

# Water fluoridation and the context for Northumberland

Public Health England

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## Executive summary

1. This paper sets out the context of water fluoridation, including the legislation, provides an overview of the scientific evidence in relation to water fluoridation and uses local information on oral health and oral health care to provide a context for the population of Northumberland.
2. Fluoride is naturally present in water supplies. In a number of areas the level is adjusted to improve oral health. This process is governed by primary and secondary legislation. Since April 2013 decision-making regarding fluoridation rests with upper tier and unitary local authorities. In Northumberland, it is estimated that approximately 135,480 residents (about 43% based on 2014 population estimates) receive fluoridated water as part of schemes which have been in place since the late 1960s.
3. Systematic reviews of the scientific evidence have reported that water fluoridation reduces levels of tooth decay in both child and adult populations served by this measure. There is also evidence that water fluoridation is associated with improved outcomes such as reduced levels of child hospital admission for tooth extraction.
4. A small minority of children in both non-fluoridated and fluoridated areas of the UK have noticeable dental fluorosis, though severe dental fluorosis is rare.
5. Systematic reviews of the scientific evidence have found no differences in general health between communities that could be attributed to fluoride in water at a concentration of 1 part per million, whether naturally occurring or added. Public Health England's own analysis of a range of key health indicators from all the fluoridated and non-fluoridated areas of the country has found no evidence of harm to the health of people in fluoridated areas.
6. Poor oral health remains a significant cause of morbidity for the population of Northumberland, 420 children aged fewer than 19 in 2015/2016 were admitted to hospital for the removal of decayed teeth. In 2015 the PHE coordinated survey of children's oral health in Northumberland found that over 25% of 5 year old children examined had evidence of dental decay experience.

## 1. Local authorities and oral health improvement and the Northumberland context

- 1.1 Tooth decay is the most common oral disease affecting children and young people in England, yet it is largely preventable. Whilst children's oral health has improved over the past 20 years, almost a third (27.9%) of five-year olds still had tooth decay in 2012. Tooth extractions under a general anaesthetic remain a common reason for hospital admissions in young children; in 2012/13 it was the most common reason for child hospital admission in England.

<http://www.hscic.gov.uk/catalogue/PUB11758/prov-mont-hes-admi-outp-ae-apr-jun-13-14-toi-rep.pdf>

Northumberland takes part in the Public Health England nationally coordinated surveys of children's oral health. The last survey of 5 year old children carried out in Northumberland showed that 25.7% of the children examined had experienced dental decay.

[http://www.nwph.net/dentalhealth/survey-results%205\(14\\_15\).aspx](http://www.nwph.net/dentalhealth/survey-results%205(14_15).aspx)

- 1.2 Poor oral health impacts on children's general health and wellbeing. When children have toothache or need treatment, they have to take time off school. This affects families, as parents will need time off work to look after their children and take them to the dentist. Persistent dental health problems may adversely affect children in other ways. For example, to benefit fully from education, children need to enter school ready to learn, to be healthy and prepared emotionally, behaviourally and socially.

The most significant impact of dental disease on an individual is the need to have teeth removed under general anaesthetic due to the consequences of dental disease. For the year 2015/2016, in Northumberland, 420 children aged fewer than 19 were admitted to hospital to have teeth taken where decay was the primary diagnosis.

<http://www.nwph.net/dentalhealth/Extractions.aspx>

The cost to the NHS for these admissions is considerable, the NHS reference costs for extraction of multiple teeth in a child 18 years and under is £847(CDO6B). Transposing these costs to Northumberland suggests a figure of £355,754 spent annually by the NHS due to the consequences of dental decay on hospital admissions alone.

<https://www.gov.uk/government/publications/nhs-reference-costs-2015-to-2016>

All dental treatment for children is paid for by the NHS, The current NHS currency, for paying dentists are Units of Dental Activity (UDA). A child who just needs prevention will require a single UDA but a child who needs treatment requires 3 UDA's or more and consequently needs at least 200% more resources from the NHS.

In Northumberland for the treatment years April 2014 to June 2016, for patients aged 18 and under; 26,323 children required 3 or more UDA for dental treatment.  
(source: Business Services Authority)

- 1.3 An emergent issue is the challenge posed by an ageing population who are retaining natural teeth and ongoing prevention of dental caries should be a priority across the life course. By 2030 Northumberland will experience the largest increase in the proportion of the population over 65 years old in the North East.  
<http://www.poppi.org.uk/index.php>

Evidence from the last Adult Dental Health Survey in 2009 and secondary analysis of the data related to life expectancy demonstrates; that those elderly who retain their teeth have an increased life expectancy compared to those who lose all their teeth who have a shorter life expectancy. Consequently Northumberland will see the greatest increase in dentate elderly in the North East who will have more teeth at risk of decay and more complex treatment needs due to increased levels of morbidity in the elderly population such as dementia, strokes and Alzheimer's disease.

Treating dental disease in this group of patients is both complex, challenging and upsetting for patients who are unable to comprehend what is happening to them. The chart in Appendix one sets out the changing demography and oral health of the population in the North East.

- 1.4 The World Oral Health Report 2003 further describes how poor oral health can have a profound effect on individuals' overall quality of life:

"The experience of pain, endurance of dental abscesses, problems with eating and chewing, embarrassment about the shape of teeth or about missing, discoloured or damaged teeth can adversely affect people's daily lives and well-being. In recent years, much research has demonstrated the impact of oral health on quality of life."

[http://www.who.int/oral\\_health/media/en/orh\\_report03\\_en.pdf](http://www.who.int/oral_health/media/en/orh_report03_en.pdf)

- 1.5 Local authorities have a statutory responsibility for assessing and promoting the health of its population and securing oral health surveys to enable the health effects of fluoridation schemes to be monitored, as set out in The NHS Bodies and Local Authorities (Partnership Arrangements, Care Trusts, Public Health and Local Healthwatch) Regulations 2012:

[http://www.legislation.gov.uk/ukxi/2012/3094/pdfs/ukxi\\_20123094\\_en.pdf](http://www.legislation.gov.uk/ukxi/2012/3094/pdfs/ukxi_20123094_en.pdf)

- 1.6 In 2014, Public Health England published guidance for local authorities to support them in discharging their responsibilities for oral health improvement in children and young people. The document reviewed the totality of the evidence of currently commissioned oral health improvement programmes and recommended a range of interventions, including water fluoridation, for consideration by local authorities. Fluoridation is recommended on the basis of 'strong evidence' of its effectiveness.

<https://www.gov.uk/government/publications/improving-oral-health-an-evidence-informed-toolkit-for-local-authorities>

- 1.7 It should be stressed that improving oral health and addressing inequalities requires a combination of strategies including upstream interventions and universal and targeted approaches. For example, supervised tooth brushing programmes may usefully be targeted at children with a particularly high risk of tooth decay in both fluoridated and non-fluoridated communities.

## 2. The context of water fluoridation

- 2.1 Fluoride is widely present in the environment, ranking thirteenth among the elements in order of abundance in the earth's crust. It occurs naturally in virtually all water. The concentration of fluoride in water is normally expressed as milligrams of fluoride per one litre of water (mg/l) or in parts fluoride per million parts of water (ppm). One mg/l equates to 1ppm. The concentration of fluoride naturally occurring in water is extremely variable, being affected by many factors including geology. In some parts of Africa and the Indian sub-continent, for example, fluoride levels in water may reach 10 or 20mg/l. In the UK, the naturally occurring level of fluoride in water is typically around 0.1 to 0.2 mg/l, although in some localities (for example Hartlepool and Uttoxeter) it is about 1.0mg/l and in some private water supplies (springs, wells, boreholes etc.) can reach 3 or 4 mg/l prior to treatment.
- 2.2 Worldwide, it is estimated that around 50 million people consume naturally fluoridated water at an optimal concentration for oral health, with a further 380 million receiving intentionally fluoridated water. Around 6 million people in England consume water containing around 1mg/l, including much of the West Midlands and parts of the North East, Cumbria, Cheshire, East Midlands and Lincolnshire. The first substantive fluoridation scheme in England was introduced by Birmingham City Council in 1964.
- 2.3 Countries with fluoridation schemes include the United States, Canada, Brazil, Argentina, Chile, England, Ireland, Spain, Australia, New Zealand, Malaysia, Singapore and South Korea. Major cities around the world with fluoridation schemes include New York, Los Angeles, Chicago, Washington DC, Philadelphia, Atlanta, Boston, Miami, Rio de Janeiro, Sao Paulo, Buenos Aires, Santiago, Birmingham, Newcastle upon Tyne, Coventry, Dublin, Cork, Seville, Bilbao, Hong Kong, Sydney, Melbourne, Brisbane, Adelaide, Perth, Auckland and Wellington.
- 2.4 Over the past ten years there has been an increase in fluoridation coverage around the world, particularly in the United States, Brazil, Chile, Australia and Malaysia, adding around 50 million people who receive this public health measure.
- 2.5 There is a long history of populations consuming water containing approximately 1ppm of fluoride in the North East. The residents of Hartlepool has had such a supply since the 1850's from the establishment of the Hartlepool Water company, South Shields residents also received water with a naturally occurring protective level of fluoride in the last century from bore holes, this supply has subsequently been changed to a different supply.
- 2.6 Northumberland, Newcastle, Gateshead, North Tyneside and County Durham local authorities instituted schemes which artificially adjusted the natural level of fluoride to the optimal, protective amount in the late 1960s early 1970s when they had water and public health responsibilities.
- 2.7 In Northumberland, it is estimated that 135,480 residents (about 43% of the population) receive fluoridated water. Fluoridated communities include Alnwick, Alnmouth, Howick, Embleton, High Newton-by-the-sea, Seahouses, Haltwhistle, Henshaw, Haydon Bridge, Corbridge, Haddon on the Wall and Prudhoe. In the south east of the County, some of the more southern wards receive artificially fluoridated water, whereas those in the east and north of that area (e.g. Ashington) are not part of a fluoridation scheme. As a result, some of Northumberland's least deprived

communities are receiving fluoridated water, whereas some of the most deprived communities are not.

- 2.8 In the 2014/15 survey of children's oral health 18% of 5 year old children in fluoridated North Tyneside had experienced dental decay compared to 26% in South Tyneside.

### **3. Regulation of fluoride in water**

- 3.1 As fluoride is one of the normal components of water, it falls within the regulatory framework for water quality. Within Europe generally, the EU Drinking Water Directive of 1998 (Directive 98/83/EC) concerns the quality of water intended for human consumption, the objective being to protect human health. It lays down the essential quality standards for drinking water, setting out the maximum level of a range of chemicals and microbiological factors which are to be permitted. Fluoride is one of the chemical parameters included in the Directive, with a maximum permitted level of 1.5mg/l. The Directive can be accessed at:  
[http://ec.europa.eu/environment/water/water-drink/index\\_en.html](http://ec.europa.eu/environment/water/water-drink/index_en.html)
- 3.2 In England and Wales, the EU Directive is given effect by Regulations made under the Water Industry Act 1991 separately covering public and private water supplies. These are The Water Supply (Water Quality) Regulations 2000 (as amended) and The Private Water Supplies Regulations 2009 (as amended). The former govern the quality of drinking water supplied by water companies and are enforced by The Drinking Water Inspectorate (DWI). They can be accessed in unofficial consolidated form at:  
[http://dwi.defra.gov.uk/stakeholders/legislation/ws\\_wqregs2000\\_cons2010.pdf](http://dwi.defra.gov.uk/stakeholders/legislation/ws_wqregs2000_cons2010.pdf). The latter govern the quality of drinking water supplied privately, for example from springs, wells, or private boreholes and are enforced by local authorities, advised by the DWI. They can be accessed at:  
<http://dwi.defra.gov.uk/stakeholders/legislation/pwsregs2009.pdf>. Both sets of Regulations provide for a maximum permitted level of fluoride in water of 1.5mg/l, mirroring the EU Directive.
- 3.3 Water fluoridation schemes in England are explicitly permitted by parliament, through the Water Industry Act 1991 which replaced the previous Act from 1985. The fluoridation sections of the 1991 Act have been significantly modified since the Act was originally commenced. The Water Act 2003 introduced into the 1991 Act a duty on water companies to comply with a validly-made fluoridation request by the then relevant NHS body (Strategic Health Authorities).
- 3.4 More recently, the Health and Social Care Act 2012 has amended the 1991 Act to introduce changes to fluoridation responsibilities, with the consultation and decision-making responsibility for schemes being transferred, from April 2013, to unitary and upper-tier local authorities and with the responsibility for making, varying or terminating fluoridation arrangements with water companies transferring to the Secretary of State for Health, to be exercised by him in accordance with the decisions of the affected local authority(ies) made in accordance with the fluoridation legislation. The Secretary of State has also become responsible for health monitoring and reporting. The functions of the Secretary of State are discharged through Public Health England, an executive agency of the Department of Health.

- 3.5 Each amended version of the Act has brought all fluoridation schemes operating at the relevant time into the scope of the amended Act, so that all existing schemes are now subject to the Act as amended in 2012. The process for local authorities to follow should they wish to introduce, vary or terminate a fluoridation scheme is set out in The Water Fluoridation (Proposals and Consultation) (England) Regulations 2013. They can be found at:  
[http://www.legislation.gov.uk/ukxi/2013/301/pdfs/ukxi\\_20130301\\_en.pdf](http://www.legislation.gov.uk/ukxi/2013/301/pdfs/ukxi_20130301_en.pdf)
- 3.6 The technical aspects of water fluoridation schemes are the responsibility of the relevant water company. A company has no formal decision-making role as to whether a scheme should be introduced, varied or terminated. In designing and operating water fluoridation plant, water companies are required to exercise those responsibilities in accordance with a technical Code of Practice published by the Drinking Water Inspectorate, the body responsible for assuring the quality of public water supplies in England and Wales. The current (2005) version of the Code can be accessed at:  
<http://dwi.defra.gov.uk/stakeholders/guidance-and-codes-of-practice/fluoridation-2005.pdf>
- 3.7 The only two chemicals permitted to be used in fluoridation schemes are specified in the Act. Their quality and purity have to comply with the relevant British (EN) standards. These are:

Disodium hexafluorosilicate BS EN 12174: 2013

Hexafluorosilicic acid BS EN 12175: 2013

British Standards are available via: <http://shop.bsigroup.com/>

(Note that a charge is payable for each Standard)

- 3.8 Each separate fluoridation scheme is subject to a legal agreement made between the responsible public health body and the relevant water company. For any new scheme commenced since 1st April 2013 the public health body is the Secretary of State for Health, acting on a duly made request of the appropriate local authority(ies). Most agreements were made in the 1960s and early 1970s by local authorities acting in their then public health role and were made with the then water utilities which have since been subsumed into the major utilities now operating in England.
- 3.9 More recent agreements made in the late 1970s/early 1980s were made by NHS bodies acting in a public health role. In accordance with the current legislation, the Secretary of State for Health is the successor body to the originating public health body for each agreement, irrespective of whether the originator was a local authority or an NHS body.

## **4. Evidence for effect of water fluoridation in improving oral health**

### **Systematic Reviews of the scientific evidence**

- 4.1 Over recent years, five systematic reviews have assessed and combined the findings of studies from around the world on the effectiveness of water fluoridation. These are:
- i. NHS Centre for Reviews and Dissemination: A Systematic Review of Water Fluoridation – at the University of York (2000);
  - ii. Centres for Disease Control and Prevention (US): Recommendations on Selected Interventions to Prevent Dental Caries, Oral and Pharyngeal Cancers and Sports-Related Craniofacial Injuries (2002);
  - iii. National Health and Medical Research Council (Australian Government): Efficacy and Safety of Fluoridation (2007);
  - iv. A review by Griffin et al in relation to adults (2007).
  - v. Cochrane Oral Health Group: Water fluoridation for the prevention of dental caries (2015)

### **4.2 York Review (2000)**

[http://www.york.ac.uk/inst/crd/CRD\\_Reports/crdreport18.pdf](http://www.york.ac.uk/inst/crd/CRD_Reports/crdreport18.pdf)

- 4.2.1 This review examined 26 studies from different countries which compared the dental health of children aged 5, 8, 9-12, 12-14 and 15 in fluoridated and non-fluoridated areas. In most instances, samples of children had been examined before and after fluoridation started.
- 4.2.2 The review found that on average, children in fluoridated communities had 2.25 fewer teeth decayed, missing and filled than children in non-fluoridated communities; there were nearly 15% more children without tooth decay in fluoridated communities than in non-fluoridated ones (i.e. 15% more children had never experienced tooth decay in their lives); the dental benefits of fluoridated water were over and above those of fluoride toothpaste and other sources of fluoride and the higher the rate of decayed, missing and filled teeth before fluoridation, the higher the percentage reductions after fluoridation.



4.2.3 In its conclusions, the York report stated: “The best available evidence (level B) from studies on the initiation and discontinuation of water fluoridation suggests that fluoridation does reduce caries prevalence, both as measured by the proportion of children who are caries-free and by the mean dmft/DMFT (decayed, missing and filled teeth) score” (level B was the quality rating given by the York team to studies judged to be of ‘moderate quality’ which measured and adjusted for at least one or two possible confounding factors, i.e., characteristics in the fluoridated or non-fluoridated areas being compared that could otherwise explain the observed differences in dental health and ensured that even where researchers examining teeth knew whether the children concerned came from a fluoridated or non-fluoridated area, other steps were taken to prevent measurement bias affecting the results.

4.3 **Centres for Disease Control and Prevention (2002)**

<http://www.thecommunityguide.org/oral/oral-ajpm-recs.pdf>

4.3.1 This review was undertaken by a US Task Force on Community Preventive Services, who analysed 21 studies comparing the dental health of children aged between 4 and 17. The Task Force concluded that children in fluoridated areas had, on average, between 30% and 50% fewer teeth decayed, missing and filled than those in non-fluoridated areas and these findings were generally applicable to fluoridated communities across the United States and in other industrialised countries with fluoridation schemes. The Task Force went on to recommend fluoridation on the basis of its strong evidence of effectiveness in reducing tooth decay.

4.4 **National Health and Medical Research Council (Australian Government) (2007)**

<http://www.nhmrc.gov.au/guidelines/publications/eh41>

4.4.1 This review took account of the York and US Task Force reviews as well as subsequent dental health studies. The NHMRC concurred with the findings of those earlier reviews and concluded that the introduction of fluoridation was ‘strongly associated’ with a reduction in levels of decayed, missing and filled teeth and with an increase in the percentage of children free from tooth decay.

4.5 **Griffin et al review of water fluoridation and adults (2007)**

<http://www.ncbi.nlm.nih.gov/pubmed/17452559>

4.5.1 A systematic review (Griffin et al, 2007) of studies of adults aged 18 to over-65 in five countries (US, UK, Canada, Australia and Sweden) concluded that, on average, tooth decay is reduced by between 27% and 35% among those who have lived all their lives in fluoridated areas.

4.6 **Cochrane Oral Health Group: Water fluoridation for the prevention of dental caries (2015)**

<http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD010856.pub2/abstract>

4.6.1 This review looked at dental effects only (tooth decay and dental fluorosis), concluding that that water fluoridation is effective at reducing levels of tooth decay among children. The introduction of water fluoridation resulted in children having 35% fewer decayed, missing and filled baby teeth and 26% fewer decayed, missing and

filled permanent teeth. They also found that fluoridation led to a 15% increase in children with no decay in their baby teeth and a 14% increase in children with no decay in their permanent teeth. The authors commented on the fact that these results are based predominantly on older studies, though they did note that they have excluded many contemporary studies comparing fluoridated and non-fluoridated communities as they did not meet their criteria.

## Other reviews

- 4.7 There have been several reviews of water fluoridation in the UK since the pilot schemes in the 1950s. This section seeks to summarise the more recent reviews.
- 4.8 Medical Research Council report (2002)  
<http://www.mrc.ac.uk/news-events/publications/water-fluoridation-and-health/>
- 4.8.1 Following publication of the York review, the Department of Health asked the Medical Research Council (MRC) to assess its findings and make recommendations on future research. The MRC report (2002) highlighted other studies which suggested that fluoridation improves children's quality of life by reducing the amount of toothache they suffer, reduces the need for children to undergo tooth extractions under a general anaesthetic, reduces tooth decay in children as young as 3 years and in adults aged up to 75 and benefits people living in non-fluoridated areas who consume drinks and foods made with fluoridated water, thereby reducing the difference in dental health there would otherwise be between fluoridated and non-fluoridated communities.
- 4.9 Review of studies conducted between 1990 and 2010  
<http://onlinelibrary.wiley.com/doi/10.1111/j.1600-0528.2012.00721.x/abstract>
- 4.9.1 Most of the effectiveness studies reviewed by York, the US Task Force and the Australian NHMRC were conducted before 1990. A more recent review (Rugg Gunn and Loc-Do, 2012) focused on 59 studies published between 1990 and 2010, finding that when fluoridated and non-fluoridated communities are compared fluoridation reduces tooth decay in primary teeth by between 30% and 59% on average and reduces tooth decay and in permanent teeth by between 40% and 49% on average. The studies examined the effects of fluoridation on teeth in ten different countries – the United States, Canada, Argentina, Brazil, the United Kingdom, Ireland, Israel, South Korea, Australia and New Zealand. The age groups of the people included in those studies ranged from 3 to 44.
- 4.10 Public Health England monitoring report (2014)  
<https://www.gov.uk/government/publications/water-fluoridation-health-monitoring-report-for-england-2014>
- 4.10.1 In March 2014 Public Health England (PHE) published a report on its analysis of children's dental health in fluoridated and non-fluoridated local authorities across England. Using data from previous national surveys of 5 and 12-year olds, PHE found that on average, five-year olds in fluoridated areas were 15% less likely to have had tooth decay than those in non-fluoridated areas - and 28% less likely when deprivation and ethnicity were taken into account; on average, 12-year olds in fluoridated areas were 11% less likely to have had tooth decay than those in

non-fluoridated areas - and 21% less likely when deprivation and ethnicity were taken into account; in fluoridated areas there were 45% fewer hospital admissions of children aged one to four for dental caries (mostly for extraction of decayed teeth under a general anaesthetic) than in non-fluoridated areas (when deprivation was accounted for, this figure rose to 55%).

- 4.11 A summary version of the report has now been published in the peer-reviewed literature. The publication can be found at <http://onlinelibrary.wiley.com/doi/10.1111/cdoe.12180/abstract>. A commentary on this paper by the independent analysts Bazian has subsequently been published on the NHS Choices website at: <http://www.nhs.uk/news/2015/08August/Pages/Water-fluoridation-a-safe-way-of-stopping-tooth-decay.aspx>
- 4.12 Royal Society of New Zealand: Health effects of water fluoridation: A review of the evidence (2014)  
<https://s3.amazonaws.com/s3.documentcloud.org/documents/1278925/fluoride.pdf>
- 4.12.1 This review concluded that there is compelling evidence that fluoridation of water at the established and recommended levels produces broad benefits for dental health and that economically and from the equity perspective fluoridation remains the safest and most appropriate approach for promoting dental public health.

### **Oral health inequalities**

- 4.13 As stated above, PHE's health monitoring report found that the differences in children's dental health between fluoridated and non-fluoridated areas were greatest when those from the most socially deprived backgrounds were compared.
- 4.14 The York review, published 14 years previously (see 4.2), also reported on studies of the relationship between tooth decay, social deprivation and water fluoridation, concluding that there appeared to be some evidence that water fluoridation reduces the inequalities in dental health across social classes in 5 and 12-year olds, specifically:
- the York analysis of five-year olds found that across all social groups, the average number of teeth affected by decay per child was lower in fluoridated than in non-fluoridated areas;
  - in fluoridated areas, the difference between the average number of teeth affected by decay per child from the least and most deprived social groups was around half the difference found in non-fluoridated areas, and
  - children from the most deprived social group in fluoridated areas had, on average, around the same number of teeth affected by decay as those from the most affluent social group in non-fluoridated areas.
- 4.15 Some caution is needed in interpreting these findings, as the York team did not identify as many studies of the impact of fluoridation on dental health inequalities as on the general efficacy of fluoridation in reducing tooth decay rates. Furthermore,

only two of the health inequalities studies reviewed by York had examined children's teeth before and after fluoridated started - one of the criteria being used for the review.

- 4.16 The Cochrane review (see 4.6 above) used their criteria concluded that, on the basis of the studies they reviewed, there was insufficient information regarding the impact on oral health inequalities.
- 4.17 A recent study (McGrady et al 2012) comparing 11 to 13 years olds in fluoridated Newcastle upon Tyne and non-fluoridated Manchester found evidence of reduced dental health inequalities in the former. The difference in levels of tooth decay between children from the most and least affluent backgrounds in Newcastle was smaller than the difference between these groups in Manchester. In other words, dental health inequalities had been narrowed in Newcastle. In each of five social groups – from the most to least affluent – Newcastle children had fewer decayed, missing and filled teeth than their equivalents from Manchester. More children in each social group in Newcastle were free of decay than those from the same group in Manchester.
- <http://www.biomedcentral.com/1471-2458/12/1122>

## **5. Evidence regarding the effect of water fluoridation on dental fluorosis (mottling)**

- 5.1 There are several potential causes of marks or blemishes on teeth. One of them is 'dental fluorosis', which results from children consuming an excess of fluoride whilst their teeth are developing, hence the current dental advice that parents should supervise their children's tooth brushing to make sure they spit out the paste. In this way, children's teeth can be protected from decay by the fluoride whilst minimising the risk dental fluorosis.
- 5.2 A small minority of children in both non-fluoridated and fluoridated areas of the UK have noticeable dental fluorosis. Usually, this is characterised by a white, pearlescent appearance of the tooth surfaces, which makes the teeth look whiter than normal. Research has found that some people think such teeth are more, rather than less, attractive.
- 5.3 Severe dental fluorosis - which is very rare in countries such as England, the Irish Republic, Australia, Canada, New Zealand and the United States with water fluoridation schemes – is unsightly, with brown staining on tooth surfaces. It is seen more commonly in parts of the world with high natural levels of fluoride in the water supply and nutritional issues may also be a factor in the development of fluorosis in these communities.
- 5.4 The York report (2000 – see 4.2) estimated that around 6% of people in non-fluoridated areas and between 10% and 12% in fluoridated areas are affected by noticeable levels of dental fluorosis. However, these calculations included naturally fluoridated areas around the world where the level of fluoride in the water is much higher than in artificially fluoridated areas and where altitude and poor nutrition may contribute to higher fluorosis levels.

- 5.5 The MRC report in 2002 (see 5.7) concluded that, as far as artificially fluoridated areas in the UK and Europe are concerned, around 3% to 4% of children may have dental fluorosis of possible aesthetic concern, compared with around 1% in non-fluoridated areas. For both fluoridated and non-fluoridated areas, the estimated prevalence figures were much lower than those in the York report.
- 5.6 PHE's fluoridated health monitoring report (2014 – see 4.10) cited the 2012 study by McGrady et al (see 5.13) which used improved methodology to assess levels of dental fluorosis. This study used a scoring system with a scale of 0-9 for severity and found that the percentage of children with mild or mild to moderate (score 3) was 6% in fluoridated Newcastle and 1% in unfluoridated Manchester. However, the prevalence of higher scores (TF4 or greater) was very low in both cities – 1% in fluoridated Newcastle and 0.2% in unfluoridated Manchester. Of these, very few children were seen with a score of 5, representing the lower end of severe fluorosis scores - 0.1% in fluoridated Newcastle and 0.2% in unfluoridated Manchester and no children were found with higher scores.
- 5.7 A surveillance report published in 2005 by the US Centres for Disease Control and Prevention, based on data collected in the United States between 1999 and 2002, said that the milder forms of fluorosis “are typically not noticeable” and that the risk factors for the more severe forms of fluorosis are drinking water with high natural fluoride levels, taking dietary fluoride supplements and ingesting fluoride toothpaste. The CDC report also says that “*a low prevalence of the milder forms of fluorosis has been accepted as a reasonable and minor consequence*” balanced against the substantial protection from dental caries by the used of fluoridated drinking water and foods, beverages and oral care products that contain fluoride.  
<http://www.ncbi.nlm.nih.gov/pubmed/16121123>
- 5.8 A European Food Safety Authority report, also published in 2005, stated that “*Mild fluorosis is generally considered to be acceptable on a population basis, in view of the concomitant beneficial effect of fluoride in the prevention of caries.*”  
<http://www.efsa.europa.eu/en/efsajournal/doc/192.pdf>
- 5.9 A US National Research Council report (2006) stated that the prevalence of severe fluorosis in communities with less than 2 mg/l of fluoride in their water is ‘near zero’.  
[http://www.nap.edu/openbook.php?record\\_id=11571&page=2](http://www.nap.edu/openbook.php?record_id=11571&page=2)
- 5.10 The Cochrane review this year (see 4.6) concluded that fluorosis of aesthetic concern might affect around 12% of people in areas with fluoride at 0.7 parts per million, though this included areas of the world with high naturally occurring levels of fluoride in the water supply, where other factors might be affecting fluorosis. This part of the study had much wider inclusion criteria for research and looked at areas with levels of fluoride occurring naturally, in some cases up to 5 parts per million as well as areas with fluoridation schemes.
- 5.11 Contrary to some claims, the American Dental Association (ADA) does not warn against making up infant formula feeds with fluoridated water. Following a systematic review of the evidence by an expert panel, the ADA's Council on Scientific Affairs published recommendations in 2011 which advised parents to continue to use optimally fluoridated water to reconstitute infant formula feed but that, if they were especially keen to minimise the risk of dental fluorosis, they should consider

purchasing a ready-to-use feed with a low fluoride content or use fluoride-free or low fluoride water to make up the feed. The ADA advice can be found at:

<http://www.ada.org/en/public-programs/advocating-for-the-public/fluoride-and-fluoridation/recent-fluoridation-issues/infant-formula-and-fluoridated-water/fluoride-and-infant-formula-faq>

## **6. Evidence regarding the effect of water fluoridation on general health**

6.1 There have been a number of reviews of the scientific evidence regarding the impact of water fluoridation on general health stretching back to the early days of water fluoridation in the UK and including a number of the reviews mentioned above in section 5. None have found evidence that water fluoridation is a cause of general ill health. This section summarises more recent reviews.

### **6.2 York Review (2000) (see 4.2)**

6.2.1 The York review looked at evidence for an association with bone fractures, cancer and other possible adverse health effects. It concluded that there was no evidence of an association with water fluoridation. Following publication of the York review, the Department of Health asked the Medical Research Council (MRC) to assess its findings and make recommendations on future research (see 5.7).

### **6.3 SCHER report (2011)**

[http://ec.europa.eu/health/scientific\\_committees/environmental\\_risks/docs/scher\\_o\\_139.pdf](http://ec.europa.eu/health/scientific_committees/environmental_risks/docs/scher_o_139.pdf)

6.3.1 A 2011 report of the EU Commission's Scientific Committee on Health and Environmental Risks (SCHER) on the health effects of fluoride in drinking water found no evidence of harm to health, concluding that the occurrence of endemic skeletal fluorosis has not been reported in the general EU population, there was not sufficient evidence linking fluoride in drinking water to the development of osteosarcoma (bone cancer), that fluoride intake from drinking water at the level occurring in the EU does not appear to hamper children's neurodevelopment and IQ levels, that human studies do not suggest adverse thyroid effects at realistic human exposures to fluoride and that there was no new evidence from human studies to indicate that fluoride in drinking water influences male and female reproductive capacity.

### **6.4 PHE monitoring report (2014) (see 4.10)**

6.4.1 The 2014 PHE monitoring report compared a range of health indicators for fluoridated and non- fluoridated areas. Selection of the indicators was based on the evidence base, theoretical plausibility, potential impact on population health, quality and availability of data, and validity of the indicator. The analysis found that there was no evidence of a difference in the rate of hip fractures, Down's syndrome, osteosarcoma (bone cancer) and all types of cancer between fluoridated and non-fluoridated areas, the rate of kidney stones was lower in fluoridated areas than non-fluoridated areas, the rate of bladder cancer was lower in fluoridated areas than non-fluoridated areas and rate of deaths from all recorded causes was lower in fluoridated areas than non-fluoridated areas but the size of the effect was small.

6.5 Royal Society of New Zealand report (2014) (see 4.11)

- 6.5.1 The 2014 report by the Royal Society of New Zealand and the Office of the New Zealand Prime Minister's Chief Science Adviser on their review of the scientific evidence on water fluoridation concluded not only that it produces broad benefits for the dental health of New Zealanders but that it is safe. It states:

*"Given the caveat that science can never be absolute, the panel is unanimous in its conclusion that there are no adverse effects of fluoride of any significance arising from fluoridation at the levels used in New Zealand. In particular, no effects on brain development, cancer risk or cardiovascular or metabolic risk have been substantiated, and the safety margins are such that no subset of the population is at risk because of fluoridation."*

The President of the Royal Society of New Zealand, Sir David Skegg, and the New Zealand Prime Minister's Chief Science Adviser, Sir Peter Gluckman, said:

*"Our assessment suggests that it is appropriate, from the scientific perspective, that fluoridation be expanded to assist those New Zealand communities that currently do not benefit from this public health measure – particularly those with a high prevalence of dental caries."*

- 6.6 The 2015 Irish Health Review Board "Health Effects of Water Fluoridation: An evidence review" can be found at:  
[http://www.hrb.ie/uploads/tx\\_hrbpublications/Health\\_effects\\_of\\_water\\_fluoridation.pdf](http://www.hrb.ie/uploads/tx_hrbpublications/Health_effects_of_water_fluoridation.pdf)
- 6.6.1 The review's aim was to inform the Irish Department of Health DoH with regard to any impact, positive and/or negative, on the general health of those exposed to community water fluoridation. The focus was on general health rather than dental health. The review found "no strong evidence that CWF is definitively associated with negative health effects."
- 6.7 Given the degree of scrutiny that has been applied to the potential links between water fluoridation and general health, PHE is satisfied that water fluoridation is a safe, as well as effective, public health measure.
- 6.8 Water fluoridation is supported by the World Health Organisation, the World Health Assembly, the Federation Dentaire Internationale, the International Association for Dental Research and health bodies in many countries around the world, including the US Centres for Disease Control and Prevention, the American Medical Association, the American Dental Association, the Canadian Medical Association, the Canadian Dental Association, the Canadian Paediatric Society and the Australian Dental Association.

[http://www.who.int/oral\\_health/strategies/cont/en/](http://www.who.int/oral_health/strategies/cont/en/)

<http://www.fdiworldental.org/media/11327/Promoting-dental-health-through-water-fluoridation-2008.pdf>

<http://www.iadr.com/i4a/pages/index.cfm?pageid=3566>

<http://www.cdc.gov/fluoridation/basics/index.htm>

<http://www.ama-assn.org/ama/pub/physician-resources/clinical-practice-improvement/clinical-quality/accreditation-collaboration/ada-council.page?>

<http://www.cps.ca/documents/position/oral-health-care-for-children>

<http://www.ada.org/en/public-programs/advocating-for-the-public/fluoride-and-fluoridation>

- 6.9 Within the UK water fluoridation is supported by the British Medical Association, the Faculty of Public Health of the Royal Colleges of Physicians, the British Dental Association, the British Society for Paediatric Dentistry and many bodies representing health professionals.

<http://www.bma.org.uk/about-the-bma/how-we-work/professional-activities-and-special-interest/board-of-science/board-of-science-publications>

[http://www.fph.org.uk/uploads/fluoridation\\_regulations\\_291004.pdf](http://www.fph.org.uk/uploads/fluoridation_regulations_291004.pdf)

<https://www.bda.org/news-centre/press-releases/dental-organisations-say-access-to-water-fluoridation-is-a-postcode-lottery>

<http://www.bspd.co.uk/LinkClick.aspx?fileticket=IUdmsibsUhk%3D&tabid=40>

David Landes  
Consultant in Dental Public Health  
Public Health England North East



## Appendix 1

North East Males and Females aged 55-74 years surveyed for the Adult Dental Health survey 2009: graphs contrasting the number of those with potentially complex dental needs with those who are edentulous, according to socioeconomic status. [32][37]

Source: Adapted from ONS (2015) Longitudinal Study (LS) based estimates of Life Expectancy (LE) by the National Statistics Socioeconomic Classification (NS to SEC): England and Wales, between 1982 to 1986 and 2007 to 2011; and Adult Dental Health Survey 2009.