hscic Health & Social Care Information Centre

Children's Dental Health Survey 2013

Report 4: The Burden of Dental Disease in Children

England, Wales and Northern Ireland

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This report may be of interest to members of the public, health policy officials, Consultants in Dental Public Health and other members of the dental profession, epidemiologists and other academics interested in children's health.

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Executive Summary

This report focuses on children who have particularly severe or extensive oral health conditions where the lifetime burden to the individual or health care system is likely to be substantial. The report looks firstly at children with severe or extensive tooth decay, identifying the proportions with many teeth affected by decay or some teeth affected by very serious decay. Using a composite indicator of those affected by severe or extensive decay, the report explores the characteristics and behaviours associated with the presence of this disease burden. The proportions of children with severe dental trauma (accidental damage), substantial tooth surface loss and unmet orthodontic treatment need on dental health grounds are also described.

A similar proportion of 5 year olds (13%) and 15 year olds (15%), roughly 1 in 7 children, were categorised as having either severe or extensive decay or both. There were substantial differences in this population by country of residence with Wales (22% at age 5 and 15) and Northern Ireland (19% at age 5 and 36% at age 15) showing a higher proportion with a decay burden than England (13% at age 5 and 14% at age 15).

A heavy decay burden was not distributed equally in society. Those from more deprived backgrounds, as measured by their eligibility for free school meals[1], had a much larger proportion with severe or extensive decay than those from more affluent backgrounds. In 15 year olds, a quarter (26%) of those eligible for free school meals had severe or extensive decay compared to 12% who were not eligible, and a similar pattern was evident in 5 year olds. A range of behavioural factors such as less frequent tooth brushing, less frequent dental attendance, a higher daily frequency of consuming sugary drinks and lower frequency of consuming water were all significantly associated with being in the group with the highest decay burden.

A logistic regression model was used to look in more detail at the associations between the characteristics and behaviour of 15 year olds and their likelihood of having severe or extensive decay. Once other factors were taken into account, 15 year olds were more likely to suffer severe or extensive decay if they lived in Wales or Northern Ireland, were eligible for free school meals, attended the dentist only when they had trouble or consumed sugary drinks more than four times a day. Drinking water at least once a day reduced the likelihood.

Around one-in-twenty 15 year olds (4%) had symptoms of severe dental trauma, and there was little evidence of any difference in prevalence related to any specific risk factor. This is likely to be due to the random, accidental nature of much of this traumatic damage. It nevertheless remains a substantial burden for the individual and for treatment services.

Severe tooth surface loss, sometimes described as tooth wear, usually occurs as a result of various processes which include acid erosion. Higher prevalence was associated with deprivation measured by eligibility for free school meals. Behavioural factors were not significantly associated with severe tooth surface loss, except that the prevalence was higher among 15 year olds who attended the dentist only with trouble, or who drank water less than once a day.

Orthodontic need was also measured at age 12 and 15. The costs of orthodontic treatment are high but the predisposing factors are generally not closely related to disease or behaviours but are more related to genetic predisposition, though this risk may be modified by disease or treatment. At age 12, the difference in unmet treatment need between those

[1] In 2013 when this survey took place, a free school meal was a statutory benefit available **only** to school aged children from families who received other qualifying benefits (such as Income Support)

who were eligible for free school meals and those who were not eligible was small and not significant. At age 15, the proportion who still had a treatment need, but were not in treatment, was significantly higher amongst those who were eligible for free school meals; 32%, compared to 17% of those not eligible. The reasons for this discrepancy are unclear.

In summary, the report shows that between 10% and 15% of 5 and 15 year olds suffer from each of these high burden diseases or conditions: severe or extensive decay, trauma or tooth surface loss. There are, however, substantial social inequalities in the distribution of these conditions, with children from the most deprived backgrounds generally being more likely to suffer this burden than other children. Individual circumstances and behaviours seem to increase the risk of suffering from such conditions.

The association between relative deprivation and unmet orthodontic treatment need on grounds recognised by the NHS for treatment at the age of 15 is an important additional observation. It suggests that more deprived children are missing out on this potential investment in their health. The reasons for this are not clear but may include higher levels of disease, disease risk or perhaps lower levels of engagement with the dental profession.

4.1 Introduction and methodology

4.1.1 Introduction

The 2013 Children's Dental Health Survey, commissioned by the Health and Social Care Information Centre (www.hscic.gov.uk), is the fifth in a series of national children's dental health surveys that have been carried out every ten years since 1973.

The 2013 survey provides information on the dental health of children in England, Wales and Northern Ireland. The survey measures changes in oral health since the last survey in 2003 and provides information on children's experiences, behaviours and attitudes relevant to their oral health.

Dental diseases can have consequences and costs, both to individuals and to the health care system that supports them. The scale of this burden, and what it means in terms of dental care, will vary, but when a tooth is decayed to a point where it is removed or restored there are consequences for the individual that will persist and likely increase for the rest of their life. These consequences may include the cost of maintenance, repair or replacement; the impact on function; and implications for self-esteem.

This may even apply to primary teeth, which will all usually be naturally lost by age 14, as the impact on the oral environment or on the eruption of the teeth that succeed them may be significant. Where disease affects many teeth, the interventions required to manage the teeth tend to become larger and more costly. Sometimes the burden to the child, their family or society can become very considerable. A relatively common and costly example is where there is pain and sepsis that can disrupt normal life or where a general anaesthetic needs to be used to provide treatment, resulting in the need for a hospital admission. Given what we know about the distribution of ill health and service use in general, we would not expect this burden of disease to be equally distributed across the population. This report describes the distribution for dental decay that is severe or extensive. It also covers dental trauma, non-carious tooth surface loss and orthodontic conditions.

4.1.2 Survey methodology

A representative sample of children aged 5, 8, 12 and 15 years attending state and independent schools, including academies and free schools in England but excluding special schools, were selected to take part in this survey. A parallel survey of children educated in special needs schools has been conducted as part of the NHS epidemiology programme in England and the results are expected to be published in March 2015[2].

A total of 13,628 children were sampled in participating schools, and 9,866 dental examinations were completed. Participation rates varied across the age cohorts, broken down as follows:

- 5 year olds 70%
- 8 year olds 65%
- 12 year olds 83%
- 15 year olds 74%.

[2] The results of that survey are expected to be published during 2015 on the following website: http://www.nwph.info/dentalhealth/

The requirement for positive written parental consent for the dental examination for 5 and 8 year olds reduced response from those cohorts.

Those 12 and 15 year olds who were examined were asked to complete a questionnaire at the same appointment as their examination; 99.6% of them completed it.

Parents of all children who were examined were invited to complete a questionnaire; the overall response rate was 43%, with response being higher amongst the parents of 5 and 8 year olds who had already provided written consent for the dental examination.

Levels of missing data within productive cases were generally low. Item non-response on the dental examination was generally below 1% of eligible cases, with the highest non-response recorded in relation to trauma to permanent teeth (up to 2.1% of cases). For straightforward question formats, item non-response in the pupil and parent questionnaires was generally below 2%. Questions using a yes/no grid format for items on a list had the highest item non-response from both children and parents. As the majority of this non-response represented failure to tick the 'no' codes relevant to the individual, it was assumed that this was the case in the production of the derived variables associated with these questions.

Further information on the survey design and implementation can be found in the Quality Statement and Technical Report published alongside this report[3].

4.1.3 Note on text and tables

Differences cited in the text are statistically significant ($p<0.05$) unless otherwise stated. This means that there is approximately a 1 in 20 risk that the difference does not exist in reality in the population when sampling error is taken into account.

A dash in a table indicates a zero value, while an asterisk indicates a proportion of less than 0.5% or a mean of less than 0.05.

The statistics in the tables are produced using weights that adjust for selection probabilities, non-response bias and population totals. The unweighted bases shown in each table indicate the number of valid responses on which the estimates are based. Weighted bases are presented for some estimates alongside standard errors and confidence intervals in Annex A. The weighted and unweighted bases may vary slightly across tables due to item non-response.

Figures presented in parentheses [ ] indicate a low base number of respondents and results are indicative only.

[3] http://www.hscic.gov.uk/pubs/ChildDentalHealth

4.2 Severe or extensive dental decay

The overall distribution of decay in children is discussed in Report 2. The presence of dental caries is not normally distributed in the population[4]. In all age groups and all areas there are large numbers of children with relatively good oral health. There are also, however, many children who have some dental caries into dentine and for some of them the number of teeth that are affected can be quite high. In Report 2, amongst 5 year olds with decay into dentine in primary teeth, the mean number of teeth affected was 3.0. In 15 year olds with decay in permanent teeth, the mean number of teeth affected was 3.1[5]. Across the population the burden of this disease is likely to be closely related to the extent and the severity of the decay present.

This report identifies a subgroup of children who are more likely to have significant problems related to dental caries in the short or long term, based on the distribution of several caries-related states that reflect untreated disease or likely treatment need. These include multiple teeth affected by caries, teeth which have been or are likely to be lost, and pain or sepsis related to dental caries.

For 5 year olds we have identified four specific conditions:

- the presence of five or more teeth with experience of decay into dentine (dmft of 5+, also categorised as high dmft, an indicator of extensive decay)[6]
- the presence of three or more teeth with obvious dental decay lesions (new or recurrent, an indicator of extensive decay)
- the presence of any very severely decayed teeth that are deemed 'unrestorable' (severe decay)
- the presence of any evidence of sepsis as part of the PUFA examination[7] (severe decay)

For 15 year olds the same conditions apply, but at age 15 these refer to permanent teeth (indicated by 'DMFT' rather than 'dmft'[6]). Also, an additional severe decay condition has been added, the loss of any permanent tooth due to decay. The reason for tooth loss is usually relatively straightforward for the examiner to ascertain on the basis of tooth position and disease history. Where tooth loss occurs due to decay, this represents a substantial impact by age 15. Among younger children, missing primary teeth were coded as unerupted permanent teeth, regardless of why they were missing, so this measure is not reported among 5 year olds.

As these are different manifestations or stages of the same disease we would expect considerable overlap. We have created a category for those children with one or more of these conditions in order to capture all children with severe or extensive dental decay. Any child who exceeds any of the thresholds applied here would have been, at the time of the

[4] See Report 2 "Dental Disease and Damage in Children", sections 2.3 and 2.4 http://www.hscic.gov.uk/pubs/ChildDentalHealth

[5] See Report 2 "Dental Disease and Damage in Children", section 2.4.2, Table 2.24 http://www.hscic.gov.uk/pubs/ChildDentalHealth

[6] The total number of Decayed, Missing (due to decay) or Filled Teeth is widely used as an index of a child's decay experience. This is abbreviated to the acronyms "dmft" for primary teeth and "DMFT" for permanent teeth

[7] PUFA is an acronym for referring to four signs of sepsis: open Pulp, obvious Ulceration, Fistula and Abscess. The PUFA examination looked for signs of serious infection (sepsis) that usually occur where a tooth has been affected by very advanced decay or extensive treatment.

survey, likely to require substantial management in the short or long term or both. This composite variable is used for the subsequent analysis as the main marker of disease burden.

The presence of both primary and permanent teeth in the same mouth, which is usual for 8 and 12 year olds, creates specific analytical and descriptive problems when presenting data on dental caries. Consequently, in the interests of clarity, this analysis is restricted to 5 and 15 year olds, since 5 year olds usually only have primary teeth, and 15 year olds usually only permanent ones.

4.2.1 The prevalence and distribution of individual conditions

Tables 4.1 and 4.2 show the distribution of the various severe or extensive decay conditions defined in the introduction for 5 and 15 year olds across England, Wales and Northern Ireland. Overall 13% of 5 year olds and 15% of 15 year olds were affected by severe or extensive dental decay. Although the overall prevalence of each individual condition ranged between 4% and 11% for 5 year olds and 2% and 9% for 15 year olds, there was quite substantial variation by country, with higher proportions of children in Wales and Northern Ireland affected than in England.

Table 4.1 Percentage of 5 year olds with severe or extensive dental decay, by country

England, Wales and Northern Ireland, 2013				Percentages
Children aged 5	England	Wales	Northern Ireland	Total
5+ teeth with obvious decay experience (high dmft)	6	11	13	6
3+ teeth with decay into dentine	10	19	18	11
Any unrestorable teeth	5	7	5	5
Any PUFA signs	4	6	5	4
Any of these	**13**	**22**	**19**	**13**
Unweighted bases	*1,526*	*493*	*530*	*2,549*

Table 4.2 Percentage of 15 year olds with severe or extensive dental decay, by country

England, Wales and Northern Ireland, 2013				Percentages
Children aged 15	England	Wales	Northern Ireland	Total
5+ teeth with obvious decay experience (high dmft)	8	14	28	9
3+ teeth with decay into dentine	5	11	10	6
Any unrestorable teeth	2	2	3	2
Any PUFA signs	2	2	3	2
Loss of any permanent teeth due to decay	6	11	13	6
Any of these	**14**	**22**	**36**	**15**
Unweighted bases	*1,313*	*554*	*551*	*2,418*

For 5 year olds, differences were particularly evident for counts of both high dmft and 3+ teeth with decay into dentine; where the prevalence for Wales and Northern Ireland was close to double that for England. The differences for unrestorable teeth and signs of sepsis were much smaller and not statistically significant.

For 15 year olds there was a similar pattern to that found for 5 year olds across the three countries in relation to high DMFT, decayed teeth and teeth missing due to decay, with much higher values for Wales and Northern Ireland. In Northern Ireland, the 28% of 15 year olds with a DMFT of five or more stands out, being 20 percentage points higher than in England, representing a rate of prevalence over three times that found in England. The DMFT statistic captures previous disease in the form of fillings and extractions and it is likely that this finding from Northern Ireland is a reflection of both current disease and treatment approaches over the previous decade whilst permanent teeth were erupting. High levels of untreated decay (three or more teeth) were also more prevalent in Wales and Northern Ireland (11% and 10% respectively) compared to England (5%) but again signs of sepsis were not significantly more frequent, suggesting that services are managing to limit the progression to this stage.

The differences between England, Wales and Northern Ireland for individual conditions are reflected when the prevalence of any of these conditions is combined. In England, 13% of 5 year olds had one or more of these conditions, compared with 22% in Wales and 19% in Northern Ireland. At the age of 15, over a third of children in Northern Ireland (36%) fell into this category, compared with 22% in Wales and 14% in England.

A large caries burden in Northern Ireland is nothing new. In 2003 the mean DMFT for 15 year olds was 4.4 compared with just 1.8 for 15 year olds in England. Although we did not investigate disease burden in the same way in 2003 as we have here, we can look back at the 5 year olds in Northern Ireland from 2003 to see whether their relative position to England and Wales is reflected in the 15 year olds a decade later. In 2003 Northern Ireland 5 year olds had a mean dmft of 2.5 compared to just 1.5 for England and 1.9 in Wales, so the relative positions look similar to the 15 year olds of 2013. The new data for the 5 year olds in 2013 suggests the difference between Northern Ireland and England at this age, whilst still

significant, is now somewhat reduced. The relative position is now much closer to that in England and the burden in Northern Ireland is approximately the same as in Wales[8].

4.2.2 The prevalence of individual conditions by sex and eligibility for free school meals

Tables 4.3 and 4.4 show the prevalence of the severe or extensive dental decay burden variables for all countries by the sex and free school meal eligibility status of children (the latter is an indicator of relative family deprivation).

In 5 year olds, boys were more likely to have at least one of the indicators of severe or extensive decay than girls (16% compared to 10%, Table 4.3).

There are strong and consistent relationships between eligibility for free school meals and all markers of severe or extensive dental decay, with a significantly higher probability of having a high caries burden amongst those who are eligible for free school meals (21% compared to 11%, Table 4.4).

Table 4.3 Percentage of 5 year olds with severe or extensive dental decay, by sex

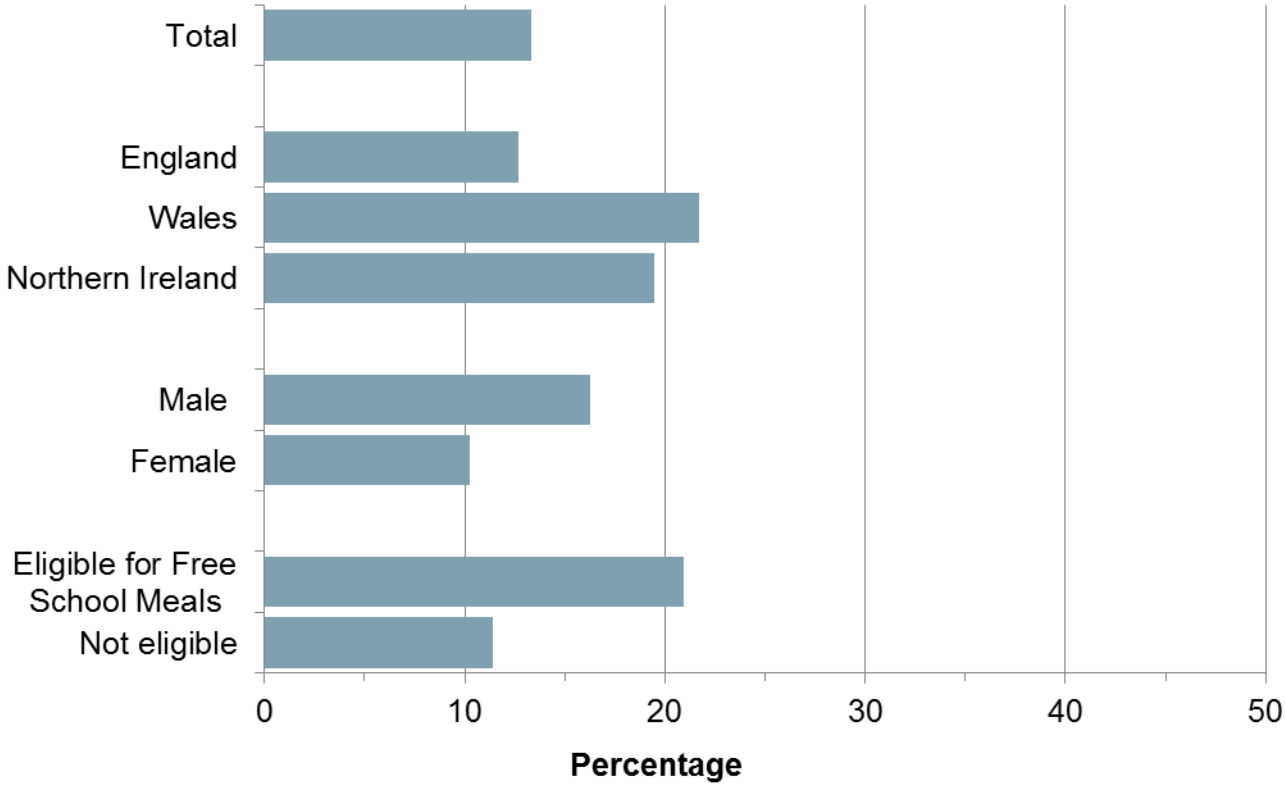
England, Wales and Northern Ireland, 2013	Percentages	
Children aged 5	Male	Female
5+ teeth with obvious decay experience (high dmft)	7	5
3+ teeth with decay into dentine	13	8
Any unrestorable teeth	6	4
Any PUFA signs	5	4
Any of these	**16**	**10**
Unweighted bases	*1,264*	*1,285*

[8] See "Obvious decay experience: Children's Dental Health in the United Kingdom 2003" available at: http://www.ons.gov.uk/ons/guide-method/method-quality/specific/health-methodology/dental-health/dental-health-of-children/index.html

Table 4.4 Percentage of 5 year olds with severe or extensive dental decay, by eligibility for free school meals

England, Wales and Northern Ireland, 2013		Percentages
Children aged 5	Eligible	Not eligible
5+ teeth with obvious decay experience (high dmft)	11	5
3+ teeth with decay into dentine	19	9
Any unrestorable teeth	11	4
Any PUFA signs	8	3
Any of these	**21**	**11**
Unweighted bases	*584*	*1,897*

Figure 4.1 Percentage of 5 year olds with severe or extensive decay, 2013



Unlike the 5 year olds, among 15 year olds there was a similar percentage of male and female children who had at least one indicator of severe decay (including those with active decay, Table 4.5). As with the 5 year olds, however, there were very substantial differences between those entitled and those not entitled to free school meals, with 26% of those entitled to free school meals having one or more of the caries burden markers, compared to 12% amongst other children (Table 4.6).

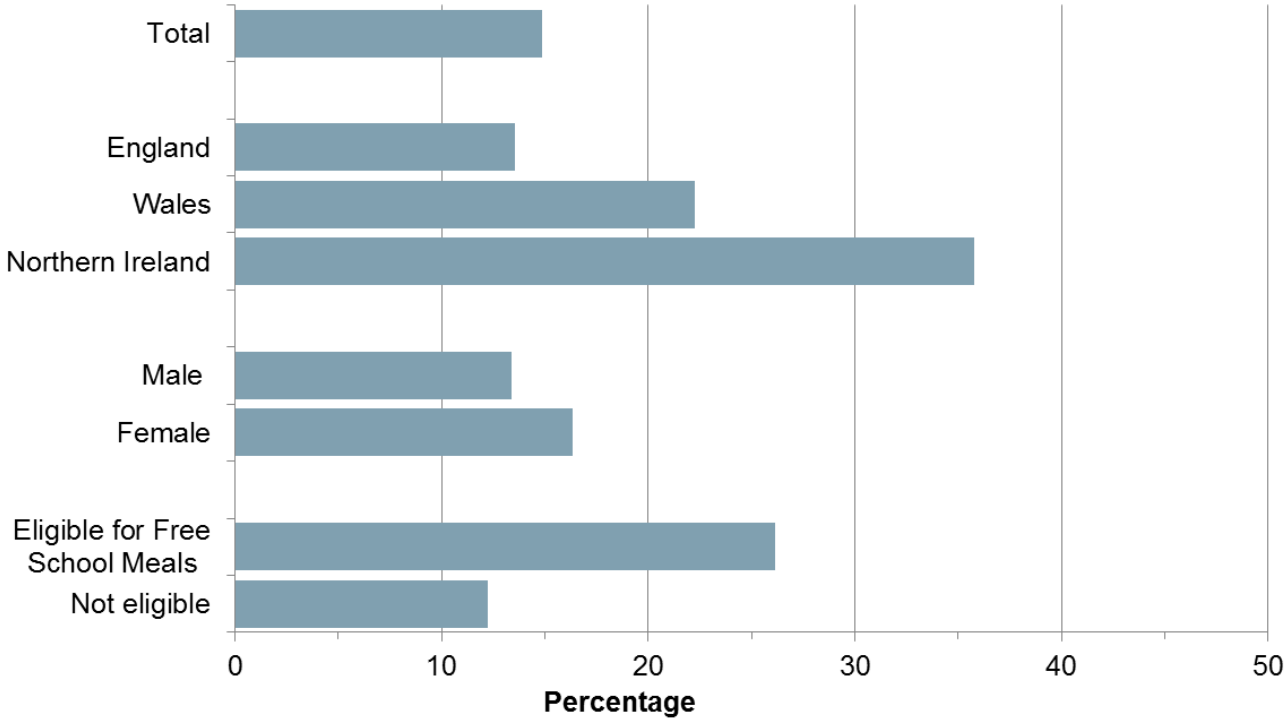
Table 4.5 Percentage of 15 year olds with severe or extensive dental decay, by sex

England, Wales and Northern Ireland, 2013	Percentages	
Children aged 15	Male	Female
5+ teeth with obvious decay experience (high DMFT)	8	10
3+ teeth with decay into dentine	5	6
Any unrestorable teeth	2	2
Any PUFA signs	2	1
Loss of any permanent teeth due to decay	6	7
Any of these	**13**	**16**
Unweighted bases	*1,155*	*1,263*

Table 4.6 Percentage of 15 year olds with severe or extensive dental decay, by eligibility for free school meals

England, Wales and Northern Ireland, 2013	Percentages	
Children aged 15	Eligible	Not eligible
5+ teeth with obvious decay experience (high DMFT)	17	7
3+ teeth with decay into dentine	10	5
Any unrestorable teeth	5	1
Any PUFA signs	5	1
Loss of any permanent teeth due to decay	10	5
Any of these	**26**	**12**
Unweighted bases	*508*	*1,761*

Figure 4.2 Percentage of 15 year olds with severe or extensive decay, 2013



4.2.3 The relationship between individual conditions and behaviour

Table 4.7 shows for 5 year olds the relationship between decay and tooth brushing frequency for those children whose parent returned a questionnaire. Young children who brush their teeth (or whose teeth are brushed) less than twice a day had much higher rates of severe or extensive decay.

Table 4.7 Percentage of 5 year olds with severe or extensive dental decay, by frequency of tooth brushing

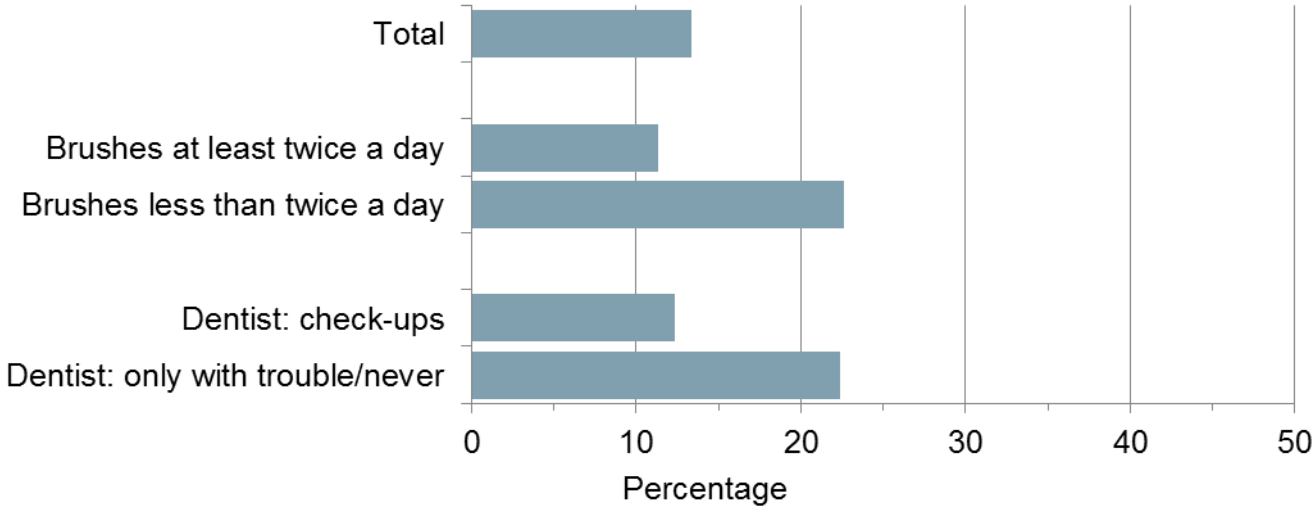
England, Wales and Northern Ireland, 2013	Percentages	
Children aged 5	At least twice a day	Less than twice a day
5+ teeth with obvious decay experience (high DMFT)	6	14
3+ teeth with decay into dentine	9	22
Any unrestorable teeth	5	12
Any PUFA signs	4	8
Any of these	**11**	**23**
Unweighted bases	*1,021*	*205*

There were also marked differences between 5 year olds whose parents said their child went to the dentist for regular check-ups compared with those who went only when their child had trouble or never went (Table 4.8). The experience of decay was much higher among the latter group.

Table 4.8 Percentage of 5 year olds with severe or extensive dental decay, by pattern of dental attendance

England, Wales and Northern Ireland, 2013	Percentages	
Children aged 5	Regular check-ups	Only when trouble/ Never
5+ teeth with obvious decay experience (high DMFT)	7	17
3+ teeth with decay into dentine	10	22
Any unrestorable teeth	6	10
Any PUFA signs	4	7
Any of these	**12**	**22**
Unweighted bases	*1,133*	*100*

Figure 4.3 Percentage of 5 year olds with severe or extensive decay, by tooth brushing frequency and dental attendance pattern, 2013



Tooth brushing and dental attendance were reported directly by 15 year old children (Table 4.9 and 4.10). As with 5 year olds, there was less likelihood of severe or extensive decay amongst 15 year olds with behaviours indicating engagement with oral health (brushing twice a day and attendance for check-ups) compared with 15 year olds without these behaviours.

Table 4.9 Percentage of 15 year olds with severe or extensive dental decay, by frequency of tooth brushing

England, Wales and Northern Ireland, 2013	Percentages	
Children aged 15	At least twice a day	Less than twice a day
5+ teeth with obvious decay experience (high DMFT)	8	12
3+ teeth with decay into dentine	5	8
Any unrestorable teeth	1	4
Any PUFA signs	2	3
Loss of any permanent teeth due to decay	6	8
Any of these	**14**	**20**
Unweighted bases	*1,880*	*497*

Table 4.10 Percentage of 15 year olds with severe or extensive dental decay, by pattern of dental attendance

England, Wales and Northern Ireland, 2013			Percentages
Children aged 15	Regular check-ups	Only when trouble	Never
5+ teeth with obvious decay experience (high DMFT)	7	18	8
3+ teeth with decay into dentine	4	11	27
Any unrestorable teeth	1	7	3
Any PUFA signs	1	5	2
Loss of any permanent teeth due to decay	5	16	1
Any of these	**12**	**30**	**28**
Unweighted bases	*1,950*	*374*	*56*

There are strong associations between dietary sugars and dental caries, but in a survey like this, dietary sugar intake is rather difficult to measure reliably. One of the more straightforward approaches is to record the frequency with which sugary foods and drinks are consumed. In this survey, 12 and 15 year olds recorded how many times a day they consumed different drinks, including those with high sugar content. For 15 year olds, consuming sugary drinks, including squash, colas and sports drinks, four or more times a day was associated with severe or extensive dental decay (Table 4.11). This was strongly associated with having high DMFT, three or more teeth with decay into dentine, and having teeth extracted due to caries, as well as severe or extensive dental decay overall.

Table 4.11 Percentage of 15 year olds with severe or extensive dental decay, by frequency of drinking sugary drinks

England, Wales and Northern Ireland, 2013			Percentages
Children aged 15	Less than once a day	One to three times a day	Four or more times a day
5+ teeth with obvious decay experience (high DMFT)	7	8	17
3+ teeth with decay into dentine	4	6	12
Any unrestorable teeth	1	2	4
Any PUFA signs	1	2	4
Loss of any permanent teeth due to decay	4	6	15
Any of these	**11**	**14**	**29**
Unweighted bases	*893*	*1,085*	*408*

Smoothies and fruit juices are also high in sugar. Although 15 year olds who consumed these drinks four or more times a day seemed more likely to have severe or extensive dental decay, this relationship was not statistically significant (Table 4.12). This is due to the relatively small numbers of 15 year olds who drank fruit juice or smoothies four or more times a day.

Table 4.12 Percentage of 15 year olds with severe or extensive dental decay, by frequency of drinking fruit juice and smoothies

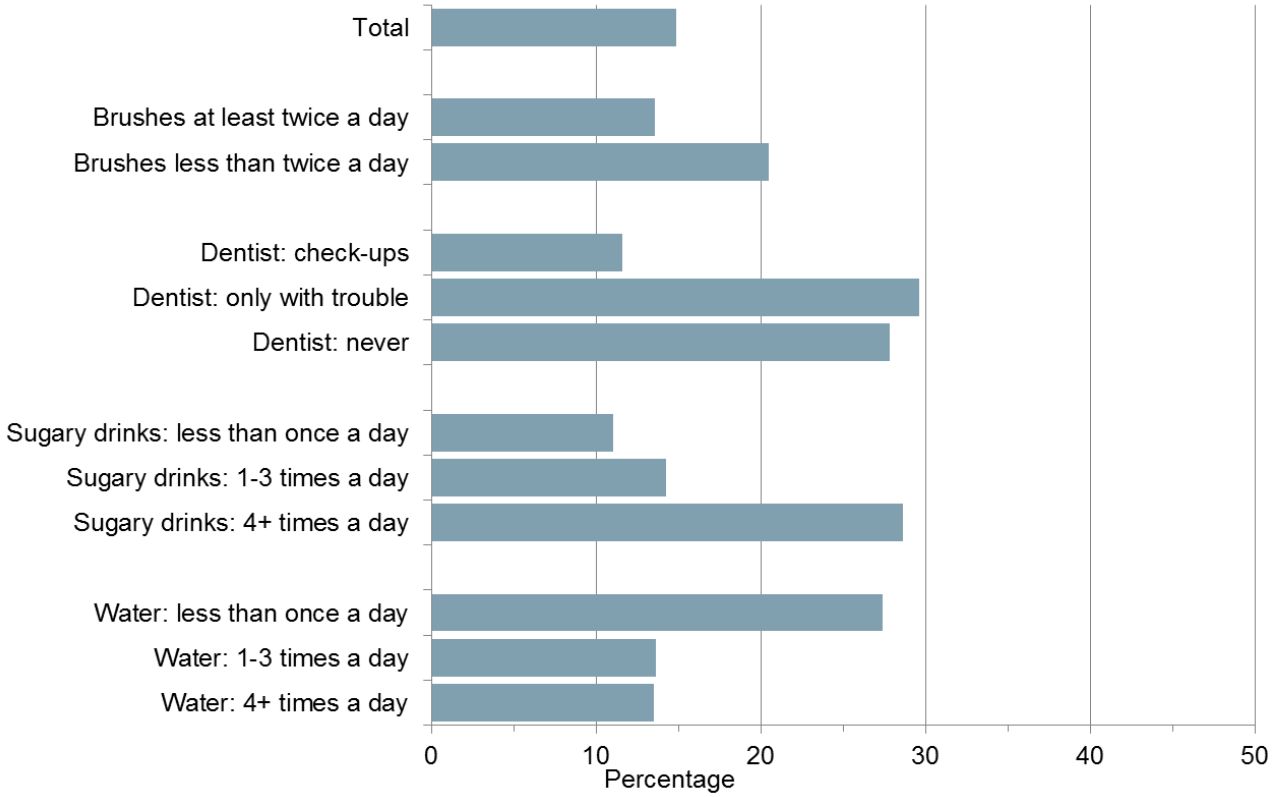
England, Wales and Northern Ireland, 2013			Percentages
Children aged 15	Less than once a day	One to three times a day	Four or more times a day
5+ teeth with obvious decay experience (high DMFT)	7	10	14
3+ teeth with decay into dentine	4	6	15
Any unrestorable teeth	2	2	5
Any PUFA signs	2	1	5
Loss of any permanent teeth due to decay	6	6	7
Any of these	**14**	**15**	**22**
Unweighted bases	*1,130*	*1,131*	*116*

Drinking water was associated with a reduced likelihood of severe or extensive dental decay (Table 4.13). Children aged 15 who drank water at least once a day were less likely to have severe or extensive dental decay than those who said they did not drink water every day.

Table 4.13 Percentage of 15 year olds with severe or extensive dental decay, by frequency of drinking water

England, Wales and Northern Ireland, 2013			Percentages
Children aged 15	Less than once a day	One to three times a day	Four or more times a day
5+ teeth with obvious decay experience (high DMFT)	18	8	8
3+ teeth with decay into dentine	10	5	5
Any unrestorable teeth	3	2	2
Any PUFA signs	4	1	2
Loss of any permanent teeth due to decay	11	6	6
Any of these	**27**	**14**	**14**
Unweighted bases	*310*	*1,277*	*786*

Figure 4.4 Percentage of 15 year olds with severe or extensive decay, by tooth brushing frequency, dental attendance pattern and consumption of sugary drinks and water, 2013



Regular smoking is relatively uncommon at age 15 (about 7% in this survey) but for 15 year olds, smoking at least once a week was associated with having high DMFT and three or more teeth with decay into dentine, as well as severe or extensive dental decay overall. There was no significant association with drinking alcohol (Tables 4.14, 4.15). Although from the data presented it is impossible to be certain, the association with smoking may not be cause and effect, but instead a reflection of other health behaviours and risks for which smoking is a particularly good marker.

Table 4.14 Percentage of 15 year olds with severe or extensive dental decay, by smoking experience

England, Wales and Northern Ireland, 2013 — Percentages

Children aged 15	Never smoked	Tried smoking/ used to smoke	Smokes sometimes (not every week)	Smokes at least once a week
5+ teeth with obvious decay experience (high DMFT)	8	7	10	20
3+ teeth with decay into dentine	5	5	4	11
Any unrestorable teeth	2	2	-	2
Any PUFA signs	2	3	-	3
Loss of any permanent teeth due to decay	6	5	6	11
Any of these	**14**	**13**	**12**	**28**
Unweighted bases	*1,693*	*440*	*75*	*176*

Table 4.15 Percentage of 15 year olds with severe or extensive dental decay, by experience of drinking alcohol

England, Wales and Northern Ireland, 2013 — Percentages

Children aged 15	Never drunk alcohol	Tried drinking alcohol/ used to drink alcohol	Drinks alcohol sometimes (not every week)	Drinks alcohol at least once a week
5+ teeth with obvious decay experience (high DMFT)	8	8	10	16
3+ teeth with decay into dentine	8	4	5	10
Any unrestorable teeth	3	1	1	5
Any PUFA signs	3	2	1	-
Loss of any permanent teeth due to decay	7	5	7	5
Any of these	**17**	**13**	**15**	**19**
Unweighted bases	*779*	*745*	*776*	*88*

4.2.4 The relationship between severe or extensive dental decay and the areas where children live

Most recent studies that have investigated social inequalities in oral health have found differences between the least and best well off in society that may be associated with the areas where people live. These relationships are complex and difficult to unpick, but it would be surprising if there were not such differences here; the data reported for free school meals, a marker of relative deprivation, suggest that this is very likely to be the case.

Two area classifications, based on the children's home postcodes, have been used to identify whether there are such relationships and, if so, whether there is a smooth gradient from (relatively) affluent to poor areas, or whether the worst oral health is particularly concentrated in those areas that are most deprived. Understanding this distribution is helpful in determining how we might try to address such inequalities.

The Indices of Multiple Deprivation (IMD) rank small areas in terms of their relative deprivation from highest deprivation to lowest deprivation using a range of indicators, within which measures associated with income and employment are given a high weight[9]. The 2011 ONS Output Area Classification (OAC) takes a slightly different approach and groups small areas based on their relative similarity on a range of 2011 census indicators covering the five census domains: demographic composition (including population density and diversity of the local population in terms of ethnicity), household composition, housing, socio-economic status (including educational qualifications) and employment. The resulting groups are descriptive and not ordered in the same way as IMDs[10].

It should be noted that area classifications describe where children were living at the time of the 2013 survey. They do not capture whether children have moved between different types of area over the course of their lifetime. It is reasonable to assume that 5 year olds are less likely to have made such a move than 15 year olds.

[9] For England see https://www.gov.uk/government/statistics/english-indices-of-deprivation-2010; for Wales, see http://wales.gov.uk/statistics-and-research/welsh-index-multiple-deprivation/?lang=en; for Northern Ireland, see http://www.nisra.gov.uk/deprivation/nimdm_2010.htm . Note that analysis of Wales was completed using the 2011 WIMD rather than WIMD 2014 released in November 2014.

[10] Further information about the 2011 Output Area Classification is available on the ONS website: http://www.ons.gov.uk/ons/guide-method/geography/products/area-classifications/ns-area-classifications/ns-2011-area-classifications/index.html

Table 4.16 shows the data for having any severe or extensive dental decay by 2011 OAC super-groups for 5 and 15 year olds. At the age of 5, the highest prevalence, around one in five, is among those classified as *Hard-pressed living*, *Constrained city dwellers* and *Ethnicity central*.[11] Areas within these groups differ in terms of their ethnic minority mix and other characteristics, but they share in common a higher than average experience of unemployment in large urban areas. This is more than twice the level of prevalence among those classified as *Rural Residents*, *Urbanites* and *Suburbanites*, which are areas of relatively lower unemployment. At age 15 there is, again, an uneven distribution and the burden is highest among those classified as *Ethnicity central* and *Multicultural metropolitans*, both of which are groups covering areas in large urban conurbations with higher than average ethnic minority populations and higher than average unemployment. Prevalence of severe or extensive decay at age 15 is lowest among *Urbanites* and *Suburbanites.*

Table 4.16 Percentage of 5 and 15 year olds with any severe or extensive dental decay, by ONS 2011 Output Area Classification (OAC) supergroups

England, Wales and Northern Ireland, 2013	Percentages	
Children aged 5, 15	5 years	15 years
Rural residents	6	15
Cosmopolitans	[19]	[22]
Ethnicity central	17	20
Multicultural metropolitans	14	19
Urbanites	9	10
Suburbanites	9	10
Constrained city dwellers	18	16
Hard-pressed living	22	16
Unweighted bases		
Rural residents	*472*	*372*
Cosmopolitans	*31*	*26*
Ethnicity central	*131*	*129*
Multicultural metropolitans	*330*	*249*
Urbanites	*293*	*244*
Suburbanites	*360*	*393*
Constrained city dwellers	*183*	*188*
Hard-pressed living	*655*	*714*

[ ] indicate a low base number and results are indicative only

These data indicate that the burden of dental caries is not equally spread across society.

[11] The comparison was made against the reference category of 'Suburbanites', as this group had a consistent sample size and low prevalence of severe or extensive decay in both age groups. The number of children classified as *Cosmopolitans* was too small for reliable comparison.

Analysis by IMD quintile is a little more challenging, because the three countries have slightly different IMD measures, which cannot be combined for analysis (Tables 4.17 to 4.19). The data are most robust for England with its larger sample. The prevalence of any severe or extensive dental decay is 18% at age 5 and 20% at age 15 for the most deprived quintile, but only 4% and 8% respectively for the least deprived[12]. Recent analysis in adults suggests that the nature of the relationships between oral health and socio-demographic measures[13] (such as IMD) are quite variable and depend on the oral health measure being used, but the distribution here is a gradient rather than a sharp cut-off between categories. Similar patterns were found in Wales and Northern Ireland, although small base sizes limit the statistical significance of these patterns and probably accounts for the slightly more untidy picture.

The burden of decay is not evenly distributed. Whilst severe or extensive decay is clearly not restricted to the most deprived in society, the risks appear to be much higher where there is deprivation.

Table 4.17 Percentage of 5 and 15 year olds with any severe or extensive dental decay, by 2010 English Index of Multiple Deprivation

England, 2013					Percentages
Children aged 5, 15	1 (highest deprivation)	2	3	4	5 (lowest deprivation)
5 year olds	18	18	11	8	4
15 year olds	20	12	9	10	8
Unweighted bases					
5 year olds	*591*	*283*	*236*	*184*	*173*
15 year olds	*531*	*244*	*157*	*172*	*156*

[12] The difference across all quintiles for 15 year olds in England is not statistically significant.

[13] Steele JG, Shen J, Tsakos G, Fuller E, Morris S, Watt RG, Guarnizo-Herreño CC, Wildman J. *The interplay between socio-economic inequalities and clinical oral health*. Published online before print October 24, 2014, doi: 10.1177/0022034514553978
http://jdr.sagepub.com/content/early/2014/10/20/0022034514553978.abstract

Table 4.18 Percentage of 5 and 15 year olds with any severe or extensive dental decay, by 2014 Welsh Index of Multiple Deprivation

Wales, 2013					Percentages
Children aged 5, 15	1 (highest deprivation)	2	3	4	5 (lowest deprivation)
5 year olds	30	29	14	23	[9]
15 year olds	32	20	25	15	[19]
Unweighted bases					
5 year olds	*146*	*101*	*82*	*93*	*41*
15 year olds	*169*	*138*	*80*	*83*	*39*

[ ] indicate a low base number and results are indicative only

Table 4.19 Percentage of 5 and 15 year olds with any severe or extensive dental decay, by 2010 Northern Ireland Measure of Multiple Deprivation (MDM)

Northern Ireland, 2013					Percentages
Children aged 5, 15	1 (highest deprivation)	2	3	4	5 (lowest deprivation)
5 year olds	[38]	25	14	14	10
15 year olds	53	35	34	23	[26]
Unweighted bases					
5 year olds	*48*	*121*	*168*	*121*	*62*
15 year olds	*141*	*148*	*117*	*85*	*46*

[ ] indicate a low base number and results are indicative only

4.2.5 Factors associated with severe or extensive dental decay in 15 year olds

The previous sections have outlined factors separately related to severe or extensive dental decay in 15 year olds. Some of these factors are independently related to each other; for example frequency of tooth brushing is associated with severe or extensive dental decay, as is free school meal eligibility, but children who are eligible for free school meals are also less likely to brush their teeth at least twice a day (see section 1.6.1 in Report 1). Logistic regression modelling provides a way to investigate each of these associations, while controlling for other factors.

The model identified associations, not causes; in other words, factors which identify 15 year olds with an increased or decreased risk of severe or extensive dental decay. These variations in risk are expressed as odds ratios and expressed relative to a reference category, which is given a value of 1. Odd ratios greater than 1 indicate higher odds (increased risk), and odds ratios less than 1 indicate lower odds (reduced risk). Also shown are 95% confidence intervals for the odds ratio. Where the interval does not include 1, this category is significantly different from the reference category. For further information on the logistic regression method used, see the technical report[14].

The model included key variables relating to children and their behaviour. The final model was developed using an iterative process to test for significant associations. Variables were rejected if the association with severe or extensive dental decay was not significant. This method enabled the exploration of a large number of potential predictor variables. The analysis was restricted to 15 year olds because they largely have complete permanent dentition and there is a wider range of behavioural variables available from the questionnaire.

The following variables were included in the model:[15]

- Sex
- Country of residence
- Eligibility for free school meals
- Output Area Classification (OAC)
- Frequency of tooth brushing
- Pattern of dental attendance
- Frequency of consuming sugary drinks
- Frequency of consuming fruit juice and smoothies
- Frequency of consuming water
- Experience of smoking
- Experience of drinking alcohol

Among 15 year olds, severe or extensive dental decay was associated with country of residence, deprivation (based on eligibility for free school meals), area characteristics, tooth brushing frequency, pattern of dental attendance, consumption of sugary drinks and of water, and smoking (Tables 4.1 to 4.19).

Associations with severe or extensive dental decay and each of the variables listed above were first explored in bivariate (cross-tabular) models that investigated the relationship

[14] http://www.hscic.gov.uk/pubs/ChildDentalHealth
[15] Because of the variation between countries, it was not possible to include Indices of Multiple Deprivation.

without controlling for other variables. These models confirmed the associations already shown (data not shown).

In a model containing only classificatory variables (sex, country of residence, eligibility for free school meals and OAC) country of residence and eligibility for free school meals were significantly associated with severe or extensive dental decay, but not sex, or OAC (data not shown).

These associations persisted when behavioural variables were added to the model. The final model is shown in Table 4.20. The variables that were significantly associated with severe or extensive dental decay in 15 year olds were the following:

- Country of residence: 15 year olds in Wales and Northern Ireland were more likely to have severe or extensive dental decay than those in England (odds ratios: Wales=1.87, Northern Ireland=3.91).
- Eligibility for free school meals: 15 year olds who were eligible for free school meals were more likely to have severe or extensive dental decay (odds ratio=1.99).
- Pattern of dental attendance: compared with 15 year olds who attended for regular check-ups, those who never went to the dentist were more likely to have severe or extensive dental decay (odds ratio=2.55), as were those who went only when they had trouble (odds ratio=2.93).
- Consumption of sugary drinks: 15 year olds who consumed sugary drinks four times a day or more had increased odds of having severe or extensive dental decay, compared with those who did not drink sugary drinks every day (odds ratio=2.13). This relationship did not exist for those who drank sugary drinks between one and three times a day.
- Consumption of water: 15 year olds who consumed water at least once a day had decreased odds of having severe or extensive dental decay, compared with those who did not drink water every day (odds ratios: water one to three times a day=0.60, four or more times a day=0.59).

Although the frequency of tooth brushing is associated with severe or extensive dental decay, in the multivariate model this association is not apparent because frequency of brushing is highly correlated with the pattern of dental attendance. Dental attendance appears to be a more powerful factor within the model probably because the advice that dentists give is likely to include effective methods of brushing as well as frequency.

Multivariate models such as this are complex to interpret because the variables under investigation include those that are related for example to the wider environment (those related to geography or deprivation) and those that are related to more direct behavioural risks (such as diet or tooth brushing). They do allow the common problem of confounding to be addressed, to show the independent influences that are left when confounding is accounted for. With time, more complex models may well be designed that are able to probe these nuanced relationships using very sophisticated statistics, but this relatively straightforward model clearly identifies strong and important independent associations with deprivation and geography as well as some very important behaviours related to diet and engagement with professional services.

Table 4.20 Characteristics significantly associated with severe or extensive dental decay among 15 year olds (odds ratios)

England, Wales and Northern Ireland, 2013

Children aged 15 — 95% confidence interval

Variable	Unweighted bases	Odds ratio	p-value	Lower	Upper
Country of residence (p<0.001)					
England	*1,313*	1			
Wales	*554*	1.87	0.035	1.04	3.34
Northern Ireland	*551*	3.91	<0.001	2.63	5.81
Eligibility for free school meals (p=0.002)					
Not eligible	*1,761*	1			
Eligible	*508*	1.99	0.001	1.32	2.99
Not answered	*149*	1.84	0.082	0.92	3.68
Pattern of dental attendance (p<0.001)					
Check-ups	*1,950*	1			
Only with trouble	*374*	2.93	<0.001	1.88	4.58
Never	*56*	2.55	0.045	1.02	6.35
Not answered	*38*	1.78	0.146	0.81	3.88
Consumption of sugary drinks (p<0.001)					
Less than once a day		1			
One to three times a day	*893*	1.2	0.415	0.77	1.87
Four times or more a day	*1,085*	2.13	0.001	1.38	3.28
Not answered	*408*	0.53	0.395	0.12	2.33
Consumption of water (p=0.014)					
Less than once a day	*310*	1			
One to three times a day	*1,277*	0.6	0.016	0.4	0.91
Four times or more a day	*786*	0.59	0.011	0.4	0.88
Not answered	*45*	0.68	0.559	0.18	2.54

4.3 Other conditions

4.3.1 The prevalence and distribution of trauma in permanent incisors

Trauma can be defined for the purposes of this analysis as fractures into dentine or pulp, discolouration due to trauma, permanent restorations placed because of trauma or one or more teeth that are missing due to trauma. Trauma can affect any child and the management of teeth damaged in this way can be both quite complex and long-term, generally with implications that will last a lifetime. In the worst cases the tooth may be lost and need to be replaced, or require root treatment and repeated restorations through a lifetime. In less severe cases the tooth can be repaired but the repair will then need lifetime management. In this analysis we have reported trauma to permanent teeth at a level where the dentine of the tooth has been involved (or is thought to be involved) or worse (pulp involvement or loss of the tooth). Minor damage clearly restricted to the enamel is excluded and we have only reported for 15 year olds as this represents the likely lifetime burden to permanent teeth from trauma in childhood.

The risks of trauma are, by their nature, random, usually related to accidents during play or sport and on the whole would not be expected to be closely correlated with other health behaviours.

The proportion of 15 year olds affected is very similar across the three countries, at around 4% of the population and there are no significant differences related to sex, free school meals, brushing or attendance (Table 4.21).

Table 4.21 Percentage of 15 year olds with any trauma in permanent incisors, by country, sex, eligibility for free school meals, frequency of tooth brushing and pattern of dental attendance

England, Wales and Northern Ireland, 2013	Percentage	*Number*
Children aged 15	Any trauma	*Unweighted bases*
Total	4	*2,418*
Country		
England	4	*1,313*
Wales	4	*554*
Northern Ireland	3	*551*
Sex		
Male	4	*1,155*
Female	3	*1,263*
Eligibility for free school meals		
Eligible	5	*508*
Not eligible	3	*1,761*
Frequency of tooth brushing		
Twice a day or more	3	*1,880*
Less than twice a day	3	*497*
Pattern of dental attendance		
For check-ups	3	*1,950*
Only with trouble	4	*374*
Never	-	*56*

4.3.2 The prevalence and distribution of surface loss into dentine in two or more incisors or four teeth overall

As soon as teeth erupt they start to wear, losing tiny amounts of tissue through everyday use. This is usually a slow process that only gradually becomes evident as the damage accumulates over a lifetime. Sometimes though it is much more rapid, and in children and young adults this is probably usually related to damage from acids in the diet or less commonly from the stomach (for example frequent vomiting). Dietary acids can come from various sources including fruits and fruit juices, but carbonated drinks (even those that are not high in sugar) are thought to be particularly damaging. Consuming sugary drinks four or more times a day was reported in 16% of 12 year olds and 14% of 15 year olds[16]. In the case of tooth wear the problem is not the sugar in food and drink, but acids in the formulation. Many sugary drinks can also be quite acidic, but acidic drinks with the potential to cause non-carious tooth surface loss can be sugar free (low calorie or sugar free carbonated drinks for example).

The implications of excessive non-carious tooth surface loss (wear) to the teeth manifest when the teeth become sufficiently damaged to affect the appearance or cause pain and sensitivity. Treating severely worn teeth can be complex, and as with trauma and dental decay, results in a substantial lifetime treatment burden because when significant tooth surface loss occurs it usually affects many teeth which often require extensive restorations.

In this report non-carious tooth surface loss is shown for both 5 and 15 years of age. At age 5 the wear will only affect the primary teeth, and wear in these teeth would rarely be treated before they were shed. Nevertheless, such early wear might indicate a significant risk to the subsequent dentition when it finally erupts. At age 15 the permanent teeth are affected. Although active treatment at this age is uncommon, this is a progressive condition and where several teeth are affected would be a real concern as it would indicate very early damage and a considerable risk and potential burden for the future.

Table 4.22 shows that 14% of 5 year olds have wear into the dentine affecting at least two incisor teeth. There are some differences by country, with Wales and Northern Ireland having slightly more children affected. Caution should be exercised with comparisons between countries as the measures of tooth wear were less reliable when submitted to calibration testing than were other examination measures, such as decay.[17]

There were no differences for sex, attendance or tooth brushing habits, but there was a large and significant difference between those who were eligible for free school meals (21%) and those who were not (12%). This is a pattern similar to that found for tooth decay, possibly reflecting some similar risks related to, for example, dietary behaviours (Tables 4.22-4.26).

[16] See Report 1 "Attitudes, Behaviours and Children's Dental Health" section 1.6.2 Table 1.61 http://www.hscic.gov.uk/pubs/ChildDentalHealth

[17] See section 4.1 of the survey Technical Report for a write up of examiner calibration. http://www.hscic.gov.uk/pubs/ChildDentalHealth

Table 4.22 Percentage of 5 year olds with tooth surface loss in two or more primary incisors, by country

England, Wales and Northern Ireland, 2013				Percentages
Children aged 5	England	Wales	Northern Ireland	Total
Surface loss into dentine in at least two incisors	13	16	21	14
Unweighted bases	*1,526*	*493*	*530*	*2,549*

Table 4.23 Percentage of 5 year olds with tooth surface loss in two or more primary incisors, by sex

England, Wales and Northern Ireland, 2013		Percentages
Children aged 5	Male	Female
Surface loss into dentine in at least two incisors	14	13
Unweighted bases	*1,264*	*1,285*

Table 4.24 Percentage of 5 year olds with tooth surface loss in two or more primary incisors, by eligibility for free school meals

England, Wales and Northern Ireland, 2013		Percentages
Children aged 5	Eligible	Not eligible
Surface loss into dentine in at least two primary incisors	21	12
Unweighted bases	*584*	*1,897*

Table 4.25 Percentage of 5 year olds with tooth surface loss in two or more primary incisors, by frequency of tooth brushing

England, Wales and Northern Ireland, 2013		Percentages
Children aged 5	At least twice a day	Less than twice a day
Surface loss into dentine in at least two primary incisors	12	19
Unweighted bases	*1,021*	*205*

Table 4.26 Percentage of 5 year olds with tooth surface loss in two or more primary incisors, by pattern of dental attendance

England, Wales and Northern Ireland, 2013		Percentages
Children aged 5	Regular check-ups	Only when trouble/never
Surface loss into dentine in at least two primary incisors	14	9
Unweighted bases	*1,133*	*100*

At age 15, when permanent teeth have erupted, it was possible to look at two different areas of the mouth. The pattern of wear can vary somewhat depending on the specific causes but the first teeth to erupt (the first molars and the incisors) tend to be the first to show wear. In order to capture different possible patterns a threshold has been set of either two incisors or four teeth overall (which may include up to four molars) showing surface loss into dentine. Although this is an arbitrary threshold it should capture only children who have unequivocal signs of tooth wear that is sufficiently extensive to be a potential problem.

At this age there are no significant differences between countries or between sexes with about 4% of the population of 15 year olds affected by significant tooth surface loss. There is again a significant difference according to free school meal status (8% of those who are eligible, 3% for those who are not) that suggests there may be a social pattern that is of relevance, and that the potential burden in future is likely to be amongst those from less well-off backgrounds (Tables 4.27 to 4.29).

Table 4.27 Percentage of 15 year olds with tooth surface loss in two or more permanent incisors or four teeth overall, by country

England, Wales and Northern Ireland, 2013				Percentages
Children aged 15	England	Wales	Northern Ireland	Total
Surface loss into dentine in at least two permanent incisors	3	4	4	3
Surface loss into dentine in at least four permanent incisors or molars	3	1	3	3
Either of these	**4**	**4**	**4**	**4**
Unweighted bases	*1,313*	*554*	*551*	*2,418*

Table 4.28 Percentage of 15 year olds with tooth surface loss in two or more permanent incisors or four teeth overall, by sex

England, Wales and Northern Ireland, 2013	Percentages	
Children aged 15	Male	Female
Surface loss into dentine in at least two permanent incisors	3	3
Surface loss into dentine in at least four permanent incisors or molars	2	3
Either of these	**4**	**4**
Unweighted bases	*1,155*	*1,263*

Table 4.29 Percentage of 15 year olds with tooth surface loss in two or more permanent incisors or four teeth overall, by eligibility for free school meals

England, Wales and Northern Ireland, 2013	Percentages	
Children aged 15	Eligible	Not eligible
Surface loss into dentine in at least two permanent incisors	5	3
Surface loss into dentine in at least four permanent incisors or molars	7	2
Either of these	**8**	**3**
Unweighted bases	*508*	*1,761*

Table 4.30 Percentage of 15 year olds with tooth surface loss in two or more permanent incisors or four teeth overall, by frequency of tooth brushing

England, Wales and Northern Ireland, 2013	Percentages	
Children aged 15	At least twice a day	Less than twice a day
Surface loss into dentine in at least two permanent incisors	3	6
Surface loss into dentine in at least four permanent incisors or molars	2	3
Either of these	**3**	**6**
Unweighted bases	*1,880*	*497*

Table 4.31 Percentage of 15 year olds with tooth surface loss in two or more permanent incisors or four teeth overall, by pattern of dental attendance

England, Wales and Northern Ireland, 2013		Percentages
Children aged 15	Regular check-ups	Only when trouble/ Never
Surface loss into dentine in at least two permanent incisors	3	6
Surface loss into dentine in at least four permanent incisors or molars	2	5
Either of these	**3**	**6**
Unweighted bases	*1,950*	*430*

Differences in the prevalence of serious tooth surface loss among 15 year olds according to how many times they drank either sugary drinks or fruit juice and smoothies tended to show a trend towards more wear with greater frequency of consumption but differences were not significant. The risk of wear is not related to sugars, but to acids. We did not have a variable that was related to acidity in drinks, but many manufactured beverages and soft drinks have the potential to cause tooth surface loss. Water is generally not particularly acidic and children who drank water less than once a day were significantly more likely than other children to have serious tooth surface loss (Tables 4.32 to 4.34).

Table 4.32 Percentage of 15 year olds with tooth surface loss in two or more permanent incisors or four teeth overall, by frequency of drinking sugary drinks

England, Wales and Northern Ireland, 2013			Percentages
Children aged 15	Less than once a day	One to three times a day	Four or more times a day
Surface loss into dentine in at least two permanent incisors	2	4	5
Surface loss into dentine in at least four permanent incisors or molars	1	3	4
Either of these	**2**	**4**	**5**
Unweighted bases	*878*	*1,064*	*405*

Table 4.33 Percentage of 15 year olds with tooth surface loss in two or more permanent incisors or four teeth overall, by frequency of drinking fruit juice or smoothies

England, Wales and Northern Ireland, 2013			Percentages
Children aged 15	Less than once a day	One to three times a day	Four or more times a day
Surface loss into dentine in at least two permanent incisors	4	3	6
Surface loss into dentine in at least four permanent incisors or molars	3	1	6
Either of these	**4**	**3**	**7**
Unweighted bases	*1,130*	*1,131*	*116*

Table 4.34 Percentage of 15 year olds with tooth surface loss in two or more permanent incisors or four teeth overall, by frequency of drinking water

England, Wales and Northern Ireland, 2013			Percentages
Children aged 15	Less than once a day	One to three times a day	Four or more times a day
Surface loss into dentine in at least two permanent incisors	7	3	3
Surface loss into dentine in at least four permanent incisors or molars	6	2	2
Either of these	**7**	**3**	**4**
Unweighted bases	*310*	*1,277*	*786*

4.3.3 The prevalence and distribution of unmet orthodontic treatment need among 15 year olds

Orthodontic malocclusion[18] is a term used to describe the arrangement and relationship of the teeth and jaws. It differs from other dental conditions in that it is not a disease and there are rarely obvious behavioural risks that can be moderated to prevent it but it can affect dental health, function and appearance. Orthodontic malocclusion can be treated by moving the teeth orthodontically. Treatment is usually of a relatively finite nature, with costs largely restricted to the time (usually 2 to 3 years) that the patient is undergoing treatment. At the end of orthodontic treatment, oral health should be improved and the enhanced appearance can have a positive psychological impact. Treatment is normally provided during the teenage years.

Demand for orthodontic services is high and treatment is specialised. Orthodontic treatment therefore presents a significant cost burden to society, including the cost of care (which may be state or privately funded), the potential for missed schooling (with appointments every six to eight weeks during treatment) and parental costs (including travel, time off work). The combined burden for society is therefore potentially considerable.

The threshold for when treatment is provided is necessarily arbitrary, and in this analysis we use the same threshold as in 2003, which is similar to that currently used within the NHS. Eligibility for treatment within the NHS is currently assessed using the Index for Orthodontic Treatment Need (IOTN)[19] which has two components, a dental health component and aesthetic component. Where the IOTN score indicates a need beyond a specific minimum threshold on the dental health component alone, or the dental health component and aesthetic components (often both), free treatment is available to any child under the age of 18 years provided that the oral health is otherwise satisfactory.

The dental health component assesses need based on missing teeth, overjet, crossbites, contact point displacements and overbite[20]. A Dental health component score of 4 indicates great need for treatment and 5 indicates very great need for treatment. Children with these scores will be eligible for orthodontic treatment. Some NHS contracts allow treatment for more severe categories of dental health component 3 (moderate need for treatment). The overall dental attractiveness of the anterior teeth is assessed using the IOTN aesthetic component. This compares the anterior teeth with ten standard photographs and grades of 8 to 10 are regarded as a definite need for treatment. The threshold applied across the NHS is by convention often a little lower than this (6 or above). The aesthetic component is a validated but, by necessity, subjective measure. The slightly higher threshold (8-10) is applied here to be consistent with the 2003 survey. For unmet need it also indicates a fairly unequivocal aesthetic indication.

[18] An orthodontic malocclusion is a problem in the way the upper and lower teeth fit together in biting or chewing.
[19] Brook PH, Shaw WC. The development of an index of orthodontic treatment priority. European Journal of Orthodontics, 1989; 11: 309-320
[20] For definitions of these terms, see the glossary contained in the Technical Report http://www.hscic.gov.uk/pubs/ChildDentalHealth

Table 4.35 shows that, at the time of the examination, 9% of 12 year old and 18% of 15 year old children were undergoing orthodontic treatment. This reflects the normal timing of orthodontic intervention. Among 15 year olds the percentage was at similar levels in all three countries (16% to 19%). Among 12 year olds, 8% in England and Wales were recorded as currently undergoing treatment, compared with 17% in Northern Ireland. Seemingly orthodontic intervention begins a little earlier in Northern Ireland.

Table 4.35 Percentage of 12 and 15 year olds undergoing orthodontic treatment, by country and age

England, Wales and Northern Ireland, 2013			Percentages
Children aged 12, 15	12 years	15 years	Total
England	8	18	13
Wales	8	16	12
Northern Ireland	17	19	18
Total	9	18	13
Unweighted bases			
England	*1,425*	*1,307*	*2,732*
Wales	*614*	*554*	*1,168*
Northern Ireland	*484*	*551*	*1,035*
Total	*2,523*	*2,412*	*4,935*

The remainder of this section is based on 12 and 15 year olds who were not undergoing treatment at the time of the dental examination as this indicates the potential residual burden and may also reflect the uptake of orthodontic services.

Table 4.36 shows the unmet orthodontic need at ages 12 and 15, using the thresholds defined above. Services vary geographically to some degree, but the data suggest that there is no significant difference in the unmet need defined by the dental health component between the three countries.

The proportion of children with a score of 8 to 10 in the aesthetic component was also similar across countries. Very few children were assessed as having a score of 8 or above in the aesthetic component who were not also deemed to have a dental health need for treatment as well. Consequently the following analysis concentrates on children with treatment need assessed according to the dental health component.

Table 4.36 Percentage of 12 and 15 year olds with unmet orthodontic treatment need, by country and age

England, Wales and Northern Ireland, 2013			Percentages
Children aged 12, 15, not undergoing orthodontic treatment	12 years	15 years	Total
England			
Unmet orthodontic treatment need (dental health component)	36	20	28
Unmet orthodontic treatment need (aesthetic component score 8-10)	10	4	7
Any unmet orthodontic treatment need (dental health component or aesthetic component score 8-10)	37	20	29
Wales			
Unmet orthodontic treatment need (dental health component)	37	21	29
Unmet orthodontic treatment need (aesthetic component score 8-10)	12	7	10
Any unmet orthodontic treatment need (dental health component or aesthetic component score 8-10)	37	21	29
Northern Ireland			
Unmet orthodontic treatment need (dental health component)	36	18	27
Unmet orthodontic treatment need (aesthetic component score 8-10)	13	3	8
Any unmet orthodontic treatment need (dental health component or aesthetic component score 8-10)	36	18	27
Total			
Unmet orthodontic treatment need (dental health component)	36	20	28
Unmet orthodontic treatment need (aesthetic component score 8-10)	10	5	7
Any unmet orthodontic treatment need (dental health component or aesthetic component score 8-10)	37	20	28
Unweighted bases			
England	*1,300*	*1,087*	*2,387*
Wales	*562*	*459*	*1,021*
Northern Ireland	*399*	*435*	*834*
Total	*2,261*	*1,981*	*4,242*

Similar proportions of boys and girls were assessed as having unmet orthodontic treatment need (Table 4.37).

Table 4.37 Percentage of 12 and 15 year olds with unmet orthodontic treatment need (dental health component), by sex

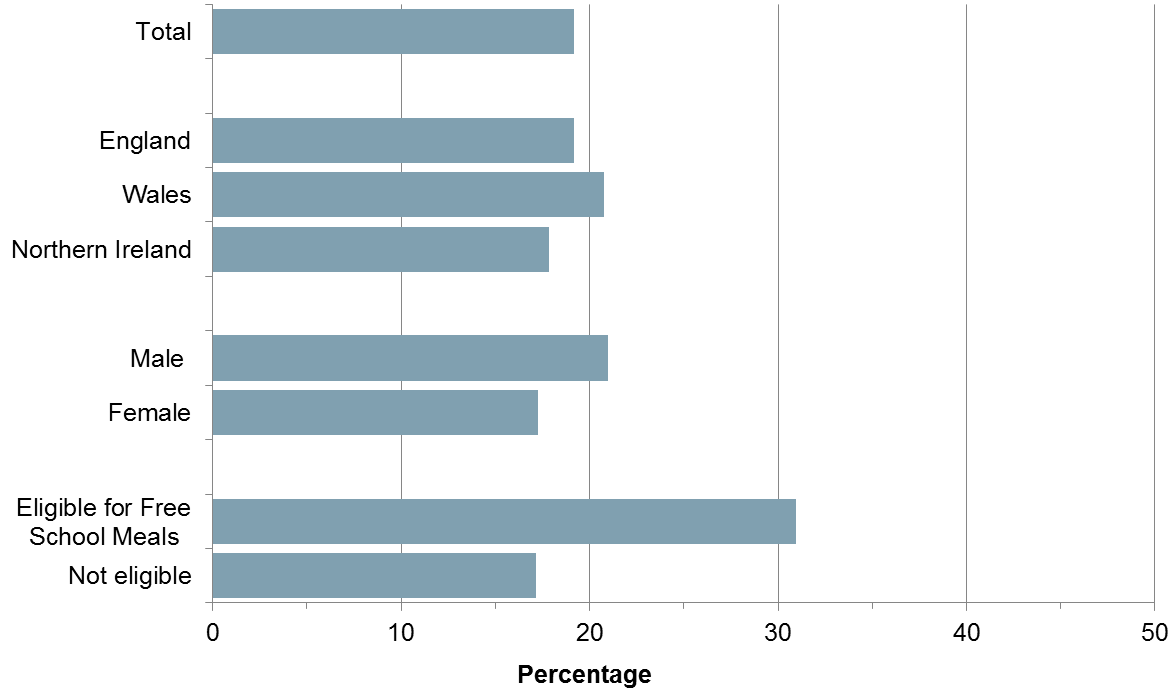
England, Wales and Northern Ireland, 2013		Percentages
Children aged 12, 15, not undergoing orthodontic treatment	12 years	15 years
Male	36	21
Female	36	18
Unweighted bases		
Male	*1,132*	*980*
Female	*1,129*	*1,001*

The opportunity for orthodontic care at age 12 and 15 is open to all children who meet the appropriate clinical threshold, but this does not mean that all children who may benefit from treatment will receive it. There are a range of reasons why children who meet the threshold do not receive treatment. Some may never seek treatment, some may have treatment delayed for specific clinical reasons, some may not know it is an option and others may be deemed by the clinician to have a level of oral health of an otherwise insufficient standard. As an example of the latter, poor plaque control or active decay are common and would contraindicate treatment. It might be a concern if there was a strong social gradient emerging in terms of the residual unmet need at age 15. Table 4.38 suggests that there is a difference by socioeconomic position with a highly significant difference between those eligible for free school meals (32% with unmet need) and those who are not (17%). At age 12 the difference is smaller and not significant.

Table 4.38 Percentage of 12 and 15 year olds with unmet orthodontic treatment need (dental health component), by eligibility for free school meals

England, Wales and Northern Ireland, 2013		Percentages
Children aged 12, 15, not undergoing orthodontic treatment	12 years	15 years
Eligible	40	32
Not eligible	35	17
Unweighted bases		
Eligible	*584*	*409*
Not eligible	*1,560*	*1,449*

Figure 4.5 Percentage of 15 year olds with unmet orthodontic treatment need, 2013



A relationship between unmet need and tooth brushing is perhaps not unexpected given that suboptimal hygiene is one reason for not embarking on treatment. The reason for the significant difference in unmet need between those who brush their teeth twice daily and those who do not (Table 4.39) is not likely simply to be due to professional decision making on the basis of hygiene. The data for attendance are very similar to those related to tooth brushing, again with a significant difference (Table 4.40). Attendance and tooth brushing frequency are likely to be proxies for a range of health behaviours and attitudes. It is clear from these data that, for whatever reason, there are groups in society who do not receive orthodontic care but who may benefit from it.

Table 4.39 Percentage of 12 and 15 year olds with unmet orthodontic treatment need (dental health component), by frequency of tooth brushing

England, Wales and Northern Ireland, 2013	Percentages	
Children aged 12, 15, not undergoing orthodontic treatment	12 years	15 years
At least twice a day	35	18
Less than twice a day	39	24
Unweighted bases		
At least twice a day	*1,643*	*1,495*
Less than twice a day	*576*	*454*

Table 4.40 Percentage of 12 and 15 year olds with unmet orthodontic treatment need (dental health component), by pattern of dental attendance

England, Wales and Northern Ireland, 2013		Percentages
Children aged 12, 15, not undergoing orthodontic treatment	12 years	15 years
Check-ups	36	18
Only with trouble	37	25
Never	31	16
Unweighted bases		
Check-ups	*1,808*	*1,542*
Only with trouble	*351*	*352*
Never	*63*	*55*

4.4 Conclusions

The burden of dental disease is not shared equally across the population. In children, dental decay is a particularly important condition because of the long term implications of decay as well as the impact of disease and treatment in childhood. There are clear social gradients and patterns when those with the greatest burden of disease are identified.

This does not mean that dental decay in 2013 is only a disease of poverty. There are children from all parts of society with a high decay burden, but for children from deprived backgrounds or areas with high unemployment it is much more likely. There are also clear associations with certain behaviours such as dental attendance and tooth brushing and it seems likely that the reasons for the social gradients may at least partly be moderated by differences in behaviours.

The pattern for non-carious tooth surface loss is rather similar to that for severe or extensive decay although the condition is quite different in terms of the mechanical and chemical processes involved. The risks for severe or extensive decay and tooth surface loss are slightly different but they do overlap in relation to diet.

For orthodontic conditions there are marked social differences in terms of unmet need, meaning there are children who may benefit from treatment but who have not yet received it by age 15, and who therefore may never receive it.

Annex A: The accuracy of the survey results

Like all estimates about a population based on a sample from that population, the results of the 2013 Children's Dental Health Survey are subject to error. The total error associated with any survey estimate is the difference between the estimate derived from the data collected and the true value for the population. The total error can be divided into two main types: random error and systematic error.

Random error, or 'sampling error', occurs because survey estimates are based not on the whole population but only on a sample of it. There may be chance variations between such a sample and the whole population. If a large number of repeats of the same survey were carried out, this error would average to zero. The size of the sample and the sample design influence the magnitude of these variations due to sampling.

Systematic error is often referred to as bias. Bias can arise because the sampling frame is incomplete, because of variation in the way the dental examination was carried out, or because non-respondents to the survey have different characteristics to respondents. When designing this survey considerable effort was made to minimise systematic error; this included training dental examiners and nurses to reduce variability between them. Nonetheless, some systematic error is likely to have remained, particularly from potential non-response bias and measurement error, and the data were weighted to reduce any potential non-response bias.

Statistical theory enables estimates to be made of the size of the random, or sampling error, but not of the systematic error or bias. A statistical estimate of the sampling error, the standard error, can be produced from the value obtained for the sample, and provides a measure of the statistical precision of the survey estimate. This allows for a confidence interval to be calculated around the sample estimate which gives an indication of the range in which the true population value is likely to fall. The confidence interval generally used in survey research is the 95% confidence interval; it comprises of approximately two (1.96) standard errors associated with the sample design.

For results based on simple random samples, without clustering or stratification, the estimation of standard errors is straightforward. The sample design of the CDH Survey, however, was not a simple random sample and therefore a more complex design calculation is needed which takes account of the stratification and clustering of the sample design. Stratification tends to reduce the standard error, while clustering tends to increase it.

In a complex sample design, the size of the standard error depends on how the characteristic of interest is spread within and between the primary sampling units (PSUs), and this is reflected in the way the data are grouped in order to calculate the standard error.

The tables in Annex A show the standard error and 95% confidence intervals for a range of the survey estimates included in this report (calculated using STATA V11.0, a statistical analysis software package). The tables do not cover all the topics discussed in the report but show a selection of estimates based on information from both questionnaires.

The tables also show the design factor, or DEFT; the ratio of the complex standard error to the standard error that would have resulted had the survey design been a simple random sample of the same sample size. This is often used to give a broad indication of the degree

to which the standard error has been adjusted to take account of the stratification and clustering in the sample design. The size of the design factor varies between survey variables reflecting the degree to which a characteristic is clustered within PSUs, or is distributed between strata. For a single variable the size of the factor also varies according to the size of the subgroup on which the estimate is based, and on the distribution of the subgroup between PSUs and strata. Design factors below 1.0 show that the complex sample design improved on the estimate that would have been expected from a simple random sample, probably due to the benefits of stratification; design factors above 1 indicate a negative impact on the prevision of the estimate relative to a simple random sample of equivalent size (probably due to the effects of clustering).

The quality indicators in these tables are valid for the estimates that they are associated with. Comparing the confidence intervals for these point estimates to see if they overlap would be a conservative approach to analysing for significant differences between the percentages. This is because the test should be based on the *variance of the difference* in the two percentages. On occasion, this is why differences commented on as significant in this report would have overlapping confidence intervals.

Table 4A1 Standard errors and confidence intervals for Table 4.1: Percentage of 5 year olds with individual indicators of severe or extensive dental decay, 2013

Estimate group	Estimate description	Proportion with (p)	Unweighted sample size	Weighted sample size ('000's)	Standard error of (p)	95% lower C.I. bound	95% lower C.I. bound	DEFT
5+ teeth with obvious decay experience (high dmft)								
England	% with 5+ teeth with obvious decay experience	5.7	1,526	641	0.8	4.2	7.2	1.3
Wales	% with 5+ teeth with obvious decay experience	10.9	493	34	1.3	8.1	13.6	0.9
Northern Ireland	% with 5+ teeth with obvious decay experience	12.9	530	24	1.5	9.8	15.9	1.1
Total	% with 5+ teeth with obvious decay experience	6.2	2,549	699	0.7	4.7	7.6	1.5
3+ teeth with decay into dentine								
England	% with 3+ teeth with decay into dentine	10.4	1,526	641	1.2	7.9	12.9	1.6
Wales	% with 3+ teeth with decay into dentine	19.1	493	34	2.6	13.6	24.7	1.5
Northern Ireland	% with 3+ teeth with decay into dentine	17.5	530	24	2.1	13.3	21.8	1.3
Total	% with 3+ teeth with decay into dentine	11.0	2,549	699	1.2	8.7	13.4	1.9
Any unrestorable teeth								
England	% with any unrestorable teeth	5.1	1,526	641	0.8	3.4	6.7	1.5
Wales	% with any unrestorable teeth	7.4	493	34	1.1	5.1	9.6	0.9
Northern Ireland	% with any unrestorable teeth	5.2	530	24	1.1	3.1	7.3	1.1
Total	% with any unrestorable teeth	5.2	2,549	699	0.8	3.7	6.7	1.8
Any PUFA signs								
England	% with any PUFA signs	4.2	1,488	614	0.7	2.7	5.6	1.4
Wales	% with any PUFA signs	5.8	443	32	1.2	3.3	8.4	1.1
Northern Ireland	% with any PUFA signs	4.7	521	23	1.0	2.6	6.7	1.1
Total	% with any PUFA signs	4.3	2,452	669	0.7	3.0	5.6	1.6

Table 4A2 Standard errors and confidence intervals for Table 4.1: Percentage of 5 year olds with severe or extensive dental decay, 2013

Estimate group	Estimate description	Proportion with (p)	Unweighted sample size	Weighted sample size ('000's)	Standard error of (p)	95% lower C.I. bound	95% lower C.I. bound	DEFT
England	% with severe or extensive dental decay	12.7	1,526	641	1.4	9.9	15.4	1.6
Wales	% with severe or extensive dental decay	21.7	493	34	2.6	16.2	27.2	1.4
Northern Ireland	% with severe or extensive dental decay	19.4	530	24	2.1	15.4	23.5	1.2
Total	% with severe or extensive dental decay	13.3	2,549	699	1.3	10.7	15.9	1.9

Table 4A3 Standard errors and confidence intervals for Table 4.2: Percentage of 15 year olds with individual indicators of severe or extensive dental decay, 2013

Estimate group	Estimate description	Proportion with (p)	Unweighted sample size	Weighted sample size ('000's)	Standard error of (p)	95% lower C.I. bound	95% lower C.I. bound	DEFT
5+ teeth with obvious decay experience (high dmft)								
England	% with 5+ teeth with obvious decay experience	7.6	1,313	612	1.2	5.2	10.0	1.6
Wales	% with 5+ teeth with obvious decay experience	14.3	554	36	3.2	7.7	21.0	2.1
Northern Ireland	% with 5+ teeth with obvious decay experience	28.1	551	24	2.9	22.0	34.1	1.5
Total	% with 5+ teeth with obvious decay experience	8.7	2,418	672	1.2	6.4	11.0	2.0
3+ teeth with decay into dentine								
England	% with 3+ teeth with decay into dentine	5.1	1,313	612	1.1	3.0	7.3	1.8
Wales	% with 3+ teeth with decay into dentine	10.7	554	36	3.2	3.9	17.6	2.5
Northern Ireland	% with 3+ teeth with decay into dentine	9.9	551	24	2.1	5.6	14.2	1.6
Total	% with 3+ teeth with decay into dentine	5.6	2,418	672	1.0	3.6	7.6	2.2
Any unrestorable teeth								
England	% with any unrestorable teeth	1.8	1,313	612	0.5	0.8	2.7	1.3
Wales	% with any unrestorable teeth	2.1	554	36	0.6	0.9	3.3	1.0
Northern Ireland	% with any unrestorable teeth	3.1	551	24	0.9	1.2	5.0	1.2
Total	% with any unrestorable teeth	1.8	2,418	672	0.4	1.0	2.7	1.6
Any PUFA signs								
England	% with any PUFA signs	1.8	1,292	598	0.4	0.9	2.6	1.1
Wales	% with any PUFA signs	1.6	554	36	0.6	0.2	2.9	1.2
Northern Ireland	% with any PUFA signs	3.1	549	24	0.7	1.7	4.4	0.9
Total	% with any PUFA signs	1.8	2,395	658	0.4	1.0	2.5	1.4
Any teeth extracted due to decay								
England	% with any teeth extracted due to decay	5.8	1,313	612	0.9	4.0	7.6	1.4
Wales	% with any teeth extracted due to decay	11.4	554	36	1.9	7.3	15.4	1.4
Northern Ireland	% with any teeth extracted due to decay	13.4	551	24	2.0	9.3	17.6	1.4
Total	% with any teeth extracted due to decay	6.3	2,418	672	0.8	4.7	8.0	1.7

Table 4A4 Standard errors and confidence intervals for Table 4.2: Percentage of 15 year olds with severe or extensive dental decay, 2013

Estimate group	Estimate description	Proportion with (p)	Unweighted sample size	Weighted sample size ('000's)	Standard error of (p)	95% lower C.I. bound	95% lower C.I. bound	DEFT
England	% with severe or extensive dental decay	13.6	1,313	612	1.8	10.0	17.2	1.9
Wales	% with severe or extensive dental decay	22.3	554	36	4.6	12.5	32.1	2.6
Northern Ireland	% with severe or extensive dental decay	35.8	551	24	2.9	29.9	41.7	1.4
Total	% with severe or extensive dental decay	14.8	2,418	672	1.7	11.4	18.2	2.4

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