The association between dental caries and anthropometric measures in 5-9 year old Bangladeshi children

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Presentation overview

• Background and literature review
• Gaps in current knowledge
• Aim and objectives
• Methods
• Pilot study
• Future work plan
Background: Dental Caries

Dental caries is a major public health problem affecting 60%-90% of children globally. In most low-income countries more than 90% of decay remains untreated.

(Petersen et al. 2005; Edelstein 2006; Bagramian et al. 2009).

Dental caries
Relationship between dental caries and children’s height and weight
High-income countries

• Association between higher levels of dental caries and higher BMI (Hayden et al. 2013).

• The major causes of the dental caries and higher BMI are similar – sugary foods and drinks (Swinburn et al. 2004; Moynihan & Petersen 2004; Hooley et al. 2012a).
Low-income countries


• Dental treatment followed by greater weight gain.

Hypothesised mechanisms linking untreated caries with compromised growth
Dental caries (leading to dental pain and infection)

Impact on oral health related quality of life

- Poor Appetite
  - Impact on eating/chewing
    - Reduced food intake
    - Malnutrition
  - Impact on eating/chewing
    - Disturbed slow wave sleep
    - Growth hormone disturbance

Compromised growth

(Adapted from Sheiham 2006, Alkarimi et al. 2014)
Oral Health Related Quality of Life (OHRQoL)

Measures of the extent that oral status and conditions disrupt normal social-role functioning and bring about major changes in behaviour (Locker, 1989).
Important domains of oral health related quality of life (OHRQoL)

- Oral symptoms
- Functional
- Social
- Psychological

(Bennadi & Reddy 2013)
Why measure oral health related quality of life (OHRQoL) in young children?

Oral diseases have a negative impact on the functional, social and psychological well-being of children and their families.

(Pahel et al. 2007; Filstrup et al. 2003; Do & Spencer 2007).
Different scales to measure OHRQoL

- Self-reported scale for children.
- Parental proxy report for children.
- Combination of self and proxy report.
- Measures of the impact of the oral health of child on the life of the family.
Dental caries adversely affects OHRQoL

• Higher caries level is significantly associated with overall poorer OHRQoL (Barbosa & Gavião 2008).

• Dental treatment is associated with improved quality of life (Alkarimi et al. 2012, Thomas & Primosch 2002a), and weight gain (Duijster et al. 2013).

Dimensions of OHRQoL most relevant to child growth: pain, eating and sleeping
1. Dental pain

- Dental caries is a common cause of dental pain in childhood.
- Dental pain is highly prevalent among children and the prevalence ranging from 5-33%.
- There is 5% to 6% increase in probability of toothache for each additional deciduous tooth with caries experience (Slade 2001).
Impact of dental pain on child growth

- Direct impact of dental pain and infection:

Increase of glucocorticoid production in response to dental pain may affect normal growth and general health of children with Severe Early Childhood Caries (SECC) (Acs et al. 1992; Ayhan et al. 1996; Ohlund et al. 2007).
Impact of dental pain on child growth (Continued)

• Indirect impact of dental pain:

Dental pain affects eating/chewing and sleeping.

Dental caries (leading to dental pain and infection)

Impact on oral health related quality of life

Poor Appetite

Impact on eating/chewing

Reduced food intake

Malnutrition

Compromised growth

Impact on sleeping

Disturbed slow wave sleep

Growth hormone disturbance

(Adapted from Sheiham 2006; Alkarimi et al. 2014)
2. Effect of dental caries on diet

- Changes in the diet from solid to liquid or semi-liquid, reduced ability to eat a varied diet resulting in reduction of caloric intake (Vania et al 2011; Clarke et al., 2006).

- Impedes achievement of dietary goals related to the consumption of fruits, vegetables and non starch polysaccharide (NSP) (Moynihan & Petersen 2004).
**Effect of dental caries on diet (continued)**

- Relatively poor nutritional health with lower vitamin D, calcium, and albumin concentrations (Schroth et al. 2013).

Dental infection and poor appetite

- Infection from dental caries and pulpal involvement may reduce appetite of children (Langhans 1996; Plata-Salamán 1996); decreased food consumption may lead to under nutrition (Stephensen 1999).

- Dental treatment can improve a child’s appetite (Alkarimi et al. 2012).
Dental caries (leading to dental pain and infection)

Impact on oral health related quality of life

- Poor Appetite
- Impact on eating/chewing
  - Reduced food intake
  - Malnutrition

Impact on sleeping

- Disturbed slow wave sleep
- Growth hormone disturbance

Compromised growth

(Adapted from Sheiham 2006, Alkarimi et al. 2014)
3. Effect of sleep disturbance on growth

- Inhibition of Slow Wave Sleep (SWS) may cause inhibition of growth hormone (GH) release.

- Pain induced stress and nervousness may cause more glucocorticoid secretion and deeper inhibition of GH release (Acs et al. 1992; Vania et al. 2011; Sheiham 2006).
Dental pain and sleep disturbance

- Dental pain is a common cause of sleep disturbance in children (Acharya & Tandon 2011) and dental treatment can improve sleep (Thomas & Primosch 2002).

- Decreases in oral health impacts on sleeping appeared to be the most important factor for weight gain after dental treatment (Duijster et al. 2013).
In summary

Impact on child’s growth

Untreated dental caries

Dental pain and poor OHRQoL

Eating disturbance

Sleeping disturbance
Gaps in current knowledge

• There is inconsistency in the association between dental caries and anthropometric measures.

• Several studies examined limited range of caries and BMI levels and not all used age- and gender-adjusted standard measures of BMI.

• Underlying mechanisms of negative association between caries and anthropometric measures not examined in depth.

• Effects of individual important dimensions of OHRQoL on anthropometric measures rarely studied.
Gaps in current knowledge

• Factors such as loss of appetite, chewing ability, changes in food choice, or sleeping patterns not explored in depth.

• Most studies did not use validated instruments.

• Currently, no validated version of any OHRQoL questionnaire for children available in Bengali.
Study Aims

- To assess the associations between dental caries status and anthropometric measures among 5 to 9 year old Bangladeshi children.

- To consider the potential role of oral health related quality of life, particularly that of dental pain, poor appetite, and problems with eating and sleeping, in the association between dental caries and anthropometric measures.
Objective 1

To adapt the “Scale of Oral Health Outcomes for 5-year-old children” (SOHO-5) to the Bengali language and to evaluate the validity and reliability of the Bengali version of the SOHO-5.
Objective 2

To examine the association between severity of dental caries and anthropometric measurements (age adjusted height and weight, and BMI-z-scores).

Working hypothesis: the severity of dental caries will be inversely associated with children’s height, weight and BMI.
Objective 3

To explore the role of OHRQoL on the association between dental caries and anthropometric measurements of the children

Working hypothesis: anthropometric measurements in 5-9 year old Bangladeshi children are affected through the impacts of dental caries on children’s OHRQoL.
Objective 4

To explore the role of dental pain, eating and sleeping difficulties and poor appetite due to dental caries on the association between dental caries and anthropometric measurements of the children.

*Working hypothesis: the association between dental caries and anthropometric measurements will be attenuated after adjusting for dental pain, appetite and difficulties with eating and sleeping.*
Study Methods
Study design

• Cross-sectional observational study.

• Study population: 5-9 year old children.
Why 5-9 year olds?

1. Growth between the ages of 5 to 9 years relatively stable (no pubertal growth change yet).

2. Ability to answer a self-reported pain and problem related questionnaire improves considerably from the age of 5.

3. WHO growth reference data are available for two age groups: 0-59 months and 5-19 years (WHO 2007).
Study location-Bangladesh
Study location

Dhaka city

Dhaka dental college and hospital
Recruitment of study participants

Department of paediatric dentistry, DDCH

Primary schools
Ethical approval and consents

- Ethical approval obtained from the UCL Research Ethics Committee.
- Ethical approval from ‘National Research Ethics Committee of Bangladesh’ through the Bangladesh Medical Research Council (BMRC).
- Permission from director of Dhaka Dental College Hospital.
- Principals of two primary schools to run the study in their institutions.
- The parents will be asked for consent before their and their child’s participation. Participation will be voluntary and anonymous.
Inclusion and exclusion criteria

Inclusion criteria

• All children aged 5-9 years coming for dental treatment to DDCH in the months of data collection.
• All school children of this age group in the 2 primary schools.

Exclusion criteria

• Children with any systemic diseases.
• Children with any acute infections, fever and diarrhoea during the week preceding the data collection.
• Children not getting parental consent.
Data collection procedures

Study participants

Children

Clinical data

Clinical dental data

Non-clinical data
(interviewer administered questionnaires)

Anthropometric data

Parents

Non-clinical data
(Self-administered questionnaires)
Collection of clinical dental data
Anthropometric measurements

- Weight and height will be measured by the same examiner according to the Food and Nutrition Anthropometric Indicators Measurement Guide (Cogill 2001).
Weight and height measurement:

Weight will be measured by using a pre-calibrated digital Seca scale.

Height will be measured by using a portable stadiometer.
Questionnaire translation

• The questionnaires for the field studies were designed in English and translated into Bengali through forward-backward translation.

• Carried out with sensitivity to the local culture.
## Summary of variables

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>Main exposure</th>
<th>Mediators</th>
<th>Covariates</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Height-for-age z-score.</td>
<td>• Untreated dental caries (d/D component of dmft/DMFT).</td>
<td>• OHRQoL.</td>
<td>• Parental height, weight.</td>
</tr>
<tr>
<td>• Weight-for-age z-score.</td>
<td>• pufa/PUFA score.</td>
<td>• Dental pain.</td>
<td>• History of past nutritional status.</td>
</tr>
<tr>
<td>• BMI-for-age z-score.</td>
<td></td>
<td>• Appetite.</td>
<td>• Socio-demographic characteristics.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Eating disturbance.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Sleeping disturbance.</td>
<td></td>
</tr>
</tbody>
</table>
Conversion of height and weight measures into Z scores

• Z scores of ht, wt and BMI will be calculated by using WHO standard references 2007 (children older than 5 years old). The BMI Z scores will be calculated using Stata 13 and a Stata add-in called zanthro (Vidmar et al. 2013).

• Z-scores will allow comparisons of individual’s weight, height or BMI, adjusted for age relative to a reference population, expressed in standard deviations (SD) from the reference mean.
DMFT/dmft index

Decayed tooth

Missing tooth

Filled tooth
PUFA/pufa index - clinical consequences of untreated dental caries (Monse et al. 2010)
## Study measures

<table>
<thead>
<tr>
<th>Study measures</th>
<th>Description</th>
<th>Children</th>
<th>Parents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appetite</td>
<td>Appetite scale (Brown et al. 1995).</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Eating difficulty</td>
<td>Changing in food choice Chenwing or eating difficulty (Versloot et al. 2006; Daher et al. 2014).</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Sleeping difficulty</td>
<td>sleep disturbance scale for children (Bruni et al. 1996).</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Covariates</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>
SOHO-5 child questionnaire

Seven questions to assess oral health-related impacts:

• Eating
• Drinking
• Speaking
• Playing
• Sleeping
• Avoiding smiling (due to appearance and due to pain)
Child questionnaire

Answer options

No
A little
A lot
Parental questionnaire

Seven questions to assess oral health-related impacts:

- Eating
- Speaking
- Playing
- Sleeping
- Avoiding smiling (due to appearance and due to pain)
- Self confidence.

Answer options
1. not at all, 2. a little, 3. moderate, 4. a lot, 5. a great deal.
Why SOHO-5?

• Both self-reports and parental proxy reports.

• Internally consistent and valid questionnaire (Tsakos et al. 2012).

• Tested and validated in Brazil, showing agreement in mother and child responses (Abanto et al. 2014).

• Responsive to change after treatment of dental caries (Abanto et al. 2013).

• Short, with child friendly answer options.
Data Analysis plan

- Data will be analysed using Stata version 13.0.
- For objective 1, the Bengali versions of the child and parental SOHO-5 questionnaires will be assessed for their validity and reliability.
Data Analysis plan (continue)

**Descriptive statistics**
- Frequency distributions of main exposure, outcome variables, mediators and covariates.
- Mean/median of d/D component of dmft/DMFT, pufa/PUFA and mean values of all outcome measures, mediators and covariates.

**Assessment of crude association**
- Distribution of outcome and exposure variables by mediators and covariates will be explored.

**Final multivariable association**
- Appropriate regression analysis methods will be used to assess the associations of interest, taking potential confounding factors into account.
Data Analysis plan (continued)

- Each outcome (height, weight and BMI-Z-scores) will be assessed separately, by d/D component of dmft/DMFT and pufa/PUFA score.
- Model 1: unadjusted.
- Model 2: Adjusted for demographics, then socioeconomic and then other covariates.
- Model 3: Model 2 + OHRQoL scores.
- Model 4: Model 2 + dental pain, appetite, eating and sleeping difficulties. These variables will first be examined separately, followed by mutual adjustment to assess their relative contribution.
Pilot study
Objectives of the pilot study

1. To assess whether the research protocol is realistic and workable.
2. To test the adequacy, feasibility and appropriateness of the research instruments.
3. To test the appropriateness and length of the questionnaire.
4. To assess the likely success of proposed recruitment approaches.
5. To identify and resolve any potential logistical problems before running the main study.
6. To finalize the sample size calculation.
Results from pilot study

- Pilot sample size: 272 children.
  - 127 from hospital setting.
  - 145 from primary school.
  - 97 (35.7%) boys and 175 (64.3%) girls.
- Mean age of all children: 7.4 years (SD= 1.2).
Table 1: Family socio-economic characteristics: hospital vs. school sample

<table>
<thead>
<tr>
<th></th>
<th>Hospital group</th>
<th>School group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Father’s education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No institutional education</td>
<td>13%</td>
<td>1%</td>
</tr>
<tr>
<td>More than higher secondary level</td>
<td>26%</td>
<td>41%</td>
</tr>
<tr>
<td>Monthly gross family Income</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lowest income group (less than 8000 BDT)</td>
<td>19%</td>
<td>7%</td>
</tr>
<tr>
<td>Highest income group (More than 30 thousand BDT)</td>
<td>5%</td>
<td>22%</td>
</tr>
</tbody>
</table>
### Table 2: Caries distribution in the sample

<table>
<thead>
<tr>
<th></th>
<th>Hospital (127)</th>
<th>School (145)</th>
<th>Total (272)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sound</td>
<td>2 (1.57%)</td>
<td>66 (45.5%)</td>
<td>68 (25%)</td>
</tr>
<tr>
<td>Caries</td>
<td>125 (98.42%)</td>
<td>79 (54.5%)</td>
<td>204 (75%)</td>
</tr>
<tr>
<td>Pufa absent</td>
<td>66 (51.97%)</td>
<td>133 (91.72%)</td>
<td>199 (73.16%)</td>
</tr>
<tr>
<td>Pufa present</td>
<td>61 (48.03%)</td>
<td>12 (8.27%)</td>
<td>73 (26.84%)</td>
</tr>
<tr>
<td>Mean (dmft+DMFT)</td>
<td>5 (0.29)</td>
<td>1.75 (0.92)</td>
<td>3.27 (1.95)</td>
</tr>
<tr>
<td>(SE)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 3: Mean weight and height, by caries experience and setting

<table>
<thead>
<tr>
<th></th>
<th>N/n</th>
<th>Mean weight in kg (SE)</th>
<th>p-value</th>
<th>Mean height in cm (SE)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole sample</td>
<td>241</td>
<td>23.35 (0.41)</td>
<td></td>
<td>120.82 (0.77)</td>
<td></td>
</tr>
<tr>
<td>Caries experience</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caries-free</td>
<td>54</td>
<td>26.14 (0.79)</td>
<td>&lt;0.05</td>
<td>126.12 (0.96)</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Any caries</td>
<td>187</td>
<td>22.62 (0.46)</td>
<td></td>
<td>120.36 (0.72)</td>
<td></td>
</tr>
<tr>
<td>Setting</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospital</td>
<td>127</td>
<td>20.84 (0.45)</td>
<td>&lt;0.05</td>
<td>117.41 (0.83)</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>School</td>
<td>114</td>
<td>26.27 (0.61)</td>
<td></td>
<td>126.37 (0.71)</td>
<td></td>
</tr>
</tbody>
</table>
Table 4: Tertile distribution of dental caries and height, weight and BMI z scores

<table>
<thead>
<tr>
<th>DMFT+dmft tertiles</th>
<th>N/n</th>
<th>Mean height z score*</th>
<th>Mean weight z score*</th>
<th>Mean BMI z score*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1 (0-1)</td>
<td>85</td>
<td>-0.02</td>
<td>0.05</td>
<td>0.07</td>
</tr>
<tr>
<td>Group 2 (2-4)</td>
<td>83</td>
<td>-0.14</td>
<td>-0.27</td>
<td>-0.29</td>
</tr>
<tr>
<td>Group 3 (5-max)</td>
<td>73</td>
<td>-0.67</td>
<td>-0.85</td>
<td>-0.66</td>
</tr>
</tbody>
</table>

*p value <0.05 (one way ANOVA test)
Sample size calculation

- To have 80% power of demonstrating a statistically significant difference of 1/3 of a standard deviation, at 95% level of significance and 5% deviation from the true value the minimum required sample size is 435 children.

- Assuming a response rate of 60% (following the results from the pilot study), the final total estimated sample size is 696. The Open Epi version 3 online calculator has been used for this calculation (Dean et al. 2015).
Feedback from pilot study

- General observation (examiners/interviewers).

- Feedback from pilot study participants regarding their understanding of the questions, difficulties related to question wordings, and their ability to answer all questions.
Feedback from pilot study (continued)

• The pilot study proved the overall feasibility of the procedures adopted for the study.

• It took no more than 15 minutes to complete the parental questionnaire.

• The pilot study has identified some potential difficulties and resulted in some minor modifications of the procedures and questionnaires.
Changes following pilot study

- **Change in the parental questionnaire administration**
  - from interview administered to self administered

- **Changes in questionnaire:**
  - Past nutritional status – change in question wording.
  - Chewing difficulty – change in question wording.
  - Additional sleep disturbance question – change in answer options.
Challenges encountered in pilot study

- The political unrest in Bangladesh.
- Lack of proper lighting in the class rooms.
- Uneven floors in some classrooms.
- Separate section for boys and girls in different shifts.
- Low attendance rate of the parents for the interview.
Future Work Plan
# Gantt chart for the rest of the PhD

<table>
<thead>
<tr>
<th>Task</th>
<th>2015</th>
<th>2016</th>
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<tr>
<td></td>
<td>June</td>
<td>July</td>
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<tr>
<td>Upgrade</td>
<td><strong>June</strong></td>
<td></td>
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<tr>
<td>Preparation in UK</td>
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<td><strong>July</strong></td>
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<tr>
<td>Preparation in BD</td>
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<tr>
<td>Data collection</td>
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<tr>
<td>Data Analysis</td>
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<tr>
<td>Writing up thesis</td>
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<td>Writing up papers</td>
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<tr>
<td>Thesis submission</td>
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- My family members.
References

References

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