Cariogenicity of soft drinks, milk, and fruit juice in low-income African-American children: a longitudinal study

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Background

- Beverage intake in US children has become more diverse and extensive over the last several decades
  - The increased intakes of sugared drinks may increase the risk of dental caries
  - Cariogenic bacteria can produce the organic acids that initiate the carious process in enamel with simple carbohydrates
- Two components to determine effective cariogenicity
  - Cariogenic potential: the ability of foods or beverages to cause a significant drop in plaque pH, demineralization of enamel, or more caries in animals under controlled experimental conditions
  - The frequency or manner of consumption should be considered along with cariogenic potential

Objectives

- Research questions
  - What are the intake patterns of soft drinks (= soda + fruit drinks), milk, and 100% fruit juice over a 2-year period?
  - Are children with a high consumption of soft drinks over two years, relative to milk and 100% fruit juice, at a higher risk of developing new carious lesions?

Methods

Sample

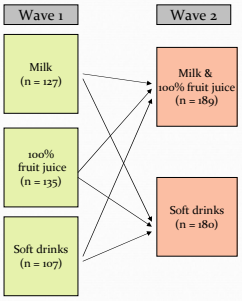
- Detroit Dental Health Project
  - A longitudinal study to investigate oral health disparities within African American community living in urban Detroit
  - From a stratified two-stage sampling design, 1386 eligible families were identified
    - Wave 1 (2002-03): 1021 pairs of child and caregiver
    - Wave 2 (2004-05): 790 pairs of child and caregiver
- Samples: preschool African-American children (n = 369)
  - Children who participated in Wave 1 and Wave 2 were selected
  - Children aged 0 to 2 years were omitted because beverage consumption data were not collected
  - Further 34 children were excluded due to the implausible dietary intakes

Methods

Study variables

- Increments of dental caries
  - Caries status of primary tooth surfaces was assessed using the International Caries Detection and Assessment System
  - Outcomes: increments of d1, d2, filled, missing, $d_2$mfs (=d2+filled+missing), $d_1$mfs (=d1+d2+filled+missing)
- Dietary information
  - The kids FFQ was used to collect intake frequencies and the usual amount consumed in 1 day
  - The collected dietary data were quantified to the gram

Beverage intake patterns



- Three major sources of sugared drinks were soft drinks, milk, and 100% fruit juice
- Cluster analysis was used to evaluate the best grouping of children based on similarities in consumption of 3 beverages
- Based on the largest contributing beverage to the total beverage consumption, 3 groups in Wave 1 and 2 groups in Wave 2 were identified

Longitudinal intake patterns

Intake patterns	Description
Pattern 1: High-high milk juice (n = 158; 44.8%)	High intake of milk or 100% fruit juice in both Wave 1 and Wave 2
Pattern 2: Low-high soft drinks (n = 104; 28.4%)	Intake of soft drinks changed from low in Wave 1 to high in Wave 2
Pattern 3: High-low soft drinks (n = 31; 7.6%)	Intake of soft drinks changed from high in Wave 1 to low in Wave 2
Pattern 4: High-high soft drinks (n = 76; 19.2%)	High intake of soft drinks in both Wave 1 and Wave 2

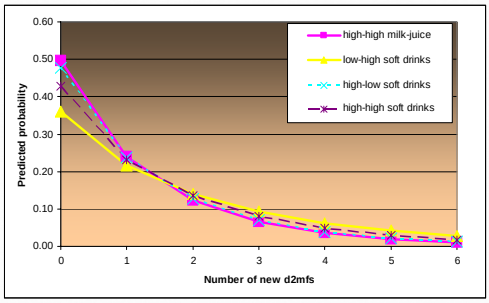
Results

- Zero-inflated negative binomial models were used to control for the large number of zero counts
- Children with a low-high soft drinks pattern had a **1.8 times** greater risk of developing new $d_2$mf surfaces, and **2.7 times** greater risk of developing new filled surfaces compared with those in the reference group
- Children with a high-high soft drinks pattern had a **2.7 times** greater risk for developing new filled surface

DV: new $d_2$mfs	IRR	95% CI
Ref: High-high milk-juice	--	--
Low-high soft drinks	**1.75**	**1.16-2.64**
High-low soft drinks	1.11	0.60-2.08
High-high soft drinks	1.29	0.86-1.93

DV: new filled surfaces	IRR	95% CI
Ref: High-high milk-juice	--	--
Low-high soft drinks	**2.67**	**1.36-5.23**
High-low soft drinks	0.50	0.17-1.53
High-high soft drinks	**2.68**	**1.44-4.96**

Results



Implications

- Given that a majority of children (59%) had visited a dentist during 2 years, we interpret the significant increase in filled surfaces in the low-high soft drinks children as rapid progression of caries to a stage where restorative care is necessary
- Caries progresses rapidly under conditions of high sugar exposure. Symptoms of sensitivity and pain may thus have lead the caregivers to seek dental care for these children

Limitations

- The Kids FFQ did not collect detailed eating patterns (e.g., between meals) and intake of water
  - Further analysis of detailed frequency of consumption and fluoride exposure was prevented
- The dietary information was collected from the interview with caregivers
  - Reporting error could occur when children grew up and spent more time outside of home

Conclusion

- Children with a high consumption of soft drinks over time, or those who increase their consumption of soft drinks relative to milk and 100% fruit juice, are at a higher risk of developing dental caries
- Soft drinks are potentially cariogenic
  - Soft drinks can still be safely consumed by young children if the exposure is reduced and dental plaque is regularly removed with a fluoridated dentifrice
- It is important to emphasize in health promotion programs the need to maintain the balance between exposure to soft drinks and preventive oral hygiene behaviors