



Revisión

Sugar-sweetened beverage intake before 6 years of age and weight or BMI status among older children; systematic review of prospective studies

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Abstract

The purpose of this study was to conduct a systematic review of prospective studies that examined the association between sugar-sweetened beverage intake before 6y of age and later weight or BMI status among older children. An electronic literature search was conducted in the MEDLINE/PubMed, SciELO, and EBSCO databases of prospective studies published from 2001 to 2011. Seven studies were analyzed. The study population was from 72 to 10,904 children. Three studies showed a consistent association between SSB intake before 6 y of age and increased weight, BMI, or waist circumference later in childhood, one study showed a positive trend of consumption of SSB and childhood obesity and the OR for incidence of overweight by baseline beverage intake was 1.04, another study it was observed that an increase in total sugar intake and sugar from sweets and beverages in children 1-2 y of age and 7-9 y of age have a tendency to increase BMI, and two studies showed no association.

In conclusion, although the trend of the reviews studies, indicate an association between sugar-sweetened beverage intake before 6 y of age and increased weight, BMI or waist circumference later in childhood, to date, the results are inconsistent, and the two studies with the higher number of children showed a positive association.

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Key words: *Sugar-sweetened beverages. Preschool children. Childhood obesity.*

INGESTA DE BEBIDAS AZUCARADAS ANTES DE LOS SEIS AÑOS Y PESO O IMC EN LOS NIÑOS MAYORES; UNA REVISIÓN SISTEMÁTICA DE ESTUDIOS PROSPECTIVOS

Resumen

El propósito de este estudio fue realizar una revisión sistemática de estudios prospectivos para valorar la asociación entre la ingesta de bebidas azucaradas (BE) antes de los seis años de edad y el peso y el IMC en niños mayores. Se realizó una búsqueda electrónica de la literatura en las bases de datos de MEDLINE/PubMed, SciELO, y EBSCO, de estudios prospectivos publicados de 2001 a 2011. Se analizaron siete estudios. La población de los estudios osciló entre 72 y 10,903 niños. Tres estudios demostraron una asociación consistente entre el consumo de BE antes de los seis años y un aumento de peso, IMC o circunferencia de cintura en años posteriores, un estudio presentó una tendencia positiva y el OR sobre la incidencia de sobrepeso basado en la ingesta basal de BE fue de 1.04. En otro estudio se observó una tendencia a aumentar el IMC con el mayor consumo de azúcar y de BE en niños de 1 a 2 años de edad y de 7 a 9 años y en dos estudios no se observó asociación.

En conclusión, aunque la tendencia de los estudios revisados indican una asociación entre la ingesta antes de seis años de BE y un aumento de peso, IMC o circunferencia de cintura a la fecha, los resultados son inconsistentes. En los dos estudios con mayor número de niños, la asociación es positiva.

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Palabras clave: *Bebidas azucaradas. Pre-escolares. Obesidad infantil.*

Introduction

Childhood obesity is increasing worldwide. According to the World Health Organization (WHO), nearly

43 million children under the age of five were overweight in 2010, 35 million in developing countries¹. The global prevalence has increased between 1990 and 2010, from 4.2% (95% CI: 3.2%, 5.2%) to 6.7% (95% CI: 5.6%, 7.7%). This trend is expected to reach 9.1% (95% CI: 7.3%, 10.9%), in 2020^{2,3}. The causes of obesity are complex, involving genetic, psychological, social and environmental components that link it to serious health problems and death in the long-term^{4,7}. Dietary factors contributing to an energy imbalance are

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considered critical for the development of later overweight and obesity, and added sugar has been considered as one of these factors⁸⁻¹⁰. Recent reports assert that sugar-containing drinks play a key role in the etiology of overweight and obesity^{11,12}. Estimates are that the mean intake of added sugar by Americans accounts for 15.8% of total energy and that the largest source of these added sugars are soft drinks such as sugar-sweetened beverages (SSB), fruit drinks, lemonade, and iced tea¹³. Children's intake of SSB has increased more in recent decades while consumption of milk has significantly decreased^{14,15}. Beverage preferences and consumption patterns begin to develop early in childhood and can persist over time¹⁶⁻¹⁸.

Previously published reviews and meta-analysis of SSB intake found a strong association between sugar-sweetened beverages intake and body weight¹⁹⁻²¹. In a meta-analysis conducted by Forshee et al. (2008)²² no association was found. However, those studies included cross sectional, prospective and randomized controlled studies with children older than 6 y of age, adolescents, and/or adult participants¹⁹⁻²².

The purpose of this study was to conduct a systematic review of prospective studies that examined the association between sugar-sweetened beverage intake before six years of age and later weight or BMI status among older children.

Methods

An electronic literature search was conducted in the MEDLINE/PubMed, SciELO, and EBSCO databases of prospective studies published from 2001 to 2011. We searched English and Spanish-language publications that examined the association between the intake of SSB, including soft drinks, soda, fruit drinks, sports drinks, sweetened iced tea, and lemonade, in children younger than 6 y and weight, BMI, and waist circumference status. Keywords used in this electronic search were: «sugar-sweetened beverages,» «preschool children,» «weight gain,» «overweight,» and «obesity». Selection of articles was restricted to prospective cohort studies in children younger than 6 y of age. After the data were examined for eligibility, ten articles were identified; two of them were excluded because they included participants older than 6y of age and one because it examined racial/ethnic differences in the SSB consumption²³⁻²⁵. Each study was assessed independently with these criteria by two of the authors (MEPM, MBG). When there was no consistency a consensus was reached with a third author (AJC).

Results

Our search resulted in 299 articles; ten of them contained information of SSB before 6 y of age and weight or BMI status among older children (fig. 1).

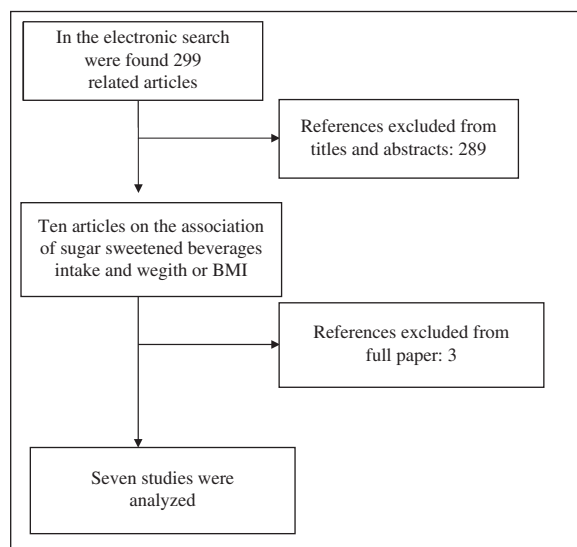


Fig. 1.—Flow diagram of the electronic search.

Seven published studies (table I) fulfilled the inclusion criteria²⁶⁻³². Three studies showed a consistent association between SSB intake before 6 y of age and increased weight, BMI, or waist circumference later in childhood²⁸⁻³⁰; one study showed a positive trend of consumption of SSB and childhood obesity²⁷; and three studies showed no association^{26,31,32}. The two strongest studies, with the highest number of participants and less sources of bias, showed a positive correlation between SSB intake and increase in weight, BMI or waist circumference^{29,30}. A summary description of all seven studies included in this systematic review is presented in table I.

Mean age of study participants was 3.2 years (0.5 to 6); the follow-up period ranged from 0.5 to 7 y; the study population varied from 72 to 10,904 children. Four studies included populations of less than 1000 children^{26-28,32}, and three studies had more than 1000 in their population²⁹⁻³¹. Most studies were conducted in the United States^{27,28,30-32}, one in Canada,²⁹ and one in Germany²⁶.

The study conducted by Herbst et al. (2011)²⁶, included a small sample group and did not analyze the consumption of beverages alone. It was observed that an increase in total sugar intake (3.7% of energy) and sugar from sweets and beverages (3.4% of energy) in children 1-2 y of age and 7-9 y of age have a tendency to increase BMI-Standard Deviation Scores (SDS); however, an increase in sugar intake was not associated to higher BMI at 7 y of age. Participants of this study were very homogeneous; therefore, no extreme values of consumption could be found.

The study conducted by Lim et al. (2009)²⁷, showed a positive trend between SSB at baseline (3 to 5 y) and z-BMI two years later, but did not reach statistical significance. However, children that were at normal weight at baseline (275), had a 4% increase risk of overweight per ounce of SSB intake at baseline, but the incidence of overweight was not significant.

Table I
Association between sugar-sweetened beverage intake before 6y of age and change in weight or BMI

Reference/country	Age range (y)	Follow-up (y)	Population	Beverage categories	Baseline	Follow-up	Results
Herbst et al. (2011) ²⁶ Germany	0.5-2	7	216 children	Added sugar from beverages; soft drinks and fruit juices.	BMI -SDS at birth 0.22 (-0.4, 0.91)	BMI-SDS at age 7y -0.07 (-0.47, 0.71)	Increases in added sugar from beverages and sweets between ages 1 and 2 y were not associated to higher BMI -SDS levels at age 7 y (P=0.4).
Lim et al. (2009) ²⁷ USA	3-5	2	365 low-income African-American children. 275 non-overweight	Soda, fruit drinks, and both combined	BMI z-score 0.14 ± 0.08	BMI z-score at age 5y 0.56 ± 0.1	There was a positive trend between consumption of sweetened beverages and z-BMI but not significant. The OR for incidence of overweight by baseline beverage intake was 1.04 (1.01-1.06, 95%CI)
Krat et al. (2008) ²⁸ USA	3-6	3	135 White children	Sweetened milk, fruit drinks, caloric and non caloric soda, soft drinks, and excluding fruit juice	BMI z-score at age 3y -0.4±0.2 WC 48.3±0.7	BMI z-score at age 6y -0.05±0.2 WC 57.5±1.5	No significant association between consumption from individual beverage and change in BMI z-score (P >0.10). A greater increase in soda consumption over time was associated to greater child waist circumference (β=0.04, p=0.0001).
Dubois et al. (2007) ²⁹ Canada	2.5-4.5	2	1,549 children	Carbonated soft drinks and fruit flavored drinks consumed between meals.		15% of SSB regular consumers were OW vs 7% of non consumers were OW	Consumptions of SSB between meals at age 2 were associated to higher OW at age 4.5. Adjusted OR 2.4 (1.11-5.05, 95% CI)
Weish et al. (2005) ³⁰ USA	2-3	1	10 904 children	All sugar-sweetened and naturally sweet drinks.	BMI 75.5% Normal or UW 14.5% At risk of OW 10.1% OW	BMI 3.1% become OW 25% become OW 67% remained OW	Normal weight vs at risk of OW: Referent: 0-<1 sweet drinks per day (SDD), <2 SDD = 2.0 (1.3-3.2) <3 SDD = 2.0 (1.2-3.2) ≥3 SDD = 1.8 (1.1-2.8)
Newby et al. (2004) ³¹ USA	2-5	0.5-1	1,345 children	Fruit juice, fruit drinks, milk, soda and diet soda.	BMI 16.6±1.3 14% at risk of OW 6.5% OW	Change in BMI 0.01 ±0.01	No significant association between sweetened beverage consumption and changes in weight or BMI.
Skinner et al. (2001) ³² USA	2-6	4	72 White children 37 boys 35 girls.	100% juice, milk, carbonated beverages and other drinks (lemonade, tea, juice drinks)	NA	BMI at age 6y 15.7 ± 1.5	No statistically significant associations between juice, carbonated beverages consumption and weight or BMI.

BMI-SDS= Sex- and age-independent BMI SDS scores. At risk of OW BMI =85th<95th percentiles, and OW= overweight BMI ≥95th percentile according to the Centers for Disease Control and Prevention growth chart.

The study conducted by Kral et al. (2008)²⁸, did not show an association between SSB intake at 3 to 6y and obesity 3y later. Nevertheless, an association between SSB intake and waist circumference was observed.

The study conducted by Dubois et al. (2007)²⁹, showed a higher risk of OW at age 4.5 y from consumption of SSB between meals at ages 2.5-4.5 y. Besides, children from families with insufficient income who regularly consumed sugar-sweetened beverages between the ages of 2.5 and 4.5 y were three times more likely to be overweight at 4.5 years of age compared to children from sufficient income households who did not consume SSB.

The study conducted by Welsh et al. (2005)³⁰, showed that the consumption of SSB at age 2-3y doubles the risk of becoming overweight, one year later, among children who were at risk for overweight; and nearly doubles the risk of remaining overweight for those who were already overweight.

The study conducted by Newby et al. (2004)³¹, showed no significant association between SSB at age 2 to 5y and overweight 6-12 months later. However, underweight children were excluded and the follow-up was short.

The study conducted by Skinner et al. (2001)³², did not show any statistical association between SSB at age 2 to 6y and weight and BMI status four years later. However, the group sample was very low (n=72), and it only included white children from high socio-economic families.

Discussion

A consistent association between the intake of sugar sweetened beverages before 6y of age and increased weight, BMI, or waist circumference later in childhood was found in three studies²⁸⁻³⁰; one study showed a positive trend without reaching statistical significant differences, and the incidence of overweight by baseline beverage intake was 1.04 (95%CI; 1.01-1.06)²⁷; in one study it was shown that the increase in total sugar intake and sweets and beverages have a tendency to increase the BMI²⁶, and two studies showed no association^{31,32}. However, the two strongest studies, with the highest number of participants and less sources of bias, showed a positive association between SSB intake and increase in weight, BMI, or waist circumference^{29,30}, and the study conducted by Skinner did not report BMI at the beginning of the study³².

Our findings are consistent with previously published reviews and meta-analyses¹⁹⁻²¹. In the systematic review conducted by Malik et al. (2006), among younger and older than 6 y of age children and adults, the authors analyzed 10 prospective studies with similar results to those observed among younger of 6 y. Three of the prospective studies analyzed by them observed that an association of consumption of SSB was significantly correlated with greater weight gain

and greater risk of obesity over time in children and adults. Likewise, in the meta-analysis conducted by Vartanian et al. (2007), authors found a positive association between soft drink consumption and overall energy intake and body weight in five longitudinal studies. However, only one study included 6 y old children. In 10 of 12 cross-sectional studies and in all four of the long-term experimental studies conducted in preschool, school children, adolescents and adults, showed that energy intake rises when soft drink consumption is increased. In the systematic review conducted by Gibson²¹, the authors identified 44 original studies (23 cross-sectional, 17 prospective and four interventions) in adult and children. Approximately half of the cross-sectional and prospective studies found a statistically significant association between sugar-sweetened beverages consumption and BMI, weight, adiposity, or weight gain in at least one subgroup. However, five prospective studies were conducted in children; of those, only one was conducted among preschool children, in the latter, it was observed that the consumption of one or more SSB per day (vs. none) was associated with increased risk of being overweight one year later.

By contrast, Forshee et al., in a meta-analysis of twelve (10 longitudinal and 2 RCT) studies, concluded that the association between BMI and consumption of SSB in children was near to zero²². The authors of this study declared that the research center with which they are affiliated has received financial support from two companies in the beverage industry.

The strength of this review is that it only included prospective studies comprised of children from six months to six years of age and a follow-up from six months to seven years of age. The limitation of this review is that the studies included used different instruments to measure sugar-sweetened beverages consumption, different indicators to evaluate obesity, and different statistical models to estimate the effect sizes and different units of time.

Conclusions

To our knowledge, this is the first review that only included prospective studies of children younger than 6 y of age. The evidence, which is consistent with prospective studies realized in older children, shows that there is a trend showing that high consumption of SSB is associated to higher BMI, waist circumference, and overweight later in childhood. And although the trend of the reviews studies, indicate an association between sugar-sweetened beverage intake before 6 y of age and increased weight, BMI or waist circumference later in childhood, to date, and the results are inconsistent, the two studies with the higher number of children showed a positive association.

More and well designed studies are warranted; however, these results suggest that prevention programs

should include actions to avoid the introduction of SSB before 6 y of age.

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