

How Soft Drinks Contribute to the Pediatric Obesity Epidemic

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Abstract: *The growing epidemic of childhood obesity has emerged as the most prevalent chronic medical condition of childhood. Recently, the effect of sugar-sweetened soft drinks has been recognized as a significant source of excess calories in the North American child's diet. Today's socioeconomic climate allows children greater access to soft drinks both in school and in the home but also in restaurants and at entertainment venues. Schools, in particular, pose a problem since many depend on funding from soft drink companies to further educational and athletic activities. Soft drink marketing directed at children is also a significant factor influencing the role they play in the American child's diet. These factors, as well as the links between soft drink consumption and childhood obesity, are examined in this article. In particular, it is shown that soft drinks not only contribute to increased energy intake, increased weight gain and body mass index (BMI), but also to nutrient displacement from milk such as calcium, protein, magnesium, phosphorus and vitamin A. Practical recommendations to achieve healthier levels of soft drink consumption by our children are provided.*

Introduction

Numerous factors have been implicated in the genesis and maintenance of the current obesity epidemic; none perhaps, as frequently or as heatedly discussed as soft drinks. These are defined for the purpose of this discussion as drinks made from carbonated water to which has been added sugar (usually in the form of high fructose corn syrup) and flavorings. Additives or replacements may include caffeine, vitamins or diet sweeteners (e.g. sucralose). Diet sodas, which are not consumed to a great extent by children, (<10% of total consumption) will be excluded from this discussion, as well as the relatively new energy and sports drinks for which little data currently exists.

Across the board, soft drinks have a similar nutritional composition. For every 12oz drink (i.e. the standard soda can) there are the equivalent of 10 teaspoons of sugar or 150kcal and little else. In particular, the content for protein, vitamins and minerals (with the exception of phosphate at 54-60mg) is close to zero. Consequently, soft drinks are considered nutritionally poor dietary supplements.

In this article, we will examine the science that supports the link between the over consumption of soft drinks and childhood obesity, the increasing role that soft drinks have taken in the diets of our youth, and some of the socioeconomic factors that have brought soft drinks to prominence. It is clear already that only changes at many levels including the home, the physician's office, schools, the community

and government will be effective at decreasing the effects of sweetened soft drinks on weight.

Do Soft Drinks Contribute to Childhood Obesity?

In multiple studies over the last decade, researchers have not conclusively shown a link between obesity in children and a simple increase in caloric intake, be it from carbohydrates or fat. What has been discovered, however, is that a decrease in physical activity, in addition, to the composition of carbohydrate is closely linked to weight gain,^{1,2} Foods with a high glycemic index are those that tend to stimulate a dramatic hyperinsulinemia in the postprandial period. The ensuing rapid drop in blood glucose that follows is detected by the body as a signal to increase hunger, and sensitizes the host to sweetened foods even in the face of relative normoglycemia. What has been shown is that increased soft-drink consumption is a direct cause of 'nutrient displacement'.^{3,4} This is the principle by which an increase in calories from sweetened juices and carbonated sweetened soft drinks displaces the calories, vitamins and calcium from milk.

Unfortunately the calories from sweetened drinks do not displace the calories from solid food as milk does. Therefore, children tend to eat as much or more while drinking soft drinks. Various studies, discussed later in this article, confirm this theory and support the general notion that sweetened soft drinks are associated with increased weight gain and BMI. The type of sweetener used in soft drinks may be just as important as its quantity. Cheaper and highly subsidized, high fructose corn syrup has largely replaced sucrose over the years as the main sweetener in soft drinks. It has a very high glycemic index and its role in the genesis of obesity is under scrutiny, but remains controversial. Some have found that its effects differ from simple glucose in that it favors lipogenesis yet does not suppress leptin, one of the prime neuroendocrine signals of satiety.^{1,5,6}

Several studies have looked, in particular, at the relationship between increased calories from sweetened soft drinks and increased body weight or BMI in children. Their results show varying degrees of an identical outcome. They are summarized in *Table 1. (p.26)*

In a 2001 study by Ludwig et al, the effect on BMI of sweetened soft drinks in a cohort of 548 sixth and seventh graders in Massachusetts over a 19 month period was examined.⁷ This prospective observational analysis hypothesized that the consumption of sugar-sweetened drinks could directly predict a change in BMI. The study strongly implies a correlation that consumption of these drinks leads to increased

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Table 1 Comparison of Studies on Soft Drink Consumption and Obesity

Study	Subject age range	Predominant racial group	Sample size	Effect on weight or BMI	Effect on total energy intake
Mrdjenovic et al. (2003)	6-13	Caucasian (84%) Other (16%)	30	Gained a mean of 1.12kg ± 0.7 kg over 4-8 wks*	Associated increased calories and decreased milk intake
Warner et al. (2006)	2-5	Hispanic (100%)	354	Significantly associated increase in BMI	1 soda/day or more associated with obesity
Ludwig et al. (2001)	11-12	Caucasian (64%) Hispanic (15%) African Amer. (14%)	548	Increased BMI	1.6 times more likely to become obese with each additional daily serving of 12oz
Berkey et al. (2004)	9-14	Caucasian (94.7%)	11755	Linear increased BMI association, > for boys than girls	~2 servings of sweetened soft-drinks had the greatest net increase in BMI

*Mean ±. Standard Deviation

BMI and overall increase in fluid caloric intake. Their data showed that for each 12 oz soft drink consumed daily, a 0.18 increase in BMI and a 60% (odds ratio 1.6) increase in risk of developing obesity can be expected. This study explored the possibility of a physiologic mechanism by which the consumption of sweetened soft drinks likely results in an “imprecise and incomplete compensation for energy consumed in liquid form.”⁷

In a much larger study by Berkey et al, over 10,000 children were enrolled and followed over a two year period to assess their anthropometric change in relation to their consumption of sweetened beverages.³ Over the course of the study, they too found that increasing consumption of soft drinks had a significant linear association with increased weight and BMI, as well as a decreased milk intake. Boys and girls who drank two or more servings a day had a mean BMI increase of 0.14 and 0.10 respectively.³ Their results also showed an increase in total energy intake.

What may be the most powerfully convincing demonstration of the link between increased sweetened soft drink consumption and obesity is the 2007 study by Vartanian et al.¹ This meta-analysis reviewed eighty-eight studies across various patient ages, study designs and multiple disciplines such as nutrition, pediatrics, endocrinology and exercise physiology. When soft drink consumption and change in body weight were examined specifically, it was shown that overall there is

indeed a positive association, mostly from increased energy intake. Interestingly, research funded by food industry sources reported smaller effects on soft drink consumption and weight gain.^{1,8} Also highlighted is the association between increased soft drink consumption and decreased milk, calcium and other nutrient intake. In addition, they described a specific association between increased sugar sweetened soft drink consumption and a two-fold more likelihood of developing type 2 diabetes later in life.

In a well designed 2003 study, Mrdjenovic and Levitsky examined a cohort of 30 children aged 6-13 years whose dietary intake was recorded over a 4-8 week period at a summer day camp.⁹ The children had unlimited access to soft drinks, 2% milk and water. Weekday foods were supplied by the camp and weights were measured at the beginning and end of the study. The authors showed that an excessive amount (>12oz/day) of sweetened beverage consumption resulted in a decrease in milk intake, a constant amount of solid food intake, and an increase in weight gain. Here, despite the small sample size, they also demonstrated that increased consumption of soft drinks was clearly associated with a greater daily caloric intake and displacement of other important nutrients such as protein, calcium, magnesium, phosphorous and vitamin A.⁹

Globally, the obesity epidemic has affected most western countries, but has done so in different ways. There is a

Table 2 Marketing Initiatives that Promote Soft Drink Consumption by Children

<p>General Sales Marketing Initiatives</p> <ul style="list-style-type: none"> • Large dedicated advertising budgets • Advantageous pricing practices • Increasing portion sizes <p>Marketing Initiatives Directly Targeting Children</p> <p>In School</p> <ul style="list-style-type: none"> • “Channel One” advertising • Pouring rights agreements • Logos on vending machines, scoreboards, supplies, etc • Contests • Free samples and coupons • Club sponsorships • Product placement in teaching materials <p>Outside of School</p> <ul style="list-style-type: none"> • Media advertising: TV, print, internet, etc • Logos on clothes, toys, etc. • Celebrity endorsements • Product placements in movies, supermarkets, etc. • Exclusive marketing tie-ins • Coupons, free samples, contests, etc. • Bundled meal packages
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paucity of studies that examine the effect of soft drinks on obesity by ethnic or socioeconomic group. At this stage, it is difficult to say if any one group in particular is more “at risk” from soft drink consumption. We do know however, that the prevalence of obesity among minorities is more than double that of Caucasians.² One study by Warner et al. in 2006 looked at the prevalence of overweight 2-5 year-old Hispanic children and found that their already increased rate of obesity was worsened by soft drink consumption.¹⁰ This study identified a significant increase in BMI for as little as one 8oz serving of soda consumed per day.

The Role of Soft Drinks in the American Child’s Diet

If soft drinks were an occasional treat, then they would not pose as much a problem as they do today. However, soft drinks have come to occupy an important place in the diets of Americans of all ages. The production of sugar-sweetened sodas has almost doubled from 1970-1997, increasing from 22 to 41 gallons per person annually.¹¹ Soft drinks have become the single most consumed food in our diets, providing 7% of all calories according to an analysis of the 1999-2000 National Health and Nutrition Examination Survey (NHANES).¹²

For our children, soft drinks have become the primary source (33%) of added, refined sugars in their diets.¹³ M. Nestle, analyzing USDA figures, reports that soft drinks have replaced milk in the diets of American children with school purchases of milk during the period 1985-97 decreasing by 30%, while soda purchases increased by 1100%.¹⁴

Consumption of soft drinks begins at an early age with daily reported intakes of 1.5oz in 1-2 year olds. Intake peaks for all age groups, including adults, at 20oz per day in 12-19 year old males.¹⁴

Socioeconomic Factors Promote Increased Soft Drink Consumption

Children have become an important market segment of soft drink sales. At least two motives explain the targeted marketing of soft drinks to children: first, the development of brand loyalty at a young age is expected to insure a lifetime of sales for a company and second, children are increasingly recognized as significant sources of discretionary spending. In 1997, one billion dollars of their own money was spent by children on soft drinks alone.¹⁵

Table 2 details a non-exhaustive list of marketing initiatives that promote soft drink consumption in children either directly or indirectly. The most important marketing strategy continues to be advertising. The Coca Cola Company, which holds a 44% share of the U.S. soft drink market, spent \$867 million on ads in 1999. Its global advertising budget in 2006 exceeded \$2.6 billion.¹⁶ Other indirect marketing strategies further promote soft drink consumption. These include keeping prices competitively low, often 2-3 times less, for example, than milk at the supermarket, or gradually increasing the standard serving size. *Table 3* (p.28) shows that the standard 12oz serving since the 1960s has now become 20oz and can be “supersized” to 40oz. This doubling of serving size often comes at only a modest price increase of 50%.

Direct marketing of soft drinks to children can occur either inside or outside of the school environment. In school, Channel One is a daily 12 minute educational television program including 2 minutes of advertisements (including soft drink ads) or public service announcements. It reaches 25% of U.S. schools and is viewed each day in 350,000 classrooms. It has been shown that children remember more ads on Channel One than news stories.¹⁷

“Pouring rights” contracts provide exclusive access by soft drink companies to schools including vending machines sales, logo placements and advertisements. In counterpart, they provide much needed financial incentives to schools. A summary of local pouring rights contracts is in *Table 4*.¹⁸ (p. 28) In Duval County, the Pepsi contract is responsible for the majority of athletic funding. Grassroots efforts to curb the obesity epidemic have resulted in eliminating sweetened soft drink sales in several large school districts (e.g. Los Angeles County). In May 2006, an agreement was brokered by The William J. Clinton Foundation between the American Beverage Association and anti obesity advocates to promote

Table 3 The Growth of Soft Drink Container Size

Period	Size	Sugar	Calories
1950's	6.5oz	5.5 tsp	75
1960's	12oz	10 tsp	150
1990's	20oz*	17 tsp	250

**"Supersizing" now commonly available in convenience stores and fast food restaurants can increase a soft drink serving to 40 oz..*

healthier vending machine choices in schools. The three largest soft drink companies (Cadbury Schweppes, Coca-Cola and PepsiCo) will allow their vending machines to carry only water, unsweetened juices and low fat milk in elementary and middle schools. In high schools, sweetened soft drinks will be replaced by flavored waters, unsweetened teas and low calorie sports drinks. The changes will be phased in over the next five years.¹⁸

Significant efforts outside of schools have been made to market soft drinks to children. Besides direct marketing in the media (TV, print, internet, etc), soft drink companies have developed exclusive, youth oriented marketing tie-ins (e.g. 2001 Harry Potter and the Sorcerer's Stone movie) and celebrity endorsements (e.g. Britney Spears, LeBron James) that are expected to increase sales through association with a favorite hero or entertainment event.

Practical Recommendations

Several practical recommendations can be made to insure healthier levels of soft drink consumption by children (See Table 5). Over-consumption of sweetened soft drinks can be easily identified in the primary care setting with a brief dietary history. This is especially important for any new patient or child with rapidly increasing weight gain or who already

plots above the 85th percentile of BMI for age. Although no definitive levels of healthy consumption can be given, and advocating elimination of all soft drink consumption is unrealistic, the counseling provided should emphasize a change in paradigm from daily dietary staple to occasional treat. Counseling should emphasize the consumption of either energy poor (e.g. water) or nutritionally balanced (e.g. dairy or soy-based) fluids.

The home is an ideal controlled environment where reductions in consumption can be affected. It is important, however, that decisions be made at a family and not individual level, and that parents serve as appropriate role models. Some families have decided that sodas, for example, will only be consumed outside of the home or have eliminated drinking and eating in front of the computer or television.

School is another controlled environment where children spend a significant number of hours during most days. "Pouring rights" contracts provide needed revenues to schools and should not be eliminated. However, enforcement of the Clinton Foundation initiative should be vigorously supported along with ongoing grassroots initiatives to encourage healthier choices. Participation in the federally mandated district and school based Wellness Programs represent ideal venues for parents, teachers and health care providers to achieve these goals.¹⁹

Agreements and or legislation to eliminate direct marketing of soft drinks to children should be promoted. The anti-tobacco campaigns have demonstrated that such an approach can decrease consumption by children. For example, endorsements of sweetened soft drinks by "teen idols" should be discouraged. However, promotion of healthier choices in the media or at youth oriented restaurants, sports and entertainment venues should be encouraged. There have even been controversial recommendations aimed at decreasing competitive pricing practices (e.g. a soda tax) or promoting diet alternatives (e.g. sucralose diet sodas).

Summary

In summary, we have shown that there is a link between the consumption of soft drinks and the development of childhood obesity. The overall effect would be low and perhaps clinically

Table 4 Northeast Florida School "Pouring Rights" Contracts*

School System	Student base (10 ³)	Company	Year	Amount (10 ⁶)	Duration (yrs)
Duval	125	Pepsi	2000	\$13.5	5**
St. Johns	27	Pepsi	2005	\$2.3	5
Clay	35	Pepsi	2005	\$5.2	5

*Source: *Florida Times Union* online search (www.jacksonville.com)
 ** renewed in 2005 for an additional 5 years.

irrelevant if overall soft drink consumption in children was low, which unfortunately is not the case. We have shown that consumption of soft drinks has been increasing, adding calories to the diet and displacing other nutrients. Some of the socioeconomic factors leading to this increased consumption have been described. We have provided practical recommendations that can be used in the home, medical office and school to help re-establish an appropriate nutritional balance for our children.

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