

# Snacking patterns among Chilean children and adolescents: is there potential for improvement?

Melissa L Jensen<sup>1,2</sup>, Camila Corvalán<sup>3</sup>, Marcela Reyes<sup>3</sup>, Barry M Popkin<sup>1</sup> and Lindsey Smith Taillie<sup>1,\*</sup>

<sup>1</sup>Global Food Research Program, Carolina Population Center, University of North Carolina, 123 W Franklin Street, Chapel Hill, NC 27516, USA; <sup>2</sup>School of Nutrition, University of Costa Rica, San José, Costa Rica; <sup>3</sup>Instituto de Nutrición y Tecnología de Alimentos, Universidad de Chile, Maucul, Chile

Submitted 15 July 2018: Final revision received 6 February 2019: Accepted 20 February 2019: First published online 24 May 2019

## Abstract

**Objective:** To examine snacking patterns, food sources and nutrient profiles of snacks in low- and middle-income Chilean children and adolescents.

**Design:** Cross-sectional. Dietary data were collected via 24 h food recalls. We determined the proportion of snackers, snacks per day and energy from top food and beverage groups consumed. We compared the nutrient profile (energy, sodium, total sugars and saturated fat) of snacks *v.* meals.

**Setting:** South-east region of Chile.

**Participants:** Children and adolescents from two cohorts: the Food Environment Chilean Cohort (*n* 958, 4–6 years old) and the Growth and Obesity Cohort Study (*n* 752, 12–14 years old).

**Results:** With a mean of 2.30 (SE 0.03) snacks consumed daily, 95.2% of children and 89.9% of adolescents reported at least one snacking event. Snacks contributed on average 1506 kJ/d (360 kcal/d) in snacking children and 2218 kJ/d (530 kcal/d) in snacking adolescents (29.0 and 27.4% daily energy contribution, respectively). Grain-based desserts, salty snacks, other sweets and desserts, dairy foods and cereal-based foods contributed the most energy from snacks in the overall sample. For meals, cereal-based foods, dairy beverages, meat and meat substitutes, oils and fats, and fruits and vegetables were the top energy contributors.

**Conclusions:** Widespread snacking among Chilean youth provides over a quarter of their daily energy and includes foods generally considered high in energy, saturated fat, sodium and/or total sugars. Future research should explore whether snacking behaviours change as the result of Chile's national regulations on food marketing, labelling and school environments.

**Keywords**  
Snacking  
Chile  
Children  
Adolescents

The past four decades have seen a worldwide increase in obesity and non-communicable diseases<sup>(1,2)</sup>. In Latin America many countries face the malnutrition double burden<sup>(3,4)</sup>. Children and adolescents are particularly vulnerable<sup>(5,6)</sup>, as a high BMI in childhood or adolescence has been associated with increased risk of CVD later in life<sup>(7)</sup>.

In Chile, 74.4% of the population was either overweight or obese in 2016<sup>(8)</sup> compared with 64.3% in 2009<sup>(9)</sup>, and obesity-related health problems were prevalent, with high blood pressure and diabetes affecting 27.5 and 9.4% of the population, respectively<sup>(8)</sup>. In the Chilean diet processed and ultra-processed foods<sup>(10)</sup> account for 55.2% of the total energy consumption. Processed foods include items such

as bread, cheese, and canned fruits and vegetables<sup>(11)</sup>. Ultra-processed foods include chips (crisps), ice cream, chocolate and other candies, and carbonated drinks, among others. Ultra-processed foods in particular have been associated with excess weight<sup>(12,13)</sup> and hypertension<sup>(14)</sup>. Only 12.9% of the population adheres to the recommendations of the Chilean National Dietary Guidelines<sup>(15)</sup>. Furthermore, less than a fifth of the population consumes five or more servings of fruits or vegetables daily, less than 15.0% consumes whole grains at least once daily and less than 50.0% consumes fish or seafood once or more weekly<sup>(9)</sup>.

Despite this evidence of generally unhealthy diets, little is known about the extent of snacking behaviours and the types of snacks the Chilean population consumes.

\*Corresponding author: Email [taillie@unc.edu](mailto:taillie@unc.edu)



Snacking is prevalent in the high-income North American countries of Canada<sup>(16)</sup> and the USA<sup>(17,18)</sup> and in Latin America, including Brazil<sup>(19)</sup> and Mexico<sup>(20,21)</sup>. Identifying snacking patterns is particularly important for children and adolescents, since eating behaviours are acquired early and track into adulthood<sup>(22)</sup>. Moreover, some evidence suggests that snacking may be linked to increased energy intake<sup>(23–25)</sup> and also that snacking on energy-dense or unhealthy foods may contribute to overweight status<sup>(26)</sup>, suggesting that the types of snacks consumed are important. Furthermore, social, environmental and individual factors affect snack selection and consumption<sup>(27)</sup>. The objective of the present study was to examine snacking patterns and snack food and beverage sources in Chilean children and adolescents in 2016 and compare the nutrient profiles of foods selected as snacks *v.* those eaten at main meals.

## Methods

### *Study design and sample*

The present study includes dietary data from two cohorts: the Growth and Obesity Cohort Study (GOCS) and the Food Environment Chilean Cohort (FECHIC), both recruited from low- and middle-income neighbourhoods in the south-eastern area of Santiago, Chile. The GOCS started in 2006 and enrolled children (*n* 1195) who attended fifty-four nursery schools in the National Nursery Schools Council Program (JUNJI, acronym for the name in Spanish)<sup>(28,29)</sup>. The GOCS participants visited the Institute of Nutrition and Food Technology Diagnostic Clinic (CEDINTA) at least once per year for a physical examination, which included dietary assessments starting in 2012. In 2016 dietary data were collected for 80.8% of the 953 GOCS participants (*n* 770). The GOCS included children who were a single birth with birth weight >2500 g, who were enrolled the previous year in a JUNJI centre, and who did not have physical or psychological conditions that could severely affect growth<sup>(28)</sup>. In 2016 these children were 12–14 years old and constituted our adolescent group.

The FECHIC included children 4–6 years old (born between 2010 and 2012) who attended one of fifty-five public schools in 2016. Because of the young ages of these children, they were invited to participate along with their mothers, since in Chile mothers are the primary caregivers and the main household food preparers, enabling them to respond to the questionnaires and dietary recalls for their children. Of 2625 families who initially expressed interest, 962 enrolled in the study. The FECHIC included children who attended the contacted schools, who were single births, whose mothers were the primary caregivers and were in charge of food purchases for the home, and who (along with their mothers) had no mental illnesses or gastrointestinal diseases that would affect food consumption. The dietary data of eighteen GOCS participants and four FECHIC participants were not reliable enough to

be included in the analysis; therefore, our total analytic sample was 1710: 752 GOCS participants and 958 FECHIC participants.

We obtained informed consent from the mothers of participants; in the case of adolescents, we also obtained an assent prior to conducting the interviews. The ethics committee of the Institute of Nutrition and Food Technology (INTA) approved the study protocol. The study was exempt from review by the Institutional Review Board of the University of North Carolina at Chapel Hill, because the university had no contact with the human subjects and received only secondary unidentified data.

### *Dietary assessment and food groups*

The data analysed in the present study were collected between April and July of 2016 either at the study participants' homes or at the CEDINTA. Trained nutritionists conducted 24 h food recalls using a multiple-pass method assisted by computer software (SER-24) developed for that purpose. For pre-school children, mothers were the primary reporters of dietary intake and the children provided complementary information for times when the mother was not present. Interviewers used a food atlas<sup>(30)</sup> with images of bowls, plates, mugs and glasses to assess serving sizes of common Chilean foods and beverages. Interviewers entered participants' responses directly into SER-24, and a second nutritionist reviewed the information later to check for inconsistencies and to ensure quality in reported data. When two interviews were available for the same participant, we used only the first day's data.

We used the US Department of Agriculture's Food and Nutrient Database<sup>(31)</sup>, which contains nutrient information searchable by food item, food group or manufacturer's name, to calculate nutrient values. To determine the nutrient values for traditional Chilean dishes not present in the Food and Nutrient Database we separated the specific ingredients and quantities and found the closest match to each ingredient using this same US Department of Agriculture database<sup>(31)</sup>.

Our team adapted food and beverage groups from a system previously developed at the Public Health Nutrition Department of the INTA<sup>(32)</sup> (see online supplementary material, Supplemental Table S1). We disaggregated the components of mixed dishes and classified them correspondingly (i.e. for *arroz a la jardinera*, we grouped rice with cereals and onions and peppers with vegetables) except for those dishes that, according to the previously established groups, were of interest when consumed whole. For example, *sopaipilla* (fried pumpkin dough), *completo* (traditional Chilean-style hot dog) and pizza were not disaggregated into ingredients (Supplemental Table S2).

### *Definitions of meals and snacks*

Participants identified the names and times of eating occasions (EO) during the interviews. They reported EO as



breakfast, *colación* (a small meal or snack), lunch, *once* (a small late-afternoon meal), dinner or *picoteo* (a snack or small appetizer). Participants could report several instances per type of EO, for example, two breakfasts at different times, but each EO could have only one label; that is, an EO could not be identified as both breakfast and snack. For our analyses, we always considered breakfast, lunch, *once* and dinner a main meal, whereas we considered *colación* and *picoteo* snacks.

*Once*, a sit-down meal, typically consists of bread, an assortment of fixings (such as avocado, jam, butter and cheese) and coffee or tea. Depending on one's lifestyle and upbringing, *once* sometimes replaces dinner. Due to the large proportion of our sample reporting *once* and not dinner, for our analysis we considered it a meal and not a snack. A study conducted in Mexico<sup>(20)</sup> similarly considered *almuerzo*, which is usually mid-morning but before lunch, a meal and not a snack.

We defined frequency of snacking based on the number of snack EO reported per day, which ranged from 0 to 10. For descriptive purposes only, we classified respondents as non-snackers (0 snacks/d), light snackers (1–2 snacks/d) and heavy snackers ( $\geq 3$  snacks/d), an approach previously used elsewhere<sup>(19)</sup>. Participants also reported the locations of EO as home, school, another person's home, mall or food court, restaurant, work, street, transportation or other.

### Statistical analyses

We determined the proportion of children and adolescents consuming snacks and the mean number (SE) of snacks consumed per age group, gender and mother's education level (less than high school, high school completed, above high school) and explored differences using  $\chi^2$  tests and *t* tests at a significance of  $P < 0.05$ . We also determined per capita and per consumer energy intake from snacks *v.* meals and explored differences within each age group. 'Per capita' refers to the mean consumption using our total sample as a denominator (stratified by age group) and 'per consumer' refers to the mean consumption of a food group among those who reported consuming it. We then determined the top ten food and beverage groups consumed as snacks and meals based on mean per capita contribution, the percentage of consumers for each food or beverage group, and the mean energy contributions of these food and beverage groups to the total energy intake among consumers.

Finally, we determined energy (kilocalories) and nutrient density (macronutrients, saturated fat, total sugars, fibre and sodium) intake per 100 g of foods and beverages consumed as snacks *v.* meals for each participant. For example, we calculated energy density for snacks as (kilocalories from snacks  $\times 100$ )/total grams of snacks. We calculated measures per 100 g because using product weight allowed us to understand the energy density across different products and eased comparability between

different EO. We analysed sodium, total sugars and saturated fats in addition to macronutrients since they are the nutrients defined in recent Chilean food regulations<sup>(33,34)</sup> as critical nutrients whose excess consumption should be avoided. Additionally, these nutrients have been defined as critical by global health organizations<sup>(35)</sup>, due to their link with obesity and non-communicable diseases. In such regulations, cut-off points are established per 100 g of a product. We used paired *t* tests at a significance level of 0.05 to compare the nutrient profiles of snacks *v.* meals within each age group. We used the statistical software package Stata version 14.3 (2017) for all analyses.

## Results

### Overall eating occasions

Children reported slightly more EO than adolescents (5.7 *v.* 5.3 EO/d,  $P < 0.05$ ), likely due to a greater percentage of children reporting *colación* and dinner than adolescents (Table 1). More children than adolescents consumed breakfast, *colación* and dinner (95.6 *v.* 87.2%, 81.0 *v.* 54.6% and 43.3 *v.* 17.8%, respectively,  $P < 0.05$ ). More adolescents than children consumed *picoteo* (72.1 *v.* 63.3%,  $P < 0.05$ ). Less than half of the participants in both age groups reported dinner (43.3% in children, 17.8% in adolescents), suggesting that many might either substitute *once* for dinner or might have referred to dinner as such.

As shown in Fig. 1, lunch contributed the most to total daily energy intake in both age groups (27.9% in children, 28.7% in adolescents), followed by *once* (17.1% in children, 23.6% in adolescents) and dinner (17.2% in children, 16.1% in adolescents). The per capita contribution of dinner to total energy intake was small in both age groups (8.7% in children, 4.2% in adolescents), which is expected due to the small percentage of participants who reported consumption of dinner.

### General snacking patterns

Snacking was a prevalent behaviour in both age groups, with 95.2% of children and 89.9% of adolescents reporting at least one snacking event in the previous day (Table 1). Snacks contributed on average 1506 kJ/d (360 kcal/d) in children and 2218 kJ/d (530 kcal/d) in adolescents. Furthermore, the mean daily energy contribution from snacks was 29.0% for children and 27.4% for adolescents (Fig. 1). The mean number of meals, snacks and EO per day did not differ significantly by sex in children (Table 2); however, adolescent females reported slightly more snacks than adolescent males (mean 2.47 (SE 0.09) *v.* 2.19 (SE 0.08) snacks/d).

### Top foods and beverages consumed

The food and beverage categories consumed as snacks were similar among children and adolescents, with eight

**Table 1** Mean energy and percentage of energy consumed per day and snacking frequency among FECHIC (children, 4–6 years) and GOCS (adolescents, 12–14 years) study participants (*n* 1710), south-eastern area of Santiago, Chile, 2016

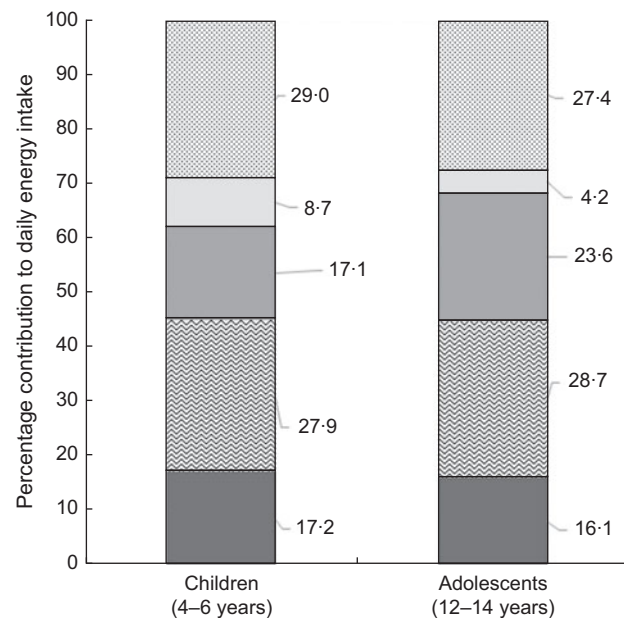
	Children ( <i>n</i> 958)				Adolescents ( <i>n</i> 752)			
	Males ( <i>n</i> 465)		Females ( <i>n</i> 493)		Males ( <i>n</i> 377)		Females ( <i>n</i> 375)	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Per capita total energy intake (kcal)	1244	18.4	1172	17.4	1991	32.5	1700	32.0
Per capita energy intake from snacks (kcal)	368	12.4	352	11.2	538	24.9	521	25.0
Per capita energy intake from snacks (% of total)	28.8	0.8	29.3	0.7	26.1	1.0	28.7	1.1
Percentage of snacker†	94.8	–	95.5	–	89.1	–	90.7	–
Per snacker energy intake from snacks (kcal)	388	12.4	368	11.2	603	25.8	575	25.4
Per snacker energy intake from snacks (% of total)	30.4	0.8	30.6	0.7	29.3	1.0	31.7	1.0
Snacking frequency (%)								
Non-snackers (0 snacks/d)	5.2	–	4.5	–	10.9	–	9.3	–
Light snackers (1–2 snacks/d)	53.3	–	57.2	–	53.9	–	47.2	–
Heavy snackers (≥3 snacks/d)	41.5	–	38.3	–	35.3	–	43.5	–
Eating occasion frequency (%)								
Breakfast	96.3	*	94.9	*	87.8	*	86.7	*
Lunch	94.6	–	95.9	–	94.7	–	94.9	–
Once	76.8	–	79.9	–	83.0	–	80.3	–
Dinner	44.3	*	42.4	*	18.8	*	16.8	*
Colación	82.8	*	79.3	*	54.1	*	55.2	*
Picoteo	60.7	*	65.7	*	70.0	*	74.1	*

FECHIC, Food Environment Chilean Cohort; GOCS, Growth and Obesity Cohort Study.

1 kcal = 4.184 kJ.

\*Significant difference between children and adolescents by sex for each type of eating occasion using  $\chi^2$  test ( $P < 0.05$ ).

†Participants reporting  $\geq 1$  snack/d.



**Fig. 1** Percentage contribution of each type of eating occasion (■, breakfast; ▨, lunch; ▩, once; □, dinner; ▤, snack) to total daily energy intake of FECHIC (children) and GOCS (adolescents) study participants (*n* 1710), south-eastern area of Santiago, Chile, 2016 (FECHIC, Food Environment Chilean Cohort; GOCS, Growth and Obesity Cohort Study)

of the top ten groups present in both age groups (grain-based desserts, dairy products, other sweets and desserts, fruit-flavoured drinks, salty snacks, fruits and vegetables, cereal-based foods, fast food). Dairy beverages and ready-to-eat breakfast cereals ranked in the top ten in

children, whereas *empanadas* and *sopaipillas* and carbonated beverages ranked in the top ten in adolescents (Tables 3 and 4). Fruits and vegetables were the most commonly consumed snack food category in children (40.0%), but grain-based desserts ranked first in adolescents (46.0%).

Similarly, for foods and beverages consumed as meals, eight out of the top ten food groups were the same in both age groups (cereal-based foods, dairy beverages, meat and meat substitutes, fruits and vegetables, oils and fats, dairy foods, grain-based desserts, fast food). Legumes and eggs were among the other top energy contributors in children, whereas for adolescents carbonated beverages and *empanadas* and *sopaipillas* ranked in the top ten (Tables 3 and 4).

#### Nutrient profile by eating occasion

As Table 5 shows, while snacks contributed about a third of the daily energy (kcal/100 g) in both age groups, they more contributed more to the total daily sugar intake (41.7% in children, 38.5% in adolescents) and slightly less to the total daily protein intake (20.0% in children, 17.4% in adolescents) than would be expected given their energy contribution compared with that of meals. Among participants who reported at least one meal and one snack in a day (*n* 1585), the daily energy density was higher for snacks (519 kJ (124 kcal)/100 g for children, 782 kJ (187 kcal)/100 g for adolescents) than for meals (356 kJ (85 kcal)/100 g for children, 431 kJ (103 kcal)/100 g for adolescents) in both age groups ( $P < 0.05$ ). Furthermore, snacks were significantly less protein dense and more carbohydrate,



**Table 2** Eating occasions (EO) per day, by sociodemographic characteristics, among FECHIC (children, 4–6 years) and GOCS (adolescents, 12–14 years) study participants (*n* 1710), south-eastern area of Santiago, Chile, 2016

Variable	Children ( <i>n</i> 958)						Adolescents ( <i>n</i> 752)							
	<i>n</i>	Snacks/d		Meals/d		Total EO/d		<i>n</i>	Snacks/d		Meals/d		Total EO/d	
		Mean	SD	Mean	SD	Mean	SD		Mean	SD	Mean	SD	Mean	SD
<b>Sex</b>														
Male (reference)	465	2.32	0.06	3.37	0.04	5.70	0.07	377	2.19	0.08	3.03	0.04	5.22	0.08
Female	493	2.29	0.05	3.40	0.04	5.70	0.06	375	2.47*	0.08	2.96	0.04	5.43*	0.09
<b>Mother's education level</b>														
Less than high school (reference)	173	2.28	0.08	3.28	0.06	5.56	0.09	213	2.19	0.11	2.96	0.06	5.15	0.11
High school completed	396	2.31	0.06	3.45	0.05*	5.76	0.07	335	2.48*	0.09	2.93	0.04	5.42	0.09
More than high school	389	2.32	0.06	3.36	0.04	5.68	0.07	169	2.14	0.11	3.16*	0.06	5.30	0.12

FECHIC, Food Environment Chilean Cohort; GOCS, Growth and Obesity Cohort Study.

\*Significantly different compared with the reference group ( $P < 0.05$ ). Independent-sample *t* test used for the mean number of snacks, meals and EO when comparing males and females. Linear regression model used to determine.**Table 3** Daily energy intake per capita, percentage of consumers and energy intake per consumer for the top ten food and beverage groups consumed as snacks and meals in the FECHIC (children, 4–6 years) study participants (*n* 958), south-eastern area of Santiago, Chile, 2016

Rank	Food group	kcal/capita†		Consumers‡		kcal/consumer§	
		Mean	SE	<i>n</i>	%	Mean	SE
<b>Snacks</b>							
1	Grain-based desserts	80	4	360	37.6	212	8
2	Dairy beverages	44	3	321	33.5	130	5
3	Dairy foods	43	2	333	34.8	124	3
4	Other sweets and desserts	34	3	263	27.5	122	9
5	Fruit-flavoured drinks	28	2	227	23.7	116	3
6	Salty snacks	27	3	128	13.4	201	16
7	Fruits and vegetables	24	1	383	40.0	61	2
8	Cereal-based foods	18	1	168	17.5	103	4
9	Ready-to-eat breakfast cereals	15	1	154	16.1	92	3
10	Fast food	9	2	45	4.7	191	16
<b>Meals</b>							
1	Cereal-based foods	210	5	890	92.9	226	5
2	Dairy beverages	163	4	818	85.4	191	5
3	Meat and meat substitutes	73	3	689	71.9	101	3
4	Fruits and vegetables	69	3	847	88.4	78	3
5	Oils and fats	66	2	825	86.1	77	2
6	Dairy foods	39	2	334	34.9	110	3
7	Grain-based desserts	34	3	160	16.7	201	12
8	Legumes	29	2	336	35.1	82	6
9	Fast food	23	3	81	8.5	263	20
10	Eggs	20	1	267	27.9	73	3

FECHIC, Food Environment Chilean Cohort.

1 kcal = 4.184 kJ.

†Mean daily per capita food group intake (including both consumers and non-consumers of each food group). For all food groups, the mean total energy intake was 5050 kJ (1207 kcal).

‡Indicates the number and percentage of participants reporting each food group as a snack or a meal.

§Mean daily kcal per food group among consumers.

total sugars, total fat and saturated fat dense than meals. The mean per capita intakes of energy and nutrients, by snacks and meals, can be found in the online supplementary material, Supplemental Table S3.

### Meal and snack consumption locations

Most of the daily energy intake from both snacks and meals was consumed at participants' homes (3372 kJ (806 kcal) for children, 4916 kJ (1175) kcal for adolescents) or school (1029 kJ (246 kcal) for children, 1686 kJ (403 kcal) for adolescents; Fig. 2). However, both groups reported a larger percentage of energy from snacks consumed at

school, 35.5–36.0%, compared with 13.7–16.3% from meals. That is, on average children consumed 544 kJ (130 kcal) in snacks at school and adolescents consumed 787 kJ (188 kcal) in snacks at school. In contrast, on average children consumed 485 kJ (116 kcal) in meals at school and adolescents 1050 kJ (215 kcal).

### Discussion

Our study shows that snacking is prevalent among Chilean children and adolescents. Snacking accounts

**Table 4** Daily energy intake per capita, percentage of consumers and energy intake per consumer for the top ten food and beverage groups consumed as snacks and meals in the GOCS (adolescents, 12–14 years) study participants (*n* 752), south-eastern area of Santiago, Chile, 2016

Rank	Food group	kcal/capita†		Consumers‡		kcal/consumer§	
		Mean	SE	<i>n</i>	%	Mean	SE
<b>Snacks</b>							
1	Grain-based desserts	152	9	344	45.7	331	14
2	Salty snacks	73	7	164	21.8	332	23
3	Cereal-based foods	50	4	168	22.3	223	11
4	Other sweets and desserts	47	4	231	30.7	154	10
5	<i>Empanadas</i> and <i>sopaipillas</i>	28	4	53	7.0	386	32
6	Carbonated beverages	27	3	131	17.4	152	9
7	Dairy foods	25	2	149	19.8	125	5
8	Fast food	24	4	47	6.3	380	41
9	Fruits and vegetables	23	2	216	28.7	81	5
10	Fruit-flavoured drinks	17	2	98	13.0	131	8
<b>Meals</b>							
1	Cereal-based foods	422	10	716	95.2	442	9
2	Meat and meat substitutes	147	7	573	76.2	193	8
3	Fast food	89	9	126	16.8	528	32
4	Oils and fats	87	3	632	84.0	104	3
5	Fruits and vegetables	80	3	639	85.0	94	4
6	Grain-based desserts	79	8	153	20.3	387	29
7	Dairy beverages	63	4	333	44.3	143	5
8	Dairy foods	57	4	299	39.8	142	7
9	Carbonated beverages	50	3	244	32.4	152	6
10	<i>Empanadas</i> and <i>sopaipillas</i>	48	7	55	7.3	643	50

GOCS, Growth and Obesity Cohort Study.

1 kcal = 4.184 kJ.

†Mean daily per capita food group intake (including both consumers and non-consumers of each food group). For all food groups, the mean total energy intake was 5050 kJ (1207 kcal).

‡Indicates the number and percentage of participants reporting each food group as a snack or a meal.

§Mean daily kcal per food group among consumers.

**Table 5** Nutrient profile (expressed in quantities per 100 g) of snacks and meals among FECHIC (children, 4–6 years) and GOCS (adolescents, 12–14 years) study participants (*n* 1710), south-eastern area of Santiago, Chile, 2016

	Children ( <i>n</i> 958)								Adolescents ( <i>n</i> 752)							
	Snacks†				Meals‡				Snacks†				Meals‡			
	% of total intake		per 100 g		% of total intake		per 100 g		% of total intake		per 100 g		% of total intake		per 100 g	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Energy (kcal)	28.9	0.5	124*	3	71.1	0.5	85*	1	27.4	0.7	187*	5.1	72.6	0.7	103*	1.2
<b>Macronutrient intake</b>																
Total protein (g)	20.0	0.5	2.9*	0.1	80.0	0.5	3.5*	0.0	17.4	0.6	3.3*	0.103	82.6	0.6	4.1*	0.1
Total carbohydrates (g)	32.8	0.6	20.0*	0.4	67.2	0.6	11.6*	0.1	29.3	0.8	27.5*	0.704	70.7	0.8	13.9*	0.2
Fibre (g)	28.7	0.7	1.1*	0.0	71.3	0.7	0.8*	0.0	26.1	0.8	1.4*	0.052	73.9	0.8	0.9*	0.0
Total sugars (g)	41.7	0.7	12.1*	0.2	58.3	0.7	4.8*	0.1	38.5	0.9	14.2*	0.472	61.5	0.9	4.4*	0.1
Total fat (g)	26.4	0.7	4.0*	0.2	73.6	0.7	2.8*	0.0	28.9	0.9	7.5*	0.301	71.1	0.9	3.5*	0.1
Saturated fat (g)	28.6	0.7	1.5*	0.1	71.4	0.7	0.9*	0.0	30.8	0.9	2.6*	0.129	69.2	0.9	1.1*	0.0
<b>Micronutrient intake</b>																
Na (mg)	24.7	0.7	95	4	75.3	0.7	90	2	22.7	0.8	152*	6	77.3	0.8	131*	3

FECHIC, Food Environment Chilean Cohort; GOCS, Growth and Obesity Cohort Study.

1 kcal = 4.184 kJ.

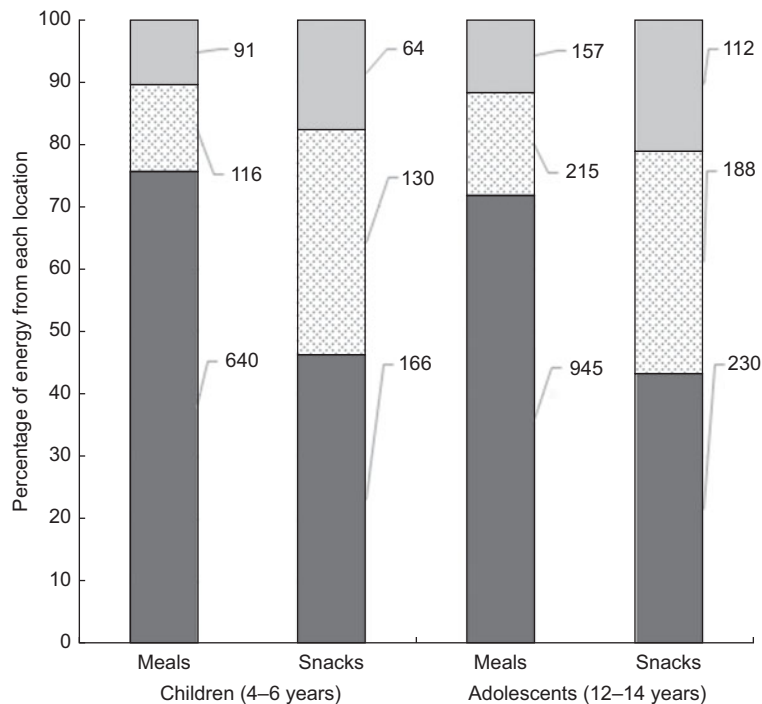
\**P* < 0.05. Paired-sample *t* test comparing snack *v.* meal energy/nutrient densities within each age group.

†Snack energy/nutrient density calculated for 912 children and 676 adolescents who reported at least one snack.

‡Meal energy/nutrient density calculated for 957 children and 750 adolescents who reported at least one meal.

for 29.0 and 27.4%, respectively, of the mean daily energy consumption in children and adolescents. In total 95.2% of the children and 89.9% of the adolescents in our study consumed at least one snack per day, with a mean per capita of 2.30 (SE 0.03) snacks/d. Grain-based desserts,

salty snacks, other sweets and desserts, dairy foods, cereal-based foods, dairy beverages, fruits and vegetables, fruit-flavoured drinks, fast food, and *sopaipillas* and *empanadas* contributed the most energy from snacks in the overall sample.



**Fig. 2** Per capita energy intake (kcal) provided by location (■, home; □, school; ▨, other) per type of eating occasion (meals, snacks) of FECHIC (children) and GOCS (adolescents) study participants (n 1710), south-eastern area of Santiago, Chile, 2016 (FECHIC, Food Environment Chilean Cohort; GOCS, Growth and Obesity Cohort Study). 1 kcal = 4.184 kJ

To our knowledge, the present study is the first to thoroughly report on snacking patterns in Chilean children and adolescents. A previous study explored the association between unhealthy snacking and academic outcomes in Chilean students from the Santiago Metropolitan Region, using a validated FFQ with fifth and ninth graders. That study reported that 56% of students consumed snacks that were high in fat, sugar, salt and energy and that unhealthy snacking lowered the odds of good academic performance<sup>(36)</sup>. Another study looked at food preferences among 10- to 13-year-old adolescents in seven public schools in Chile and found that the snacks most commonly purchased were sweet snacks (35%), juice and ice cream (33%), salty snacks (30%), yoghurt (11%) and fruit (7%)<sup>(37)</sup>. Similar to these studies, in our larger sample size with both children and adolescents, snacks tended to be foods and beverages that are energy dense and high in total sugars and saturated fat.

Several studies have assessed snacking behaviours in low- and middle-income countries, including Brazil, Mexico and China. The percentage of snackers among both age groups in our study (90% or above) was higher than that reported in Mexico (75% among 2- to 5-year-olds, 68% among 6- to 13-year-olds). Similarly, the average number of snacks consumed per day was higher in our study than that reported in Mexico (1.6 snacks/d and 1.2 snacks/d, respectively)<sup>(20)</sup>. Likewise, snacking by adolescents was more prevalent and more frequent in Chile than in Brazil, where 79% of 10- to 18-year-olds reported at least

one snack daily and an average of 1.6 snacks/d<sup>(19)</sup>. This difference might be partly explained by the way we defined snacking (self-identified by participants as either *colación* or *picoteo*) in comparison to a definition based on the reported time of day, the energy content of the EO or the time lapsing between EO. Snacking patterns in Chile are more like those reported in the USA, where 95 and 92% of children and adolescents, respectively, report at least one snacking occasion daily and an average of 3.0 and 2.5 snacks are consumed per day<sup>(17)</sup>.

One of the main concerns is the quality of the foods and beverages consumed as snacks by our sample. In children the most frequently reported snack items were fruits and vegetables, grain-based desserts (i.e. cookies and other sweet bakery products), dairy foods (i.e. yoghurt), dairy beverages, and other sweets and desserts (i.e. chocolates, other candies and frozen treats). Adolescents most frequently reported grain-based desserts, other sweets and desserts, fruits and vegetables, cereal-based foods and salty snacks. It is important to note that even though fruits and vegetables rank high in terms of reported frequency as snacks, due to their lower energy density, other foods and beverages considered less healthy provide a greater proportion of the energy per capita from snacks. These food and beverage choices consumed as snacks are similar to those reported as snacks in other countries. In Brazil<sup>(19)</sup> the top five food groups consumed by 10- to 18-year-old snackers were sweets and desserts; sugar-sweetened beverages; fried or baked dough with meat, cheese or



vegetables; sweetened coffee and tea; and fruit. In Mexico fruit, milk and yoghurt, salty snacks, candy, cookies, sweetened breads and *atoles* contributed to snacking occasions among 2- to 5-year-olds. Similarly, among 6- to 13-year-olds these food groups were important in addition to sandwiches, *tortas* or filled rolls, and carbonated sodas<sup>(20)</sup>.

In our study the food and beverage groups consumed as meals could potentially be of a healthier profile than that of snacks. For children meat and meat substitutes, legumes, eggs, and oils and fats (likely used in food preparation) are the top contributors to meals but not to snacks, whereas for adolescents, meat and meat substitutes, oils and fats, and dairy beverages were the main contributors to meals but not to snacks. Given these differences in food groups consumed as snacks or meals, the differences in the nutrient profile of both types of EO are somewhat expected. Even though snacks contribute to about a third of the daily energy in both age groups, they contribute more total sugars and slightly less total protein (expressed as a percentage of total intake) compared with meals. Snacks were also more energy dense; less protein dense; and more carbohydrate, total sugars, total fat and saturated fat dense than meals.

Of interest is the apparent shift from snacks that might contribute important nutrients in children to less healthy snacks in adolescents. In our study 40.0% of children consumed fruits and vegetables as snacks, but only 28.7% of adolescents did so; 34.8% of children consumed dairy foods (mostly yoghurt), but only 19.8% of adolescents did so; and items high in added sugars and fats (desserts, salty snacks, fast food, and *empanadas* and *sopaipillas*) were reported more frequently by adolescents. Specifically, 37.6% of children reported grain-based desserts *v.* 45.7% of adolescents, 27.5% of children reported other sweets and desserts *v.* 30.7% of adolescents, 13.4% of children reported salty snacks *v.* 21.8% of adolescents, and 4.7% of children reported fast food *v.* 6.3% of adolescents. When considering both snacks and meals in our sample, the shift by age in some food group consumption is even more evident. For example, 25.5% of children reported consuming carbonated beverages, while in adolescents this percentage nearly doubled to 47.2%. Similarly, fast food (12.8% in children, 21.7% in adolescents) and *empanadas* and *sopaipillas* (5.6% in children, 14.1% in adolescents) were noticeably more commonly consumed by adolescents than children. Adolescents are more independent in their food selections and preferences might play a greater role in their decisions. Thus, the role of the school food environment in snacking choices should not be overlooked, as it influences the snack foods available to children and adolescents during the day, especially given that it is likely that children have money to purchase these snacks<sup>(37)</sup>.

Our findings show that a larger percentage of energy reported from snacks is consumed at school (35.5–36.0%)

in comparison to the percentage of energy reported from meals consumed at school (13.7–16.3%). This should raise awareness regarding the importance of the availability of healthy snacks at school. In Chile both primary and secondary schools tend to have a *kiosko escolar*, a small store in the school where foods are made, sold or both (separate from the school lunch programme)<sup>(38)</sup>. As in other Latin American countries, these small food stores have traditionally sold a mix of foods made on-site and packaged foods, and until recently had not been subject to regulations regarding the nutritional quality of the items sold<sup>(39)</sup>. Previous research has evidenced that unhealthful food options were readily available to Chilean students in school *kioskos*<sup>(40,41)</sup>. However, whether and how this has changed in the current policy context is yet to be determined.

For example, the Chilean Government recently passed a law regarding food labelling and advertising (approved in 2012 and implemented starting in 2016)<sup>(42)</sup> that can potentially affect snacking behaviours, particularly among adolescents. The law requires front-of-package warning labels for foods and beverages that surpass previously specified levels of energy, sodium, total sugars and saturated fats. Furthermore, these products are subject to marketing restrictions and cannot be sold in schools<sup>(33)</sup>. These regulations may affect many of the foods and beverages typically consumed as snacks by children and adolescents.

The front-of-package labelling regulations are an especially promising way of nudging snacking behaviours. A study in Guatemala seeking to understand which snack foods are most frequently purchased by children and how aspects of food packaging influence their perceptions found that some visual aspects influenced their favourite products and also led some children to incorrectly perceive that foods contained healthy ingredients when they did not<sup>(43)</sup>. This suggests that the Chilean front-of-package labelling can potentially influence children and adolescents' selections of snack foods, but whether and how this will occur is an important question to address, particularly in light of our results.

We acknowledge several limitations in our study. First, we investigated snacking patterns over a one-day period, which might not be representative of children and adolescents' usual food consumption, and therefore usual snacking patterns might be different. Second, recall bias is always a possibility in self-reported dietary intake measures, especially when working with younger populations. Despite the different strategies we used (such as a food atlas to probe for portions consumed and caregivers responding for younger children during interviews), there is a possibility of misreporting by participants. Third, the literature has previously raised the challenges of defining what is considered a snack and the implications of different definitions<sup>(44)</sup>. As in previous studies, our participants self-identified snacks<sup>(17,20,45)</sup>. For each EO participants reported whether they considered the EO a snack or a





meal. However, this measure of snacking might exclude snack foods that are consumed as part of main meals and therefore might not give a complete picture of the population's consumption of snacks<sup>(44)</sup>.

Finally, due to our recruitment strategies, the socio-economic characteristics of our study sample are likely homogenous and not representative of the entire population in Chile. However, it is important to note that 92% of Chilean children and adolescents (1st–8th grade) attend public-funded schools<sup>(46)</sup>, and we therefore believe that our results can be generalizable to a vast majority of this age group.

## Conclusion

We found that snacking is widespread among Chilean children and adolescents and that it contributes greatly to daily energy intakes. Even though, as others have noted, snacking as a behaviour is not necessarily unhealthy<sup>(19)</sup>, the food categories consumed as snacks in our sample are generally considered high in energy, saturated fat, sodium and/or total sugars, and therefore are potentially targeted by the newly implemented nationwide food regulation, with the exception of the fruits and vegetables frequently consumed as snacks. Future research is needed to understand how these regulations affect snacking behaviours and how snacking in this population is associated with weight gain trajectories through childhood and adolescence.


## Acknowledgements

**Acknowledgements:** The authors thank Phil Bardsley and Karen Ritter for their assistance with data management; Natalia Rebolledo and Michael Essman for support with food and beverage grouping; and Fernanda Sanchez, Nancy Casas and Macarena Jara for their help in understanding the data collection process in Chile. **Financial support:** Funding for this study came from Bloomberg Philanthropies with additional support from IDRC Grant 108180 (INTA–UNC), CONICYT FONDECYT #1161436, and the NIH National Research Service Award (Global Cardiometabolic Disease Training Grant) #T32 HL129969-01A1. The funders had no role in the design, analysis or writing of this article. **Conflict of interest:** None of the authors have conflict of interests of any type with respect to this manuscript. **Authorship:** All authors designed the study; C.C. and M.R. acquired the data; M.L.J. analysed the data and drafted the manuscript with contributions from all co-authors; all authors assisted in the interpretation of the results, provided critical intellectual feedback to help revise, and approved the final manuscript. **Ethics of human subject participation:** This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving human

subjects were approved by the Ethics Committee of the Institute of Nutrition and Food Technology (INTA) at the University of Chile. Written informed consent was obtained from all subjects or their legal guardian.

## Supplementary material

To view supplementary material for this article, please visit <https://doi.org/10.1017/S1368980019000971>

**Author ORCID.**  Melissa L Jensen, 0000-0002-9830-076X.

## References

1. Popkin BM (2006) Global nutrition dynamics: the world is shifting rapidly toward a diet linked with noncommunicable diseases. *Am J Clin Nutr* **84**, 289–298.
2. Malik VS, Willett WC & Hu FB (2013) Global obesity: trends, risk factors and policy implications. *Nat Rev Endocrinol* **9**, 13–27.
3. Rivera JA, Pedraza LS, Martorell R *et al.* (2014) Introduction to the double burden of undernutrition and excess weight in Latin America. *Am J Clin Nutr* **100**, issue 6, 1613S–1616S.
4. Uauy R, Albala C & Kain J (2001) Obesity trends in Latin America: transiting from under- to overweight. *J Nutr* **131**, issue 3, 893S–899S.
5. Rivera JÁ, de Cossío TG, Pedraza LS *et al.* (2014) Childhood and adolescent overweight and obesity in Latin America: a systematic review. *Lancet Diabetes Endocrinol* **2**, 321–332.
6. Corvalán C, Garmendia M, Jones-Smith J *et al.* (2017) Nutrition status of children in Latin America. *Obes Rev* **18**, 7–18.
7. Lawlor DA, Benfield L, Logue J *et al.* (2010) Association between general and central adiposity in childhood, and change in these, with cardiovascular risk factors in adolescence: prospective cohort study. *BMJ* **341**, c6224.
8. Ministerio de Salud, Gobierno de Chile (2017) Encuesta Nacional de Salud 2016–2017. Primeros Resultados. [http://www.minsal.cl/wp-content/uploads/2017/11/ENS-2016-17\\_PRIMEROS-RESULTADOS.pdf](http://www.minsal.cl/wp-content/uploads/2017/11/ENS-2016-17_PRIMEROS-RESULTADOS.pdf) (accessed June 2018).
9. Ministerio de Salud, Gobierno de Chile (2010) Encuesta Nacional de Salud 2009–2010. <http://www.minsal.cl/portal/url/item/bcb03d7bc28b64dfe040010165012d23.pdf> (accessed August 2017).
10. Cediel G, Reyes M, da Costa Louzada ML *et al.* (2018) Ultra-processed foods and added sugars in the Chilean diet (2010). *Public Health Nutr* **21**, 125–133.
11. Monteiro CA, Cannon G, Moubarac J-C *et al.* (2015) Dietary guidelines to nourish humanity and the planet in the twenty-first century. A blueprint from Brazil. *Public Health Nutr* **18**, 2311–2322.
12. Canella DS, Levy RB, Martins AP *et al.* (2014) Ultra-processed food products and obesity in Brazilian households (2008–2009). *PLoS One* **9**, e92752.
13. Mendonca RD, Pimenta AM, Gea A *et al.* (2016) Ultraprocessed food consumption and risk of overweight and obesity: the University of Navarra Follow-Up (SUN) cohort study. *Am J Clin Nutr* **104**, 1433–1440.
14. Mendonca RD, Lopes AC, Pimenta AM *et al.* (2017) Ultra-processed food consumption and the incidence of hypertension in a Mediterranean cohort: the Seguimiento Universidad de Navarra Project. *Am J Hypertens* **30**, 358–366.
15. Departamento de Nutrición, Universidad de Chile (2010) Encuesta Nacional de Consumo Alimentario. <http://>



- www.minsal.cl/sites/default/files/ENCA-INFORME\_FINAL.pdf (accessed August 2017).
16. Nishi SK, Jessri M & L'Abbe M (2018) Assessing the dietary habits of Canadians by eating location and occasion: findings from the Canadian Community Health Survey, Cycle 2.2. *Nutrients* **10**, E682.
  17. Dunford EK & Popkin BM (2017) 37 year snacking trends for US children 1977–2014. *Pediatr Obes* **13**, 247–255.
  18. Dunford EK & Popkin BM (2017) Disparities in snacking trends in US adults over a 35 year period from 1977 to 2012. *Nutrients* **9**, E809.
  19. Duffey KJ, Pereira RA & Popkin BM (2013) Prevalence and energy intake from snacking in Brazil: analysis of the first nationwide individual survey. *Eur J Clin Nutr* **67**, 868–874.
  20. Taillie LS, Afeiche MC, Eldridge AL *et al.* (2015) Increased snacking and eating occasions are associated with higher energy intake among Mexican children aged 2–13 years. *J Nutr* **145**, 2570–2577.
  21. Duffey KJ, Rivera JA & Popkin BM (2014) Snacking is prevalent in Mexico. *J Nutr* **144**, 1843–1849.
  22. Beckerman JP, Alike Q, Lovin E *et al.* (2017) The development and public health implications of food preferences in children. *Front Nutr* **4**, 66.
  23. Duffey KJ & Popkin BM (2013) Causes of increased energy intake among children in the US, 1977–2010. *Am J Prev Med* **44**, e1–e8.
  24. Berteus Forslund H, Torgerson JS, Sjostrom L *et al.* (2005) Snacking frequency in relation to energy intake and food choices in obese men and women compared to a reference population. *Int J Obes (Lond)* **29**, 711–719.
  25. Chapelot D (2011) The role of snacking in energy balance: a biobehavioral approach. *J Nutr* **141**, 158–162.
  26. Larson NI, Miller JM, Watts AW *et al.* (2016) Adolescent snacking behaviors are associated with dietary intake and weight status. *J Nutr* **146**, 1348–1355.
  27. Hess JM, Jonnalagadda SS & Slavin JL (2016) What is a snack, why do we snack, and how can we choose better snacks? A review of the definitions of snacking, motivations to snack, contributions to dietary intake, and recommendations for improvement. *Adv Nutr* **7**, 466–475.
  28. Kain J, Corvalan C, Lera L *et al.* (2009) Accelerated growth in early life and obesity in preschool Chilean children. *Obesity (Silver Spring)* **17**, 1603–1608.
  29. Gaskins AJ, Pereira A, Quintiliano D *et al.* (2017) Dairy intake in relation to breast and pubertal development in Chilean girls. *Am J Clin Nutr* **105**, 1166–1175.
  30. Cerda R, Barrera C, Arena M *et al.* (2010) *Atlas Fotográfico de Alimentos y Preparaciones Típicas Chilenas*, primera edición ed. Santiago: Universidad de Chile.
  31. US Department of Agriculture, Agricultural Research Service (2016) USDA National Nutrient Database for Standard Reference, Release 28. <https://ndb.nal.usda.gov/ndb/> (accessed July 2017).
  32. Quintiliano D & Jara M (2016) *Protocolo Sistema de Clasificación de los Alimentos – CEPOC*. Santiago: Universidad de Chile.
  33. Ministerio de Salud, Gobierno de Chile (2012) Ley 20606: Sobre composición nutricional de los alimentos y su publicidad. <https://www.leychile.cl/Navegar?idNorma=1041570> (accessed August 2017).
  34. Corvalan C, Reyes M, Garmendia ML *et al.* (2019) Structural responses to the obesity and non-communicable diseases epidemic: update on the Chilean law of food labelling and advertising. *Obes Rev* **20**, 367–374.
  35. Pan American Health Organization (2016) Nutrient Profile Model. [http://iris.paho.org/xmlui/bitstream/handle/123456789/18621/9789275118733\\_eng.pdf?sequence=9&isAllowed=y](http://iris.paho.org/xmlui/bitstream/handle/123456789/18621/9789275118733_eng.pdf?sequence=9&isAllowed=y) (accessed July 2016).
  36. Correa-Burrows P, Burrows R, Orellana Y *et al.* (2015) The relationship between unhealthy snacking at school and academic outcomes: a population study in Chilean schoolchildren. *Public Health Nutr* **18**, 2022–2030.
  37. Bustos N, Kain J, Leyton B *et al.* (2010) Snacks usually consumed by children from public schools: motivations for their selection. *Rev Chil Nutr* **37**, 178–183.
  38. Ministerio de Salud & Ministerio de Educación, Gobierno de Chile (2016) Guía de Kioscos y Colaciones Saludables. <https://www.minsal.cl/wp-content/uploads/2016/05/GUIA-DE-KIOSCOS-SALUDABLES.pdf> (accessed September 2018).
  39. Fraser B (2013) Latin American countries crack down on junk food. *Lancet* **382**, 385–386.
  40. Prochownik K, Vera-Vergara M & Cheskin L (2015) New regulations for foods offered to school children in Chile: barriers to implementation. *Int J Nutr* **1**, 29–38.
  41. Bustos N, Kain J, Leyton Br *et al.* (2011) Changes in food consumption pattern among Chilean school children after the implementation of a healthy kiosk. *Arch Latinoam Nutr* **61**, 302–307.
  42. Corvalán C, Reyes M, Garmendia ML *et al.* (2013) Structural responses to the obesity and non-communicable diseases epidemic: the Chilean Law of Food Labeling and Advertising. *Obes Rev* **14**, Suppl. 2, 79–87.
  43. Letona P, Chacon V, Roberto C *et al.* (2014) A qualitative study of children's snack food packaging perceptions and preferences. *BMC Public Health* **14**, 1274.
  44. Hess JM & Slavin JL (2018) The benefits of defining 'snacks'. *Physiol Behav* **193**, 284–287.
  45. Duffey KJ & Popkin BM (2011) Energy density, portion size, and eating occasions: contributions to increased energy intake in the United States, 1977–2006. *PLoS Med* **8**, e1001050.
  46. Gobierno de Chile, Ministerio de Educación (2017) Estadísticas de la Educación 2016. [https://centroestudios.mineduc.cl/wp-content/uploads/sites/100/2017/07/Anuario\\_2016.pdf](https://centroestudios.mineduc.cl/wp-content/uploads/sites/100/2017/07/Anuario_2016.pdf) (accessed November 2018).