

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

Masuma Pervin Mishu

PhD student (Dental Public Health)

Department of Epidemiology and Public Health

Supervisors:

Prof. Richard G Watt

Dr. Georgios Tsakos

Prof. Aubrey Sheiham

Dr. Anja Heilmann

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

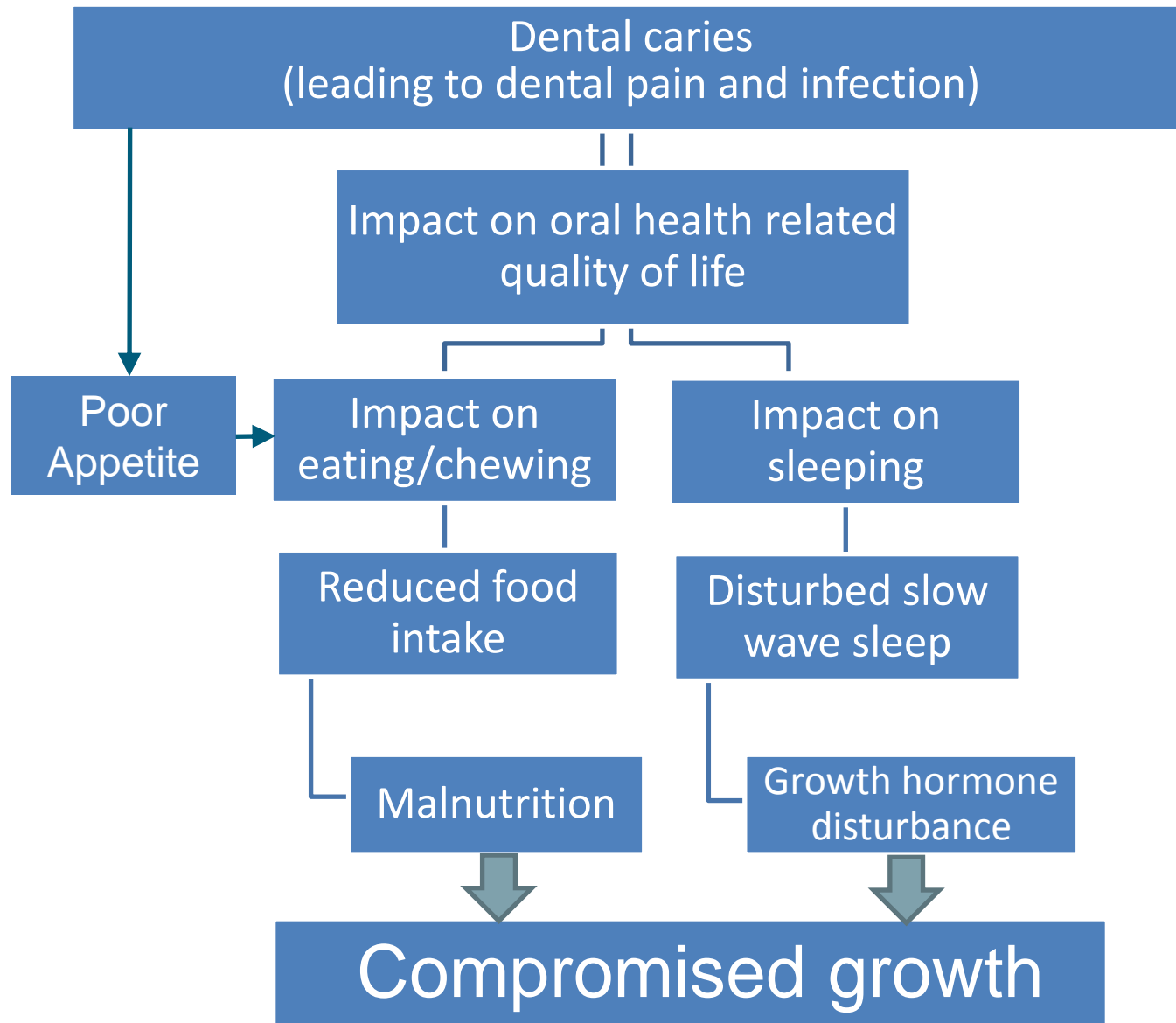
- Association between higher levels of dental caries and higher BMI (Hayden et al. 2013).
- The major causes of the dental caries and higher BMI are similar – sugary foods and drinks (Swinburn et al. 2004; Moynihan & Petersen 2004; Hooley et al. 2012a).

Low-income countries

- Inverse relationship between caries and children's height, weight and BMI (Alkarimi et al. 2014; Mishu et al. 2013; Benzian et al. 2011).
- Dental treatment followed by greater weight gain.

(Acs et al. 1999; Malek Mohammadi et al. 2009; Acs & Lodolini 1998; Monse et al. 2012).

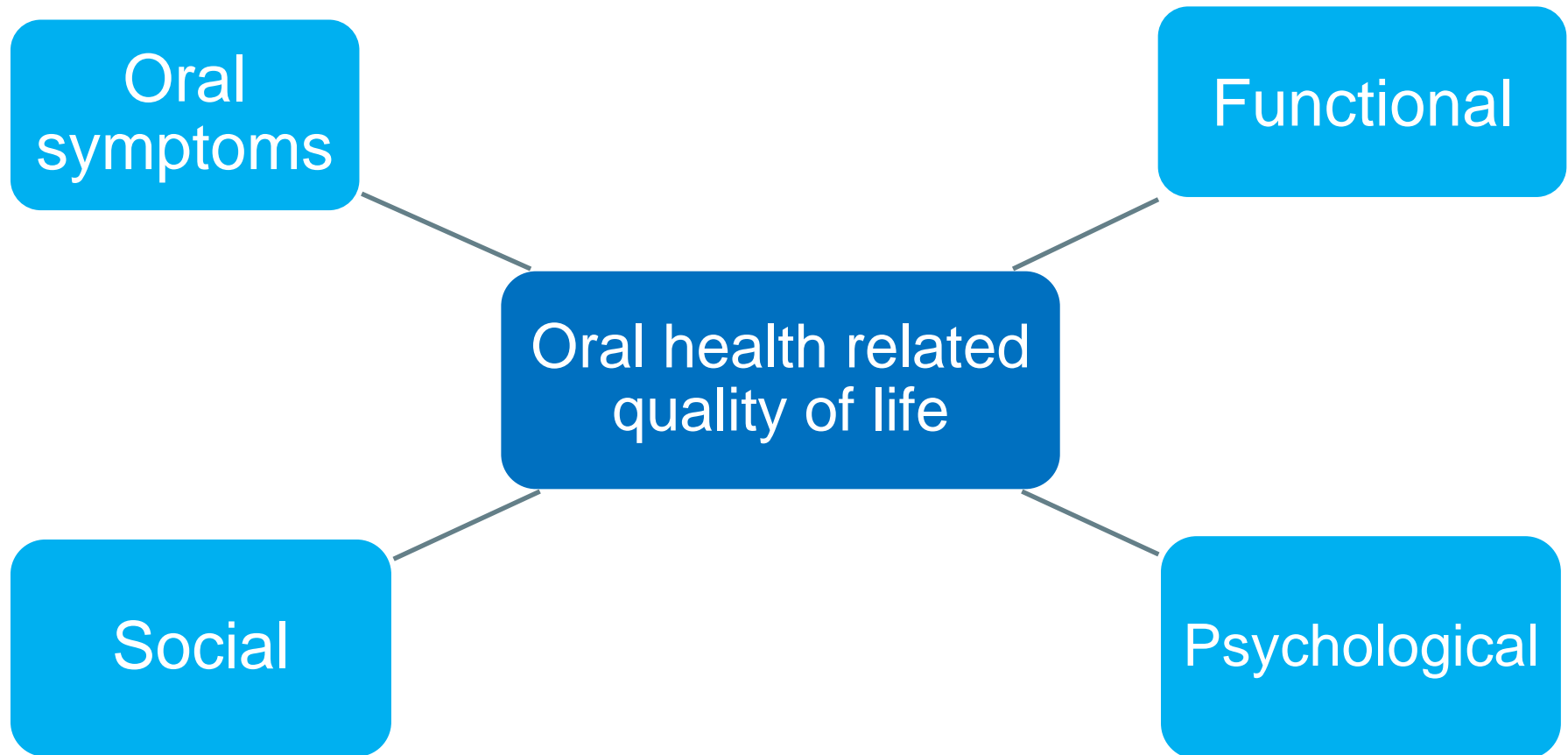
Hypothesised mechanisms linking untreated caries with compromised growth



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)



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)

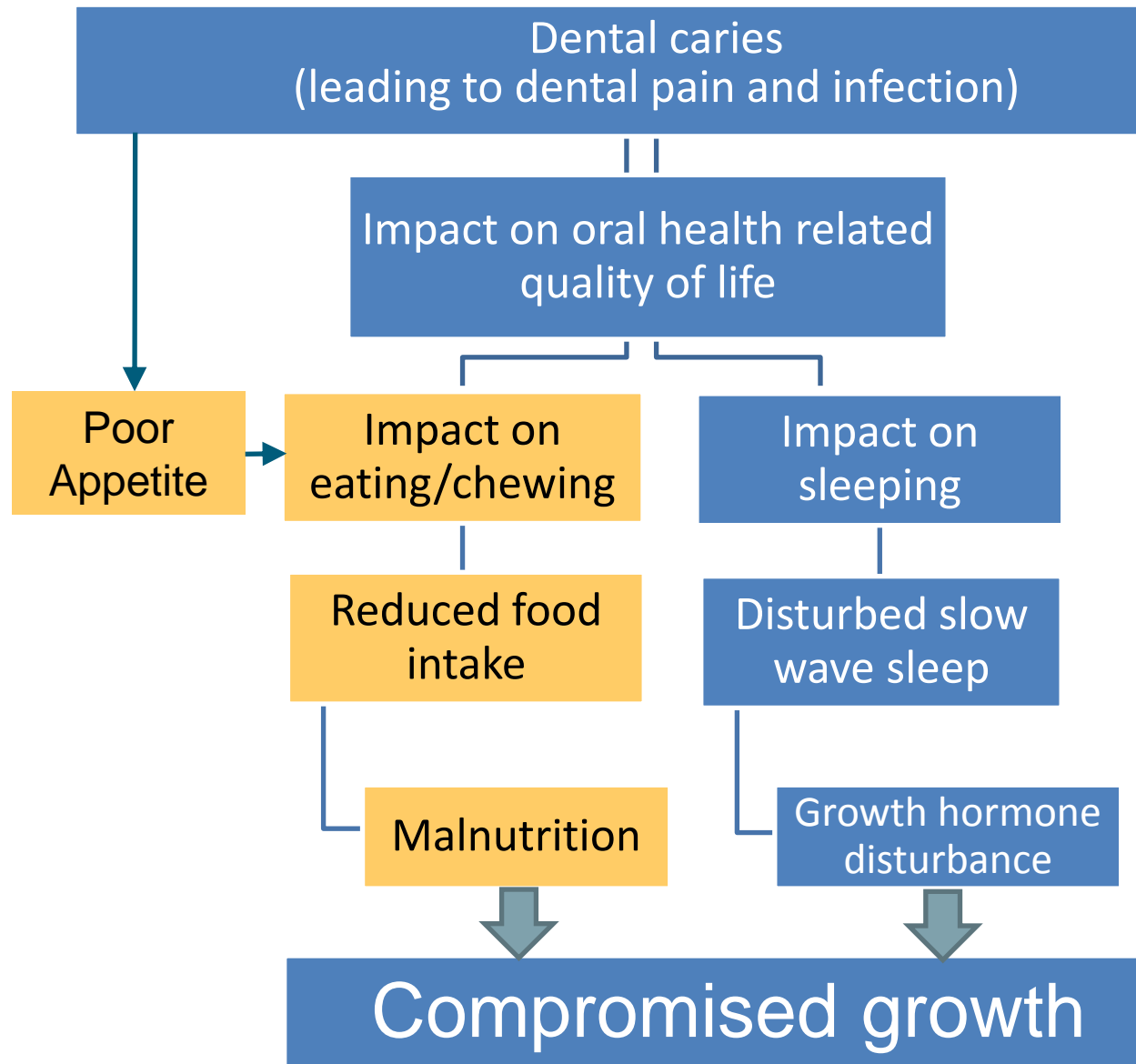
(Acs et al. 1992; Ayhan et al. 1996; Ohlund et al. 2007).

Impact of dental pain on child growth (Continued)

- **Indirect impact of dental pain:**

Dental pain affects eating/chewing and sleeping.

(Moura-Leite et al. 2011; Moura-Leite et al. 2008; Bönecker et al. 2012; Shepherd et al. 1999).



2. Effect of dental caries on diet

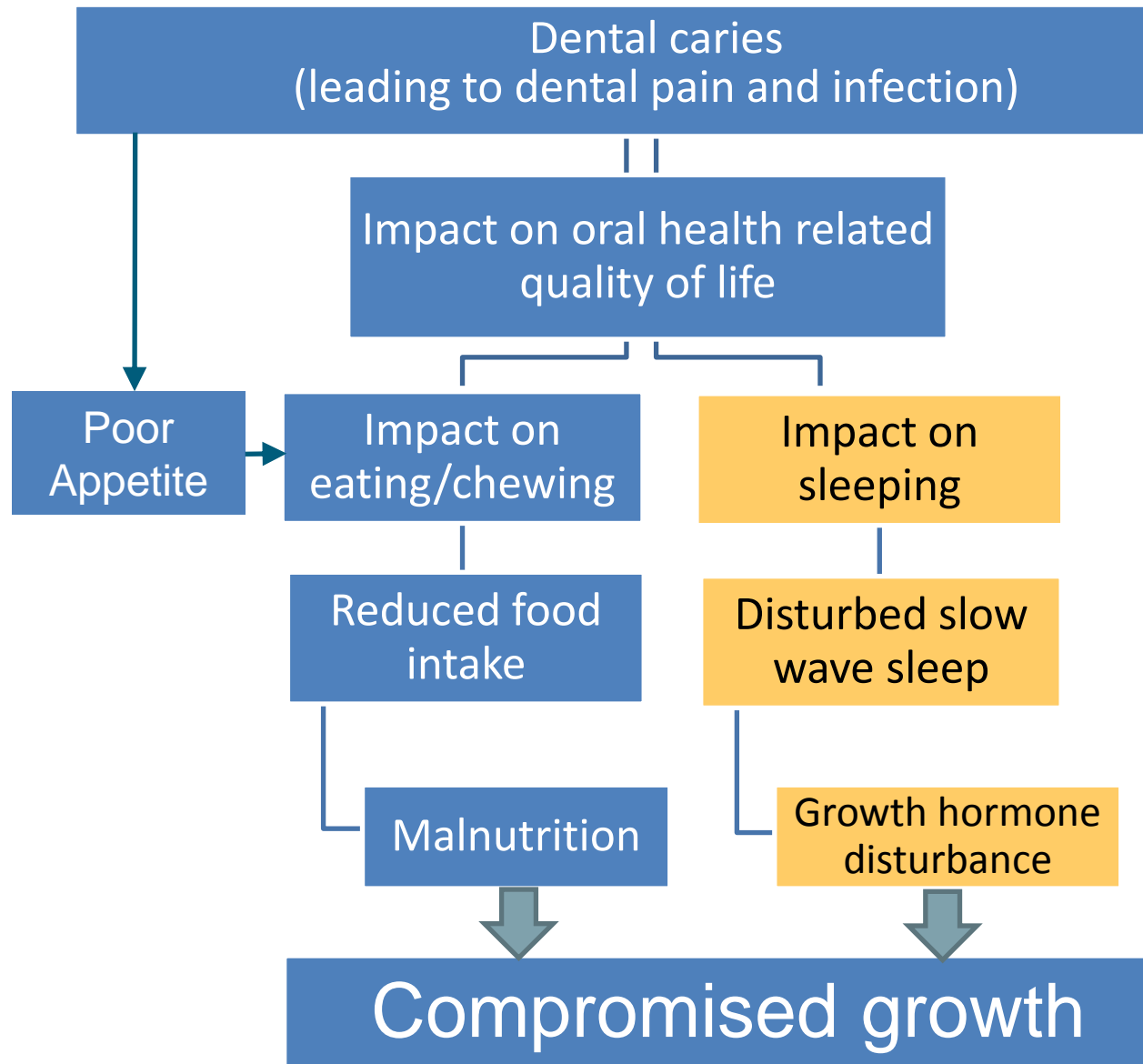
- Changes in the diet from solid to liquid or semi-liquid, reduced ability to eat a varied diet resulting in reduction of caloric intake (Vania et al 2011; Clarke et al., 2006).
- Impedes achievement of dietary goals related to the consumption of fruits, vegetables and non starch polysaccharide (NSP) (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).
- Increased risk of iron deficiency anemia (Clarke et al. 2006; Schroth, Levi, 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).



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).

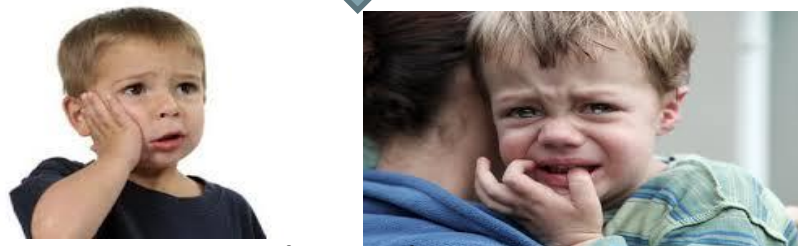
Dental pain and sleep disturbance

- 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



Untreated dental caries



Dental pain and poor OHRQoL



Eating disturbance

Sleeping disturbance



Impact on child's growth



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

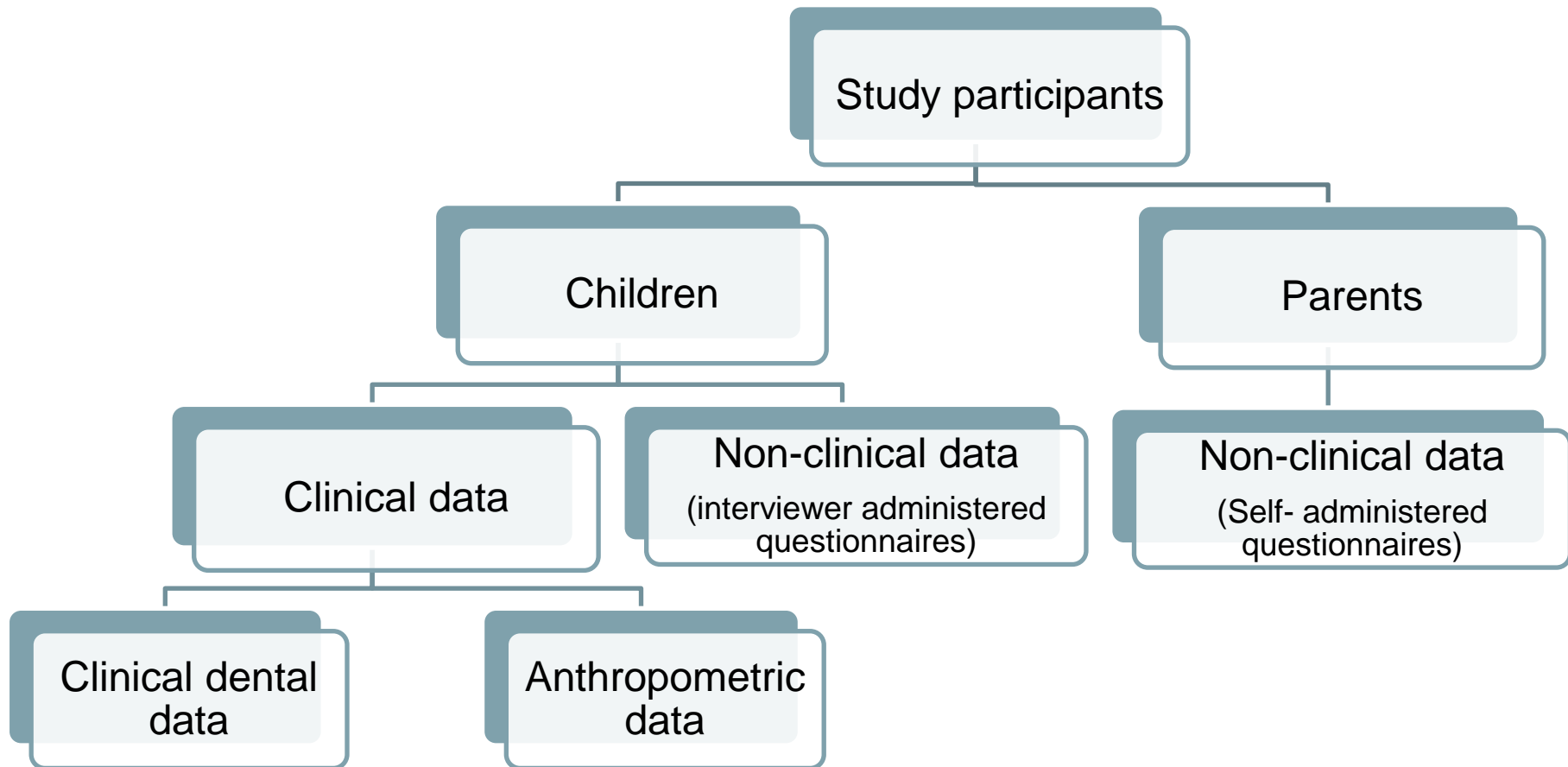
Inclusion criteria

- 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



Collection of clinical dental data

By a dental survey through clinical dental examination using standard World Health Organization – Oral Health Survey Basic Methods-2013 (WHO 2013).



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

Outcomes	Main exposure	Mediators	Covariates
<ul style="list-style-type: none"> Height-for-age z-score. Weight-for-age z-score. BMI-for-age z-score. 	<ul style="list-style-type: none"> Untreated dental caries (d/D component of dmft/DMFT). pufa/PUFA score. 	<ul style="list-style-type: none"> OHRQoL. Dental pain. Appetite. Eating disturbance. Sleeping disturbance. 	<ul style="list-style-type: none"> Parental height, weight. History of past nutritional status. Socio-demographic characteristics.

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

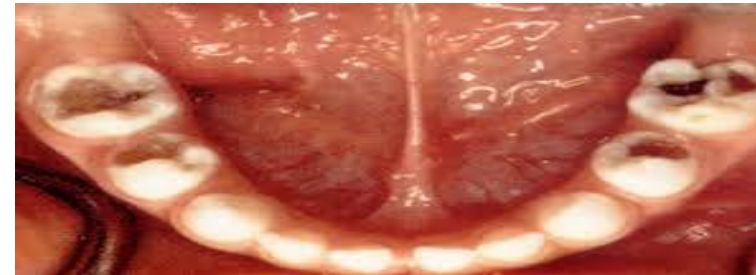


Missing tooth



Filled tooth

PUFA/pufa index- clinical consequences of untreated dental caries (Monse et al. 2010)



Pulpal involvement



Ulceration



Fistula and Abscess

Study measures

		Children	Parents
OHRQoL and dental pain	Scale of Oral Health Outcomes for 5-year-old children (SOHO-5): both child and parental version (Tsakos et al. 2012).	✓	✓
Appetite	Appetite scale (Brown et al. 1995).		✓
Eating difficulty	Changing in food choice Chewing or eating difficulty (Versloot et al. 2006; Daher et al. 2014).		✓
Sleeping difficulty	sleep disturbance scale for children (Bruni et al. 1996).		✓
Covariates			✓

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.alittle, 3.moderate, 4.alot, 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

		Hospital group	School group
Father's education	No institutional education	13%	1%
	More than higher secondary level	26%	41%
Monthly gross family Income	Lowest income group (less than 8000 BDT)	19%	7%
	Highest income group (More than 30 thousand BDT)	5%	22%

Table 2: Caries distribution in the sample

	<i>Hospital(127)</i>	<i>School(145)</i>	<i>Total (272)</i>
Sound	2 (1.57%)	66 (45.5%)	68 (25%)
Caries	125 (98.42%)	79 (54.5%)	204 (75%)
Pufa absent	66 (51.97%)	133 (91.72%)	199 (73.16%)
Pufa present	61 (48.03%)	12 (8.27%)	73 (26.84%)
Mean (dmft+DMFT)	5 (0.29)	1.75 (0.92)	3.27 (1.95)
(SE)			

Table 3: Mean weight and height, by caries experience and setting

	<i>N/n</i>	<i>Mean weight in kg (SE)</i>	<i>p-value</i>	<i>Mean height in cm (SE)</i>	<i>p-value</i>
Whole sample	241	23.35 (0.41)		120.82 (0.77)	
Caries experience					
Caries-free	54	26.14 (0.79)	<0.05	126.12 (0.96)	<0.05
Any caries	187	22.62 (0.46)		120.36 (0.72)	
Setting					
Hospital	127	20.84 (0.45)	<0.05	117.41 (0.83)	<0.05
School	114	26.27 (0.61)		126.37 (0.71)	

Table 4: Tertile distribution of dental caries and height, weight and BMI z scores

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

*p value <0.05 (oneway ANOVA test)

Sample size calculation

- To have 80% power of demonstrating a statistically significant difference of $\frac{1}{3}$ 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

Task	2015							2016								
	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	March	Apr	May	June	July	Aug	Sep
Upgrade																
Preparation in UK																
Preparation in BD																
Data collection																
Data Analysis																
Writing up thesis																
Writing up papers																
Thesis submission																

Acknowledgements

- My supervisors.
- Commonwealth scholarship commission.
- Supporting people in UCL: Dr Antiopi Ntouva, Jess Porter, Dr Manu Mathur, PhD students in Dental Public Health group.
- Survey team in Bangladesh.
- All the study participants.
- My family members.

References

- Abanto, J., Tsakos, G., Ardenghi, T.M., Paiva, S.M., Raggio, D.P., Sheiham, A. & Bönecker, M., 2013. Responsiveness to change for the Brazilian Scale of Oral Health Outcomes for 5-year-old children (SOHO-5). *Health and Quality of Life Outcomes*, 11(1), p.137.
- Abanto, J., Tsakos, G., Paiva, S.M., Raggio, D.P., Celiberti, P. & Bönecker, M., 2014. Agreement between children aged 5-6 years and their mothers in rating child oral health-related quality of life. *International journal of paediatric dentistry / the British Paedodontic Society [and] the International Association of Dentistry for Children*, 24(5), pp.373–9.
- Acs, G., Lodolini, G., Kaminsky, S. & Cisneros, G.J., 1992. Effect of nursing caries on body weight in a pediatric population. *Pediatric Dentistry*, 14(5), pp.302–5. Available at: <http://www.aapd.org/assets/1/25/Acs-14-05.pdf> [Accessed November 25, 2013].
- Acs, G., Lodolini, G., Shulman, R. & Chussid, S., 1998. The effect of dental rehabilitation on the body weight of children with failure to thrive: case reports. *Compendium of continuing education in dentistry (Jamesburg, N.J. : 1995)*, 19(2), pp.161–164.
- Acs, G., Shulman, R., Ng, M.W. & Chussid, S., 1999. The effect of dental rehabilitation on the body weight of children with early childhood caries. *Pediatric Dentistry*, 21(2), pp.109–113.
- Alkarimi, H.A., Watt, R.G., Pikhart, H., Jawadi, A.H., Sheiham, A. & Tsakos, G., 2012. Impact of treating dental caries on schoolchildren's anthropometric, dental, satisfaction and appetite outcomes: a randomized controlled trial. *BMC public health*, 12, p.706.
- Alkarimi, H. a, Watt, R.G., Pikhart, H., Sheiham, A. & Tsakos, G., 2014. Dental Caries and Growth in School-Age Children. *Pediatrics*, 133(3), pp.e616–e623.
- Ayhan, H., Suskan, E. & Yildirim, S., 1996. The effect of nursing or rampant caries on height, body weight and head circumference. *The Journal of Clinical Pediatric Dentistry*, 20(3), pp.209–212.
- Bagramian, R.A., Garcia-Godoy, F. & R, V.A., 2009. The global increase in dental caries. A pending public health crisis. *American Journal of Dentistry*, 22, pp.3–8.
- Barbosa, T. & Gavião, M., 2008. Oral health-related quality of life in children: Part II. Effects of clinical oral health status. A systematic review. *International Journal of Dental Hygiene*, 6(2), pp.100–107.
- Bennadi, D. & Reddy, C.V.K., 2013. Oral health related quality of life. *Journal of International Society of Preventive and Community Dentistry*, 3(1), pp.1–6.
- Benzian, H., Monse, B., Heinrich-Weltzien, R., Hobdell, M., Mulder, J. & van Palenstein Helderman, W., 2011. Untreated severe dental decay: a neglected determinant of low Body Mass Index in 12-year-old Filipino children. *BMC public health*, 11, p.558.
- Bönecker, M., Abanto, J., Tello, G. & Oliveira, L.B., 2012. Impact of dental caries on preschool children's quality of life: an update. *Brazilian Oral Research*, 26(spe1), pp.103–107.
- Cogill, B., 2001. *Anthropometric Indicators Measurement Guide*, Food and Nutrition Technical Assistance Project, Academy for Educational Development.
- Clarke, M., Locker, D., Berall, G., Pencharz, P., Kenny, D.J. & Judd, P., 2006. Malnourishment in a population of young children with severe early childhood caries. *Pediatric Dentistry*, 28(3), pp.254–9.
- Dean, A., Sullivan, K. & Soe, M., 2015. OpenEpi: Open Source Epidemiologic Statistics for Public Health, Version. Available at: <http://www.openepi.com/SampleSize/SSMean.htm> [Accessed January 1, 2015].
- Duijster, D., Sheiham, A., Hobdell, M.H., Itchon, G. & Monse, B., 2013. Associations between oral health-related impacts and rate of weight gain after extraction of pulpally involved teeth in underweight preschool Filipino children. *BMC public health*, 13(1), p.533.
- Do, L.G. & Spencer, A., 2007. Oral health-related quality of life of children by dental caries and fluorosis experience. *Journal of Public Health Dentistry*, 67(3), pp.132–9.
- Edelstein, B.L., 2006. The dental caries pandemic and disparities problem. *BMC oral health*, 6 Suppl 1(Suppl 1), p.S2.
- Filstrup, S.L., Briskie, D., da Fonseca, M., Lawrence, L., Wandera, A. & Inglehart, M.R., 2003. Early childhood caries and quality of life: child and parent perspectives. *Pediatric Dentistry*, 25(5), pp.431–40.
- Hayden, C., Bowler, J.O., Chambers, S., Freeman, R., Humphris, G., Richards, D. & Cecil, J.E., 2013. Obesity and dental caries in children: a systematic review and meta-analysis. *Community Dentistry and Oral Epidemiology*, 41(4), pp.289–308.
- Hooley, M., Skouteris, H., Bogatin, C., Satur, J. & Kilpatrick, N., 2012. Body mass index and dental caries in children and adolescents: a systematic review of literature published 2004 to 2011. *Systematic Reviews*, 1(1), p.57.
- Langhans, W., 1996. Bacterial products and the control of ingestive behavior: clinical implications. *Nutrition (Burbank, Los Angeles County, Calif.)*, 12(5), pp.303–15.

References

- Malek Mohammadi, T., Wright, C.M. & Kay, E.J., 2009. Childhood growth and dental caries. *Community Dental Health*, 26(1), pp.38–42.
- Mishu, M.P., Hobbell, M., Khan, M.H., Hubbard, R.M. & Sabbah, W., 2013. Relationship between Untreated Dental Caries and Weight and Height of 6- to 12-Year-Old Primary School Children in Bangladesh. *International Journal of Dentistry*, 2013, available from <<http://dx.doi.org/10.1155/2013/629675>>.[5 June 2015]
- Monse, B., Heinrich-Weltzien, R., Benizian, H., Holmgren, C. & van Palenstein Helderma, W., 2010. PUFA—an index of clinical consequences of untreated dental caries. *Community Dentistry and Oral Epidemiology*, 38(1), pp.77–82.
- Monse, B., Duijster, D., Sheiham, A., Grijalva-Eternod, C.S., van Palenstein Helderma, W. & Hobbell, M.H., 2012. The effects of extraction of pulpally involved primary teeth on weight, height and BMI in underweight Filipino children. A cluster randomized clinical trial. *BMC public health*, 12(1), p.725.
- Moura-Leite, F.R., Ramos-Jorge, M.L., Bonanato, K., Paiva, S.M., Vale, M.P. & Pordeus, I.A., 2008. Prevalence, intensity and impact of dental pain in 5-year-old preschool children. *Oral health & Preventive Dentistry*, 6(4), pp.295–301.
- Moura-Leite, F.R., Ramos-Jorge, J., Ramos-Jorge, M.L., Paiva, S.M., Vale, M.P., Pordeus, I.A. & Moura-Leite, F.R., 2011. Impact of dental pain on daily living of five-year-old Brazilian preschool children: prevalence and associated factors. *European archives of paediatric dentistry : official journal of the European Academy of Paediatric Dentistry*, 12(6), pp.293–297.
- Moynihan, P. & Petersen, P.E., 2004. Diet, nutrition and the prevention of dental diseases. *Public Health Nutrition*, 7(1A), pp.201–26.
- Ohlund, I., Holgersson, P.L., Backman, B., Lind, T., Hernell, O. & Johansson, I., 2007. Diet intake and caries prevalence in four-year-old children living in a low-prevalence country. *Caries Research*, 41(1), pp.26–33.
- Pahel, B.T., Rozier, R.G. & Slade, G.D., 2007. Parental perceptions of children's oral health: the Early Childhood Oral Health Impact Scale (ECOHIS). *Health and Quality of Life Outcomes*, 5(1), p.6.
- Petersen, P.E., Bourgeois, D., Ogawa, H., Estupinan-Day, S. & Ndiaye, C., 2005. The global burden of oral diseases and risks to oral health. *Bulletin of the World Health Organization*, 83(9), pp.661–9.
- Plata-Salamán, C.R., 1996. Anorexia during acute and chronic disease. *Nutrition (Burbank, Los Angeles County, Calif.)*, 12(2), pp.69–78.
- Swinburn, B.A., Caterson, I., Seidell, J.C. & James, W.P.T., 2004. Diet, nutrition and the prevention of excess weight gain and obesity. *Public Health Nutrition*, 7(1A), pp.123–46.
- Thomas, C.W. & Primosch, R.E., 2002. Changes in incremental weight and well-being of children with rampant caries following complete dental rehabilitation. *Pediatric Dentistry*, 24(2), pp.109–113.
- Schroth, R.J., Levi, J., Kliewer, E., Friel, J. & Moffatt, M.E.K., 2013. Association between iron status, iron deficiency anaemia, and severe early childhood caries: a case-control study. *BMC pediatrics*, 13, p.22.
- Schroth, R.J., Levi, J.A., Sellers, E.A., Friel, J., Kliewer, E. & Moffatt, M.E.K., 2013. Vitamin D status of children with severe early childhood caries: a case-control study. *BMC pediatrics*, 13(1), p.174.
- Sheiham, A., 2006. Dental caries affects body weight, growth and quality of life in pre-school children. *British Dental Journal*, 201(10), pp.625–6.
- Shepherd, M.A., Nadanovsky, P. & Sheiham, A., 1999. Dental public health: The prevalence and impact of dental pain in 8-year-old school children in Harrow, England. *British Dental Journal*, 187(1), pp.38–41.
- Slade, G.D., 2001. Epidemiology of dental pain and dental caries among children and adolescents. *Community Dental Health*, 18(4), pp.219–27.
- Stephensen, C.B., 1999. Burden of Infection on Growth Failure. *J. Nutr.*, 129(2), p.534–538.
- Tsakos, G., Blair, Y.I., Yusuf, H., Wright, W., Watt, R.G. & Macpherson, L.M.D., 2012. Developing a new self-reported scale of oral health outcomes for 5-year-old children (SOHO-5). *Health and Quality Of Life Outcomes*, 10(1), p.62.
- Vidmar, S.I., Cole, T.J. & Pan, H., 2013. Standardizing anthropometric measures in children and adolescents with functions for egen: Update. *Stata Journal*, 13(2), pp.366–378.
- Vania, A., Parisella, V., Capasso, F., Di Tanna, G.L., Vestri, A., Ferrari, M. & Polimeni, A., 2011. Early childhood caries underweight or overweight, that is the question. *European Journal of Paediatric Dentistry : official journal of European Academy of Paediatric Dentistry*, 12(4), pp.231–5.
- WHO, 2013. Oral Health Surveys: Basic Methods | Health, Education, Social Protection News & Notes – RSS Feeds. Available at: <http://hesp-news.org/2013/12/13/oral-health-surveys-basic-methods/> [Accessed September 23, 2014]

Thank you

