

# Feasibility, utility and impact of a national dental epidemiological survey of three-year-old children in England 2013

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Dental epidemiological surveys of children often focus on caries levels of five-year-olds as they are accessible and amenable to examination. Standardised surveys of this age group have been successfully carried out in the UK for many years. If improvements to caries level at age five are to be made then it is important to know when caries develops in the preceding years and what the likely causes are. This paper reports on the feasibility, utility and impact of a standardised survey of three-year-old children which took place in England. **Method:** Standardised examinations were carried out on consented three-year-olds attending child care sites which had been randomly sampled using a method described in a national protocol. Feasibility was assessed by compliance results, utility from examples of use of the data and impact by a count of media responses at the time of publication. **Results:** Data from 53,814 examinations provided caries level estimates for 88% of lower tier local authorities, this number representing 8% of the population of this age cohort. Of the children for whom parental consent was provided, 8% refused to be examined at school and 9% were absent. The arising information was used in a variety of ways by local authorities and health planners. The media response was strong with coverage by TV, radio, printed press and online reporting. **Conclusion:** This national survey of the oral health of three year olds was feasible but more labour intensive than surveys of school age children and the information derived has good utility and impact.

**Key words:** child, dental epidemiology, caries, three-year-olds, preschool, England, UK

## Introduction

Dental epidemiological surveys of caries among children have been carried out across the world, with five-year-olds being the age group most commonly examined. Data on this age group has been systematically collected in the UK, using the British Association for the Study of Community Dentistry, (BASCD) standards since the 1980s (Pine *et al.*, 1997). These data are considered to be sufficiently robust for them to be used to monitor activity and impact by local government in England as the figures form part of the Public Health Outcomes Framework (DH, 2012). This has focussed attention on improving oral health in this age group and, in turn, the need to understand disease levels among younger age groups has been recognised.

Small scale representative population surveys have been carried out on three-year-olds (Booth *et al.*, 1989; Davies *et al.*, 2001; Marcenes *et al.*, 2010) and other surveys have taken place using convenience samples (Holt *et al.*, 1988; Silver, 1992). This paper reports on the feasibility, utility and impact of a survey which was carried out across England which had the aim of producing robust estimates of caries severity and prevalence among three-year-olds attending child care sites for each local authority and region.

## Method

A protocol was developed which was based upon experience of a multi-site survey of three-year-olds in Greater

Manchester and which incorporated as much of the BASCD standards for sampling, examining, diagnostic criteria for caries and analysis as possible (Pine *et al.*, 1997; Pitts *et al.*, 1997). The protocol deviated from that for surveys of older children in three regards; the sampling method, examination position and the convention relating to missing incisors.

This protocol was piloted in the North West, involving 20 examining teams covering 36 local authority areas. Following this pilot the protocol was revised only with regard to examining position, which was changed from the child being upright to the child being supine.

The revised protocol was used for the survey which took place in all English regions, except the North West, during 2013. National training and calibration on this protocol was provided by the Public Health England Dental Public Health Epidemiology Team and BASCD for regional standards. This was then cascaded at regional training and calibration events so that all fieldwork teams knew how to carry out the survey and included a calibrated clinical examiner. These teams were generally employed within community dental services.

The population sampling frame was three-year-olds attending private and state-funded nurseries, nursery classes attached to schools, children's centres and play groups. A quota sampling method was employed which sought to reflect the provision of each of these types of child care within each local authority.

The fieldwork teams approached randomly sampled sites to seek cooperation. Information letters and consent forms were distributed to parents of age-eligible children and responses collected in. A second letter and form was sent to parents who did not respond to the first. Only children for whom written parental consent had been given were included in the survey.

The children were examined at their child care sites using portable equipment. They were examined supine with standard lighting and drying was achieved by the use of cotton wool rolls or tips. The recording of caries was visual only and related to the dentinal level and beyond.

Missing incisors were recorded in two ways; one used the convention applied for five-year-olds which assumes that all missing incisors have been exfoliated as this would allow fair comparison between three-year-olds and five-year-olds. The other assumed that all missing incisors had been extracted because of decay as this is the most likely cause for loss and allows a more accurate calculation of prevalence and severity of caries for this age group.

Home postcodes were used to allocate children to local authorities and children without recognised postcodes were not included in the analysis. Information was provided for the lowest tier of local government to show information at the smallest local level. Information at upper tier (where several lower tier authorities are clustered together for many functions) and government office level was also provided (fixed clusters of many local authorities, both lower and upper tier).

Colleagues working in dental public health were asked about the utility of the data arising from this survey and the impact was measured by a count of media responses, collated by the Public Health England communications office.

## Results

The main study findings were presented in a report, along with detailed tables of estimates at lower tier local authority level (PHE, 2014).

Overall, of the three-year-old children in England whose parents gave consent for their participation in this survey 12% had experienced obvious decay. On average, these children had 3.07 teeth that were decayed, missing or filled. The average number of decayed, missing or filled teeth ( $d_3mft$ ) in the whole sample (including the 88% who were decay free) was 0.36.

The survey found greater polarisation of disease than among five-year-olds with a smaller proportion of children having experience of decay and those in this category having a relatively high severity. There was wide variation between and within government regions and between local authority areas. The usual geographical distribution between regions varied somewhat from that usually seen for five-year-olds. However, the association between deprivation measures and caries levels was weaker than in other child age groups.

There was some correlation at local authority level between estimates of caries severity and prevalence at age three with the same measures at age five, but there were notable outliers to this that require investigation.

## Coverage

In total, 145 upper-tier local authorities out of 152 took part in the survey, providing reliable estimates for 289 lower-tier local authorities out of 326. Simple non-response to the first and second requests for consent was the most common reason for non-consent.

The final analysis included 53,814 clinical examinations representing 8% of the population of this age cohort and 97% of those children examined.

Across the regions, representation varied from 5% of the three-year-old population in Yorkshire and the Humber and in London to 14% in the North West. At upper-tier local authority level coverage varied from less than 1% in West Sussex to 46% in Rutland. The extent and types of provision of child care varied from one area to another and this had a large impact upon the ability to access children and so the variations in the proportion of the population represented.

## Feasibility

Of children with consent 8% declined to take part on the day of examination. Absenteeism accounted for a further loss of 9% of consented children. The fieldwork teams were able to undertake the sampling, contacting, recruitment, examination and data entry, although much of this was labour intensive and required persistence and repeat visits to sites to examine children that attended the sites on a part-time basis. Where teams extended their fieldwork period over the whole academic year some found problems finding sufficient numbers of children at some sites who had not yet had their fourth birthdays.

## Additional analysis

Further analysis beyond that previously reported has been possible because of the additional variables collected in this survey of young children. Children who had been affected by caries of their incisors were identified and the following definition was applied to describe those with severe early childhood caries: "*Caries affecting any surface of one or more upper primary incisors, regardless of the caries status of any other teeth.*"

The prevalence of this is given for most geographies in the main report with 3.9% of children overall found to be so affected, with a range of 0.0 to 16.1%. Among children with general caries only, the mean  $dmft$  was 3.1 (95%CI 3.0,3.1) whilst that for children with severe ECC was 4.8 (95%CI 4.6,4.9).

## Variation between types of providers

Coding was used to identify what type of child care site the volunteer children attended. It is clear that for severity and prevalence of general and incisor caries children who attended state run establishments (nursery classes attached to primary schools, children's centres child care facilities and nurseries) had significantly higher levels of disease than those attending privately funded establishments (private nurseries and playgroups) (Table 1). On average the mean  $d_3mft$  scores for children attending state run provision ranged from 0.4 to 0.5, whilst the scores in private provision ranged from 0.2 to 0.3. The prevalence of both general and severe early childhood caries were higher in state funded sites (12.6% vs 16.2% and 5.2% vs 6.2%) than privately funded ones (8.5% vs 9.7% and 2.2% vs 2.7%).

**Table 1.** Prevalence and severity of caries among three-year-old children attending different types of child care, 2013, values with 95% confidence intervals

<i>Type of child care establishment</i>	<i>Mean <math>d_3mft</math> of whole sample</i>	<i>% of children with obvious caries experience</i>	<i>Mean <math>d_3mft</math> of those with caries experience</i>	<i>% of whole sample with incisor caries</i>
Local Authority nursery class attached to a primary school	0.54 (0.51, 0.57)	16.2 (15.6, 16.8)	3.31 (3.20, 3.42)	6.2 (5.8, 6.6)
Local Authority children's centre child care facility	0.54 (0.48, 0.60)	15.4 (14.2, 16.6)	3.48 (3.23, 3.73)	5.9 (5.1, 6.7)
Local Authority funded nursery not in children's centre	0.45 (0.39, 0.51)	12.6 (11.4, 13.9)	3.54 (3.20, 3.88)	5.2 (4.4, 6.0)
Private nursery regardless of site	0.23 (0.22, 0.24)	8.5 ( 8.1, 8.9)	2.68 (2.57, 2.79)	2.2 (2.0, 2.4)
Playgroup regardless of funding or site	0.27 (0.25, 0.29)	9.7 ( 9.2, 10.3)	2.79 (2.64, 2.94)	2.7 (2.3, 3.0)
All types of establishment	0.36 (0.35, 0.37)	11.7 (11.4, 12.0)	3.07 (3.01, 3.14)	3.9 (3.7, 4.0)

**Table 2.** Prevalence and severity of caries among three-year-old children attending child care establishments, by ethnic background, 2013, values with 95% confidence intervals

<i>Ethnic group</i>	<i>N</i>	<i>Mean <math>d_3mft</math> of ethnic group</i>	<i>Percentage of children with obvious caries experience</i>	<i>Mean <math>d_3mft</math> of those with caries experience</i>	<i>Percentage with incisor caries of whole sample</i>
White	15,375	0.27 (0.25, 0.29)	9.5 (9.5, 10.5)	2.82 (2.69, 2.85)	2.8 (2.7, 3.3)
Mixed	987	0.44 (0.34, 0.54)	12.0 (10.0, 14.0)	3.72 (3.11, 4.33)	4.4 (2.7, 5.3)
Asian / Asian British	2,205	0.98 (0.88, 1.08)	25.4 (23.2, 26.8)	3.85 (3.59, 4.11)	12.7 (11.6, 14.4)
Black / Black British	1,119	0.38 (0.30, 0.46)	11.2 (9.2, 12.9)	3.38 (2.89, 3.87)	4.4 (2.8, 5.2)
Other	363	1.08 (0.86, 1.30)	29.5 (24.3, 33.7)	3.67 (3.20, 4.14)	14.9 (11.3, 18.7)
Total	20,049	0.38 (0.36, 0.39)	11.8 (11.4, 12.3)	3.17 (3.06, 3.29)	4.3 (4.0, 4.6)

**Table 3.** Comparison of estimates of caries severity and prevalence among three-year-old children using the two different conventions regarding missing incisors, values with 95% confidence intervals

	<i>Using BASCD standard convention for primary dentition – assuming all missing incisors have been exfoliated</i>		<i>Using new convention for three year olds - assuming all missing incisors have been extracted because of caries</i>	
	<i>Mean <math>d_3mft</math></i>	<i>% with caries experience</i>	<i>Mean <math>d_3mft</math></i>	<i>% with caries experience</i>
Whole sample	0.35 (0.34, 0.36)	11.6 (11.3, 11.9)	0.36 (0.35, 0.37)	11.7 (11.4, 12.0)

The collection of data on the children's ethnicity used information provided by parents when their children started at the child care site. It was collected for 36% of participants.

Higher severity of general caries and prevalence of general and incisor caries were found among children of an Asian or Asian/British background and among children of non-specified other ethnic groups compared with those from white, mixed and black or black British backgrounds (Table 2). The severity and prevalence of general caries of the Asian and other non-specified ethnic groups was more than double that of the white, mixed and black children. The proportions of Asian children affected by incisor caries were more than three times that of the white, mixed and black children.

The application of a different convention with regard to missing incisors was logical considering the age group

of the children under scrutiny. For this survey it was assumed that all missing incisors had been extracted as this was likely to have been true in the majority of cases. This contrasts with the convention applied to five-year-olds under BASCD standardisation which states that all missing incisors should be assumed to have exfoliated (Pine *et al.*, 1997). The data collected in this survey permitted comparison of the results using both conventions. This revealed that very little difference was found in the estimates of severity or prevalence. The mean  $d_3mft$  using BASCD criteria was 0.35 (95%CI 0.34,0.36) while that produced by applying the convention that all missing incisors had been extracted produced an estimate of 0.36 (95%CI 0.35,0.37). Similarly close estimates of prevalence of caries experience arose from the two conventions; 11.6% and 11.7%.

### *Utility*

The information derived from this survey was used to inform Joint Strategic Needs Assessments, Health and Wellbeing Board strategies and plans for Children and Young people programmes. The data was mapped using severity scores and prevalence of both general and incisor caries and the findings used by commissioners of oral health improvement services. Comparisons were made with severity and prevalence data of five-year-olds in the same geographic areas to identify at what ages interventions were required (PHE, 2013). A number of local authorities used the information to make business cases for new fluoride varnish or supervised brushing programmes or to maintain the funding for existing programmes in a climate of cuts to local authority funding.

### *Impact*

Release of survey data by Public Health England resulted in extensive media coverage across national news, on broadcast, print and online. All the major national newspapers reported the results of the survey and mentioned the connection between decay and sugary foods and drinks, as did many local papers. Many of these also ran articles online, bringing the total number of items online to more than 200. The dental trade press and several parenting magazines printed reports. Interviews about the topic were provided to most major morning, lunchtime and evening news and current affairs programmes and radio interviews were conducted for more than 16 regional networks.

## **Discussion**

### *Feasibility*

Using the methodology described it would appear that this type of survey is feasible, although labour intensive. Trained and calibrated fieldwork teams were able to obtain information about pre-school child care sites from their local authorities and undertake the quota sampling method that suited this population. In some situations it was not known how many children of the correct age would be present at each child care site and this made planning more difficult. Teams who started their surveys late in the academic year found fewer children of eligible age at each site than those who started early on.

Coverage was good, although uneven and this may have been because of the varying levels of child care that are provided within each local authority.

Contact with nurseries, children's centres and playgroups was more difficult than that with nursery classes attached to schools as the former were unfamiliar with national dental surveys and the fieldwork teams carrying them out.

Obtaining consent was a little easier than for school based surveys of older children because parents were more present at pre-school sites and could, therefore be asked directly to complete the required forms.

### *Examination*

Children of this age group were able to co-operate with the simple examination as only 8% of consented children declined to take part on the day of examination. Absenteeism accounted for a further loss of 9% of consented children.

### *Convention relating to missing incisors*

The small differences that were found when the estimates arising from the two conventions relating to missing incisors are compared are likely to have arisen because few children had experienced any extractions (4.1%). Among those who had experienced extractions it is likely that very few had lost incisors only and no other teeth. This would explain why the convention which included missing incisors in the calculation of caries experience had little impact.

### *Sources of bias*

The requirement for positive consent may have biased the findings such that lower estimates of caries levels were reported than would have been the case if all children attending child care sites had been included. Previous analysis of the effect of requiring positive consent for dental epidemiological surveys showed that this did bias the results and that the impact of the requirement could not be corrected. Factors over and above socio-economic ones were associated with return of consent forms and these were probably linked with lifestyle and other issues which were also related to the likelihood of caries being present (Davies et al., 2014; Monaghan et al., 2011).

As this survey could only include children attending child care sites it excludes children who are looked after at home or by child minders. It cannot be known if caries levels among these children differ from the survey population so the estimates produced do not relate to the whole population of three-year-olds.

Local policies and geographic distances between centres may have dictated the provision of child care and this may have also influenced results. In more urban areas there may be greater provision of child care than in rural ones.

There may have been some bias relating to ethnicity as this was not a mandatory variable. It is likely that these data were only collected from areas where there was a mix of people from different ethnic backgrounds and less so from areas where the population was predominantly white British. Confounding by socio-economic factors could therefore have featured in this analysis and, as caries levels are associated with ethnicity, have modified the results from estimates given by a whole population. Analysis of the weighted estimates for those where ethnicity was recorded reveals that for this group the mean  $d_{3,mft}$  and proportion with caries experience were no different to the whole sample but a slightly higher proportion had incisors caries (4.1% vs. 3.9%).

### *Utility of information*

The information produced has been welcomed by local authorities and dental public health colleagues who have used it to show which sectors of the population require more support to reduce general and incisor caries and the age at which interventions are best implemented to achieve improvements in caries levels among five year olds. For example, the estimates of disease for clusters of wards have been produced and mapped for some local authorities and these have revealed areas where incisor caries among three-year-olds is highest.

In such areas targeted schemes to reduce long-term bottle use and encourage non-cariogenic drinks for babies have been implemented. In other areas the survey data has highlighted areas where more activity should be focussed on diet and optimising the benefits of fluoride toothpaste for three to five-year-olds.

Knowledge about caries levels among very young children from different ethnic backgrounds is also useful for designing oral health improvement interventions. The finding that caries levels among children from Asian or Asian British backgrounds are higher than other ethnic groups is consistent with that found by the survey of 3 and 4 year olds in East London. That survey concluded that preschool children from a White Eastern European, Bangladeshi and Pakistani background are likely to experience significantly poorer oral health than their White British counterparts (Marcenes *et al.*, 2013).

In a few sites the children involved in this survey at age three will be re-examined at age five. This longitudinal approach could give valuable additional insight into caries progression and the outcomes are awaited.

### Impact

The wide media interest in decay levels among such young children was useful in highlighting the persisting problem of decay in this population. Messages about the causes of decay and methods of preventing it were widespread and given via a range of routes. This is helpful in educating parents and carers in their role and achieved a reach that extended far beyond what could be achieved by current health education methods.

In conclusion, it would seem that wide use of the additional information provided by this survey, over and above that of routinely surveyed five-year-olds would justify the additional time and resources involved as the information generated is useful and the impact in raising the issue of oral health in very young children was significant.

### Acknowledgements

The co-operation of all the child care sites, parents and children is gratefully acknowledged, as are the considerable efforts of all the regional epidemiology coordinators and standards and the fieldwork teams who worked diligently to complete this survey.

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