

## Nutrition and Early Childhood Oral Health: Before Birth and After

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## Outline

- How caries are formed
- Role of food in caries formation
- Nutrition solutions to prevent caries
- Demystifying probiotics, sugars and sugar substitutes as related to oral health
- Impact of vitamin D during pregnancy

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## Early Childhood Caries (ECC)

- Defined as 1 or more primary teeth affected by decay in children < 72 months of age (AAPD 2009)



Nursing caries  
Nursing bottle syndrome  
Milk bottle caries

Baby-bottle tooth decay  
Bottle mouth syndrome

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Table I. Previous used terms for ECC among infants and preschoolers

- Baby-bottle tooth decay
- Baby-bottle syndrome
- Labial caries
- Circular caries
- Nursing-bottle mouth
- Milk-bottle caries
- Nursing caries
- Nursing-bottle caries
- Nursing-bottle syndrome
- Bottle-propping caries
- Bottle-baby syndrome and bottle-mouth caries
- Rampant caries
- Melanodontie infantile/"les dents noire de tout-petits"
- Sucking-cup caries
- Sugared-tea caries
- Sweet-tea caries
- Sugar nursing-bottle syndrome

**76.5% of terms related to feeding practices**

Schroth RJ et al. Int J Circumpolar Health 2007; 66(2): 153-167.

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## The Pregnancy Connection

- Primary teeth begin to form as early as 6 weeks & start to calcify during the 2<sup>nd</sup> trimester
- Problems during pregnancy (malnutrition, premature birth, maternal diabetes, prenatal infections) may interfere with dental enamel formation predisposing enamel hypoplasia (EH) and Developmental Defects of Enamel
- Enamel hypoplasia is a risk factor for ECC

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## How a cavity is formed

- Food containing carbohydrates enters the mouth
- Bacteria breakdown the carbohydrates and decrease the oral pH e.g. *Mutans Streptococci* (MS)
- The acidic environment breaks down the tooth enamel




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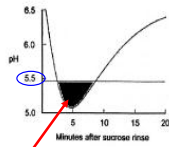
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## Stephan Curve

### Value of Stephan Curves

The value of the Stephan Curve is that it provides a means by which the cariogenic challenge to a tooth may be measured. Actually, it only really measures the potential cariogenic challenge because the Critical pH value varies between individuals.

The cariogenic challenge (cariogenicity) is measured as the area delimited by the Critical pH and the Stephan Curve shown in red in the diagram on the right.



Cariogenic challenge

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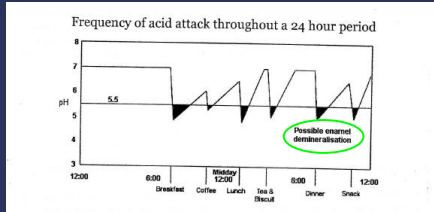
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## Many cariogenic challenges occur with normal eating habits during a day

- The diagram shows a typical 24 hour period in which 6 separate cariogenic challenges can be identified. This could be looked on as the normal "minimum" number. Any addition of snacks like carbohydrates have an effect on the challenge to teeth




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## Question

- Two mothers give their children chocolate bars as treats. The first mother insists the child eat small pieces throughout the day to make it last. The other allows her child to eat the whole chocolate bar at once.
- Which mother has made the best decision for her child's oral health? Why?

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## Bottle-feeding

- Bottle frequency & use
  - Limit bottle use to feeding time only.
  - No propping of bottles – continual exposure of teeth to bottle contents. Parents encouraged to hold bottle while infant is feeding.
  - Bedtime (even naptime) bottle can → ECC
  - Sipping bottle throughout the day → ECC

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## Bottle-feeding (continued)

- Bottle contents
  - Only plain water is safe for teeth, especially for bedtime bottle
  - Juice, pop, drink mixes (including syrups), sweetened liquids → ECC
- Age of weaning
  - Late weaning (after 12-14 months) → ↑ risk for ECC

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## Other Infant Feeding Practices

- Training cups & Sippy cups
  - Problems with no spill training cups:
    - Become a substitute for the bottle
    - Equally as dangerous as bottles if used inappropriately and contains drinks with sugars and/or acids
    - Often used past normal weaning age
    - Convenience and less mess for parents, but parents may not know the risk to oral health
- Lidless training cups
  - Safer alternative and may help transition to regular drinking cup




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## Introduction of Solid Foods

- In some cultures mothers may pre-chew their infant's food
  - Be culturally sensitive when sharing info. Let parents know they may be passing along cavity-causing bacteria to their child. Recommend parent maintains good oral health.
  - Pre-chewed rice → ↑ risk for ECC
- Age solids introduced may also influence caries risk
  - Delayed introduction of solids may → ↑ risk for ECC
  - Others have reported no association with ECC

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## Cariogenicity of foods

- Increased in foods that are
  - High in carbohydrates
  - Acidic
  - Slowly cleared from the oral cavity

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## Foods high in carbohydrates

- Sweet foods:
  - Sugar: beets, cane, molasses
  - Honey, agave nectar
- High starch vegetables:
  - Corn, potatoes, yams
- Grain-based foods:
  - Wheat: bread, pasta, couscous
  - Rice, oatmeal, quina, barley, rye

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## pH of Foods

- <3: lemons, limes, grapes, soft drinks
- >3 <5: apple, apricot, beet, blueberry, cherry, pickle, grapefruit, ketchup, nectarine, orange, peach, pineapple, plum, strawberry, tomato, honey
- >5 <7: coffee, banana, corn, cabbage, maple syrup, onion, potato, watermelon
- >7: crackers, egg white
- >9: baking soda

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## Foods that slowly clear the mouth

- Dried fruit
- Fruit snacks (fruit roll-up, fruit by the foot)
- Gummy candies
- Hard candies/lollipops

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## Snack foods found to contribute to caries in the ECC literature

- High fat / high sugar snacks Freeman et al 1997
- Not eating fruit as snacks Freeman et al 1997
- Chips daily
- Cake daily
- Chocolate daily
- Candy
  - ≥ 1/week
  - > 1/day

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### Snack drinks contributing to ECC

- Soda pop
- Frequency of carbonated drinks with sugar Freeman et al 1997
- Bedtime drink with sugar Freeman et al 1997
- Fruit juices
- Canned milk
- Sugar added to cow milk
- Powdered beverages/drink crystals
- Syrups, cordial

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### Dental Smart Snacks

- Yogurt or cottage cheese
- Nuts (choking hazard before 4 years)
- Bean spreads (ie: hummus)
- Cheese and crackers
- Fruit and veggies

Drink water to rinse out the mouth!

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### Solutions: less sugary foods

- Limit the amount of sugary foods and beverages
  - For example, only have sugary foods as a dessert after a meal instead of as snacks throughout the day

**moderation**

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## Solutions: meals and snacks

- Children have small stomachs and need to eat frequently
- This means: 3 meals and 2-3 snacks
- This does not mean: grazing throughout the day
- Grazing continuously exposes your teeth to an “acid attack”

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## What about sugar alternatives?

- Non-nutritive sugars are cariostatic
  - Sugar alcohols: mannitol, sorbitol, etc
  - Aspartame, acesulfame-K, sucralose, sodium cyclamate, stevia
- Xylitol may be anticariogenic

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## Xylitol in Caries Prevention

- Xylitol is a sugar substitute
  - Increased use as a sweetener to improve oral health
  - Studies (Turku Sugar Studies and others): the relationship between
    - Xylitol and reduced plaque formation and bacterial adherence
    - Inhibits enamel demineralization because of reduced acid production
    - Directly inhibits *Streptococcus mutans* (MS)
    - Reduced caries rates (4-10 grams/day in 3-7 consumption periods)
    - Safety of xylitol (diarrhea reported in those consuming 3-60 grams/day)
- AAPD policy statement

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## Xylitol products

- Proven effectiveness:
  - Xylitol gum
- Uncertain effectiveness at present but requires research:
  - Mints and gummies
  - Chewable tablets
  - Lozenges
  - Toothpastes
  - Mouthwashes
  - Nutraceuticals

Source: AAPD Policy on the use of xylitol in caries prevention 2007/2008

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## Solutions: beverages

- Satisfy thirst with water, drink milk at meal times
- Children do not need juice or any beverage other than milk and water
- Milk (dairy) - noncariogenic
- Phosphoproteins in milk prevent demineralization
- Good source of calcium, phosphorous, and vitamin D, all needed for tooth mineralization

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## Solutions: dairy-cheese

- Cheese
  - Helps remove food particles from tooth surface
  - Provides an alkaline buffer
  - Increases flow of saliva
  - Increase remineralization of enamel

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### Policy on ECC – Prevention strategies relating to nutrition

- Don't put infants to sleep with bottle containing fermentable carbohydrates
- If infant falls asleep while feeding, clean the teeth before laying down to bed
- Use regular cup by 1<sup>st</sup> birthday

Source: AAPD Policy on ECC: Classifications, Consequences, & Preventive Strategies 2010

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### Policy on ECC – Prevention strategies relating to nutrition

- Avoid repetitive consumption of liquids with fermentable carbohydrates from bottle or no-spill sippy cups
- Wean from bottle by 12-14 months of age
- Avoid between-meal snacks & prolonged exposure to foods & juice or beverages with fermentable carbohydrates

Source: AAPD Policy on ECC: Classifications, Consequences, & Preventive Strategies 2010

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### Summary

- Risk of dental caries depends on
  - What is eaten (good, bad, neutral)
  - How long the food is kept in the mouth
  - How often the teeth are exposed to an acid attack
  - Dental care

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## Probiotic Bacteria

- Probiotics are living microorganisms added to food which beneficially affect the host
- To date, only one single study carried out in early childhood reported
  - Decrease counts of *Mutans Streptococci* (MS) in saliva in 3- to 4-year-old children after 7 months of daily consumption of probiotic milk
  - Significant caries reduction in 3- to 4-year-old children after 7 months of daily consumption of probiotic milk
- Probiotic bacteria may have an inhibitory effect on oral pathogens

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## Probiotic Bacteria (continued)

- Studies in adults:
  - Decreased counts of MS in saliva
  - Decreased gingivitis
  - Decreased prevalence of oral candida

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## Role of Vitamin D: Study Objectives

- Determine 25(OH)D status of primarily urban dwelling women during pregnancy
- Determine the incidence of enamel hypoplasia and ECC in their offspring
- Determine the association between maternal prenatal 25(OH)D levels, enamel hypoplasia and ECC

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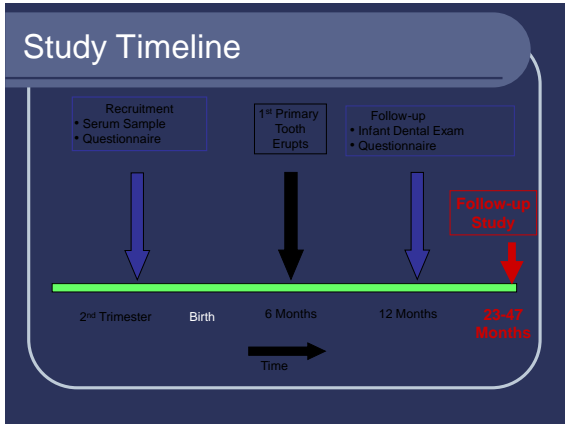
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### Maternal Results

<i>Characteristics of Participating Women</i>		
Number enrolled		207
Mean age (years ± SD)		19.0 ± 4.7 years
Resided within Winnipeg city limits		190/205 (92.7%)
Recruitment Site:		
HSC Outpatient Department		170 (82.1%)
Health Action Centre		24 (11.6%)
Mount Carmel Clinic		13 (6.3%)
Heritage:		
Aboriginal		186 (90.3%)
Non-Aboriginal		20 (9.7%)

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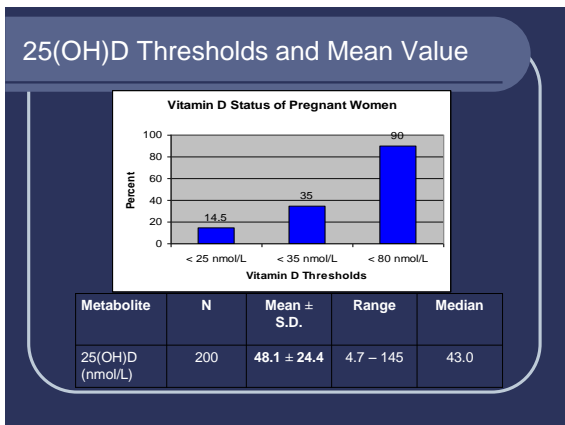
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## Infant Results

<i>Characteristics of Infants Examined</i>	
Number infants	135
Males	55.6%
Mean Age (months ± SD)	16.1 ± 7.4 months
Incidence of Enamel Hypoplasia	29/134 (21.6%)
Incidence of ECC (cavitated lesions)	31 (23.0%)
Incidence of ECC (including white spot incipencies)	49 (36.3%)

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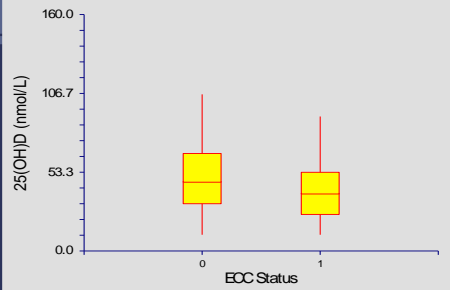
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Mean Maternal 25(OH)D Levels by Infant ECC Status



0 = caries free (52.4 nmol/L)  
 1 = ECC (41.4 nmol/L)      p=.045

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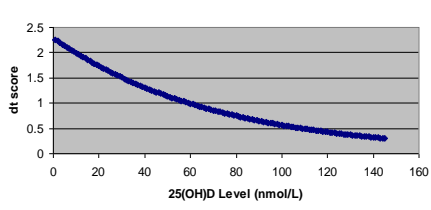
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Predicted dt score by 25(OH)D Level



- Poisson regression examined the relationship between the average number of primary teeth affected by decay (dt) and maternal levels of vitamin D during pregnancy.
- Higher vitamin D levels during pregnancy were inversely related to the number of primary teeth affected by caries. As vitamin D levels increased, dt scores decreased. (p=.0002)

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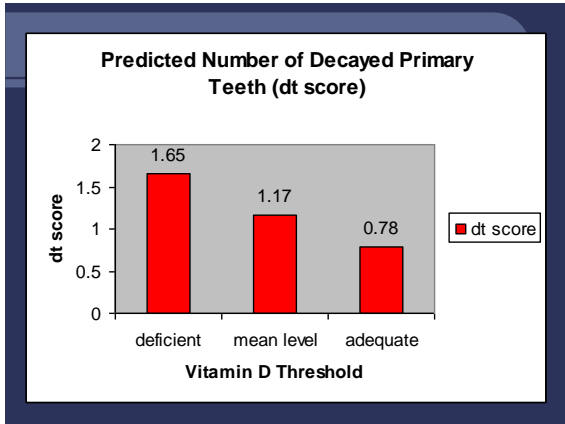
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### Logistic regression for ECC\* (excluding white spot lesions) – Significant variables from smaller models

Variable	Regression Coefficient (b)	Standard Error b	Standard Deviation of Variable in Sample	Adjusted Odds Ratio	+ 95% Confidence Interval	P value
Low annual income <small>(reference: &gt; \$18,000)</small>	-2.19	1.59		0.11	0.005, 2.51	.17
Drink milk <small>(reference: &lt; often)</small>	-0.35	0.57		0.71	0.23, 2.18	.55
Enamel hypoplasia <small>(reference: no)</small>	2.05	0.60		7.73	2.41, 24.84	.0006
No one with full-time employment in household <small>(reference: no)</small>	0.91	0.86		2.49	0.46, 13.39	.29
Infant's age at time of dental examination <small>(reference: 3-14 months)</small>	-1.67	0.57		0.19	0.061, 0.57	.0034
25(OH)D	-0.022	0.012	24.44	0.59	0.32, 1.06	.077

\*ECC reference = yes      R<sup>2</sup> = 29.7%

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### Backwards logistic regression for ECC\* (excluding white spot lesions) – Significant variables from smaller models

Variable	Regression Coefficient (b)	Standard Error b	Standard Deviation of Variable in Sample	Adjusted Odds Ratio	+ 95% Confidence Interval	P value
Enamel hypoplasia <small>(reference: no)</small>	2.33	0.57		10.30	3.37, 31.49	<.0001
Infant's age at time of dental examination <small>(reference: 3-14 months)</small>	-1.74	0.56		0.18	0.059, 0.52	.0020
25(OH)D	-0.027	0.012	24.44	0.52	0.29, 0.92	.019

\*ECC reference = yes      R<sup>2</sup> = 29.7%

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## Discussion

- Current and Future Research:
  - MACHS Vitamin D supplementation project (100,000 IU during pregnancy)
  - Case-control study comparing vitamin D status of children undergoing dental surgery for Severe ECC vs. caries-free controls
  - Need for further birth cohort studies that examine multiple risk factors for EH and ECC

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## Conclusions

- Participants had low vitamin D concentrations during pregnancy, suggesting a need to improve prenatal levels to promote perinatal health
- Vitamin D levels were influenced by: Aboriginal heritage, ratings of prenatal health, vitamin use, SES, drinking milk, and season

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## Conclusions

- Enamel Hypoplasia:
  - Low calcium levels during pregnancy (risk)
  - Drinking milk (protective), margarine use (protective), awareness of vitamin D (protective)
- ECC:
  - Daily milk intake (protective), absence of full-time employment in household during pregnancy (risk)
  - Age at dental examination (risk), presence of enamel hypoplasia (risk), lower maternal 25(OH)D during pregnancy (risk)

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## Questions?

- Thanks!

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