Fluoridation of water

A briefing from the BMA board of science - February 2009 (updated March 2015)
BMA Policy
The BMA believes that the government should be more proactive in helping to reduce inequalities in dental health that exist across social groups within the UK (United Kingdom) and remains committed to the fluoridation of mains water supplies, following appropriate public consultation. Where optimal fluoride levels do not occur naturally, doctors support artificial fluoridation of water on the grounds of effectiveness, safety and equity. The regional disparity of fluoridated water has resulted in detrimental effects on oral health in areas where fluoride levels are below optimum. A comprehensive approach that ensures universal coverage of fluoridated water across the UK is therefore required. Doctors are calling on the UK Governments to review their policies on water fluoridation and proactively support the implementation of fluoridation schemes.

Background

Tooth decay
Dental caries (tooth decay) is a major oral health problem in most industrialised countries, with children an especially vulnerable group. The most recent ONS (Office for National Statistics) study on the dental health of children across the UK - from 2003 - found that by the age of five over 43 per cent of children had obvious signs of decay, rising to 57 per cent by the age of eight. More recent surveys have been conducted in England, Wales and Scotland. A 2014 PHE (Public Health England) report highlighted that 12 per cent of three-year-olds in England had experience of obvious caries in 2013, involving one tooth or more decayed to dentinal level, extracted or filled because of caries. A separate PHE report found that 27 per cent of five-year-old children in England experienced dental decay in 2012. In Wales, the 2011/12 dental survey of five-year-olds reported that 41.4 per cent had dental decay. A national study of oral health in Scotland found that in the 2013/14 school year, 32 per cent of children aged four and five-years-old had obvious decay experience in their primary teeth. While up to date data for Northern Ireland are not available, the 2003 ONS study estimated that the prevalence of dental caries was 61 per cent among five-year-olds.

There are significant inequalities in oral health across the UK, with lower income and higher deprivation associated with poorer oral health. In England, there is a positive correlation between the average number of DMFT (decayed missing or filled teeth) among five-year-olds and local authority deprivation score. In Wales, a strong relationship has been demonstrated between mean decay levels and degree of deprivation. Between 2011 and 2012 there was an average of 1.03 decayed teeth per child among the least deprived 20 per cent of five-year-olds and 2.16 amongst the most deprived 20 per cent. A 2014 study of tooth decay amongst four and five-year-old children in Scotland found that only 17 per cent of children from the most affluent areas had obvious signs of tooth decay compared to 47 per cent in the most deprived areas. There are no recent statistics for oral health inequalities in Northern Ireland.

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a BMA policy on water fluoridation was first established in 1977 and has since been reaffirmed in 1982, 1983, 1984, 1998 and 2014.
b One part per million (1ppm).
c An update on children’s dental health in the UK is expected to be published in 2015 by the Office of National Statistics.
d Decay of the tooth enamel to reveal the ivory layer forming the mass of the tooth directly under the layer of enamel.
Fluoridation

Fluoride is a mineral naturally present in all water supplies at varying concentrations throughout the UK. Its potential for benefiting oral health was first identified in the 1930s, and it is now used widely in toothpastes and mouth rinses to help prevent dental caries. Fluoride disrupts the process of tooth decay by strengthening the enamel so that it is more resistant to acid. The CDC (the US Centre for Disease Control and Prevention) has identified the fluoridation of drinking water as one of the ten most significant medical achievements of the 20th century. Many authorities worldwide artificially fluoridate their water supplies to either improve the oral health of the population as a whole, or specifically target deprived areas to help combat inequalities in dental health. Information on artificial water fluoridation schemes in different countries can be found in Appendix 1.

In the UK, less than 10 per cent of the population receive fluoridated water; around half a million people receive naturally fluoridated water, with a further 5.5 million receiving water which has been artificially fluoridated at, or around, the optimum level. The West Midlands oversees the most extensive fluoridation scheme serving over three-quarters of its population. There are also smaller schemes in operation in other parts of the country, including the North East, the East Midlands, Yorkshire and Humber, Eastern England and the North West. There are no artificial fluoridation schemes in operation in other countries within the UK.

Legislation

The Water Industry Act 1991, amended by The Water Act 2003, is the primary legislation relating to water fluoridation in England. PHE have a role in producing guidance for LAs (local authorities) to ensure that there is a framework in place for conducting public consultations. PHE also have a role in overseeing the decision-making process, and are required to produce reports assessing the effects of water fluoridation on health (see Box 1). As a result of the Health and Social Care Act 2012, LAs have had responsibility for public consultations regarding any changes to the fluoridation of mains water supplies - involving either the addition of fluoride, or the termination of existing fluoridation schemes - since April 2013. Water supplies often cross LA boundaries, which can complicate decision-making on the implementation of fluoridation schemes. PHE have produced a toolkit for local authorities on improving oral health which includes guidance on commissioning, public consultation and coordination of fluoridation schemes. In Scotland, water fluoridation is governed by the Water (Fluoridation) Act 1985, and is the responsibility of the Scottish Government Health and Social Care directorate. In Northern Ireland it is the responsibility of the Department of the Environment under the Water Order 1987. Both nations emphasise the importance of local consultation before the implementation of any fluoridation schemes. In Wales, it is at the discretion of the Welsh government as to whether additional fluoride is added to the water supply for it to reach optimal levels for preventing caries. There are currently no plans to implement water fluoridation schemes.

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Water with fluoride levels occurring at or near optimal levels of one part per million (1ppm).
Evidence

There has been substantial research conducted on the effects of water fluoridation over the past two decades. In 2000, the York Review - a systematic review of public water fluoridation - concluded that the best available evidence supports the beneficial effect of water fluoridation on dental caries, and found evidence that water fluoridation can help reduce inequalities in dental health across social classes.\textsuperscript{13} The review found no clear association between water fluoridation and bone fracture or incidence of cancer, but noted that dental fluorosis of aesthetic concern was found in one in 24 people who drank fluoridated water.\textsuperscript{13}

In response to the York Review, the Medical Research Council published a report in 2002 asserting that water fluoridation had beneficial effects on reducing dental caries and tackling oral health inequalities. It found no evidence to substantiate a link between water fluoridation and problems with the immune or reproductive system, the kidneys, the gastrointestinal tract or developmental (birth) defects.\textsuperscript{14} The CDC reported in 2002 that 18 to 40 per cent of the reduction in dental caries in the US was attributable to community water fluoridation, with another contributory factor being the widespread use of fluoride toothpaste. It concluded that water fluoridation remains the most effective means of reducing dental caries, and helps to reduce dental health inequalities associated with socio-economic status.\textsuperscript{15}

In 2014, PHE published guidance for LAs on commissioning to improve the oral health of children and young people, recommending water fluoridation as an effective and deliverable intervention for improving oral health.\textsuperscript{16} The safety and effectiveness of water fluoridation is supported by a significant body of evidence. Despite this there remains a need for this information to be widely disseminated amongst the public, to allay fears associated with artificial fluoridation schemes.

Health benefits of water fluoridation

There are a number of additional studies that contribute to the wealth of affirmative evidence on water fluoridation in terms of health benefits, reduction of health inequalities and safety. A 2012 study comparing the oral health of 11-13 year-old lifetime residents of Manchester and Newcastle offers further evidence that fluoridated water improves oral health and can reduce oral health inequalities; in Newcastle (fluoridated) 25 per cent were caries free at the white spot lesion\textsuperscript{1} threshold, whereas in Manchester (non-fluoridated) these rates were as low as 15 per cent.\textsuperscript{16} One 2014 study compared dental related hospital admissions in two former SHAs (strategic health authorities) in the West Midlands (largely fluoridated) and North West (largely non-fluoridated) between 2006-07 and 2008-09. It found that there was a 27-fold difference in rates of admission for the extraction of decayed or pulpally\textsuperscript{4}/periapically\textsuperscript{5} involved teeth in the most deprived PCTs (primary care trusts) between the two areas.\textsuperscript{17} The termination of water fluoridation schemes in Anglesey in 1991 was associated with a subsequent significant increase in the number of DMFT amongst five-year-old children.\textsuperscript{18,19}

\textsuperscript{1} White spot lesions are usually the first visual sign of tooth decay.
\textsuperscript{4} Pulpal: relating to the pulp: the soft tissue within the pulp cavity, consisting of connective tissue containing blood vessels, nerves, lymphatics.
\textsuperscript{5} Periapical: at or around the apex of the root of a tooth.
Consistent with comparative studies, a cross-sectional study of 11 year-old children in Korea with dental caries found that water fluoridation can not only lead to lower prevalence of dental caries, but can also help to mitigate socio-economic inequalities in oral health.\textsuperscript{20}

**Safety of fluoridated water**

In a review of the evidence, the Scientific Committee on Health and Environmental Risks concluded that there was insufficient evidence to support claims that fluoride in water at optimal levels had any significant adverse health impact.\textsuperscript{21} An increased risk of mild fluorosis has been commonly indicated as the only negative effect of water fluoridation.\textsuperscript{13, 14, 16, 21, 24, 22} Clinically “mild” fluorosis appears as white opaque striations across the enamel surface of the tooth; this is largely an aesthetic issue and is outweighed by significant improvements in oral health. A literature review of the aesthetic perceptions of dental fluorosis and relationships with OHRQoL (oral health related quality of life) concluded that there were no negative effects on respondents OHRQoL from very mild or mild fluorosis, however severe fluorosis could have a negative impact on quality of life.\textsuperscript{23} The report noted that severe levels are rare in countries that do not have water with naturally occurring high levels of fluoride.\textsuperscript{23}

**Box 1**

*PHE – Water fluoridation health monitoring report for England 2014*

This report - published in March 2014 - fulfils the legal requirement for PHE to monitor the effects of fluoridation schemes on the health of people living in the respective areas covered. The report acknowledges fluoridated water as an effective method of reducing caries, presenting evidence of a reduction in dental caries at age five and 12 years in fluoridated areas, compared to non-fluoridated areas. The report also indicates that no detrimental health effects are associated with water fluoridation and concludes that it is a safe, effective and beneficial health intervention.

**Ethical considerations**

The 2007 Nuffield Council on Bioethics publication *Public Health: Ethical Issues* found that the key motivations for fluoridating a water supply - tackling health inequalities, protecting children, and creating an environment which sustains good health - were all consistent with the responsibilities a liberal state has to intervene in the interests of public health.\textsuperscript{24} It also identified three potential ethical objections:

- **without consent, fluoridation schemes cannot be justified** – fluoridation of water supplies affects all members of a targeted area. The scale of such an intervention makes it impossible for concerned individuals to withdraw their consent or opt-out of an operational scheme;
- **fluoridation removes the personal choice of those affected** – irrespective of the need to obtain consent, fluoridation of water supplies removes the personal choice of those who would wish to be exempt on the basis of held values (eg on the purity of water);
• fluoridation coerces adults to lead healthy lives – the fluoridation of water supplies restricts freedoms in such a way as to force adults to lead healthier lives.

In evaluating the ethical considerations, the Nuffield report stresses the importance of considering the balance of risks and benefits; the potential for alternatives; and where there are harms, the role of consent. Due to the nature of water fluoridation schemes, consent and intervention on an individual basis is not possible. The Nuffield report concludes that public consultation is therefore necessary. This becomes increasingly relevant in areas with lower rates of caries, where public health interventions are arguably less necessary.

A debate also exists over whether the addition of fluoride to water supplies constitutes a medicinal intervention and, if so, whether water fluoridation represents the forced medication of a population. Whilst the addition of fluoride does represent a public health intervention, fluoride is naturally present in water supplies and there is no difference in artificially fluoridated water, and naturally fluoridated water. The BMA believes that universal fluoridation of mains water supplies is justified on the basis of safety and effectiveness and is necessary to tackle the ongoing disparity in oral health throughout the UK.

Cost-effectiveness
The cost-effectiveness of water fluoridation has been extensively studied over many years. Economic analysis indicates that it is more cost-effective than alternative strategies in improving population-wide oral health, and that the cost-effectiveness of water fluoridation increases with the number of potential beneficiaries. A comparative study of hospital admissions over a three year period in the former West Midlands and North West SHAs found that people (up to the age of 19) in the North West SHA were 27 times more likely to have a dental extraction under general anaesthetic, costing £4 million per year. Evidence from other countries also indicates that water fluoridation is a cost-effective intervention. An analysis of this approach in Quebec indicated that, at an expected average effectiveness of 30 per cent reduction in caries, one dollar invested in the programme saved $71.05–$82.83 per Quebec’s inhabitant in dental costs (in 2010), or more than $560 million for the State.

Alternatives to water fluoridation
The use of topical applications of fluoride, such as toothpaste and mouthwash, is encouraged by dental organisations worldwide, irrespective of any public fluoridation schemes in place. Alternative strategies for population-wide water fluoridation include fluoridated milk or, more commonly, salt. Research has demonstrated that, in countries where there is universal exposure, fluoridated salt is as effective as water fluoridation in preventing dental caries. Fluoridated milk has also been found to be an effective method of reducing caries. Fluoridated salt or milk have an advantage over water fluoridation as they allow fluoridated and non-fluoridated products to be available to the public. This retains a degree of customer choice and therefore eliminates the need to obtain consent for the intervention. These strategies do not, however, have the same potential as water fluoridation for achieving community-wide exposure to fluoride, as some groups
may choose the non-fluoridated option. Research indicates that lower socio-economic groups, who are most vulnerable to dental caries, are less likely to choose a fluoridated product, such as salt or milk, than those from higher socio-economic groups.\textsuperscript{30} Therefore interventions of this kind, have a significant disadvantage in public health terms, and are likely to be significantly less effective in reducing inequalities in oral health than fluoridation of mains water supplies.

Conclusion

There is substantial evidence that water fluoridation is a practical, successful and cost-effective public health strategy for improving oral health. Fluoride has been found to be highly protective against dental caries, and there is no evidence of any significant adverse risk to human health at optimal levels. Water fluoridation has the greatest impact among those most at risk of social deprivation, and is the most effective intervention for reducing oral health inequalities. Fluoridation schemes that ensure universal coverage of water containing optimal levels of fluoride would improve oral health throughout the UK, and help reduce existing oral health inequalities. Doctors are calling on the UK Governments to actively support the implementation of artificial fluoridation schemes where the natural concentration of fluoride in drinking water is sub-optimal, and to ensure that the safety and effectiveness of water fluoridation is adequately communicated to the public.
### Appendix 1

**Artificial water fluoridation levels in various countries worldwide**

<table>
<thead>
<tr>
<th>Country</th>
<th>Population that receive artificially fluoridated water</th>
<th>Per cent of population served</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>194,206,000</td>
<td>66</td>
</tr>
<tr>
<td>Brazil</td>
<td>73,200,000</td>
<td>41</td>
</tr>
<tr>
<td>Republic of Ireland</td>
<td>3,250,000</td>
<td>73</td>
</tr>
<tr>
<td>Australia</td>
<td>17,600,000</td>
<td>80</td>
</tr>
<tr>
<td>Canada</td>
<td>14,260,000</td>
<td>44</td>
</tr>
<tr>
<td>Libya</td>
<td>400,000</td>
<td>22</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>6,708,309</td>
<td>100</td>
</tr>
<tr>
<td>Chile</td>
<td>11,000,000</td>
<td>70</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>5,797,000</td>
<td>10</td>
</tr>
<tr>
<td>Malaysia</td>
<td>20,700,000</td>
<td>75.5</td>
</tr>
<tr>
<td>Israel</td>
<td>5,272,000</td>
<td>70</td>
</tr>
</tbody>
</table>

Source: Jones S & Lennon K (2005, updated 2012) *One in a million: the facts about water fluoridation (3e).*

References

6. www.nhs.uk/Conditions/Fluoride
7. www.cdc.gov
12. www.nhsdirect.wales.nhs.uk