Fluoride and oral health inequalities: childhood caries
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Inequality in childhood caries experience—Australian children 2012-14

5-10 years old
Mean dmfs 3.0 (2.8-3.2)

9-14 years old
Mean DMFS 0.9 (0.8-1.0)
Inequalities in childhood caries

• Social determinant models for childhood caries offer a wide range of possible interventions to reduce both caries experience and inequalities in caries
• Many interventions are aimed at reducing risk factors
• Some aim to increase protective factors especially through fluorides
Aim

To explore some theoretical considerations and empirical evidence for the role of fluoride in inequalities in childhood caries
Impact of fluoride interventions on inequalities in childhood caries

Depends on:
Community/population effectiveness
Social distribution and intensity of the interventions
Effectiveness of fluoride interventions

Efficacy/effectiveness varies
Preferred – those interventions that maintain a low fluoride concentration at the tooth surface
Suggests a rank order of efficacy/effectiveness established in trials
However in the translation to the real world the impact of fluorides on a community/population will also depend on the individual effort needed to obtain a preventive benefit
Frieden’s Health Impact Pyramid

Suggests an inverse relationship between individual needed to implement an intervention and community/population impact

- Social circumstances which determine and stabilize individual behaviours resist efforts at behaviour change
- The very circumstances which shape inequality in child caries impede the population impact of fluoride interventions which rely on individual effort

(Frieden 2010).
Changing the context to make individuals’ default behaviours more healthy, e.g., drinking fluoridated tap water.

Long-lasting protective interventions, e.g., fluoride varnish.

Clinical interventions, e.g., professionally applied fluoride products.

Counselling and education on home use of fluoride products, e.g., fluoride mouth rinses.

The Fluoride Impact Pyramid
Fluoride interventions may be
• Targeted, or
• Universal
Childhood caries inequalities

Targeted interventions

- Most are well-intentioned demonstration programs in convenient settings
- May be effective, but usually no evidence on population inequalities
- Issues: Effort to sustain intervention, difficulty in up-scaling

Socioeconomic position
Childhood caries inequalities

Universal interventions

- Intension for fluoride intervention to be universally available
- Examples fluoridation or use of fluoridated toothpaste
- However, intensity might still be socially patterned
- Influences the outcome for inequalities
Childhood caries inequalities

Neutral universalism – Unchanged absolute, but increased relative inequality

Caries

Socioeconomic position
Childhood caries inequalities

Disproportionate universalism – Increased absolute & relative inequality

Caries

Socioeconomic position

Before

After
Childhood caries inequalities

Proportionate universalism – Decreased absolute & relative inequality

Socioeconomic position

Before

After
Empirical evidence: water fluoridation

- York review (McDonagh et al 2000)—
  Some evidence that water fluoridation reduced caries in lower SES children in the UK
- Cochrane review (Iheorzor-Ejiofor et al 2015) –
  Insufficient evidence the water fluoridation results in a change in caries by SES
- More recently, NHMRC (2017) concluded –
  Water fluoridation reduces caries across SES groups
  Limited evidence that it reduces inequalities
  Cautioned, limited number of studies, especially from Australian context, studies low quality and had varying results
  Called for further research
Impact of water fluoridation on inequalities in childhood caries

Depends on:

- Social distribution, and
- Intensity of the intervention
Association between household income and exposure to water fluoridation

<table>
<thead>
<tr>
<th>Equiv. Household Income</th>
<th>Exposed to WF Row % (95%CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1 (Low)</td>
<td>66.8 (63.1-70.1)</td>
</tr>
<tr>
<td>Q2</td>
<td>66.7 (63.1-70.1)</td>
</tr>
<tr>
<td>Q3</td>
<td>70.7 (67.1-72.1)</td>
</tr>
<tr>
<td>Q4 (High)</td>
<td>76.0 (72.1-79.5)</td>
</tr>
</tbody>
</table>

Exposure to water fluoridation was significantly associated with SES.
Distribution by household income of Australia child population and those exposed to water fluoridation

<table>
<thead>
<tr>
<th>Income</th>
<th>Population %</th>
<th>Exposed to WF Col % (95%CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1(Low)</td>
<td>29.5</td>
<td>28.2 (25.8-30.7)</td>
</tr>
<tr>
<td>Q2</td>
<td>24.0</td>
<td>23.0 (21.6-24.4)</td>
</tr>
<tr>
<td>Q3</td>
<td>21.2</td>
<td>21.4 (20.1-22.8)</td>
</tr>
<tr>
<td>Q4(High)</td>
<td>25.2</td>
<td>27.4 (24.8-30.2)</td>
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</tbody>
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The social distribution of fluoridated water is not significantly biased by SES.
Distribution by household income of Australia child population and exposure to water fluoridation, tooth brushing 2+ /day and having had professionally applied topical fluoride

<table>
<thead>
<tr>
<th>Income</th>
<th>Population %</th>
<th>Exposed to WF %</th>
<th>Brush 2+ /day %</th>
<th>Topical fluoride %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1(Low)</td>
<td>29.5</td>
<td>28.2</td>
<td>25.1</td>
<td>19.1</td>
</tr>
<tr>
<td>Q2</td>
<td>24.0</td>
<td>23.0</td>
<td>23.6</td>
<td>22.6</td>
</tr>
<tr>
<td>Q3</td>
<td>21.2</td>
<td>21.4</td>
<td>22.4</td>
<td>23.7</td>
</tr>
<tr>
<td>Q4(High)</td>
<td>25.2</td>
<td>27.4</td>
<td>28.9</td>
<td>34.6</td>
</tr>
</tbody>
</table>

The social distribution of brushing 2+ a day and having had a professionally applied topical fluoride are significantly biased by SES.
Empirical evidence: water fluoridation

- A default behaviour, drinking tap water becomes a positive preventive behaviour (Mechanic, 1997)

- However, fluoridated water is delivered to households at the same concentration (intensity)

- So, it is interesting to look at the outcome for caries experience and inequality in childhood caries as a result of exposure to water fluoridation
Caries experience 5-10-year old (dmfs) and 9-14-year old (DMFS) Australian children by equivalized household income quartiles and water fluoridation status (Do et al, submitted September 2017)

Empirical evidence: water fluoridation

- Absolute inequality in childhood caries reduced, relative inequalities unchanged
- Inequalities not eliminated
- A composite of interventions required
Empirical evidence: water fluoridation

Summary

- Social distribution of exposure to water fluoridation not biased, but intensity of the fluoride delivery across social status groups is not proportionate to the risk of caries
- All SES groups benefit (benefit is universal)
- Yet, low SES groups benefit more form water fluoridation than high SES groups
- Some mechanisms of fluoride action are related to the presence of sub-clinical caries activity, water fluoridation is associated with a greater effect for low SES groups (benefit is proportionate)
- Consistent with social justice and equal opportunity for children
Policy implications

• Interventions using fluoride vary in community/population effectiveness depending on their need for individual effort

• Fluoride interventions may be neutral, increase or decrease absolute and/or relative inequalities depending on their social distribution and intensity

• Recent findings show that water fluoridation reduces absolute but not relative inequalities in childhood caries, supporting social justice and equal opportunity as considerations in setting public policy
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Further information:
Do & Spencer 2016; Do et al, submitted