

# The caries experience of 5-year-old children in Scotland, Wales and England in 2011–2012: Reports of cross-sectional surveys using BASCD criteria

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**Objective:** This paper collates differences in methods and trends in caries prevalence in surveys of the oral health of young children undertaken in Scotland, Wales and England in 2011–12. For Wales and England this was the second survey carried out since changes were required in consent arrangements. **Method:** In compliance with BASCD criteria representative samples were drawn within the geographies of primary care organisations across the UK, and within Local Authorities across England and Wales. Consent was sought in two ways; via opt-in parental consent in England and Wales and opt-out parental consent in Scotland. Children aged five were examined in England and those aged 5 to 6 were examined in Wales and Scotland. Examinations were conducted in schools by trained and calibrated examiners and caries was diagnosed at the dentinal threshold using visual criteria. **Results:** In Scotland there is a continuing decline in caries prevalence in young school children. Comparison with the previous survey using positive consent in England and Wales shows a decline in caries in both England and Wales although decay levels remain higher in more deprived areas. **Conclusion:** International comparisons assist in interpreting data and trends even if there are some differences in approach. A trend line is more useful than a single data point for monitoring of oral health. This second survey using positive parental consent in England and Wales has enabled trend analysis for the first time since the consent arrangements changed.

**Key words:** epidemiology, dental caries, dmf index, Great Britain, parental consent

## Introduction

This paper reports on the data from surveys of the oral health of children at the start of formal education carried out in Scotland, Wales and England during the school year 2011–2012. Fieldwork for these was carried out by National Health Service clinical teams using training, calibration, sampling and criteria to measure caries experience established by the British Association for the Study of Community Dentistry (BASCD) (Pine *et al.*, 1997a, 1997b; Pitts *et al.*, 1997). United Kingdom (UK) level national training was provided by BASCD for regional coordinators, trainers and standard examiners using criteria consistent with previous surveys and the BASCD criteria.

The United Kingdom consists of Great Britain (England, Scotland and Wales) plus Northern Ireland and health matters are a matter for the national parliamentary bodies in each of these countries. Northern Ireland chose not to collect caries data through a survey in 2011/2012. In the remaining three countries examinations were carried out in state-funded primary schools using standardised portable equipment, techniques and conventions. In the UK formal education commences at age 5 and only 6% of children in the UK are in private schools and therefore not included in the survey. Dental caries was diagnosed at the caries into dentine (d<sub>3</sub>) level using a visual method only. No use was made of radiography, transillumination or compressed air.

The introduction of a requirement for positive parental (opt-in) consent in England and Wales in 2006 limited direct comparison of results with Scotland (Davies *et al.*, 2011, 2014). This requirement was not introduced in Scotland, where a form of passive parental (opt-out) consent underpins their National Dental Inspection Programme. Scotland can undertake retrospective comparison with data collected prior to 2006, whereas England and Wales cannot. England and Wales have had to set new baselines because of the change in consent arrangements and have only collected data using the revised approach once since then. The collection of data in 2011–12 provides a second data point and the monitoring of decay trends over the last four years in England and Wales. This paper provides an overview of the results and signposts the complete results.

## Scotland

### Method

Following UK calibration of benchmark examiners in June 2011, training and calibration of 47 fieldwork teams was carried out in Edinburgh in November 2011. Training involved an introductory session, followed by revision of the survey procedures, tooth/surface codes and diagnostic criteria based on the BASCD Trainers' Pack. Clinical training sessions were then undertaken on school children, and

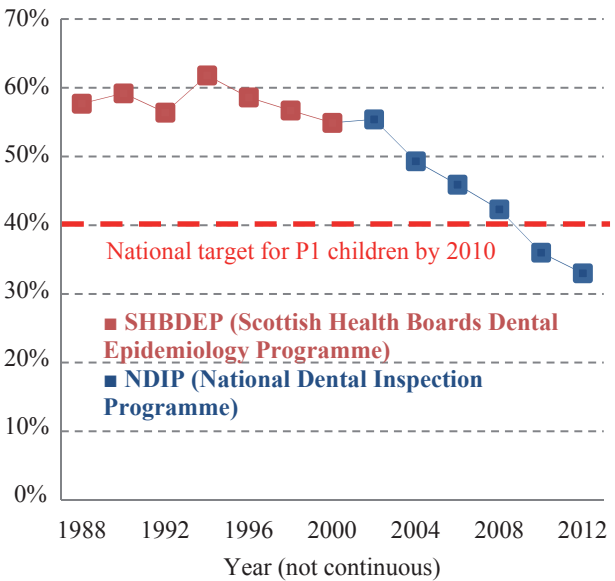
were followed by calibration sessions on a further group of Primary 1 (P1) children. Calibration sessions involved four groups of examiners examining 12 children. Inter-examiner agreement was assessed using percentage agreement and Kappa statistic assessed at the patient level for the 12 children examined in each of the four groups (Cohen, 1960).

Each of the 14 NHS Boards in Scotland identified the number of children needed to obtain a representative sample from their primary one population. The sample sizes provided adequate numbers to allow meaningful comparisons between NHS Boards to be drawn. Using the residential postcode of the child, caries results for each NHS Board are calculated by the Scottish Index of Multiple Deprivation (SIMD) quintile for that Health Board. These are then corrected to match the expected Board quintile ensuring that the result is representative of the Health Board population (SIMD, 2009). Caries results for each Health Board are then weighted by population to give the mean Scottish figures. In the course of the survey, 10% of the children in the sample were re-inspected to assess the consistency of the examination decisions of the dentists who were undertaking the inspections and check for diagnostic reliability during the fieldwork.

### Results

All 47 dental teams calibrated with percentage agreement ranging from 94% to 99% and the Kappa estimates for  $d_3mft$  scores at the patient level did not drop below moderate agreement ( $K=0.41-0.60$ ). For eight inspection teams, the Kappa level was lower than substantial, but no lower than moderate agreement.

Across Scotland 13,232 children were inspected, representing 24.1% of the state sector P1 population (children aged 5-6 in their first year of schooling). Across the 14 NHS Boards the percentage inspected ranged from 9.1% to 98.2%. The average age of the children examined was 5.5 years for both girls and boys – the same as for the four previous surveys 2004/10 (Merrett *et al.*, 2008; Pitts *et al.*, 2007).



**Figure 1.** Twenty-four year trend in the proportion of Primary 1 Scottish children (five-year-olds) with obvious decay experience

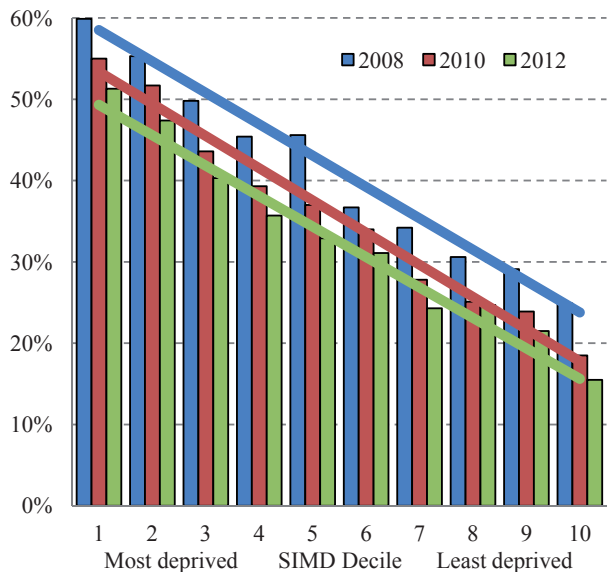
By 2012, the Scottish mean  $d_3mft$  had decreased to 1.35 (from 1.52 in 2010). The percentage of P1 children across Scotland having obvious decay experience reduced to an all time low of 33%, down from 36% in 2010. Across the 14 Health Boards mean  $d_3mft$  ranged from 0.79 teeth in Orkney to 1.57 in Eilean Siar (The Western Isles) while the prevalence of tooth decay experience ranged from 21.3% in Orkney to 38% in Eilean Siar.

Figure 1 shows the long term trend in the percentage of Primary 1 Scottish Children with obvious decay experience. In 2008 residential postcodes were used for the first time to allocate each child to a datazone allowing stratification of the national caries results by SIMD quintile or decile. Since then it has been possible to attribute SIMD values to most children who were examined in each of the three most recent surveys. Figure 2 shows the caries inequalities gradient based on the prevalence of children with tooth decay experience by SIMD decile. While tooth decay is reducing across all deciles, the best-fit regression lines approximating to the relative health inequalities gradient appears to be constant.

### Comment

The Epidemiological surveys of tooth decay at the level of Health Boards in Scotland started in 1988 when BASCD introduced surveys of 5-year-olds. inclusion of the 1983 OPCS survey results allow a national trend in mean  $d_3mft$  to be charted for the last 28 years. Both the mean  $d_3mft$  and the percentage of children with tooth decay experience show steady improvement since 2003. Figure 1 demonstrates the decline in caries prevalence. This is largely credited to the Scottish Childsmile programme (child-smile.org.uk) which provides a range of preventive interventions which include free toothbrushes and fluoride toothpaste for all children aged one to five years, plus daily weekday supervised toothbrushing for children aged 3 to 5 years of age. The 2012 mean  $d_3mft$  value of 1.35 is the lowest since national data began to be collected in 1983.

Results of the 2011/12 survey are available at [www.scottishdental.org/index.aspx?o=2153](http://www.scottishdental.org/index.aspx?o=2153).



**Figure 2.** Proportion of Primary 1 children with obvious decay experience by Scottish Index of Multiple Deprivation decile; 2008, 2010 and 2012

## England

### Method

Within England, The Dental Observatory (2011) provided a national protocol which was based on the standards laid down by BASCD for undertaking population representative epidemiological surveys of caries among child cohorts. Following the UK training and calibration event all ten regional coordinators cascaded training to Primary Care Trust fieldwork teams and organised regional calibration exercises. This ensured that all fieldwork teams were aware of essential aspects of the protocol and examiners were standardised against regional standard examiners who had themselves been calibrated against the UK standard examiner.

The geographical unit for sampling was lower tier Local Authorities (LAs) and all state funded, mainstream schools were included in the first level of sampling. Within sampled schools children of the correct age were identified and randomly sampled in larger schools. Consent was sought from parents of all children randomly sampled to take part and a second request for this was sent for parents who did not respond to the first. Examination was only carried out with children for whom positive, written consent had been provided.

### Results

Estimates of caries severity and prevalence could be calculated for 310 out of 326 lower tier LAs. Thirteen LAs did not take part in the survey and in three LAs fewer than 30 children were examined so a robust estimate could not be computed. This level of coverage is similar to that in recent previous surveys.

Included in the final analysis were 133,516 children, representing 65.2% of those sampled and 21.0% of this age group in mainstream, state schools. This total compares with 66.8% of those sampled in the 2008 survey and 25% of the age group in mainstream schools. Weight-

ing of the responses by deprivation quintile to allow for shortfalls or over-representation of particular quintiles in specific LAs or PCTs was undertaken to produce improved estimates of caries levels for each population. Overall the weighted mean severity for England was 0.94  $d_3mft$  (95% confidence interval 0.93, 0.95), significantly lower than the previous survey when the estimate was 1.11 (95%CI 1.10, 1.12). The prevalence was also lower, being 27.9 % in 2012 (95%CI 27.7%, 28.1%) compared with 30.9% in 2008 (95%CI 30.7%, 31.1%). The same boundaries have been retained from 2008 and 2012 by 289 local authorities, so for these comparison is possible. In 27 LAs (9.3%) caries estimates of severity were statistically significantly lower than in the 2008 survey, 257 LAs (89%) had similar levels and in 5 LAs (1.7%) there was an apparent statistically significant increase in caries severity (Figure 3). The trend for reduced levels of caries was apparent in all government office regions. For eight of those nine regions mean caries levels in 2012 were statistically significantly lower than in 2008.

Analysis of data by deprivation, using home postcode Index of Multiple Deprivation scores (IMD) revealed significant reductions in caries levels in all deprivation quintiles when 2012 data were compared with 2008 data. The reductions increased as deprivation increased.

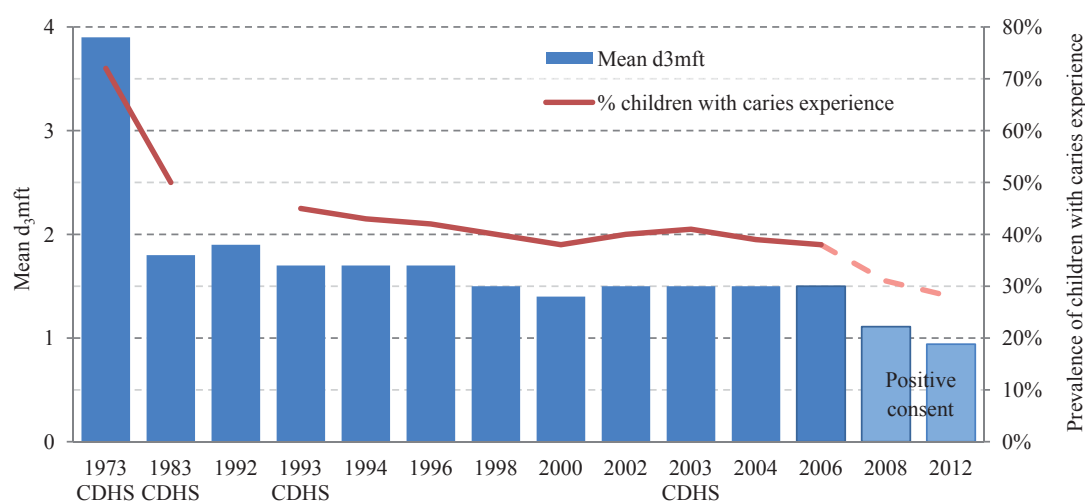
### Comment

Further analysis is being undertaken to investigate the most likely reasons for the apparent reduction in caries levels in England. Survey data are available at [www.nwph.net/dentalhealth](http://www.nwph.net/dentalhealth).

## Wales

### Method

Immediately following the UK training and calibration exercise the Wales training and calibration exercise was held to train fieldwork teams in the new consent arrangements and the examination criteria. With the ex-



**Figure 3.** Changes in mean  $d_3mft$  and proportions of children with caries experience among 5 year olds reported by Child Dental Health Surveys (CDHS) and National Dental Epidemiology Programme surveys over time in England

Notes: The scale of data collection years is not uniform. Surveys involving positive consent (opt-in) are shown as paler bars for severity and with a dashed line for prevalence

ception of Powys the seven new Local Health Boards in Wales are not coterminous with the 22 Unitary Authorities (UAs) referred to in the last survey. The boundaries of the remaining six do however match that of 2, 3, 5 or 6 UAs, thus their data and awareness of school year population size allows weighted Local Health Board data to be calculated. Sampling was undertaken on a UA basis and the data in this report are referred to by UA.

Dental epidemiological surveys in Wales are now required to use positive parental consent (Welsh Assembly Government, 2006). The 2011-12 protocol for Wales included standard letters inviting participation and response slips which were adapted by the fieldwork teams with local contact details. These letters were sent to parents with a stamped addressed envelope on two occasions, in contrast with the 2007-08 survey which employed one mail-shot only. Examiners only examined those children willing to co-operate who had been sampled for the survey and whose parents had returned a positive consent. Data collected by fieldwork teams were checked locally before forwarding to the Welsh Oral Health Information Unit for data cleaning and analysis.

## Results

Some 11,561 children were sampled and 7,734 examined. Across Wales this equates to 67% of those children sampled who were examined. Across the UAs in Wales the participation rate varied from 51% in Newport to 82% in Neath Port Talbot. Although use of a second mailing

in Wales generated a higher response rate than the single mailing in 2007-08 (56% of those sampled in Wales), the participation rate of those sampled remains well below the 87% Welsh average when negative consent method was used in 2005-06 (see Table 1).

Previous analysis suggested that those without caries were more likely to participate in surveys than those with caries experience (Monaghan *et al.*, 2011, Davies *et al.*, 2011). Thus it might be expected that the use of a second mailing in 2011-12 in Wales would result in greater participation from those with caries experience than the first mailing did, and therefore be associated with a slight rise in reported caries prevalence. Further analysis of the Welsh data demonstrated that respondents to the second mailing for consent did have higher levels of decay than first mailing respondents. Despite this change and finding in 2011-12 the proportion of children with caries prevalence was lower than in 2007-08 (41% compared with 48%). Similarly there were falls in mean  $d_3mft$  scores from 1.98 (95%CI 1.89-2.07) in 2007-08 to 1.59 (95%CI 1.52-1.67) in 2011-12, and in mean  $d_3mft$  scores of those with caries experience ( $d_3mft(d_3mft>0)$ ) from 4.16 (95%CI 4.02-4.29) in 2007-8 to 3.85 (95%CI 3.72-3.97) in 2011-2012. The overall picture is of improved caries prevalence among P1 children in Wales.

Although at the all Wales level there was a statistically significant reported reduction in caries prevalence and severity in 2011-12 compared with 2007-08, the patterns at UA level were less stark. For caries prevalence ( $\%d_3mft>0$ ), mean decay experience ( $d_3mft$ ) and mean

**Table 1.** Participation rates for surveys of Primary 1 children (five-year-olds) in Wales

Unitary Authority	Positive Consent (opt-in)									Passive Consent (opt-out)		
	2011-12 both mailshots			2011-12 one mailshot		2007-08 one mailshot			2005-06 one mail shot			
	Sample drawn	Number examined	% of sample	Number examined	% of sample	Sample drawn	Number examined	% of sample	Sample drawn	Number examined	% of sample	
Anglesey	431	326	75.6	274	63.6	397	256	64.5	382	361	94.5	
Blaenau Gwent	339	179	52.8	161	47.5	341	138	40.5	350	277	79.1	
Bridgend	353	244	69.1	234	66.3	339	221	65.2	380	348	91.6	
Caerphilly	558	319	57.2	301	53.9	475	211	44.4	596	476	79.9	
Cardiff	822	647	78.7	576	70.1	1,311	751	57.3	1,448	1,291	89.2	
Carmarthenshire	482	322	66.8	307	63.7	534	391	73.2	495	442	89.3	
Ceredigion	246	201	81.7	175	71.1	236	155	65.7	241	189	78.4	
Conwy	473	268	56.7	211	44.6	531	319	60.1	483	446	92.3	
Denbighshire	597	315	52.8	267	44.7	455	277	60.9	412	371	90.0	
Flintshire	772	573	74.2	441	57.1	706	585	82.9	748	679	90.8	
Gwynedd	981	706	72.0	623	63.5	920	530	57.6	921	850	92.3	
Merthyr	100	60	60.0	49	49.0	184	93	50.5	162	134	82.7	
Monmouth	597	416	69.7	366	61.3	559	294	52.6	543	436	80.3	
Neath Port Talbot	589	484	82.2	431	73.2	639	394	61.7	643	542	84.3	
Newport	445	227	51.0	185	41.6	494	180	36.4	508	371	73.0	
Pembrokeshire	374	273	73.0	200	53.5	380	252	66.3	456	396	86.8	
Powys	596	387	64.9	343	57.6	536	368	68.7	496	440	88.7	
Rhondda Cynon Taf	608	403	66.3	344	56.6	714	409	57.3	699	618	88.4	
Swansea	905	582	64.3	530	58.6	985	489	49.6	985	865	87.8	
Torfaen	487	224	46.0	187	38.4	349	166	47.6	384	306	79.7	
Vale of Glamorgan	293	212	72.4	174	59.4	406	297	73.2	472	437	92.6	
Wrexham	509	366	71.9	299	58.7	571	324	56.7	449	385	85.7	
All Wales	11,557	7,734	66.9	6,678	57.8	12,662	7,100	56.1	12,253	10,660	87.0	



decay experience among those with decay experience (mean  $d_3mft(d_3mft>0)$ ), there were 1 or 2 UAs where these indicators were slightly worse but where the difference was not significant, a larger number of UAs where the indicators suggested improved caries prevalence but again not statistically significant, and from 2 to 5 UAs where the improvement seen was statistically significant.

Reduced caries prevalence was seen in Bridgend (45% to 35%), Caerphilly (55% to 44%), Carmarthenshire (53% to 31%) and Newport (61% to 45%). From 2007-08 to 2011-12 there was a significant decrease in the mean decay experience of children with decay ( $d_3mft(d_3mft>0)$ ) in Flintshire (3.7 to 2.9), Swansea (4.6 to 3.6) and Carmarthenshire (4.2 to 3.2). Together these factors contributed to significant falls in mean  $d_3mft$  between 2007-08 and 2011-12 in Bridgend (1.7 to 1.1), Caerphilly (2.4 to 1.7), Carmarthenshire (2.2 to 1.0), Flintshire (1.6 to 1.0), and Swansea (2.2 to 1.6). It should be noted that in all of these UAs the number of children examined exceeded the minimum required by the BASCD standards.

Decay in Wales is still more frequent in more deprived communities. In Blaenau Gwent there was no evidence of improvement in oral health across these surveys. The overall mean  $d_3mft$  score of 3.1 is the result of the fact that 64% of children in Blaenau Gwent have some decay experience; and for those children with decay experience an average of 4.8 teeth are affected by decay.

### Comment

There was a slight increase in the average age of participating children in 2011-12 compared with 2007-08 which would be expected to be associated with an increase in reported deciduous decay rather than a decrease. The second mailing would also be expected to contribute to an increase in reported decay levels. Wales started running a pilot nursery-based supervised tooth-brushing campaign in 2009 targeting 3 to 5 year-olds in the more deprived quintiles of the population called Designed to Smile (see [www.designedtosmile.co.uk](http://www.designedtosmile.co.uk) for further details). This programme has been rolled out across Wales since 2009 and may be one factor contributing to reported falls in decay levels.

Details of the 2011-12 Welsh survey including full results can be found at [cardiff.ac.uk/dentl/research/themes/appliedclinicalresearch/epidemiology/oralhealth](http://cardiff.ac.uk/dentl/research/themes/appliedclinicalresearch/epidemiology/oralhealth)

### Discussion

The reductions in disease prevalence and severity are to be welcomed. Caries levels in the permanent dentition among samples of older children have been reducing since 1973 (Davies *et al.*, 2012) but levels among five year olds have shown far less improvement in the past 20 years. Further analysis is required to establish where these improvements have taken place and which sub-groups have benefited. This should lead to some indication of the likely reasons for the changes in disease levels in each country.

The changed consent arrangements in England and Wales, but not Scotland, present a continuing challenge to those wishing to compare caries experience between all three nations. Legal opinion has required the current

consent arrangements in Wales and England. This is unlikely to be reversed unless evidence is provided that all other avenues have been explored. Even so there is no certainty that we could return to the previous arrangements. Developing further understanding of the impact of the new consent arrangements will assist in interpretation of the data and comparison with data across national boundaries. In the meantime those who require data for monitoring oral health and planning of services need to understand both the current oral health of the population and trends in disease experience. Making further changes to data collection and reporting means starting again from a new baseline. Thus it seems wise to maintain the current arrangements for data collection and reporting.

### Recommendations

Readers are reminded that the form of consent affects participation rates of children with and without caries and as a result direct comparison of findings from Scotland with those from England and Wales is not appropriate. Further analysis of the impact of the consent arrangements will be needed to inform any further changes in data collection or reporting.

Detailed analysis of datasets in all three countries could test hypotheses which might explain the reasons for changes in disease levels.

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