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Short Communication

The school environment and sugar-sweetened beverage consumption among Guatemalan adolescents

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Abstract

Objective: The current study sought to examine Guatemalan adolescents' consumption of sugar-sweetened beverages (SSB), identify which individual-level characteristics are associated with SSB consumption and describe school characteristics that may influence students' SSB consumption.
Design: Within this observational pilot study, a questionnaire was used to assess students' consumption of three varieties of SSB (soft drinks, energy drinks, sweetened coffees/teas), as well as a variety of sociodemographic and behavioural characteristics. We collected built environment data to examine aspects of the school food environment. We developed Poisson regression models for each SSB variety and used descriptive analyses to characterize the sample.
Setting: Guatemala City, Guatemala.
Subjects: Guatemalan adolescents (*n* 1042) from four (two public, two private) secondary schools.
Results: Built environment data revealed that students from the two public schools lacked access to water fountains/coolers. The SSB industry had a presence in the schools through advertisements, sponsored food kiosks and products available for sale. Common correlates of SSB consumption included school type, sedentary behaviour, frequency of purchasing lunch in the cafeteria, and frequency of purchasing snacks from vending machines in school and off school property.
Conclusions: Guatemalan adolescents frequently consume SSB, which may be encouraged by aspects of the school environment. Schools represent a viable setting for equitable population health interventions designed to reduce SSB consumption, including increasing access to clean drinking-water, reducing access to SSB, restricting SSB marketing and greater enforcement of existing food policies.

Keywords
Sugar-sweetened beverages
School health
Nutrition policy
Latin America

Many low- and middle-income countries in Latin America are experiencing a double burden of malnutrition, characterized by the persistence of undernutrition coupled with dramatic increases in the prevalence of overweight/obesity[1–3]. The prevalence of overweight/obesity in Latin American adolescents ranges from 18·9 to 36·9 %[4] and reflects a notable shift from traditional diets to a greater intake of nutrient-poor, energy-dense foods, such as sugar-sweetened beverages (SSB)[3,5].

Latin Americans are among the greatest consumers of SSB globally[6]. For instance, Guatemalan females and males consume an average of 2·7 and 2·9 SSB servings/d, respectively[6]. The high frequency of SSB consumption in Latin America, and Guatemala particularly, is concerning, given the associations between SSB intake and increased risk of overweight/obesity[7–13], lower intake of micronutrients[14–17] and the development of dental caries[18–22]. These factors underscore the need to examine adolescents' SSB consumption and identify the factors that promote SSB intake.

Schools represent an important area of influence for adolescents, given their population coverage and the amount of time youth spend in school. School-based interventions may represent a promising strategy to address the 'double burden'[23,24]. However, few studies have examined the school food environment in Guatemala and its potential influence on students' diets. These data could

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inform culturally relevant school-based interventions to decrease youths' SSB intake at the population level.

The present pilot study sought to examine SSB intake in a sample of Guatemalan adolescents, identify individual-level characteristics associated with SSB consumption and describe school characteristics that may influence students' SSB intake.

Methods

Study overview

The current study used data from a convenience sample of schools in Guatemala City that participated in the COMPASS Guatemala pilot study during the 2014/15 school year[25]. Details on COMPASS and the Guatemala pilot study can be found online (www.compass.uwaterloo.ca) and in print[25,26].

Participants

Four secondary schools participated in COMPASS Guatemala. Schools 1 and 2 were public (i.e. students attend for free), while Schools 3 and 4 were private (i.e. students paid tuition). All students enrolled in these schools (*n* 1359) were eligible to participate, and the participation rate was high (*n* 1277, 94·0 %). We removed 235 (18·4 %) participants from analyses due to missing data; however, we included those with missing BMI data. The final sample comprised 1042 participants.

Data collection tools

School- and student-level data were collected through the COMPASS school environment application (Co-SEA) and the COMPASS student questionnaire (C_q), respectively[27,28]. The process of adapting and evaluating these tools in the Guatemalan context is described elsewhere[25]. COMPASS staff used the Co-SEA to assess school infrastructure by recording this information via notes and photographs. The C_q is a paper-based questionnaire that students completed during class, comprising questions on demographic characteristics and several health behaviours.

Outcome, control and potential explanatory variables

Participants' responses to the following three C_q questions reflect the three outcome measures: 'On a typical school day (Monday to Friday), on how many days do you do the following: (i) drink soft drinks (e.g. soda, fruit drinks, Gatorade, etc.). Do not include diet or sugar-free drinks; (ii) drink energy drinks (e.g. Red Bull, Monster, Adrenaline, etc.); and (iii) drink coffee or tea with sugar (e.g. cappuccino, frappuccino, iced tea, iced coffees, etc.)?' These questions are similar to those asked in the Canadian C_q, although we modified the examples to reflect drinks that are commonly available in Guatemala.

We reviewed data collectors' Co-SEA photographs and notes to examine the presence of water coolers/fountains and SSB industry-sponsored food kiosks within the schools. School administrators confirmed the presence/absence of these facilities within their schools.

We treated gender, grade, weight status (i.e. BMI (kg/m^2) category based on reported height and weight and WHO classifications, adjusted for age and sex[29]) and school type (private, public) as control variables. The Guatemalan secondary school system comprises three 'basic grades' and two 'professional training' grades, which we denoted as grades 1–5, representing adolescents aged 13–18 years. We considered school type as a marker of participants' socio-economic status, consistent with previous research[30,31].

We selected potential explanatory variables based on *a priori* hypotheses and previous literature. They included tobacco, marijuana and alcohol use, sedentary behaviour, physical activity, bullying victimization and weight goal. We defined these variables in a manner that is consistent with previous COMPASS studies[32–36]. We also considered four food purchasing behaviours as potential explanatory variables, which reflect participants' weekday frequency of purchasing lunch and snacks from various food outlets on and off school property.

Data analysis

We used descriptive statistics to examine variation in participants' mean number of weekdays of consuming each SSB type across school- and individual-level socio-demographic and behavioural variables, and univariate Poisson regression analyses to identify the significance of this variation.

We developed a separate joint Poisson regression model for each SSB type using a two-step process. First, we ran a series of univariate analyses to identify if each potential explanatory variable was independently associated with each outcome. We removed variables that were not statistically significantly ($P > 0·2$) from the analysis. Second, we included all significant variables from this first screening stage in a multivariate model and used backward selection to drop the least significant variable, until all variables were statistically significant ($P < 0·05$). We forced control variables into the models. We performed statistical analyses using the statistical software package SAS version 9.4.

Results

Drinking-water from fountains/coolers was inaccessible for students at Schools 1 and 2, while Schools 3 and 4 contained purified water coolers for students and staff. Schools 1, 2 and 4 contained industry-sponsored food kiosks that students could access during lunch and school breaks. The Co-SEA data demonstrated the presence of the

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SSB industry in schools through advertisements, products available for sale and donated goods. For example, Schools 2 and 4 displayed athletic trophies featuring Coca-Cola® and Pepsi® logos.

Participants reported consuming soft drinks, sweetened coffees/teas and energy drinks an average of 2·58, 2·40 and 0·58 d in a typical school week. Few participants reported no use of soft drinks (*n* 210, 20·2 %) and sweetened coffees/teas (*n* 308, 29·6 %) in a typical school week; however, 74·2 % of participants (*n* 773) reported no use of energy drinks. Similarly, daily reported use was relatively common with respect to soft drinks (*n* 293, 28·1 %) and sweetened coffees/teas (*n* 321, 30·8 %), although rare with energy drinks (*n* 40, 3·8 %).

Table 1 presents the average weekday frequency of SSB consumption across school- and individual-level characteristics. There was significant ($P < 0·05$) variation in participants' frequency of SSB consumption according to school, school type, grade, alcohol use, sedentary behaviour, weight goal and the food purchasing variables, across all three SSB outcomes.

Table 2 shows the adjusted relative rates derived from the Poisson regression analyses for the final models. Common correlates of SSB consumption across all models include school type, sedentary behaviour, frequency of purchasing lunch in the cafeteria, and frequency of purchasing snacks from a vending machine on and off school property. Participants who purchased lunch or snacks from various food outlets at a greater frequency had a significantly higher rate of SSB consumption across all three categories, as did public-school students. For example, the relative rate of 1·28 denotes that public-school students consume soft drinks at a 28 % greater rate than private-school students (i.e. in terms of weekdays reporting soft drink consumption), controlling for all other variables.

Discussion

The present study underscores the high rate of SSB consumption among a sample of Guatemalan adolescents, socio-economic differences in consumption, and adolescents' food purchasing behaviours as important predictors of SSB intake.

Participants reported a high consumption frequency of soft drinks and sweetened coffees/teas. Guatemala is a global leader in coffee-growing, and unlike in Western nations, coffee is commonly served to young children and toddlers in Guatemala[37,38]. Previous research has identified that sweetened coffee is the most commonly reported consumed beverage among Guatemalan schoolchildren, largely due to cultural tradition[39]. Prevention efforts should focus on decreasing youths' consumption of soft drinks, since they are the most popular SSB among adolescents and have limited cultural significance (i.e. unlike coffees/teas).

Public-school participants reported a significantly higher rate of SSB consumption than private-school participants across all beverage categories. The discrepancy may reflect, in part, the lack of access to water fountains/coolers we observed within public schools. The lack of this healthy alternative may encourage public-school students to purchase other, less healthful beverages in school. Other research from Guatemala has identified low water consumption among marginalized sub-populations due to limited access to clean drinking-water, perceptions that tap water is unsafe to drink and the costliness of bottled water[40,41]. These findings underscore the importance of considering health equity in population-level interventions designed to reduce adolescents' SSB intake.

We identified a positive correlation between purchasing meals/snacks from school food outlets and SSB consumption, suggesting that the school food environment may encourage SSB intake. Many Guatemalan youth purchase products from school food kiosks, including those who bring a home-packed lunch to school[42]. The Guatemalan Ministry of Education has attempted to prohibit the sale of SSB and other processed foods within schools[43,44]. While the present study did not explicitly examine the types of foods offered through these outlets, there is evidence that these regulations are largely unenforced, as many vendors offer a range of energy-dense snacks and beverages[42,45]. Stricter enforcement of current regulations for school foods in Guatemala, or perhaps new regulations, may reduce access to and discourage consumption of SSB and other unhealthy products among students.

The present study identified the SSB industry's presence in Guatemalan secondary schools via sponsored kiosks stocked with SSB, branded donated goods and advertisements. It is feasible that the availability of and exposure to SSB in school food outlets encourages students to consume these beverages, since they increase students' access to these items and may also influence their food selections and perceptions of appropriate dietary choices[46]. Research from North America has demonstrated the positive association between in-school SSB availability and consumption[47–51], although these associations have not been well explored in low- and middle-income countries. This research gap underscores the need for greater investment in research platforms like COMPASS in Guatemala and other low- and middle-income countries. Other research has identified that most food advertisements in food outlets within and surrounding Guatemala schools feature SSB, which increase youth's exposure to these brands[45]. The presence of the SSB industry in Guatemalan schools suggests that the beverage industry is capitalizing on this unregulated environment to access a key subgroup of consumers. Collectively, these features

Table 1 Frequency of sugar-sweetened beverage consumption, according to school- and individual-level sociodemographic and behavioural characteristics, among secondary-school students participating in COMPASS Guatemala (*n* 1042), 2014/15 school year

			Frequency of soft drink consumption*			Frequency of sweetened coffee/tea consumption*			Frequency of energy drink consumption*		
	n	%	Mean	SD	*P* value†	Mean	SD	*P* value†	Mean	SD	*P* value†
Total			2·58	1·89		2·40	2·06		0·58	1·22	
School					<0·001			<0·001			<0·001
School 1	158	15·2	2·97	1·88		3·13	1·99		0·78	1·32	
School 2	522	50·1	2·93	1·84		2·87	2·06		0·79	1·38	
School 3	303	29·1	1·94	1·80		1·40	1·67		0·15	0·64	
School 4	59	5·6	1·78	1·65		1·41	1·83		0·34	1·12	
School type					<0·001			<0·001			<0·001
Private	362	34·7	1·91	1·78		1·40	1·70		0·18	0·74	
Public	680	65·3	2·94	1·85		2·93	2·05		0·79	1·36	
Gender					<0·001			0·31			<0·001
Female	531	51·0	2·32	1·88		2·35	2·05		0·37	1·02	
Male	511	49·0	2·86	1·85		2·45	2·08		0·80	1·37	
Grade					0·001			0·04			<0·001
1	262	25·2	2·82	1·85		2·52	2·03		0·68	1·30	
2	287	27·5	2·57	1·84		2·52	2·09		0·62	1·27	
3	187	17·9	2·75	1·88		2·34	2·03		0·59	1·30	
4	153	14·7	2·27	1·94		2·31	2·11		0·58	1·23	
5	153	14·7	2·30	1·94		2·10	2·04		0·33	0·78	
Weight status‡					0·21			<0·001			0·01
Healthy weight	508	48·8	2·51	1·90		2·15	2·04		0·51	1·11	
Underweight	28	2·7	2·43	1·89		2·43	2·13		0·46	1·32	
Overweight	102	9·8	2·41	1·90		2·43	2·04		0·57	1·17	
Obese	29	2·8	2·76	1·64		3·07	2·02		0·93	1·41	
Tobacco use					0·39			0·15			0·002
Non-current tobacco user	1019	97·8	2·58	1·88		2·39	2·06		0·57	1·20	
Current tobacco user	23	2·2	2·87	2·12		2·87	2·07		1·13	1·84	
Marijuana use					0·24			0·14			<0·001
Non-current marijuana user	1013	97·2	2·57	1·89		2·38	2·06		0·56	1·20	
Current marijuana user	29	2·8	2·93	1·89		2·83	1·98		1·41	1·64	
Alcohol use					0·02			<0·001			0·03
Non-current alcohol user	794	76·2	2·65	1·87		2·49	2·06		0·55	1·17	
Current alcohol user	248	23·8	2·37	1·93		2·11	2·05		0·67	1·38	
Sedentary behaviour					<0·001			0·08			0·001
Not sedentary	130	12·5	2·66	1·89		2·43	2·06		0·61	1·25	
Sedentary	912	87·5	2·06	1·76		2·18	2·08		0·38	0·98	
Physical activity					<0·001			0·10			0·67
Physically active	424	40·7	2·42	1·90		2·33	2·07		0·54	1·20	
Not physically active	618	59·3	2·82	1·85		2·49	2·05		0·63	1·25	
Bullying victimization					0·89			0·03			<0·001
Non-victim	850	81·6	2·58	1·88		2·35	2·06		0·54	1·16	
Bullying victim	192	18·4	2·57	1·90		2·61	2·05		0·76	1·45	
Weight goal					0·006			0·007			0·03
Not trying to do anything about weight	132	12·7	2·55	1·95		2·56	2·19		0·49	1·20	
Gain weight	174	16·7	2·92	1·88		2·51	2·07		0·73	1·35	
Lose weight	439	42·1	2·42	1·91		2·20	2·03		0·55	1·15	
Stay the same weight	297	28·5	2·64	1·81		2·54	2·03		0·58	1·25	

Table 1 *Continued*

			Frequency of soft drink consumption*			Frequency of sweetened coffee/ tea consumption*			Frequency of energy drink consumption*		
	n	%	Mean	SD	*P* value†	Mean	SD	*P* value†	Mean	SD	*P* value†
Frequency of purchasing lunch from the school cafeteria§					<0·001			<0·001			<0·001
0	590	56·6	2·12	1·87		2·08	2·03		0·33	0·88	
1	74	7·1	2·49	1·71		2·22	1·87		0·47	0·97	
2	97	9·3	2·76	1·72		2·26	2·03		0·69	1·28	
3	60	5·8	3·08	1·55		2·82	2·05		0·90	1·42	
4	23	2·2	2·91	1·70		3·43	1·95		1·17	1·47	
5	198	19·0	3·72	1·66		3·21	1·99		1·15	1·72	
Frequency of purchasing lunch in a fast-food place/restaurant§					<0·001			<0·001			<0·001
0	736	70·6	2·35	1·92		2·34	2·08		0·50	1·14	
1	146	14·0	2·64	1·59		2·02	1·91		0·62	1·22	
2	75	7·2	3·41	1·68		2·88	2·07		0·48	1·08	
3	28	2·7	3·57	1·73		2·93	1·98		0·82	1·22	
4	14	1·4	3·29	1·38		2·86	1·70		1·36	1·69	
5	43	4·1	4·09	1·57		3·26	2·05		1·56	1·89	
Frequency of purchasing snacks from a school vending machine§					<0·001			<0·001			<0·001
0	844	81·0	2·45	1·89		2·25	2·06		0·50	1·12	
1	57	5·5	2·25	1·55		2·46	1·79		0·60	1·10	
2	36	3·5	3·03	1·56		2·50	1·95		0·64	1·29	
3	28	2·7	3·25	1·60		3·71	1·56		1·07	1·68	
4	8	0·7	3·75	1·91		3·63	2·07		1·63	1·77	
5	69	6·6	3·78	1·79		3·36	2·05		1·25	1·79	
Frequency of purchasing snacks from a vending machine, corner store, snack bar or canteen off school property§					<0·001			<0·001			<0·001
0	820	78·7	2·39	1·88		2·25	2·07		0·45	1·09	
1	82	7·9	2·61	1·70		2·49	1·87		0·57	0·98	
2	61	5·9	3·57	1·51		3·25	1·89		1·18	1·53	
3	24	2·3	3·83	1·46		2·96	2·05		1·17	1·43	
4	7	0·7	3·29	1·70		3·57	2·15		1·86	2·27	
5	48	4·5	3·90	1·78		3·25	2·01		1·52	1·95	

*Number of weekdays (0–5 d) that participants reported consuming beverage.
†*P* values derived from univariate Poisson regression analyses including each outcome and each explanatory variable.
‡Participants with missing weight status (*n* 375) were included in analyses, although not shown here.
§Number of weekdays (0–5 d) that participants reported the food purchasing behaviour.

Table 2 Individual-level sociodemographic and behavioural correlates of weekly consumption of three varieties of sugar-sweetened beverage among Guatemalan secondary-school students participating in the COMPASS study (*n* 1042), 2014/15 school year

	Frequency of soft drink consumption*		Frequency of sweetened coffee/tea consumption*		Frequency of energy drink consumption*	
	Adjusted relative rate†	95 % CI	Adjusted relative rate†	95 % CI	Adjusted relative rate†	95 % CI
Gender						
Female	1·00	Ref.	1·00	Ref.	1·00	Ref.
Male	1·18	1·09, 1·28	0·98	0·90, 1·06	1·86	1·57, 2·21
Grade						
1	1·00	Ref.	1·00	Ref.	1·00	Ref.
2	0·86	0·78, 0·96	0·94	0·84, 1·04	0·79	0·64, 0·98
3	0·96	0·86, 1·08	0·90	0·80, 1·02	0·79	0·61, 1·01
4	0·89	0·78, 1·01	1·05	0·92, 1·20	0·95	0·72, 1·24
5	0·90	0·79, 1·02	0·92	0·80, 1·05	0·55	0·40, 0·76
Weight status						
Healthy weight	1·00	Ref.	1·00	Ref.	1·00	Ref.
Underweight	0·89	0·69, 1·14	1·01	0·79, 1·29	0·70	0·40, 1·24
Overweight	0·95	0·82, 1·08	1·06	0·93, 1·22	1·00	0·75, 1·34
Obese	0·99	0·79, 1·25	1·11	0·89, 1·38	1·19	0·80, 1·79
School type						
Private school	1·00	Ref.	1·00	Ref.	1·00	Ref.
Public school	1·28	1·16, 1·41	2·00	1·78, 2·24	3·32	2·50, 4·40
Tobacco use	–		–		–	
Marijuana use						
Non-current marijuana user	–		–		1·00	Ref.
Current marijuana user	–		–		1·67	1·19, 2·35
Alcohol use						
Non-current alcohol user	–		1·00	Ref.	1·00	Ref.
Current alcohol user	–		1·12	1·01, 1·25	1·71	1·40, 2·09
Sedentary behaviour						
Not sedentary	1·00	Ref.	1·00	Ref.	1·00	Ref.
Sedentary	1·24	1·09, 1·42	1·20	1·06, 1·36	1·42	1·06, 1·91
Physical activity	–		–		–	
Bullying victimization						
Non-victim	–		1·00	Ref.	1·00	Ref.
Bullying victim	–		1·12	1·01, 1·23	1·32	1·09, 1·60
Weight goal	–		–		–	
Frequency of purchasing lunch from the school cafeteria‡	1·07	1·04, 1·09	1·03	1·01, 1·05	1·14	1·09, 1·19
Frequency of purchasing lunch in a fast-food place/restaurant‡	1·06	1·03, 1·09	–		1·06	1·00, 1·11
Frequency of purchasing snacks from a school vending machine‡	1·03	1·00, 1·06	1·04	1·01, 1·07	1·06	1·00, 1·11
Frequency of purchasing snacks from a vending machine, corner store, snack bar or canteen off school property‡	1·06	1·03, 1·09	1·03	1·00, 1·06	1·16	1·10, 1·23

Ref., reference category; – denotes no significant effect in model(s), variable was excluded from model through backward selection.
*Number of weekdays (0–5 d) that participants reported consuming beverage.
†Rates adjusted for all other variables in the column; values represent the rate of weekday beverage consumption (i) relative to the reference category (in the case of categorical explanatory variables) or (ii) associated with a one-unit increase in the independent variable (in the case of count explanatory variables).
‡Number of weekdays (0–5 d) that participants reported the food purchasing behaviour.

contribute to a food environment that can undermine individual efforts to improve dietary behaviours.

The present study has many strengths, including providing valuable evidence on the extent of SSB consumption among Guatemalan youth. The large student sample size and inclusion of public and private schools enable comparisons across socio-economic groups. The study also contributed to the creation of a new research collaboration between Guatemalan and Canadian health researchers and research capacity building in a low- and middle-income country.

Our findings should be interpreted in light of the study's limitations. First, the outcomes reflect conservative estimates of SSB intake (i.e. relative to data on volume or number of servings), since the unit of measure is number of 'days' and participants can consume numerous SSB daily. Second, the samples of participants included in the analyses *v.* removed were significantly different across several demographic variables (see online supplementary material, Supplemental Table 1); however, these groups did not vary significantly across outcomes measures. Third, sedentary behaviour and physical activity categories were based on

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Canadian guidelines, due to the lack of Guatemalan guidelines. While there were several efforts to evaluate the appropriateness and students' comprehension of the Guatemalan C_q, we did not formally adapt the tool. Finally, the present pilot study included four schools, which may not represent other school environments in Guatemala.

Conclusions

Guatemalan adolescents frequently consume SSB. Adolescents' purchasing from food outlets on and near school property represent important predictors of SSB intake. School-level interventions may be well poised to address the high rate of SSB intake among Guatemalan youth. Specific strategies include increasing the availability of free drinking-water to students, decreasing access to SSB, restricting SSB marketing and enforcing legislation surrounding the sale of SSB in schools.

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Supplementary material

To view supplementary material for this article, please visit https://doi.org/10.1017/S1368980017001926

References

1. Mbowe O, Diaz A, Wallace J *et al.* (2014) Prevalence of metabolic syndrome and associated cardiovascular risk factors in Guatemalan school children. *Matern Child Health J* **8**, 1619–1627.
2. Ramirez-Zea M, Kroker-Lobos MF, Close-Fernandez R *et al.* (2014) The double burden of malnutrition in indigenous and nonindigenous Guatemalan populations. *Am J Clin Nutr* **100**, issue 6, 1644S–1651S.
3. Kain J, Cordero SH, Pineda D *et al.* (2014) Obesity prevention in Latin America. *Curr Obes Rep* **3**, 150–155.
4. 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.
5. Uauy R & Monteiro CA (2004) The challenge of improving food and nutrition in Latin America. *Food Nutr Bull* **25**, 175–182.
6. Singh GM, Micha R, Khatibzadeh S *et al.* (2015) Global, regional, and national consumption of sugar-sweetened beverages, fruit juices, and milk: a systematic assessment of beverage intake in 187 countries. *PLoS One* **10**, e0124845.
7. Malik VS, Schulze MB & Hu FB (2006) Intake of sugar-sweetened beverages and weight gain: a systematic review. *Am J Clin Nutr* **84**, 274–288.
8. Te Morenga L, Mallard S & Mann J (2012) Dietary sugars and body weight: systematic review and meta-analyses of randomised controlled trials and cohort studies. *BMJ* **346**, e7492.
9. Malik VS, Willett WC & Hu FB (2009) Sugar-sweetened beverages and BMI in children and adolescents: reanalyses of a meta-analysis. *Am J Clin Nutr* **89**, 438–439.
10. Malik VS & Hu FB (2011) Sugar-sweetened beverages and health: where does the evidence stand? *Am J Clin Nutr* **94**, 1161–1162.
11. Malik VS, Popkin BM, Bray GA *et al.* (2010) Sugar-sweetened beverages and risk of metabolic syndrome and type 2 diabetes: a meta-analysis. *Diabetes Care* **33**, 2477–2483.
12. Hu FB & Malik VS (2010) Sugar-sweetened beverages and risk of obesity and type 2 diabetes: epidemiologic evidence. *Physiol Behav* **100**, 47–54.
13. Harrington S (2008) The role of sugar-sweetened beverage consumption in adolescent obesity: a review of the literature. *J Sch Nurs* **24**, 3–12.
14. Frary CD, Johnson RK & Wang MQ (2004) Children and adolescents' choices of foods and beverages high in added sugars are associated with intakes of key nutrients and food groups. *J Adolesc Health* **34**, 56–63.
15. Libuda L, Alexy U, Buyken AE *et al.* (2009) Consumption of sugar-sweetened beverages and its association with nutrient intakes and diet quality in German children and adolescents. *Br J Nutr* **101**, 1549–1557.
16. Fiorito LM, Marini M, Mitchell DC *et al.* (2010) Girls' early sweetened carbonated beverage intake predicts different patterns of beverage and nutrient intake across childhood and adolescence. *J Am Diet Assoc* **110**, 543–550.
17. Vartanian LR, Schwartz MB & Brownell KD (2007) Effects of soft drink consumption on nutrition and health: a systematic review and meta-analysis. *Am J Public Health* **97**, 667–675.
18. World Health Organization (2003) *Diet, Nutrition and the Prevention of Chronic Diseases. Report of a Joint WHO/FAO Expert Consultation. WHO Technical Report Series* no. 916. Geneva: WHO.
19. Heller KE, Burt BA & Eklund SA (2001) Sugared soda consumption and dental caries in the United States. *J Dent Res* **80**, 1949–1953.
20. Sohn W, Burt BA & Sowers MR (2006) Carbonated soft drinks and dental caries in the primary dentition. *J Dent Res* **85**, 262–266.

21. Warren JJ, Weber-Gasparoni K, Marshall TA *et al.* (2009) A longitudinal study of dental caries risk among very young low SES children. *Community Dent Oral Epidemiol* **37**, 116–122.
22. Touger-Decker R & van Loveren C (2003) Sugars and dental caries. *Am J Clin Nutr* **78**, issue 4, 881S–892S.
23. Letona P, Ramirez-Zea M, Caballero B *et al.* (2014) Formative research to develop a community-based intervention for chronic disease prevention in Guatemalan school-age children. *BMC Public Health* **14**, 101.
24. Pehlke EL, Letona P, Ramirez-Zea M *et al.* (2016) Healthy casetas: a potential strategy to improve the food environment in low-income schools to reduce obesity in children in Guatemala City. *Ecol Food Nutr* **55**, 324–338.
25. Bredin C, Chacon V, Barnoya J *et al.* (2015) Expansion of the COMPASS study to Guatemala: a program of training and research designed to improve youth health through school-based programs, policies and built environment resources. *COMPASS Tech Rep Ser* **3**, issue 6. https://uwaterloo.ca/compass-system/publications/expansion-compass-study-guatemala-program-training (accessed July 2017).
26. Leatherdale ST, Brown KS, Carson V *et al.* (2014) The COMPASS study: a longitudinal hierarchical research platform for evaluating natural experiments related to changes in school-level programs, policies and built environment resources. *BMC Public Health* **14**, 331.
27. Leatherdale ST, Bredin C & Blashill J (2014) A software application for use in handheld devices to collect school built environment data. *Measurement* **50**, 331–338.
28. Bredin C & Leatherdale ST (2014) Development of the COMPASS student questionnaire. *COMPASS Tech Rep Ser* **2**, issue 2. https://uwaterloo.ca/compass-system/publications/development-compass-student-questionnaire (accessed July 2017).
29. World Health Organization (2015) Growth reference 5–19 years: BMI-for-age (5–19 years). http://www.who.int/growthref/who2007_bmi_for_age/en/ (accessed July 2017).
30. Bermudez OI, Toher C, Montenegro-Bethancourt G *et al.* (2010) Dietary intakes and food sources of fat and fatty acids in Guatemalan schoolchildren: a cross-sectional study. *Nutr J* **9**, 1.
31. Montenegro-Bethancourt G, Doak CM & Solomons N (2009) Fruit and vegetable intake of schoolchildren in Quetzaltenango, Guatemala. *Rev Panam Salud Publica* **25**, 146–156.
32. Herciu A, Laxer R, Cole A *et al.* (2014) A cross-sectional study examining factors associated with youth binge drinking in the COMPASS study: year 1 data. *J Alcohol Drug Depend* **2**, 2.
33. Leatherdale ST (2015) An examination of the co-occurrence of modifiable risk factors associated with chronic disease among youth in the COMPASS study. *Cancer Causes Control* **26**, 519–528.
34. Patte KA & Leatherdale ST (2017) A cross-sectional analysis examining the association between dieting behaviours and alcohol use among secondary school students in the COMPASS study. *J Public Health (Oxf)* **39**, 321–329.
35. Leatherdale ST & Harvey A (2015) Examining communication- and media-based recreational sedentary behaviors among Canadian youth: results from the COMPASS study. *Prev Med* **74**, 74–80.
36. Minaker L & Leatherdale ST (2016) Association between weight and smoking not mediated by weight loss attempts or bullying. *Am J Health Behav* **40**, 21–30.
37. Dewey KG, Romero-Abal ME, Quan de Serrano J *et al.* (1997) A randomized intervention study of the effects of discontinuing coffee intake on growth and morbidity of iron-deficient Guatemalan toddlers. *J Nutr* **127**, 306–313.
38. Engle PL, VasDias T, Howard I *et al.* (1999) Effects of discontinuing coffee intake on iron deficient Guatemalan toddlers' cognitive development and sleep. *Early Hum Dev* **53**, 251–269.
39. Montenegro-Bethancourt G, Vossenaar M, Doak CM *et al.* (2010) Contribution of beverages to energy, macronutrient and micronutrient intake of third-and fourth-grade schoolchildren in Quetzaltenango, Guatemala. *Matern Child Nutr* **6**, 174–189.
40. Nagata JM, Barg FK, Valeggia CR *et al.* (2011) Coca-colonization and hybridization of diets among the Tz'utujil Maya. *Ecol Food Nutr* **50**, 297–318.
41. Makkes S, Montenegro-Bethancourt G, Groeneveld IF *et al.* (2011) Beverage consumption and anthropometric outcomes among schoolchildren in Guatemala. *Matern Child Nutr* **7**, 410–420.
42. Pehlke EL, Letona P, Hurley K *et al.* (2016) Guatemalan school food environment: impact on schoolchildren's risk of both undernutrition and overweight/obesity. *Health Promot Int* **31**, 542–550.
43. Secretaría de Seguridad Alimentaria y Nutricional (2012) Plan del Pacto Hambre Cero en Guatemala. http://web.maga.gob.gt/wp-content/uploads/pdf/home/pacto_hambre_cero.pdf (accessed August 2017).
44. Comisión Nacional de Escuelas Saludables Ministerio de Educación de Guatemala (2014) Escuelas Saludables Dirección General de Fortalecimiento de la Comunidad Educativa. http://www.mineduc.gob.gt/DIGEFOCE/documents/2014/GUIA_BASICA_ESCUELAS_SALUDABLES_A_COLOR.pdf (accessed August 2017).
45. Chacon V, Letona P, Villamor E *et al.* (2015) Snack food advertising in stores around public schools in Guatemala. *Crit Public Health* **25**, 291–298.
46. Rideout K, Levy-Milne R, Martin C *et al.* (2007) Food sales outlets, food availability, and the extent of nutrition policy implementation in schools in British Columbia. *Can J Public Health* **98**, 246–250.
47. Park S, Sappenfield WM, Huang Y *et al.* (2010) The impact of the availability of school vending machines on eating behavior during lunch: the Youth Physical Activity and Nutrition Survey. *J Am Diet Assoc* **110**, 1532–1536.
48. Johnson DB, Bruemmer B, Lund AE *et al.* (2009) Impact of school district sugar-sweetened beverage policies on student beverage exposure and consumption in middle schools. *J Adolesc Health* **45**, 3 Suppl., S30–S37.
49. Grimm GC, Harnack L & Story M (2004) Factors associated with soft drink consumption in school-aged children. *J Am Diet Assoc* **104**, 1244–1249.
50. Wiecha JL, Finkelstein D, Troped PJ *et al.* (2006) School vending machine use and fast-food restaurant use are associated with sugar-sweetened beverage intake in youth. *J Am Diet Assoc* **106**, 1624–1630.
51. Mâsse LC, de Niet-Fitzgerald JE, Watts AW *et al.* (2014) Associations between the school food environment, student consumption and body mass index of Canadian adolescents. *Int J Behav Nutr Phys Act* **11**, 29.