Relationship Between Consumption of Sugar-Containing Beverages and Weight Gain in Children

Session I: Overview of the Science
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Background on Sugar-Sweetened Beverages

* Associated with obesity in adults and children, but unclear in younger children
* Mechanism unclear
  * Increased total calorie consumption (liquid calories less satisfying)
  * Independent effect of the sugars themselves
  * Controlled for total energy
  * Non-controlled for total energy

* Despite reduction in recent years, SSB and added sugar consumption greatly exceeds recommendations
Background on Sugar-Sweetened Beverages

* We examined fruit juice content
  * The nutrient content is very similar to sugar-sweetened beverages (SSBs)
  * High consumption among young children
* Sugar-containing beverages (SCB) = SSBs + fruit juice
* SCBs may affect body fat contribution
  * Total adiposity
  * Central adiposity

Clinical Question

Does increased consumption of SCBs among children under 12 years result in excess weight gain?
Results

2887 Unique Citations

- 2762 Citations Excluded
- 124 Citations
- 86 Citations Excluded

31 studies with SCB as exposure
- 31 with total adiposity as outcome
- 6 with central adiposity as outcome

15 studies with fruit juice as exposure
- 15 with total adiposity as outcome
- 2 with central adiposity as outcome

Critical Appraisal

Table 2: Critical appraisal of cohort studies that examined the association between sugar-containing beverages and excess weight gain/adiposity in children

<table>
<thead>
<tr>
<th>Author/Year</th>
<th>Did the authors address a clearly focused issue?</th>
<th>Was the cohort recruited in an acceptable way?</th>
<th>Was the exposure measured accurately?</th>
<th>Was the outcome measured accurately?</th>
<th>Were the subjects taken account of the confounding factors?</th>
<th>Was the follow-up of the subjects long enough? (Y/N)?</th>
<th>Overall risk of bias</th>
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Table 3: Critical appraisal of randomized controlled trials

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<th>Author/Year</th>
<th>Random Sequence</th>
<th>Allocation</th>
<th>Blinding of intervention</th>
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**Included Studies**

* 38 studies met the inclusion criteria
  * 1 RCT (at high risk of bias)
  * 37 cohort studies
* Risk of bias
  * 8 high
  * 15 moderate
  * 15 low
* Substantial heterogeneity
  * Populations
  * Study designs
  * Exposures
  * Covariates

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**<12: SCB ~ Total Adiposity**

* 31 studies
* 29 analyses did not control for total energy
  * 17 (59%) with + association
* 13 analyses controlled for total energy
  * 6 (46%) with + association
* 40%-71% of analyses tended positive whether or not:
  * Change over change analysis design
  * Sample size $\geq 250$
  * Risk of bias low
  * Controlled for age, sex, PA
  * U.S. study
<12: SCB ~ Central Adiposity

* 6 studies
  * 5 of 6 (83%) analyses not controlling for total energy were +
  * 1 of 2 (50%) analyses controlling for total energy were –

* 67%-100% of analyses tended positive whether or not
  * Change over change analysis design
  * Sample size > 250
  * Risk of bias low
  * Controlled for age, sex, PA
  * U.S. study

<12: Juice ~ Total Adiposity

* 15 studies
  * 5 of 11 (45%) analyses not controlling for total energy were +
  * 0 of 8 analyses controlling for total energy were +

* 20%-40% of analyses tended positive whether or not
  * Change over change analysis
  * Sample size > 250
  * Risk of bias low vs. moderate or high
  * Controlled or not controlled for age, sex, PA
  * U.S. study or not
  * No studies were positive if:
    * Sample size < 250
<12: Juice ~ Central Adiposity

* 2 studies
  * Differing study designs
  * 2 of 2 were negative
    * Whether controlling or not controlling for total energy

<5: SCB or Juice ~ Total Adiposity

* 11 studies evaluated total adiposity
  * No studies evaluated central adiposity
  * Association with SCBs +:
    * 85% of n=6 that were not controlled for total energy
    * 33% of n=3 that were controlled for total energy
  * Association with Fruit Juice +:
    * 75% of n=4 studies not controlled for total energy
    * 33% of n=3 studies controlled for total energy

* 70%-100% of analyses were positive if:
  * Sample size ≥ 250
  * Risk of bias low
  * Not controlled for age, sex, PA
  * Non-U.S. study
Methods used in published studies vary widely

Results of review indicate:
* A positive association between SCB consumption among children < 12 and both total and central adiposity, regardless of study design
* The association with total adiposity may be strongest among children < 5 at baseline

Summary of Results

Methods used in published studies vary widely

The review of the literature found
* Mixed results with fruit juice only and total adiposity
  * Most published studies are positive in children < 5 but not in children < 12
  * No published studies of SCBs or fruit juice among children < 5 and central adiposity
* Controlling for total energy decreases but does not eliminate likelihood of a positive association
Robust methodology
- Adhered to PRISMA Guidelines for conducting and reporting a systematic review
- Comprehensive literature search
- Screening, data abstraction in duplicate

Strengths

- Only SR focused on children <12 years
- Conducted several sub-group analyses
  - Controlled for total energy vs not
  - SCB vs fruit juice
- No studies identified as having been funded by the food, beverage, or sugar industry
  - It is possible that funding could have been provided indirectly
Substantial variation in the definition of SCB
* Sweetened beverages
* 100% fruit juice
* Sweetened tea/coffee
* Variation in recording sweet beverage exposure
* No two studies had similar methodology
* Meta-analysis could not be performed
  * Vote counting utilized
  * Did not look at data stratified by baseline weight
  * SCB may have greater impact on those with different weight & obesity status at baseline

Out of 38 studies, only one was an RCT
* High risk of bias
* Measurement of exposure
  * Some studies evaluated exposure during either one or multiple observations at baseline and assumed that the exposure level extended for the duration of the study
  * Some studies calculated an average exposure from longitudinal observations, but did not describe how this average was calculated
**Weaknesses**

* Most studies  
    * Were retrospective  
    * Had significantly small numbers of subjects in the cohort used for the analysis compared to the original cohort  
    * Did not control for age, sex and physical activity

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**Weaknesses**

**The review of the literature found**

* The clinical relevance of any association is unclear  
  * Even for those studies that did demonstrate an association most had a small magnitude of effect  
  * Difficultly in measurement  
  * Effect within the range of usual consumption of children at this age is possibly minimal

**Of note:** To reduce the prevalence of obesity among U.S. children age 2-5 years to 5%, the level observed in the 1970s, it has been estimated that an average reduction of only 33 calories/day would be needed (Wang, 2012)
Substantial evidence exists for a positive association between SCBs and total and central adiposity among children. The evidence related to fruit juice is not as strong. Evidence is most consistent with SCB consumption among children <5 years. The observed association appears to be due in part due to an increase in total energy intake with increased SCBs. SCBs also appear to have an energy independent effect.

Additional high-quality RCTs and well-designed long-term cohort studies are needed to determine the extent to which the differences observed are due to Residual confounding. Differences in the

  * Exposure (type or amount) of beverage consumed
  * Metabolic condition of the children studied
  * Other factors

Additional studies could significantly alter these conclusions.
HEALTHIER CHOICES
Acknowledgements

- Olivia Pickett, Librarian, National Maternal and Child Health Oral Health Resource Center, Georgetown University, for her assistance in conducting the literature search
- Kyden Hawley for assistance with references