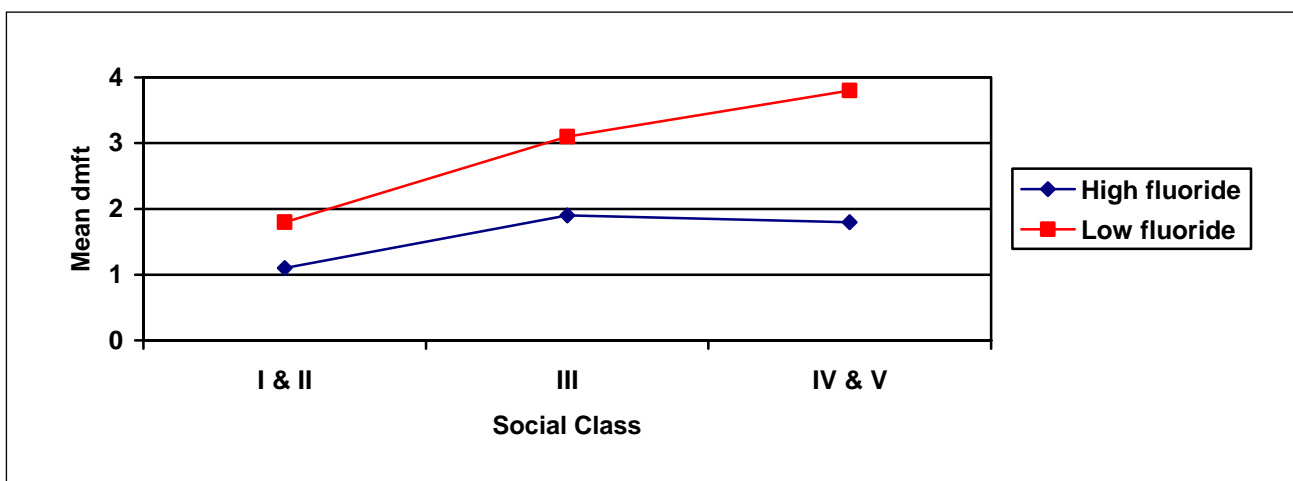


Water Fluoridation: A briefing on the York University Systematic Review and Subsequent Research Developments

The York University Systematic Review

1. This systematic review, subsequently referred to as the York Review, was commissioned by the Chief Medical Officer of the Department of Health and involved “an up to date expert scientific review of fluoride and health”. It was published by the University of York in September 2000 (McDonagh *et al.* 2000a) and in an abridged version in the British Medical Journal in October 2000 (McDonagh *et al.* 2000b).
2. 214 studies met the full inclusion criteria for one or more of the objectives.
3. The main conclusions were:
 - 3.1. The best available evidence (26 included studies) suggests that fluoridation of drinking water supplies does reduce caries prevalence, both as measured by the proportion of children who are caries free (an increase of 14.8%) and by the mean change in dmft/DMFT (a decrease of 2.25 teeth).
 - 3.2. A beneficial effect was still evident in the 9 included studies conducted after 1974 (when fluoride toothpastes became widely available).
 - 3.3. There appears to be some evidence (from 15 included studies) that water fluoridation reduces the inequalities in dental health across social classes in 5 and 12 year olds, using the dmft/DMFT index. (Figure 1 below is taken from the York Review).

Figure 1. Tooth decay in 5-year-old children by social class and water fluoridation - average number of decayed, missing or filled teeth per child (dmft).



Reproduced from McDonagh et al 2000a, by kind permission of the University of York Centre for reviews and Dissemination.

- 3.4. The prevalence of dental fluorosis increases with the concentration of fluoride in the water as shown in Table 1 below:

Table 1. The prevalence of dental fluorosis of aesthetic concern at different water fluoride concentrations (data from McDonagh et al 2000a).

Fluoride levels in drinking water (parts per million)	% of population with fluorosis of aesthetic concern
0.1	6.3
0.4	8.2
0.7	10.0
1.0	12.5

- 3.5. Twenty-nine included studies examined the relationship between bone fractures and other bone development problems and water fluoridation. No association was found.
- 3.6. Twenty-six included studies examined the relationship between water fluoridation and cancers. No clear association was found between water fluoridation and incidence of or mortality from bone cancers, thyroid cancer or all cancers.
- 3.7. The authors noted that given the level of interest surrounding the issue of public water fluoridation, it is surprising to find that little high quality research has been undertaken. Any future research into the safety and efficacy of water fluoridation should be carried out with appropriate research methods to improve the quality of the existing evidence base.

The MRC Working Group Report

4. In the light of these findings the Medical Research Council, at the request of the Department of Health, set up a Working Group to consider what further research was required to improve knowledge about fluoridation and health. The report and recommendations of the Working Group were published in September 2002 (Medical Research Council 2002).
5. In general the MRC report endorsed the findings of the York Report, but on some issues took a different view. In particular:
- 5.1. Because of the limited data available in the UK to investigate whether water fluoridation reduces social inequalities in dental health, the search was extended to include research conducted in other developed countries with similar socio-economic conditions to the UK such as the USA, Canada, Europe, Australia and New Zealand. The MRC report concluded that in the majority of studies water fluoridation reduced dental caries inequalities between high and low social groups; in no study did water fluoridation increase inequalities.
- 5.2. A further statistical analysis by members of the York team, conducted at the request of the MRC Group, (MRC,2002, Page 19) indicated that the risk of aesthetically

important dental fluorosis was higher in naturally fluoridated than in artificially fluoridated areas (personal communication P Whiting, 2001). This was an unexpected finding given that theoretical chemistry would suggest that there would be no difference in the bio-availability of fluoride from either source. (See 9 and 10 below). The York team suggested that some confounding factor(s) might be operating. Many of the 88 studies included by York in their main analyses were conducted on populations in developing countries consuming naturally fluoridated water. The environment in some of these countries is likely to be substantially different from that in the UK. For example, malnutrition, a known cause of enamel defects (Rugg-Gunn et al 1997) may be prevalent, and the climate might be hotter, resulting in higher consumption of water. For these reasons the MRC suggested that the prevalence of dental fluorosis of aesthetic concern in populations in the UK drinking artificially fluoridated water was probably lower than the estimates presented by the York Report (see 3.4 above). Furthermore, more recent UK (and Irish) studies (See Table 2 below) support the MRC's contention (Tabari *et al.* 2000; Whelton *et al.* 2003; Chadwick and Pendry 2004; Cochran *et al.* 2004; Tavener *et al.* 2004).

Table 2. The prevalence of dental fluorosis of aesthetic concern in recent UK (and Irish*) studies

Authors and year of publication	Age ** Group (years)	Year of fieldwork	Area(s) in which study was conducted	F or NF	% prevalence
Tabari et al (2000)	8 – 9	1998	Newcastle Northumberland	F NF	3% 1%
* Cochran et al (2004)	8	1997 – 1998	Cork Knowsley	F NF	4% 1%
Tavener et al (2004)	8 – 9	2001 - 2002	North-West England	NF	1%
* Whelton et al (2003)	8	2001 - 2002	Republic of Ireland Republic of Ireland Northern Ireland	F NF NF	4% 0% 0%
Chadwick and Pendry (2004)	12	2003	United Kingdom	*** NF	1%

* Irish data presented for cross-border studies.

** Youngest age group selected for studies covering more than one age group.

*** F and NF communities combined. Approx 10% of UK water supply fluoridated.

5.3. The MRC report noted (p28) that a broader consideration of the epidemiological evidence on fluoride and bone health suggests that it is of higher quality than the York Review indicates. A number of these studies, including a recent MRC funded study (Hillier *et al.* 2000) in Durham and Hartlepool, were conducted on

populations drinking naturally fluoridated water. It was suggested to the MRC that fluoride in naturally fluoridated water was not bioavailable or was less bioavailable than fluoride in artificially fluoridated water. Further research to resolve this question was one of the main MRC research recommendations (see 6 below).

5.4. The York Review identified 26 studies examining possible associations between water fluoridation and cancer, although 2 studies were not included in the main analysis, (see 3.6 above). One of these two studies (Hoover *et al.* 1991) was very large and included 125,000 incident cancers and 2.3 million deaths with follow-up for up to 35 years of fluoridation. The MRC Group expressed the view that this important study by the US National Cancer Institute should have been included and added further weight to the MRC's and the York Review's conclusions that available evidence suggests no link between either cancer in general, or any specific cancer type.

6. The MRC Working Group made 14 research recommendations covering:

- total exposure and uptake
- dental caries
- dental fluorosis
- social class
- bone health
- cancer.

The Group noted that studies on bioavailability and absorption from naturally and artificially fluoridated drinking water were particularly important because, if the bioavailability is the same, many of the findings relating to natural fluoridation can also be extrapolated to artificial fluoridation (Medical Research Council 2002 pages 41-42).

The Newcastle Bio-availability Study

7. In response to the MRC Report, the Department of Health commissioned a study by the University of Newcastle School of Dental Sciences entitled *Bioavailability of fluoride in drinking water – a human experimental study* (Maguire *et al.* 2004).

8. The study was carried out on 20 healthy adults aged between 20-35 years. Each subject attended 5 experimental sessions testing a different water on each occasion (Hard, Soft, Natural and Artificial Fluoride, and a Reference Standard). Blood samples and urine samples were collected at baseline, and (for blood) 8 hours, and (for urine) 24 hours following the ingestion of the water samples.

9. There was no statistically significant difference between artificially fluoridated and naturally fluoridated water, or between hard and soft water, for plasma fluoride concentration or for urinary fluoride excretion in healthy young adults. Thus, within the limits imposed by the small number of subjects, the study found no evidence for any differences in fluoride absorption from artificially and naturally fluoridated water supplies at fluoride concentrations around 1 part per million.

Response to the Newcastle Study

10. Dr Paul Harrison, Acting Director of the MRC Institute for Environment and Health, and Chairman of the MRC Working Group on Water Fluoridation and Health, commenting on the University of Newcastle bioavailability report, noted that:

10.1. There appears to be no imperative to undertake new studies into the differential accumulation of natural and artificial fluoride in target tissues.

10.2. Further studies on hip fracture are not warranted.

10.3. The findings of studies of naturally fluoridated populations can continue to be applied to populations exposed to artificially fluoridated water.

10.4. The conclusions of the (Newcastle) study match the outcome predicted by theoretical chemistry.

10.5. To maintain confidence, it is recommended that the evidence base is periodically re-assessed, with a “weight of evidence” approach continuing to be applied (Harrison 2004).

DoH Response to the remaining MRC Research Recommendations

11. In addition to commissioning the Newcastle study, the Department of Health considered the remaining research recommendations of the MRC Working Group. Lord Warner, Parliamentary Under-Secretary of State for Health, outlined the Department’s approach in a Written Answer (Lord Warner 2004). He reported that the Chief Medical Officer and Chief Dental Officer had recommended that the research community is consulted about (inter alia):

- developing a robust design for the evaluation of potential new fluoridation schemes
- continuing to monitor cancer rates in relation to fluoride in water
- and continuing to monitor fluoride exposure using data already collected as part of the National Diet and Nutrition Survey.

Concluding Commentary

12. Water fluoridation has been designated one of the ten most important public health measures currently available (Centers for Disease Control and Prevention 1999a; Centers for Disease Control and Prevention 1999b), and the publication of the York Review was an important milestone in its continuing and developing evaluation. At the time of writing, around 350 million people worldwide are continuing to benefit from water fluoridation, and new schemes are regularly introduced (British Fluoridation Society 2004). The York Report was a timely reminder of the need to maintain and update the research database supporting all public health measures. The MRC Working Group’s report, the Newcastle bioavailability study, the recent publication of the results of new dental fluorosis studies in Newcastle, Northern Ireland, Knowsley, Manchester, for the UK as a whole, and for the Republic of Ireland (Tabari *et al.* 2000; Whelton *et al.* 2003; Chadwick and Pendry 2004; Cochran *et al.* 2004; Tavener *et al.* 2004), together with the Department of Health’s recent response to the research agenda as outlined above, are all constructive responses to the challenges to the research community set down by York.

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British Fluoridation Society
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