent decades, which now has one of the highest rates of SB consumption in Latin America.[12]

Evidence on the impacts of diet on the development of MS in Chile is scarce, especially on the effects of SB consumption. We studied the associations between selected beverages of this type and MS in adults. The Chilean government recently approved legislation banning advertising encouraging consumption of foods labeled as having a high calorie content or high sugar content. The exposures measured were consumption of nonalcoholic processed SBs or SDs, which, according to the Chilean Health Ministry's Food Sanitary Regulation, includes nonalcoholic drinks, SDs, and juice drinks (liquid or powdered).[13]

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POPULATION AND METHODS

This study was a cross-sectional study of individuals born between 1974 and 1978 at Limache Hospital in the Valparaíso Region of Chile, who were measured at ages 32 to 38 years between 2010 and 2012, as part of follow-up study.[14] They represented a random sample of the 3092 persons born at the hospital during 1974 to 1978. Losses to follow-up were because of death (n = 6), refusal to participate (n = 29), moving away from the area (n = 166), address being not available (=116), not contacting after repeated visits (n = 114), and refusal to participate in the blood draw or being unavailable for it (n = 65), so the sample for this cross-sectional study was 735.

A food frequency questionnaire (FFQ) on consumption over the last month was used, accompanied by a photographic atlas of food portions and their weight in grams. The study was done over 3 years at different seasons of the year by certified nutritionists. The FFQ provided information about the frequency of consumption and quantities of certain processed SBs consumed: SDs (sweetened carbonated beverages) and juice drinks (processed juices and powdered reconstituted juices), but not juice squeezed or blended from whole fruits at home. Information on total caloric intake was also obtained from the FFQ and the data were adjusted for caloric intake. Food processor 2 (FP2) using typical food for Chile was used for analyzing the data.[15] The International Physical Activity Questionnaire was applied to obtain information about physical activity, with 3 categories based on the intensity of the activity, length of time, and frequency per week: light, moderate, and very active.[16] Schooling and occupation of the head of household were used to determine socioeconomic level, using the classification system suggested by the European Society for Opinion and Marketing Research.[17] The subjects were classified into 3 categories—medium, medium-low, and low—whereas none were classified as belonging to the high socioeconomic level.

The subject's resting blood pressure was measured twice with a digital Omron 740C manometer, and the average of both measurements was then calculated. Waist perimeter was obtained using a flexible measuring tape at the midpoint between the lowest rib and the iliac crest. Blood samples were taken after at least 8 hours of fasting to determine glucose, triglyceride, and HDL levels.

DEFINITION OF VARIABLES

The exposure variable was consumption of nonalcoholic, processed SBs or SDs, which, according to the Chilean Health Ministry's Food Sanitation Regulation,[13] includes nonalcoholic drinks, SDs, and juice drinks (liquid or powdered). This variable did not include infusions with sugar (tea and coffee) because the survey that was applied—for those liquids—contained separate questions about grams of sugar.

This SB consumption was categorized into less than 200, 200 to 400, and greater than 400 mL using household measures; a standard glass contained about 200 mL and provided about 101 Kcal per 200 mL. Sex, age, physical activity, socioeconomic level, and calorie consumption were taken into consideration as modifier or confounders.

DATA ANALYSIS

Medians and interquartile ranges were used because the variables did not follow a normal distribution. Categorical variables were analyzed using percentages with their respective confidence intervals. Comparison of groups for continuous variables of independent samples was performed using nonparametric tests (Mann-Whitney), as well as the χ^2 independence test for the categories. A logistic regression model was developed for consumption of SBs (exposure variable) and MS, with and without adjustment (for sex, age, socioeconomic level, physical activity, and caloric intake). Possible interactions between the covariables and consumption of SBs were analyzed previously. Possible interactions with sex and obesity were analyzed, and as no interaction was found, it was not necessary to stratify the model by any variable. The odds ratios (ORs) with 95% confidence intervals (CIs) and *P* values are reported, with values equal to or less than .05 considered significant. The data analyses were performed with STATA 12 software.

RESULTS

The median age of the population was 35 years, with more women than men. Most of the participants had a medium-low (66%) socioeconomic level, with 6% in the lowest. More than half of the population (58%) engaged in moderate physical activity daily, with men engaging in more intense physical activity than women were. Median calorie intakes was 2752 kcal for men and 1728 kcal for women, and 89% of the participants consumed SBs. Men were higher consumers than women (Table 1).

Median consumption of SBs was 180 mL (p25–75 = 71–429), equal to about 1 glass. Consumption of juice drinks was lower: 24 mL (p25–75 = 10–76), whereas consumption of SDs was about three-quarters of a cup (median, 163 mL; p25–75 = 71–386). Median intake of men was double that of women.

Although half of the participants consumed 200 mL or less per day of SBs (about 1 cup), a quarter of them consumed more than 400 mL/d. More men consumed more than 400 mL/d.

The prevalence of MS was 28%, and it was more common among women. Elevated waist circumference and low HDL were most frequently affects, with over half of the participants showing these; again more frequently in women than men. Almost a third of the population had

TABLE 1 Characteristics of the Chilean Adults Studied by Sex

	Total (n = 735)	Men (n = 252)	Women (n = 483)	*P*
Age, median (IQR), y	35 (34–37)	36 (34–37)	35 (34–36)	.004[a]
SEL, % (CI 95%)				
Low	6 (4–8)	5 (2–8)	7 (4–9)	.437[b]
Medium-low	66 (63–70)	69 (63–74)	64 (60–69)	
Medium	28 (25–31)	26 (21–33)	29 (25–33)	
Physical activity, % (CI 95%)				
Light	18 (15–22)	14 (10–19)	20 (17–24)	.001[b]
Moderate	58(54–61)	50 (44–56)	62 (57–66)	
Intense	24(21–27)	36 (30–42)	18 (15–21)	
Calorie intake, median (IQR), kcal	2044 (1549–2754)	2752 (2168–3382)	1728 (1395–2264)	.001[a]
Obesity, %	33 (30–37)	25 (20–31)	37 (33–42)	.001[b]
People who consumed sugar-sweetened beverages (%)	89(87–92)	94 (91–97)	87 (83–90)	.001[b]

Abbreviations: SEL, socioeconomic level; CI, confidence interval; IQR, interquartile range.
[a]Mann-Whitney *U* test.
[b]χ^2 test.

elevated blood pressure and triglyceride levels and a fourth had high blood glucose levels. For the latter factors men were more likely to have them than women.

There were no sex differences in consumption of SBs between individuals with and without the MS by sex.

There was no association between total SB consumption and MS, nor was one observed between total juice drink consumption and MS. However, the association between SD consumption and MS compared with nonconsumption was linear. Consumption of less than 200 mL had an OR of 1.59 (95% CI, 1.01–2.51); 200 to 400 mL, an OR of 2.06 (95% CI, 1.20–3.54); and more than 400 mL, an OR of 2.07 (95% CI, 1.18–3.63), after adjusting for sex, physical activity, socioeconomic level, and calorie consumption for all foods except drinks (Table 2). When the associations between consumption of SBs and the various components of MS were examined, consumption levels above 400 mL was associated only with high waist circumference (OR, 2.17; 95% CI, 1.16–4.04) compared with nonconsumers of such drinks. No association was found with any of the other components (Table 3).

DISCUSSION

We did not find an association between total consumption of certain SBs and MS. There was an association with the waist circumference component of the MS at intakes above 400 mL/d of SBs, but not for hypertriglyceridemia, low low-density lipoprotein, high blood pressure, or high fasting glucose. When SDs were analyzed separately, we found an association with MS. Other studies of adults have reported that consumption of SBs is associated with greater prevalence of MS and metabolic risk factors, but the definitions for the beverages included has varied form one study to another.[8,18–21]

The results of this study are in line with those described above, particularly in relation to consumption of SBs (in quantities >400 mL) and the association with elevated waist perimeter.[18,19] This may be explained by the high calorie count of SBs, which may contribute to increased weight and specifically to increased visceral fat due to the content of high-fructose corn syrup and other sugar (sucrose).[9]

A study conducted in Costa Rica reported a positive relationship between a reduction in consumption of SBs and their substitution with fresh fruit juice and a 29% reduction in the risk of MS.[22] Similar results were observed in a clinical trial conducted among obese Mexican women.[23]

Many countries have high rates of consumption of SBs: In the United States, for example, 49% of the population reported consuming such products.[24,25] A similar situation was observed in developing countries in Asia[26,27] and

TABLE 2 Association Between Consumption of Sugar-Sweetened Beverages by Category of Consumption and Metabolic Syndrome, in a Cross-Sectional Study in Chilean Adults

	Without Adjustment Model, OR (CI)	*P*	Adjusted Model, OR (CI)	*P*
Sugar-sweetened beverages (n = 735)				
Do not consume (n = 81)	1.00		1.00	
<200 mL (n = 338)	1.27 (0.60–2.71)	.537	1.34 (0.62–2.90)	.459
200–400 mL (n = 147)	1.65 (0.73–3.73)	.231	1.95 (0.84–4.50)	.119
>400 mL (n = 169)	1.46 (0.65–3.27)	.359	2.23 (0.95–5.25)	.066
Juice drinks (n = 735)				
Do not consume (n = 294)	1.00		1.00	
<200 mL (n = 397)	0.98 (0.65–1.49)	.934	2.29 (0.65–8.04)	.197
200–400 mL (n = 22)	0.25 (0.03–1.88)	.177	2.38 (0.69–8.25)	.173
>400 mL (n = 22)	0.52 (0.12–2.29)	.386	0.56 (0.08–3.75)	.550
Soft drinks (n = 735)				
Do not consume (n = 162)	1.00		1.00	
<200 mL (n = 301)	1.55 (0.99–2.44)	.057	1.59 (1.01–2.51)	.049
200–400 mL (n = 132)	1.86 (1.10–3.15)	.021	2.06 (1.20–3.54)	.009
>400 mL (n = 140)	1.69 (0.99–2.85)	.050	2.07 (1.18–3.63)	.011

Adjusted for sex, physical activity, socioeconomic level, and calorie intake of the rest of the diet excluding sugar-sweetened beverages.
Abbreviations: CI, confidence interval; OR, odds ratio.

Latin America. These include Mexico, where 22% of daily caloric intake comes from SBs,[28] and Brazil, where per capita sales of SBs have risen 147% in the last decade.[29] These figures have been decreasing in some countries, thanks to policies and strategies in the matter, but there is still a long way to go.[30]

In Chile, few studies of SB consumption among adults have been conducted; most are focused on children and adolescents. There are references to consumption of such beverages in studies aimed at understanding patterns of consumption or dietary habits in the general population,[31,32] and more recently from the results of the National Food Consumption Survey carried out in Chile in 2010 to 2011, which indicate that the consumption rate was 82% for the Chilean population.[33]

This study found consumption of SBs of 179 mL per day per person, or 5 L per month. According to data from Chile's National Soft Drink Association (Asociación Nacional de Bebidas Refrescantes, ANBER), the typical Chilean family consumes 26 L of carbonated drinks each month, which is equivalent to 6.5 L per person, slightly higher than the level found in this study.[12] The National Food Consumption Survey mentioned previously reported median consumption of 212 mL daily per person,[33] which is also higher than the quantity found in our study. Therefore, it seems that our study population consumes these products frequently but in lower quantities in comparison to national data.

In the US Framingham cohort study, the proportion of subjects who consumed less than 1 portion daily was 64%,[18] higher than what was found in our study (46%).

This study included only processed juices. If fresh juices had been included, the figures would have shown a greater frequency and volume of consumption than in other regions of the country because fruit is widely available in the study area. Fresh juice (100% natural fruit) was not included because even though they contain sugar, they are considered by the authorities to be healthy because of their contributions of other nutrients and are now indulged in Chilean policy recommendations.[34,35] More research is needed to determine if a more inclusive definition than that used in this study of SBs would result in the same findings. Also, better ascertainment of the

TABLE 3 Association Between Consumption of Sugar-Sweetened Beverages and Components of the Metabolic Syndrome, in a Cross-Sectional Study in Chilean Adults

	Elevated Waist Perimeter		Elevated Triglycerides		Low HDL		Elevated Blood Pressure		Elevated Glucose Level	
	Adjusted Model, OR (CI)	*P*	Adjusted Model, OR (CI)	*P*	Adjusted Model, OR (CI)	*P*	Adjusted Model, OR (CI)	*P*	Adjusted Model, OR (CI)	*P*
Do not consume (n = 81)	1.00		1.00		1.00		1.00		1.00	
<200 mL (n = 338)	1.60 (0.95–2.73)	0.080	0.95 (0.55–1.66)	0.847	1.46 (0.87–2.46)	0.148	1.09 (0.60–1.95)	0.778	1.64 (0.48–5.69)	0.433
200–400 mL (n = 147)	1.54 (0.84–2.83)	0.161	1.14 (0.62–2.10)	0.668	1.74 (0.97–3.14)	0.064	0.91 (0.47–1.77)	0.786	2.24 (0.60–8.28)	0.226
>400 mL (n = 169)	2.17 (1.16–4.04)	0.015	1.20 (0.65–2.21)	0.559	1.37 (0.75–2.49)	0.306	1.47 (0.77–2.80)	0.238	2.69 (0.73–9.88)	0.136

Adjusted for sex, physical activity, socioeconomic level and calorie intake of the rest of the diet excluding sugar-sweetened beverages.
Abbreviations: CI, confidence interval; HDL, high-density lipoprotein; OR, odds ratio.

independent effects of SBs on the MS might be evident with larger sample sizes.

In this population, we observed a 28% prevalence of MS, lower than the 35.3% reported for Chile's population in 2010 in the National Health Survey (Encuesta Nacional de Salud [ENS]).[5] Unlike the ENS findings, one of the observations of this study was a greater proportion of MS among women compared with men. This difference may be because of the fact that the study population is semirural and most of the women do not work outside the home and are therefore more sedentary in comparison with men, most of whom work in agriculture, which which may explain why 37% of women are obese compared with 25% of men in this population.

The population in this study had a higher proportion of high blood pressure than the national population; however, the distribution by sex was similar to the ENS.[5] The level of elevated glucose was 24%, which is more than double the figure found in the national data. These differences may be the result of the ENS use of a reference glucose level of 126 mg/dL for a diabetes diagnosis; in this study, 100 mg/dL was the cutoff (Program Adult Treatment Panel III diagnostic criterion for MS); the same is true for high blood pressure, which used the values for MS.[4,14] Our analysis of the prevalence of triglyceride levels above 150 mg/dL showed proportions similar to those found in the national survey; both studies revealed a higher proportion among men. With regard to low HDL, we also found figures similar to those of the ENS.[5]

The main limitation of this study has to do with its cross-sectional design, which does not allow for analysis over time to determine causality. Another limitation is that the consumption information was obtained through application of a dietary survey, which may be affected by memory bias, as well as the difficulty to quantify the portion intake, which may underreport intakes. Another limitation is that the study was conducted with a representative sample of the population of Limache (Valparaiso Region, Chile), but not of the entire Chilean population. Regarding the analysis, it would have been interesting to study the contribution of alcoholic beverages separately, and not only included in the total caloric intake, which constitutes an additional limitation of the study. One more limitation is that the measure of glycemic control in this study represents a single fasting measurement; it would be helpful for future research to evaluate long-term relationships through clinical trials that also assess the postprandial response. An additional limitation is constituted by some possible confounders in evaluating these cross-sectional results, which were not controlled: insulin resistance, having a personal history of diabetes, having a sibling or parent who has diabetes, and having a personal history of polycystic ovarian syndrome (for women).

Among the advantages of this study are that it was based on a large sample of adults, with instruments developed by trained, qualified nutritionists who were constantly supervised, supported by an atlas (indicating portion sizes) and equivalence tables (for more precise indications of reported consumption). Also, the clinical measurements were taken under standard conditions.

CONCLUSION

No association was observed between total intake of SBs considered in this study and MS. Consuming SBs in high quantities (>400 mL) was associated with increased waist

circumference, but no other components of the MS. Greater consumption of SDs is related to a higher chance of MS.

Further studies need to be considered in setting policy regarding diet and health, and preferably with another study design stronger than the cross-section, which allow to establish causality and a greater strength of association, with larger and more representative sample than were possible in this study, with more inclusive definitions of SBs and stronger dietary assessment tools. More experimental studies are needed to obtain more conclusive data than observational studies and from this, to give conclusive information to the authorities to take health decisions.

REFERENCES

1. Bian S, Gao Y, Zhang M, et al. Dietary nutrient intake and metabolic syndrome risk in Chinese adults: a case-control study. *Nutr J*. 2013;12:106.
2. de Oliveira EP, McLellan KC, Vaz de Arruda Silveira L, Burini RC. Dietary factors associated with metabolic syndrome in Brazilian adults. *Nutr J*. 2012;11:13.
3. Guallar-Castillon P, Perez RF, Lopez Garcia E, et al. Magnitude and management of metabolic syndrome in Spain in 2008–2010: the ENRICA study. *Rev Esp Cardiol (Engl Ed)*. 2014;67(5):367–373.
4. Saklayen MG. The Global Epidemic of the Metabolic Syndrome. *Curr Hypertens Rep*. 2018;26;20(2):12.
5. Ministerio de Salud de Chile. Encuesta Nacional de Salud 2009–2010, Minsal.; www.minsal.cl. Accessed January 2018.
6. Reilly MP, Rader DJ. The metabolic syndrome: more than the sum of its parts? *Circulation*. 2003;108(13):1546–1551.
7. National Heart LaBI. Metabolic syndrome. https://www.nhlbi.nih.gov/health-topics/metabolic-syndrome. Accessed January 2018.
8. Narain A, Kwok CS, Mamas MA. Soft drink intake and the risk of metabolic syndrome: a systematic review and meta-analysis. *Int J Clin Pract*. 2017;71(2).
9. Klurfeld DM, Foreyt J, Angelopoulos TJ, Rippe JM. Lack of evidence for high fructose corn syrup as the cause of the obesity epidemic. *Int J Obes (Lond)*. 2013;37(6):771–773.
10. Stanhope KL. Sugar consumption, metabolic disease and obesity: the state of the controversy. *Crit Rev Clin Lab Sci*. 2016;53(1):52–67.
11. Deshpande G, Mapanga RF, Essop MF. Frequent sugar-sweetened beverage consumption and the onset of cardiometabolic diseases: cause for concern? *J Endocr Soc*. 2017;1(11):1372–1385.
12. ANBER. *Total Ventas en Volumen*. 2013;2014. www.anber.cl. Accessed January 2018.
13. Ministerio de Salud de Chile. Reglamento Sanitario de los Alimentos. 1996. www.minsal.cl. Accessed January 2018.
14. Amigo H, Bustos P, Zumelzu E, Rona RJ. Cohort profile: the Limache, Chile, birth cohort study. *Int J Epidemiol*. 2014;43(4):1031–1039.
15. Yale J. The Food Processor II software review. *Biol Med*. 1990;63(4):341–342.
16. IPAQ. Cuestionario Internacional de Actividad Física. Ginebra 2002. www.ipaq.ki.se. Accessed January 2018.
17. ADIMARK. *El nivel socioeconómico Esomar. Manual de aplicación Adimark*. Santiago de Chile: GFK Adimark: Investigación de Mercado y Opinión Pública; 2000: http://www.microweb.cl/idm/documentos/ESOMAR.pdf. Accessed January 2018.
18. Dhingra R, Sullivan L, Jacques PF, et al. Soft drink consumption and risk of developing cardiometabolic risk factors and the metabolic syndrome in middle-aged adults in the community. *Circulation*. 2007;116(5):480–488.
19. Malik VS, Popkin BM, Bray GA, Despres JP, Willett WC, Hu FB. Sugar-sweetened beverages and risk of metabolic syndrome and type 2 diabetes: a meta-analysis. *Diabetes Care*. 2010;33(11):2477–2483.
20. Appelhans BM, Baylin A, Huang MH, et al. Beverage Intake and metabolic syndrome risk over 14 years: the Study of Women's Health Across the Nation. *J Acad Nutr Diet*. 2017 Apr;117(4):554–562.
21. Barrio-Lopez MT, Martinez-Gonzalez MA, Fernandez-Montero A, Beunza JJ, Zazpe I, Bes-Rastrollo M. Prospective study of changes in sugar-sweetened beverage consumption and the incidence of the metabolic syndrome and its components: the SUN cohort. *Br J Nutr*. 2013;110(9):1722–1731.
22. Mattei J, Malik V, Hu FB, Campos H. Substituting homemade fruit juice for sugar-sweetened beverages is associated with lower odds of metabolic syndrome among Hispanic adults. *J Nutr*. 2012;142(6):1081–1087.
23. Hernandez-Cordero S, Barquera S, Rodriguez-Ramirez S, Villanueva-Borbolla MA, Gonzalez de Cossio T, et al. Substituting water for sugar-sweetened beverages reduces circulating triglycerides and the prevalence of metabolic syndrome in obese but not in overweight Mexican women in a randomized controlled trial. *J Nutr*. 2014;144(11):1742–1752.
24. Sohyun P, Liping P, Bettylou S, Heidi MB. Consumption of sugar-sweetened beverages among US adults in 6 states: Behavioral Risk Factor Surveillance System, 2011. *Prev Chronic Dis*. 2014;11:E65.
25. Centers for Disease Control and Prevention. Get the Facts: Sugar-Sweetened Beverages and Consumption. 2014. www.cdc.gov/nutrition/data-statistics/sugar-sweetened-beverages-intake.html. Accessed October 18, 2018.
26. Pan WH, Wu HJ, Yeh CJ, et al. Diet and health trends in Taiwan: comparison of two nutrition and health surveys from 1993–1996 and 2005–2008. *Asia Pac J Clin Nutr*. 2011;20(2):238–250.
27. Han E, Powell LM. Consumption patterns of sugar-sweetened beverages in the United States. *J Acad Nutr Diet*. 2013;113(1):43–53.
28. Barquera S, Hernández-Barrera L, Tolentino ML, et al. Energy intake from beverages is increasing among Mexican adolescents and adults. *J Nutr*. 2008;138(12).
29. Vargas-Garcia EJ, El Evans C, Cade JE. Impact of interventions to reduce sugar-sweetened beverage intake in children and adults: a protocol for a systematic review and meta-analysis. *Syst Rev*. 2015;4:17.
30. Kit BK, Fakhouri TH, Park S, Nielsen SJ, Ogden CL. Trends in sugar-sweetened beverage consumption among youth and adults in the United States: 1999–2010. *Am J Clin Nutr*. 2013;98(1):180–188.
31. Silva P, Durán S. Bebidas azucaradas, más que un simple refresco. *Rev Chil Nutr*. 2014;41(1).
32. Crovetto M, Uauy R. Evolución del gasto en alimentos procesados en la población del Gran Santiago en los últimos 20 años. *Rev Med Chil*. 2012;140(3).
33. Ministerio de Salud. Encuesta Nacional de Consumo Alimentario 2010–2011. www.minsal.cl. Accessed January 2018.
34. Auerbach BJ, Dibey S, Vallila-Buchman P, Kratz M, Krieger J. Review of 100% fruit juice and chronic health conditions: implications for sugar-sweetened beverage policy. *Adv Nutr*. 2018;9(2):78–85.
35. Velasquez-Melendez G, Molina MD, Bensenor IM, Cardoso LO, Fonseca MJ, Moreira AD, et al. Sweetened soft drinks consumption is associated with metabolic syndrome: cross-sectional analysis from the Brazilian Longitudinal Study of Adult Health (ELSA-Brasil). *J Am Coll Nutr*. 2017;36(2):99–107.