FINAL REPORT TO FUNDER – ORAL & DENTAL RESEARCH TRUST – Lifecourse determinants of dental caries in three-year-old children: a feasibility study

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Dissemination –

Mrs Jenny Owen presented the findings from this project at the International Conference in Paediatric Dentistry at Glasgow Conference Centre, July 2015.

This report is available on the White Rose Research Online repository at:
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Abstract –

Background: Birth cohorts, such as Born in Bradford (BiB), provide a unique opportunity to study the influence of socio-economic and environmental factors acting in pregnancy, birth and infancy on the development of dental caries (decay) in later life. Dental epidemiology surveys (DES) are undertaken annually in Bradford for different age groups using a standardised and robust methodology as part of the national dental epidemiology programme.

Aim: To explore through data linkage the association of dental caries at three years old with birthweight in a cohort of Bradford children.

Design: Parents of children consented to participate in DES had the additional option of consenting for data linkage where their child was also part of BiB. Data linkage, following establish protocols, was undertaken using each child's unique NHS number. Associations between caries (dmft) and the following variables were investigated: birthweight, ethnicity, gestation, gender, parity, maternal education, deprivation and maternal language. Simple descriptive and exploratory statistical analysis was undertaken

Results: From the sample of 152 children examined for the DES in Bradford, 69 parents consented for data linkage. However, only 36 of these 69 children had actually participated in BiB. Six children had caries (dmft >0). There were no statistical associations between any variable and caries.

Conclusions: Data linkage and analysis was successfully undertaken between the DES and BiB data sets, with data safely transferred. Almost half the parents who consented for data linkage, inaccurately thought their child was also part of BiB. Alternative approaches need to be explored to accurately recruit children participating in both annual DES and BiB.

Background – Dental caries is the most prevalent preventable condition in children[1] and is a significant national public health problem and priority[2]. In parts of the country over half of five year olds have dental caries involving multiple teeth [3]. Bradford children have the highest prevalence of dental caries in Yorkshire and are some of the highest levels in England[3]. Serial cross sectional studies in Bradford showed dental caries was significantly associated with deprivation (by a factor of three based on the most and least deprived IMD quartlies)[4] and ethnicity (worse by a factor of two in children from a Pakistani origin)[5] even when adjusting for confounders.

Established risk factors for dental caries (such as a cariogenic diet and infrequent use of fluoride toothpaste) explain some but not all of the observed disparities in oral health. Identifying other mechanisms by which disparities result in poor oral health is therefore important and will ultimately influence future preventive strategies. A lifecourse approach suggests that adverse exposures and insults are accumulated throughout life. It applies the dynamic concept of a chain of circumstances, where the exposure to one factor is likely to be connected with exposure to other factors and these exposures are likely to accumulate over the lifecourse[6]. This approach has the potential to explain disparities in oral health by identifying risk factors occurring in early life that result in poor oral health. Few longitudinal birth cohorts have included measures of oral health[7 8]. These studies are small and have not collected detailed dental data through childhood. They describe how disparities during pregnancy and at birth are associated with oral health in later life. In Bradford, the Born in Bradford birth cohort (BiB) has been running since 2007. All mothers giving birth at the Bradford Royal Infirmary maternity unit were invited to enrol from 2007 to 2011. Over 13,500 babies were recruited, representing over 60% of all births in the hospital[9]. These children are mainly bi-ethnic with 45% coming from a Pakistani origin and 39% from a white British origin. A unique opportunity therfore existed in Bradford to link data already being collected by BiB, see figure 1, with dental data collected for the national dental epidemiology programme. The 2012/13 survey was the first in England to examine a representative sample of three-year-olds in each primary care cluster area.

The research project planned to use the conceptual model proposed by Fisher-Owens et al.[10], shown in figure 1, as a framework to explore early childhood exposures on birthweight and dental caries that may be influenced by community and family level factors. Birthweight is an important and widely used measure of health at birth as well as being an important determinant of adult health[6]. The BiB cohort has identified that infants from Pakistani origin mothers are on average 200grams lighter than those born to white British mothers. Analysis of a large cross sectional study[11 12] and small cohort studies of premature babies[13 14] have concentrated on the association between low birthweight and dental caries with differing conclusions on whether any association existed. For example, a Brazilian cohort[8] identified reduced child's height at the age of one with primary dentition caries at six years old. A UK birth cohort[15] found an association between increased weight and height at birth and dental caries at five years old. It was therefore planned to examine these

associations in young high-risk populations with respect to dental caries, poverty, ethnicity and low birth weight children.

Figure 1 – shows the data collected for children participating in the Born in Bradford birth cohort and the relevant domain within which it was allocated.

Conceptual model of the determinants of oral health [based on Fisher-Owens et al.]

Data available within BiB and the relevant domain within the model

COMMUNITY-LEVEL INFLUENCES
Physical Environment: fluoride in water

FAMILY-LEVEL INFLUENCES
Family Composition: number of parents and siblings
Socioeconomic Status: parent's education, deprivation, employment
Health Behaviours, Practices and Coping Skills of Family: parenting styles, use of supplements and vitamins, smoking and alcohol use, maternal physical activity, maternal diabetes
Social Support: who lives in house
Culture: language, migration history

CHILD-LEVEL INFLUENCES
Biological & Genetic: specific medical conditions including Down syndrome, cleft lip and palate and congenital cardiac anomalies, *Pregnancy related factors:* length of gestation, smoking and alcohol during pregnancy, maternal age, mode of birth, gestational diabetes, parity, maternal weight, height & BMI,
Physical and Demographic: ethnicity, gender, weight and head circumference at birth,
Health Behaviours and Practices: child feeding practices, dietary history, snack food frequency, uptake of primary medical services and immunisations.
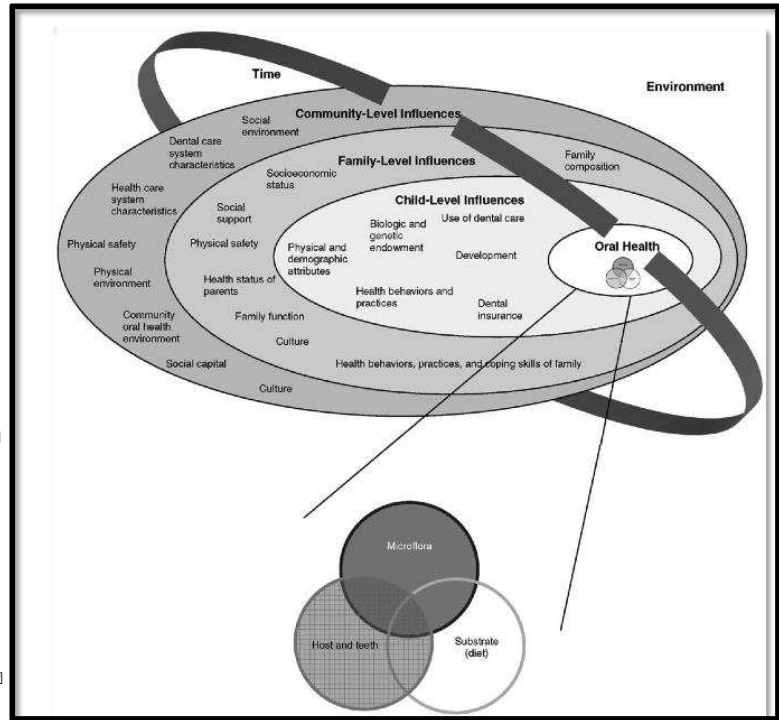
Aim - In a cohort of Bradford children, to explore through data linkage the association between dental caries at three years old and birthweight.

Methodology - Relevant ethical and research permissions were obtained prior to study commencement (Appendix A to D). The research study was funded by the Oral and Dental Research trust (Appendix E and F).

The Dental Epidemiology survey was a random sample of 152 three-year-old children undertaken in 2013. Ethical permission was granted to add a further box to the consent form. By ticking this box parents agreed to have their dental data linked to that of their BiB data if they were participating in both studies.

INCLUSON CRITERIA:
- Children who are participating in both the BiB birth cohort and the three-year-old Dental Epidemiology programme in Bradford.
- Positive consent from parents to permit data linkage
- Only data from singleton births were included

ORAL EXAMINATION for Dental Epidemiology survey – Two dentists from the Bradford District Care Trust Salaried Dental Service undertook the data collection following a standard calibration training day. The national protocol for dental examinations for the Dental Epidemiology programme is well established and specific details for this oral health survey are well described (http://www.nwph.net/dentalhealth/survey-results%203(12_13).aspx).

The survey collected the following data: the child's demographic (age, ethnic group, postcode), visible plaque (present or absent), fluoride varnish application (as reported by parents), dental caries level (using a standardised system of decay, missing and filled teeth) and the presence of any acute infection (yes or no). Dental caries was recorded using a dmft index that was calculated by adding the number of decayed (d), missing (m) and filled (f) teeth (t). There are 20 primary teeth in a three year old and therefore the dmft value range between 0 (no decayed, missing or filled teeth) to 20 (where all primary teeth are either decayed, missing or filled). Dmft can also be calculated for a population by adding individual dmft scores and dividing by the number of children to calculate a mean dmft

DATA LINKAGE – The data for those children who had positively consented for data linkage from the three year old oral health survey were transferred to the BiB research team. These data were transferred using a secure and encrypted email link which followed the BiB data protection protocols. The data were subsequently stored within the BiB data warehouse. Data linkage was undertaken based primarily on the NHS number. To ensure accuracy date of birth, postcode and name were used as secondary parameters to verify the correct child was identified. Once data linkage was undertaken, analyses used the BiB unique study number and this ensured reports were fully anonymised.

STATISTICAL ANALYSIS: Simple descriptive statistical analysis was undertaken to describe the data. A more complex analysis was planned (described in Appendix E) if sufficient children consented for data linkage.

Results

The Dental Epidemiology survey of three-year-old children in Bradford undertook dental examinations for 152 children. From this sample 69 parents consented for data linkage (45.4%). When these 69 children were compared to the BiB records, only 36 children were part of both BiB and Dental Epidemiology survey (23.6% of the initial three year old sample).

DENTAL CARIES – The primary outcome variable was dental caries. Six children had dental caries. Three children had a dmft score of 1 and a further three had a dmft score of 2. The remaining children had a dmft score of 0 (e.g. no decayed, missing or filled teeth). The table below shows distribution of dmft scores between children from different ethnic groups.

		Ethnicity			
		White British	Pakistani	Other	
dmft	0	12	13	5	30
	1	1	2	0	3
	2	0	2	1	3
		13	17	6	

For the remainder of the analysis, owing to the small numbers, those with dental caries (e.g. a dmft score > 0) have been grouped together. For each variable analysed there was no statistical difference between those children with and without dental caries.

BIRTHWEIGHT

	Number of children	Mean (grams)	Std.Dev	Min (grams)	Max (grams)
No caries (dmft =0)	30	3284.7	483.7	2400	4360
Caries (dmft >0)	6	3313.3	472.4	2660	4060

GESTATION

	Number of children	Mean (weeks)	Std.Dev	Min (weeks)	Max (weeks)
No caries (dmft =0)	30	39.6	1.04	37	41
Caries (dmft >0)	6	40.2	1.33	38	42

GENDER

	Male	Female	Total
No caries (dmft =0)	17	13	30
Caries (dmft >0)	3	3	6

PARITY

	Number of children in the family					Total
	First child	Second child	Third child	Fourth child	Fifth child	
No caries (dmft =0)	11	9	5	3	2	30
Caries (dmft >0)	6	2	2	1	1	6

EDUCATION

	Maternal education						Total
	<5 GCSE equivalent	5 GCSE equivalent	A level equivalent	Higher than A level equivalent	Foreign unknown	Missing – not completed	
dmft =0	5	11	6	4	1	3	30
dmft >0	1	2	2	0	0	1	6

DEPRIVATION
Three different markers of deprivation were analysed. These were Index of Multiple Deprivation scores based on their postcode, whether parents were receiving means tested state benefits and their house tenure

	IMD quintiles (2010)						Total
	1	2	3	4	5	Missing	
No caries (dmft =0)	22	2	2	0	1	3	30
Caries (dmft >0)	4	0	1	0	0	1	6

	Receiving means tested state benefits			
	Yes	No	Missing	Total
No caries (dmft =0)	11	16	3	30
Caries (dmft >0)	2	3	1	6

	Housing tenure							
	Buying it mortgage/loan	Owns it	Rents it	Lives here rent free	Pays part rent part mortgage	Don't know	Missing	Total
No caries (dmft =0)	3	11	1	9	2	1	3	30
Caries (dmft >0)	2	2	0	0	0	1	1	6

LANGUAGE

At the initial BiB questionnaire, completed in late pregnancy, mothers were given the choice of several languages with which to complete it. We choose this variable as a marker for what language mothers felt most comfortable using.

	Language used to administer BiB baseline questionnaire				
	English	Mirpuri/ Punjabi	Urdu	Missing	Total
dmft =0	20	1	6	3	30
dmft >0	4	0	1	1	6

FLUORIDE VARNISH APPLICATION

At the time of the three-year-old Dental Epidemiology survey, parents were asked if their child had had fluoride varnish applied to their teeth by either their dentists or the community based fluoride application programme.

	Fluoride varnish application			
	Yes	No	Do not know	Total
dmft =0	12	13	5	30
dmft >0	1	4	1	6

SEPSIS – One child had acute sepsis present in their mouth at the time of the dental examination.

DISCUSSION

This feasibility study has established a methodology for of data linkage between routine oral health data collected for Dental Epidemiology survey and BiB socio-demographic and birth data for children and their parents participating in both studies. This study has demonstrated the following important achievements:

Firstly, appropriate ethical approval and research permissions were obtained. Owing to the status of the Oral and Dental Research Trust as a non-commercial partner, support from the National Institute of Research Clinical Research Network was successfully applied for and recruitment entered as part of the UKCRN portfolio and accrual system.

Secondly a data sharing agreement between the University of Leeds, Public Health England and Bradford Institute for Health Research was successfully negotiated. This took a significant amount of time owing to the reorganisation of Dental Public Health services from Primary Care Trusts to Public Health England. The study established a sound working relationship with wider stakeholders such as Bradford Metropolitan District Council and Bradford District Care Trust, who undertook the dental survey, thus enabling its successful completion.

Thirdly, the study has verified the ability to link children between the two datasets, Dental Epidemiology survey and BiB, using their NHS numbers. Other demographic data held by the dental survey provided valuable additional verification to ensure appropriate linkage. The established data transfer protocols enabled the safe and secure transfer of data between these different organisations.

Parents of sixty-nine children consented to allow data linkage between the two data sets. This represented just under half (45.4%) of the dental survey. While there were initial plans to recruit over 200 children to the three-year-old Dental Epidemiology survey, this was the first time such a survey had been undertaken. The logistics of recruiting children from nurseries, both private and state funded, proved challenging in comparison to school based surveys at 5 and 12 years old. Therefore the overall sample size was reduced from initial estimations. The research protocol and ethical approval did not permit any analysis of those parents who had not consented for data sharing to ascertain how many of these children (n= 83) were part of the BiB birth cohort.

Where successful data linkage was possible, the results were similar to the wider Bradford sample. The table below reports some of these dental parameters. For example, the percentage of children with dental caries and sepsis is almost identical to the wider sample. There was a larger difference in the dmft prevalence for children with caries between the BiB sample and the Bradford 3-year-old DES. This may relate to the low levels of dental caries, e.g. dmft values of 1 and 2 seen in the BiB sample. Owing to the nature of dmft a few children with significant dental caries, e.g. high number of teeth affected by dental caries, can disproportionately influence the mean dmft values.

	Number of children	dmft	Percentage of children with dental caries	dmft for children with dental caries	Percentage of children with sepsis
BiB sample	36	0.25	17%	1.5	3%
Bradford 3 year old sample	152	0.69	20%	3.47	4%

Finally, for those children who were part of both the Dental Epidemiology survey and BiB, the study has demonstrated that data linkage and analysis is possible. In this small sample there were very little missing data from the earlier BiB questionnaires. The study originally proposed more complex statistical modelling and analysis. However, owing to the small number of the children available for data linkage, this was not appropriate beyond simple descriptive and exploratory statistics. It does however show that with a larger sample (2015 Dental Epidemiology survey of 5 year olds plans to undertake oral health assessments for 2,500 children) and a higher prevalence of dental caries (the prevalence of dmft >0 was 46% in the 2012 five year old survey) more robust and complicated statistical modelling would be feasible. Based on this feasibility study, we anticipate that we could recruit in excess of 500 participants. This would allow the association between socio-economic and environmental factors acting in pregnancy, birth and infancy on the development of dental caries in later childhood to be explored as well as facilitating the exploration of the relationship between caries and childhood growth and adiposity.

Conclusion

- The research team have established a robust methodology and good working relationships with a number of stakeholders to safely complete this project.

- Data linkage and analysis were successfully undertaken between a Dental Epidemiology survey and BiB, with data safely transferred.

- Owing to the small sample available, only simple statistical analysis was possible with no significantly association identified between birthweight and caries at the age of three years old.

- Almost half the parents who consented for data linkage, inaccurately thought their child was also part of BiB. Alternative approaches need to be explored to accurately recruit children participating in both annual Dental Epidemiology survey and BiB.

- Opportunities exist to learn from this project and undertake further data linkage when the Dental Epidemiology survey is undertaken for five-year-old children in 2015. This survey plans to examine 2,500 children in Bradford, of whom we expect at least 500 to consent for data linkage with their BiB data.

APPENDICIES – available from the lead author – please email p.f.day@leeds.ac.uk

Appendix A - Ethics permission (13/NW/0273)

Appendix B - R and D approval (127297)

Appendix C - UK CRN support letter (14749)

Appendix D - Data sharing agreement

Appendix E - ORDT funding letter

Appendix F – ORDT research proposal

Appendix G – Research abstract submitted in the poster prize presentation category at the International Association of Paediatric Dentistry Conference in July 2015 at Glasgow Conference Centre.

APPENDICIES – available from the lead author – please email p.f.day@leeds.ac.uk

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