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Dietary Salt Intake, Sugar-Sweetened Beverage Consumption, and Obesity Risk

Carley A. Grimes, Lynn J. Riddell, Karen J. Campbell and Caryl A. Nowson

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Dietary Salt Intake, Sugar-Sweetened Beverage Consumption, and Obesity Risk

WHAT'S KNOWN ON THIS SUBJECT: Sugar-sweetened beverage (SSB) consumption is associated with childhood obesity risk. Because dietary salt intake is a determinant of fluid consumption in adults, a high-salt diet may predict greater consumption of SSBs and therefore increase obesity risk.

WHAT THIS STUDY ADDS: In Australian children, the amount of salt consumed was positively associated with fluid consumption, and predicted the amount of SSB consumed. In addition, SSB consumption was associated with obesity risk, indicating a potential link between salt intake and childhood obesity.

abstract

FREE

OBJECTIVE: To determine the association among dietary salt, fluid, and sugar-sweetened beverage (SSB) consumption and weight status in a nationally representative sample of Australian children aged 2 to 16 years.

METHODS: Cross-sectional data from the 2007 Australian National Children's Nutrition and Physical Activity Survey. Consumption of dietary salt, fluid, and SSB was determined via two 24-hour dietary recalls. BMI was calculated from recorded height and weight. Regression analysis was used to assess the association between salt, fluid, SSB consumption, and weight status.

RESULTS: Of the 4283 participants, 62% reported consuming SSBs. Older children and those of lower socioeconomic status (SES) were more likely to consume SSBs (both Ps $<$ .001). Dietary salt intake was positively associated with fluid consumption (r = 0.42, $P <$ .001); each additional 1 g/d of salt was associated with a 46 g/d greater intake of fluid, adjusted for age, gender, BMI, and SES ($P <$ .001). In those consuming SSBs (n = 2571), salt intake was positively associated with SSB consumption (r = 0.35, $P <$ .001); each additional 1 g/d of salt was associated with a 17 g/d greater intake of SSB, adjusted for age, gender, SES, and energy ($P <$ .001). Participants who consumed more than 1 serving ($\geq$250 g) of SSB were 26% more likely to be overweight/obese (odds ratio: 1.26, 95% confidence interval: 1.03–1.53).

CONCLUSIONS: Dietary salt intake predicted total fluid consumption and SSB consumption within consumers of SSBs. Furthermore, SSB consumption was associated with obesity risk. In addition to the known benefits of lowering blood pressure, salt reduction strategies may be useful in childhood obesity prevention efforts. *Pediatrics* 2013;131:14–21

AUTHORS: Carley A. Grimes, BNutrDiet (Hons), Lynn J. Riddell, PhD, Karen J. Campbell, PhD, and Caryl A. Nowson, PhD

Centre for Physical Activity and Nutrition Research, School of Exercise and Nutrition Sciences, Deakin University, Burwood, Australia

KEY WORDS

dietary sodium chloride, child, adolescent, beverages, obesity

ABBREVIATIONS

CI—confidence interval
CNPAS—Children's Nutrition and Physical Activity Survey
estBMR—estimated basal metabolic rate
OR—odds ratio
SES—socioeconomic status
SSB—sugar-sweetened beverage

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Address correspondence to Caryl A. Nowson, PhD, Centre for Physical Activity and Nutrition Research, School of Exercise and Nutrition Sciences, Deakin University, 221 Burwood Highway, Burwood, Victoria 3125, Australia. E-mail: nowson@deakin.edu.au

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In 2007–2008, a quarter of Australian children aged 5 to 17 years were overweight or obese.[1] Greater consumption of sugar-sweetened beverages (SSBs) over the previous 2 decades[2,3] may be 1 factor associated with the rise in childhood obesity rates.[4,5] Although there are some inconsistencies across studies,[6–9] there is a growing body of evidence to support the notion that increased SSB consumption is associated with childhood obesity.[5,10,11] Emerging evidence suggests that a reduction in dietary salt intake may reduce SSB consumption.[12] The mechanism behind this relationship lies in the homeostatic trigger of thirst in response to the ingestion of dietary salt.[13,14] After the consumption of dietary salt, there is a subsequent rise in plasma sodium concentration, and to maintain body fluid homeostasis, thirst is stimulated, thus promoting fluid intake.[14,15] The association between salt and fluid consumption has been demonstrated in an experimental trial in adults in which a 100 mmol/d reduction in sodium (6 g/d salt) in hypertensive adults predicted a 367-mL reduction in 24-hour urinary volume.[16] It is suggested that in an environment where soft drinks are readily available, a high salt diet may encourage greater consumption of soft drinks in children.[15]

In a national survey of UK children aged 4 to 18 years, dietary salt intake was positively associated with total fluid consumption, and there was a weak, but statistically significant, positive association with SSB consumption.[12] To date, no other study using a nationally representative sample has confirmed these findings. Therefore, the aims of the current study were to (1) examine the association between dietary salt intake and overall fluid consumption, as well as SSB consumption, and (2) examine the association between SSB consumption and weight status in a nationally representative sample of Australian children aged 2 to 16 years.

METHODS

2007 Australian National Children's Nutrition and Physical Activity Survey

The full details of the methodology used in the cross-sectional Children's Nutrition and Physical Activity Survey (CNPAS) have been previously reported.[17] The method of our analysis of these data has previously been published.[18] The study was approved by the National Health and Medical Research Council registered Ethics Committees of Commonwealth Scientific Industrial Research Organization and University of South Australia. All participants (or where the child was aged <14 years, the primary caregiver) provided written consent.

Data Collection

Data were collected at 2 time points, between February and August 2007, the first consisting of a face-to-face interview and the second a telephone interview. Demographic data were collected for both the participating child and the primary caregiver. A 3-pass 24-hour dietary recall was used to determine all food and beverages consumed from midnight to midnight on the day before the interview at both time points of data collection.[17] Portion sizes were estimated by using a food model booklet and standard household measures. The 24-hour dietary recall was conducted with the primary caregiver of participants aged ≤9 years and with the study child in participants aged ≥9 years. In this analysis, the average dietary intake data from both days have been used.[17]

Sodium intake was calculated by using the Australian nutrient composition database AUSNUT2007.[19] Sodium intake (in milligrams) was converted to salt equivalents (g) by using the conversion 1 g of sodium chloride (salt) = 390 mg sodium. Because sodium was assessed by using the 24-hour dietary recall method, reported salt intake does not include salt added at the table or during cooking. Total fluid (grams) included all sources of fluid consumed either as a beverage or added to meals and recipes. Consistent with the Dietary Guidelines for Americans 2010, the definition of SSB included sugar-sweetened soda, cordials, fruit drinks, flavored mineral waters, and sports and energy drinks.[20] Consistent with the methodology used to collect dietary data in the CNPAS, as well as the AUSNUT2007 food composition database, which lists nutrient data per 100 g, the unit of measurement for total fluid and SSB is expressed as grams.

Body weight and height were measured by using standard protocols.[21] BMI was calculated as body weight (kg) divided by the square of body height (m^2). Participants were grouped into weight categories (very underweight, underweight, healthy weight, overweight, obese) by using the International Obesity Task Force BMI reference cutoffs.[22,23]

Potential Confounders

Physical activity was objectively measured in participants aged 5 to 16 years (n = 2939, 79% of sample) by using the New Lifestyles 1000 pedometer. Participants were instructed to wear the pedometer from the time of rising in the morning until going to bed at night. From these data, the average time spent in minutes per day on moderate to vigorous physical activity, equivalent to >3 metabolic equivalents, was calculated. Only those participants who wore the pedometer for a minimum of 6 days were included in the analysis adjusted for physical activity (n = 2304).

The highest level of education attained by the primary caregiver was used as a marker for socioeconomic status (SES): (1) high includes those with a university/tertiary qualification; (2) mid includes those with an advanced diploma, diploma, certificate III/IV, or trade certificate; and (3) low includes those with some or no level of high school education.

Assessment of Underreporting

The Goldberg cutoff method is commonly used in dietary studies to identify participants whose reported energy intake is insufficient to meet energy requirements needed for survival (underreporter).[24] To apply this method, estimated basal metabolic rate (estBMR) was calculated for each participant.[25] The ratio of each participant's reported energy intake to estBMR (EI:estBMR), was then compared with the published Goldberg cutoff value.[26,27] A participant with an EI:estBMR below the <.90 cut point was deemed to be an underreporter. On this basis, 204 participants (4.5%) were classified as underreporters and excluded from the analysis.

Statistical Analysis

Statistical analyses were completed by using Stata/SE 11 (StataCorp, College Station, TX) and PASW Statistics 17.0 (PASW Inc, Chicago, IL). A *P* value of <.05 was considered significant. To account for the complex sample design, analyses were completed with the Stata svy command, by using cluster variable (post code), stratum variable (region), and population weightings (age, gender, region). Data are presented as mean (SD) or *n* (% weighted) where appropriate. Independent *t* tests were used to compare the mean of continuous variables, and Pearson χ^2 tests were used to assess differences in categorical variables. Pearson's correlation coefficient was used to assess the association between dietary salt intake and (1) total fluid consumption and (2) SSB consumption. Multiple regression analysis was used to adjust for potential confounding variables. The salt and fluid consumption model was adjusted for age, gender, SES, and BMI. Additional adjustment for physical activity was completed in 5- to 16-year-olds with available physical activity data (*n* = 2304). To control additionally for the confounders of age and gender, the regression analysis was stratified first by gender and second by age group.

Participants were categorized as SSB consumers if they reported consuming some SSB (>0 g/d) over the two 24-hour dietary recall periods. Because 38% (*n* = 1712) of participants did not consume any SSB, this created a highly negative skewed variable for SSB grams per day. Thus, the association between salt intake and SSB consumption was assessed within a subsample of participants, including only those participants who were classified as SSB consumers (*n* = 2571). This model was adjusted for age, gender, SES, and energy derived from sources other than SSB (ie, total energy intake minus energy from SSBs). Given that the outcome variable, SSBs, is a source of energy, controlling for total energy (kJ/d) would over adjust within the model. Therefore, the partition method was used to adjust for energy, which includes only the energy (kJ/d) that is derived from sources other than SSB (ie, total energy intake minus energy from SSBs). Additional adjustment for physical activity was completed in those 5- to 16-year-olds with available physical activity data (*n* = 1511). Additional age and gender stratification was not completed for the salt and SSB model because of low numbers in each group within this subsample. Data from linear regression are presented as regression coefficient (β) with 95% confidence interval (CI), corresponding *P* values, and the coefficient of determination (R^2).

The association between SSB consumption and weight status was assessed by using binary logistic regression. Participants were dichotomized into 2 weight categories, (1) "healthy weight" and (2) "overweight/obese," which included both overweight and obese participants. For this analysis, those participants who fell into the very underweight (*n* = 32) and underweight (*n* = 179) categories were excluded. The consumption of SSB was grouped into number of servings (1 serving size = 250 g). On the basis of the average level of consumption of SSB across the 2 days of 24-hour recall, participants were grouped into 1 of the following 3 categories: no servings (ie, 0 g), <1 serving (ie, 1–249 g), or >1 serving (ie, ≥250 g). Adjustment was made for gender, age, SES, and energy derived from sources other than SSB and physical activity in 5- to 16-year-olds. Data are presented as odds ratio (OR) with 95% CI and corresponding *P* values.

RESULTS

Demographic Characteristics and Nutrient Intake

Basic characteristics of the 4283 participants are listed in Table 1. Sixty-two percent of all participants reported consuming SSBs. Gender was not associated with SSB consumption; however, age and SES were both significantly associated with SSB consumption (both $P < .001$). The proportion of children consuming SSBs increased with age, and children of low SES were more likely to consume SSBs than those children of high SES. Consumers of SSBs were more likely to be overweight and obese than nonconsumers of SSBs ($P < .05$).

Dietary Salt Intake and Its Association With Fluid Consumption

The mean dietary salt intake (salt equivalents) was ~6 g/d, and fluid intake was ~1440 g/d (Table 1). Salt intake increased with age, from 4.3 (1.5) g/d in 2- to 3-year-olds to 8.1 (3.2) g/d in 14- to 16-year-olds. Similarly, fluid consumption increased with age, from 1064 (374) g/d in 2- to 3-year-olds to 1799 (752) g/d in 14- to 16-year-olds.

TABLE 1 Demographic Characteristics and Dietary Intake of SSB Consumers Versus Nonconsumers (n = 4283)

Demographic Characteristic/Dietary Component	Total Sample, *n* (%)	SSB Consumer, *n* (%)	Nonconsumer, *n* (%)	P^a
No. of participants	4283	2571 (61.6)	1712 (38.4)	
Gender				
Male	2170 (51.7)	1335 (63.2)	835 (36.8)	.12
Female	2113 (48.3)	1236 (59.9)	877 (40.1)	
Age group				
2–3 y	1057 (12.8)	469 (44.8)	588 (55.2)	<.001
4–8 y	1208 (35.2)	702 (57.0)	506 (43.0)	
9–13 y	1058 (33.1)	744 (69.6)	314 (30.4)	
14–16 y	960 (18.9)	656 (67.6)	304 (32.3)	
SES category				
Low	1342 (34.1)	892 (68.2)	450 (31.8)	<.001
Mid	1506 (35.6)	975 (65.3)	531 (34.7)	
High	1435 (30.3)	704 (51.9)	731 (48.2)	
Wt classification[b]				
Very underweight	32 (0.7)	23 (0.8)	9 (0.6)	<0.05
Underweight	179 (4.2)	99 (3.8)	80 (5.0)	
Healthy wt	3193 (74.3)	1900 (73.7)	1293 (75.1)	
Overweight	697 (16.3)	423 (16.4)	274 (16.1)	
Obese	182 (4.5)	126 (5.3)	56 (3.2)	
Salt intake (g/d), mean (SD)[c]	6.3 (2.6)	6.5 (2.6)	5.8 (2.4)	<0.001
Fluid intake (g/d), mean (SD)	1438 (607)	1510 (628)	1321 (554)	<0.001
Energy intake (kJ/d), mean (SD)	8296 (2507)	8579 (2543)	7843 (2378)	<0.001

[a] P values determined by using χ^2 and independent t test.
[b] Weight classification based on the International Obesity Task Force BMI reference cutoffs.[22,23]
[c] Salt equivalent (1 g = 390 mg sodium).

There was a positive correlation between salt intake and total fluid consumption (r = .42, $P < .001$), with each additional 1 g/d of salt being associated with a 92 g/d greater intake of total fluid, and salt intake alone accounted for 15% of the variance in fluid consumption (Table 2). This association remained significant after adjustment for age, gender, SES, and BMI in which each additional 1 g/d of salt was associated with a 46 g/d greater intake of total fluid. Additional adjustment for time spent in moderate and vigorous physical activity in 5- to 16-year-olds (n = 2304) did not significantly alter this association. When stratified by gender and age group, the association between salt and fluid consumption remained significant in boys and girls and for each age group.

Dietary Salt Intake and the Association With SSB Consumption

In those participants who consumed SSBs (n = 2571), the average intake of SSB was 248 (233) g/d. In these SSB consumers, the average intake of SSB increased with increasing age: 2 to 3 years 114 (115) g/d; 4 to 8 years 169 (157) g/d; 9 to 13 years 279 (217) g/d; and 14 to 16 years 373 (314) g/d. Within this subsample of SSB consumers, there was a positive correlation between salt intake and SSB consumption (r = .35, $P < .001$). Each additional 1 g/d of salt was associated with a 30 g/d greater intake of SSB, and salt intake alone accounted for 11% of the variance in SSB consumption (Table 3). After adjustment for age, gender, SES, and energy derived from sources other than SSB, the association remained significant and each additional 1 g/d of dietary salt was associated with a 17 g/d greater intake of SSB ($P < .001$).

SSB Consumption as a Predictor of Weight Status

Children who consumed >1 serving of SSB were 34% ($P < .001$) more likely to be overweight/obese ($P < .01$, Table 4). This association remained significant after adjustment for age, gender, SES, and energy derived from sources other than SSB. In the subsample of 5- to 16-year-olds with physical activity data (n = 2180), after adjustment for time spent in moderate or vigorous physical activity, the association between SSB consumption and overweight/obesity risk was no longer significant. There was no association between weight status and those children who consumed up to only 1 serving of SSB.

DISCUSSION

In this 2007 nationally representative survey of Australian children aged 2 to 16 years, we found that the amount of dietary salt consumed was positively associated with overall fluid consumption and with the amount of SSB consumed in SSB consumers. Overall, we found that >60% of Australian children consumed SSBs; this is lower than that observed in US children (80%).[28] Consistent with studies from Europe and the US, we found older children[29–31] and those from lower SES[32,33] were more likely to consume SSBs.

To our knowledge, this is only the second study to examine the association between dietary salt intake and fluid and SSB consumption in children in a large population study. We found 1 g/d of dietary salt was associated with 46 g/d greater intake of total fluid, which is similar to the result found by He et al[12] in a nationally representative sample of UK children aged 4 to 18 years (1 g/d of dietary salt was associated with a 100 g/d greater intake of total fluid). Our findings indicating an association between dietary salt and fluid consumption in children are consistent with experimental evidence in animals showing increased ad libitum drinking behavior when consuming a diet high in salt[34,35] and adults having a lower total urinary output (a measure of fluid consumption) when reducing dietary salt intake.[16] In children on relatively high salt intakes,

TABLE 2 Multiple Linear Regression Analyses of Fluid Consumption (g/d) and Dietary Salt Intake (g/d) in Australian Children Aged 2 to 16 Years, by Gender and Age Group (n = 4283)[a,b]

Model	β (95% CI)	R^2	β (95% CI)	R^2	n	β (95% CI)	R^2
	Unadjusted		Adjusted for age, gender, SES, BMI			Adjusted for age, gender, SES, BMI, MVPA[c]	
Total sample (n = 4283)	92.1 (81.9–102.2)**	.15	45.5 (34.5–57.6)**	0.26	2304	44.7 (28.6–61.0)**	.22
Stratified by gender	Unadjusted		Adjusted for age, SES, BMI			Adjusted for age, SES, BMI, MVPA[c]	
Boys (n = 2170)	98.4 (87.5–109.2)**	.18	50.9 (36.0–65.8)**	0.28	1142	51.8 (31.3–72.2)**	.22
Girls (n = 2113)	66.3 (52.6–79.9)**	.07	29.8 (15.0–44.6)**	0.19	1162	29.7 (11.2–48.2)*	.15
Stratified by age group	Unadjusted		Adjusted for gender, SES, BMI			Adjusted for gender, SES, BMI, MVPA[c]	
2–4 y (n = 1057)	64.0 (48.6–79.5)**	.07	61.3 (46.3–76.3)**	0.08		No PA data[d]	
4–8 y (n = 1208)	50.2 (31.6–68.9)**	.05	39.6 (22.7–57.8)**	0.09	728	41.3 (19.5–63.1)**	.11
9–13 y (n = 1058)	74.0 (57.0–91.0)**	.08	60.9 (42.2–79.6)**	0.13	820	67.8 (41.5–94.0)**	.13
14–16 y (n = 960)	53.8 (33.5–74.4)**	.05	34.4 (10.3–55.8)**	0.10	756	31.5 (4.6–58.5)*	.13

MVPA, moderate to vigorous physical activity.

[a] In all models: dependent variable = fluid consumption (g/d) and independent variable = salt intake (g/d).

[b] All models are statistically significant $P < .001$.

[c] Completed within subsample of participants with physical activity data available.

[d] Analysis not completed in 2- to 3-year-olds because physical activity (PA) was not measured in this age group.

* $P < .01$.

** $P < .001$.

experiencing a drive for fluid where there is ready access to SSB may influence greater consumption of SSBs.

Among consumers of SSBs, we found each additional 1 g/d of salt was associated with a 17 g/d greater intake of SSB, adjusted for confounders, and that dietary salt alone explained 11% of the variance in SSB consumption, which is similar to the findings from the UK study.[12] In view of the wide-ranging determinants of eating behaviors,[36] this finding emphasizes the potential role of salt reduction in lowering SSB consumption. In UK children, the magnitude of the association reported between dietary salt and SSB intake was slightly greater; each additional 1 g/d of dietary salt consumed was associated with a 27 g/d greater intake of SSB (adjusted for age, gender, and body weight). The discrepancy between these results may be explained by the adjustment of additional confounders within our analysis (SES and energy derived from sources other than SSB) or due to differences in dietary assessment methods or between-country differences in dietary patterns.

In addition, we found a weak positive association between SSB consumption and risk of being overweight or obese. Participants who consumed >1 serving of SSB were 26% more likely to be overweight or obese; however, this association was no longer significant after additional adjustment for physical activity. The lack of association after adjustment for physical activity may be explained in part by the reduced sample size and therefore reduced statistical power for this analysis. Other studies examining the association between SSB consumption and risk of overweight have found either no association[8,9] or only an association in certain subsamples.[6,7] Inconsistent findings across studies may be explained by discrepancies in definitions of SSBs, differing age cohorts, varying study designs, and the adjustment for varying confounders.

We acknowledge the reasonably small predicted β coefficient of change in SSB consumption for a 1 g/d change in salt intake (ie, 17 g of SSB) within consumers of SSBs, and thus the significance of a reduction in SSB of this magnitude might be considered negligible. However, at the population level, the importance of minor dietary changes in improving nutritional intakes[37] and health outcomes[38] should not be underestimated. The current assessed dietary salt intake of Australian children,[39] which excludes discretionary use of salt at the table or in cooking, far exceeds dietary recommendations.[40] On average, a 5 g/d reduction in dietary salt is needed to take Australian children to the adequate intake level. On the basis of our regression analysis, a reduction in salt of this magnitude would predict an 85-g/d reduction in SSB consumption within

TABLE 3 Multiple Linear Regression Analyses of SSB Consumption (g/d) and Dietary Salt Intake (g/d) Within Consumers of SSBs (n = 2571)[a,b]

Model	B	95% CI	R^2
Unadjusted	29.7	25.0–34.5**	.11
Adjusted for age, gender, SES, energy derived from sources other than SSB	17.4	9.8–25.0**	.19
Adjusted for age, gender, SES, energy derived from sources other than SSB, MVPA[c]	21.2	10.8–31.5**	.14

MVPA, moderate to vigorous physical activity.

[a] In all models: dependent variable = SSB consumption (g/d) and independent variable = salt intake (g/d).

[b] All models are statistically significant $P < .001$.

[c] Completed within subsample of participants with physical activity data available (n = 1511).

** P value $< .001$.

TABLE 4 Association Between SSB Consumption and Weight Status (Healthy Weight Versus Overweight/Obese) in Australian Children Aged 2 to 16 Years (n = 4072)[a,b,c]

SSB Serving (250g)	N (Weighted %)	Unadjusted			Adjusted for Age, Gender, SES, Energy Derived From Sources Other Than SSB			Adjusted for Age, Gender, SES, Energy Derived From Sources Other Than SSB, MVPA[d]		
		OR	95% CI	P Value	OR	95% CI	P Value	OR	95% CI	P Value
No servings	1623 (38.2)									
≤1 serving	1587 (39.0)	1.03	0.85–1.27	.74	0.99	0.82–1.21	.94	0.92	0.68–1.25	.59
>1 serving	862 (22.8)	1.34	1.12–1.60	.01	1.26	1.03–1.54	.03	1.22	0.90–1.68	.20

MVPA, moderate to vigorous physical activity.

a In all models, dependent variable is "healthy weight" versus "overweight/obese," and independent variable is number of servings (250 g) of SSB.

b Underweight participants (n = 211) have been excluded from this analysis.

c All models statistically significant $P < .001$.

d Includes only those participants aged 5 to 16 y where physical activity data were available (n = 2180).

SSB consumers, equivalent to a 120-kJ/d reduction in energy intake. Over the life course, minor changes in energy balance can increase the risk of obesity.[4,41] Thus, salt reduction strategies combined with other SSB reduction strategies may help to reduce energy intake and could be useful in obesity prevention efforts. In summary, both this study and that of He et al,[12] completed in large, nationally representative samples of children from Australia and the United Kingdom,[12] show a modest positive association between dietary salt intake and SSB consumption, with strikingly similar results between the 2 population groups.

The study also has a number of limitations; first, the 24-hour dietary recall fails to capture the amount of salt coming from salt added at the table and during cooking and as such is likely to be an underestimation of the true value of salt intake[42] because discretionary salt use appears to be relatively common in Australian children.[18] Despite the rigorous collection of dietary data within the 2007 Australian CNPAS,[17] it is well understood that underreporting of energy intake is a common limitation of 24-hour dietary recalls.[26] Furthermore, because underreporting is more likely to occur in overweight or obese children and adolescents,[43] this may distort results in which adiposity is included as an outcome measure. However, to minimize bias from unreliable data due to underreporting, we used the Goldberg cutoff method to identify and exclude underreporters. Second, we used data from 24-hour dietary recalls; however, a validated food model booklet was used during dietary recalls to assist participants in estimating portion sizes of beverages.[17] In addition, it is possible that seasonal variation may influence fluid consumption, but 3 seasons were represented because data were collected over a 6-month period that captured summer, autumn, and winter. It is acknowledged that due to the cross-sectional nature of this study, no causality can be drawn and that observed associations may in part be due to a clustering of dietary behaviors, a component of which relates to access to specific foods in the home environment. The consumption of sugar-sweetened soft drink is associated with reduced vegetable[44] and milk consumption[45] (typically low-salt foods) and higher consumption of fast food[46,47] and fried meats and fried snacks (eg, hamburgers and French fries[44]; typically high-salt foods). Thus, it is possible that some of the association reported in the current study is a result of the overall clustering of "unhealthy" dietary behaviors. The major strengths of this study include the use of a large, nationally representative sample of Australian children, with comprehensive and standardized collection of dietary intake, anthropometric, and demographic data.

CONCLUSIONS

The consumption of SSBs is relatively common in Australian children aged 2 to 16 years, and dietary salt intake was positively associated with overall fluid consumption. Furthermore, within consumers of SSBs, dietary salt intake predicted SSB consumption, and SSB consumption was associated with an increased risk of obesity in which consuming >1 serving of SSB was associated with increased risk of being overweight or obese. Therefore, in addition to the known benefits of salt reduction on reducing blood pressure, a reduction in salt intake in children may assist in reducing the amount of SSB consumed, which in turn may lower childhood obesity risk.

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POWER CALCULATIONS: *When comparing the efficacy of two treatments in a clinical trial, or when following up two groups in an observational study, four outcomes are possible: 1) the study detects a "true" difference; 2) the study finds a difference, but there is no "true" difference (***alpha error***); 3) the study finds no difference, and there is none; and 4) the study demonstrates no difference, but there is a "true" difference (***beta error***). The* P *value indicates the probability of alpha error (outcome #1 vs #2), and is calculated at the study's conclusion. The likelihood of beta error can be reduced before starting the study by* **power calculation**. *The* **statistical power** *of a study is influenced principally by the number of study participants and the size of the difference to be detected.*

Power calculations are used when planning a study to determine the likelihood that, if a predetermined clinically meaningful difference is present, it will be detected. The most contentious part of a power calculation is deciding what constitutes a clinically meaningful difference. A power of 80% or 90% to detect this difference generally is assumed to be sufficient to validate that there is no clinically meaningful difference between the two groups.

*In "Similar renal outcomes in children with ADPKD diagnosed by screening or presenting with symptoms" (*Pediatric Nephrology*: November 2010) by Mekahli, et al, renal outcomes were compared among children with autosomal dominant polycystic kidney disease diagnosed by prenatal ultrasound compared to those diagnosed only when they presented with symptoms. There were no differences detected between these two groups. This finding could be "true" (outcome #3 above) or false (outcome #4). Since the investigators did not report a power calculation, we do not know whether their study had adequate statistical power and sample size to detect a true difference between groups.*

How should readers use power calculations? In a study that demonstrates no differences between two treatments, check to see whether the authors include a power calculation. Lack of a power calculation represents an important weakness. However, once the study is done, it does not matter what the investigators believed they would find in the study design. What they actually found determines the usefulness of the study. This is best expressed using a 95% confidence interval, which uses data generated by the study to estimate a range of values likely to include the parameter of interest in a general population. Unfortunately, Mekahli, et al also did not report confidence intervals for the differences in outcomes between the two groups in this study.

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