Water fluoridation for the prevention of dental caries

Review information

Review type: Intervention

Review number: 0284

Authors

Zipporah Iheozor-Ejiofor[1], Lucy O'Malley[2], Anne-Marie Glenny[1], Richard Macey[2], Rahul Alam[3], Peter Tugwell[4], Tanya Walsh[2], Vivian Welch[5], Helen V Worthington[1]

[1]Cochrane Oral Health Group, School of Dentistry, The University of Manchester, Manchester, UK
[2]School of Dentistry, The University of Manchester, Manchester, UK
[3]Institute of Population Health, Centre for Primary Care, The University of Manchester, Manchester, UK
[4]Department of Medicine, Faculty of Medicine, University of Ottawa, Ottawa, Canada
[5]Bruyère Research Institute, University of Ottawa, Ottawa, Canada

Citation example: Iheozor-Ejiofor Z, O'Malley L, Glenny A-M, Macey R, Alam R, Tugwell P, Walsh T, Welch V, Worthington HV. Water fluoridation for the prevention of dental caries. Cochrane Database of Systematic Reviews 2013 , Issue 12 . Art. No.: CD010856. DOI: 10.1002/14651858.CD010856 .

Contact person

Anne-Marie Glenny

Professor in Evidence Based Oral Health Care
Cochrane Oral Health Group
School of Dentistry, The University of Manchester
Coupland III Building, Oxford Road
Manchester
M13 9PL
UK

E-mail: a.glenny@manchester.ac.uk

Dates

Assessed as Up-to-date:	19 February 2015
Date of Search:	19 February 2015
Next Stage Expected:	1 December 2017
Protocol First Published:	Issue 12 , 2013
Review First Published:	Not specified
Last Citation Issue:	Issue 12 , 2013

What's new

Date	Event	Description
2 February 2015	Amended	Background updated to reinforce the need for the review. Change to risk of bias domains, incorporating an item on 'sampling' Change to the handling of missing data; imputation of missing standard deviations for DMFT and dmft data

History

Date	Event	Description

Abstract

Background

Dental caries is a major public health problem in most industrialised countries, affecting 60% to 90% of school children. Community water fluoridation was initiated in the US in 1945 and is currently practiced in about 39 countries around the world. It is considered to be a key strategy for preventing dental caries. Given the continued interest in this topic, from both health professionals, policy makers and the public, it is important to update and maintain a systematic review that reflects contemporary evidence.

Objectives

To evaluate the effects of water fluoridation (artificial or natural) for the prevention of dental caries.

To evaluate the effects of water fluoridation (artificial or natural) on dental fluorosis.

Search methods

We searched the following electronic databases: The Cochrane Oral Health Group's Trials Register (to 19 February 2015); The Cochrane Central Register of Controlled Trials (CENTRAL) (Issue 1, 2015); MEDLINE via OVID (1946 to 19 February 2015); EMBASE via OVID (1980 to 19 February 2015); Proquest (to 19 February 2015); Web of Science Conference Proceedings (1990 to 19 February 2015); ZETOC Conference Proceedings (1993 to 19 February 2015). We searched the US National Institutes of Health Trials Registry (ClinicalTrials.gov) and the WHO International Clinical Trials Registry Platform for ongoing trials. There were no restrictions on language of publication or publication status in the searches of the electronic databases.

Selection criteria

For caries data, only prospective studies with a concurrent control, comparing at least two populations, one receiving fluoridated the other non-fluoridated water and at least two points in time evaluated, were included. For the assessment of fluorosis, any study designs, with concurrent control, comparing populations exposed to different water fluoride concentrations were included. Populations of all ages receiving fluoridated water (naturally or artificially) and populations receiving non-fluoridated water were included.

Data collection and analysis

Risk of bias assessment was undertaken using an adaptation of the Cochrane risk of bias tool.

The following caries indices were included in the analyses: decayed, missing and filled teeth (dmft (deciduous dentition) and DMFT (permanent dentition)), and proportion caries free in both dentitions. For dmft and DMFT analyses we calculated the difference in mean change scores between fluoridated and control groups. For the proportion caries free we calculated the difference in the proportion caries free between the fluoridated and control groups.

For fluorosis data we calculated the log odds and presented as probabilities for interpretation.

Data on other harms are presented as a narrative.

Main results

A total of 144 studies met the inclusion criteria; 107 studies provided sufficient data for quantitative synthesis. The evidence for all outcomes measured is very low quality.

The results from the caries severity data indicate that the initiation of water fluoridation results in reductions in dmft of 1.81 (95% CI 1.31 to 2.31; 9 studies, 44268 participants) and in DMFT of 1.16 (95% CI 0.72 to 1.61; 10 studies, 78764 participants). This translates to a 35% in dmft and a 26% reduction in DMFT compared to the median control group mean values. There were also increases in the percent of children caries free of 15% (95% CI 11% to 19%) in the deciduous dentition (10 studies, 39966 participants) and 14 % (95% CI 5% to 23%) in the permanent dentition (8 studies, 53538 participants).

There is insufficient information to determine whether initiation of a water fluoridation programme results in a change in disparities in caries levels across SES.

There is insufficient information to determine the effect of stopping water fluoridation programmes on caries levels.

With regard to dental fluorosis, for a fluoride level of 0.7 ppm the percentage of participants with fluorosis of aesthetic concern was estimated to be approximately 12% (95% CI 8% to 17%; 40 studies, 59,630 participants). This increases to 40% (95% CI 35% to 44%) when considering fluorosis of any level (90 studies, 180,530 participants).

Authors' conclusions

There is very little contemporary evidence evaluating the effectiveness of water fluoridation for the prevention of caries.

The data indicates that water fluoridation is effective at reducing caries levels in both the deciduous and permanent dentition in children; this is based on very low quality evidence. The quality of the evidence is influenced by the observational nature of the study designs, the high risk of bias within the studies, heterogeneity and the applicability of the evidence to current lifestyles. The decision to implement a water fluoridation programme relies upon an understanding of the population's oral hygiene, the availability and uptake of other caries prevention strategies, their diet and consumption of tap water and the movement/migration of the population. There is insufficient evidence to determine whether water fluoridation results in a change in disparities in caries levels across SES. There was no evidence to determine the effectiveness of water fluoridation for preventing caries in adults.

There is a significant association between both dental fluorosis of aesthetic concern and all types of dental fluorosis and fluoride level. However, this evidence is again very low quality.

Plain language summary

Water fluoridation for the prevention of dental caries

To be completed by consumer co-ordinator.

Background

Description of the condition

Dental caries is a chronic and progressive disease of the mineralised and soft tissues of the teeth. Its aetiology is multifactorial and is related to the interactions over time between tooth substance and certain microorganisms and dietary carbohydrates, producing plaque acids. Demineralisation of the tooth enamel (non-cavitated dental caries) follows and in the absence of successful treatment, can extend into the dentine and the dental pulp (cavitated dental caries), impairing its function (Ten Cate 1991). Despite reductions in the prevalence and severity of dental caries over time (CDC 2005), social inequalities in dental health persist (OECD 2011), with significant numbers of individuals and communities having a clinically significant burden of preventable dental disease. Dental caries is associated with pain, infection, tooth loss and reduced quality of life (Sheiham 2005). In children, the burden of dental disease also includes lost school time and restricted activity days, as well as problems in eating, speaking and learning. This especially affects those from lower income families owing to their higher prevalence of caries (Feitosa 2005). Given the progressive nature of the condition and widespread prevalence in adulthood, most children are at risk of dental caries.

Clinical need and burden of disease

Dental caries is a major public health problem in most industrialised countries, affecting 60% to 90% of school children (Petersen 2003). It has been estimated that in the United States (US) 42% of children 2 to 11 years of age have caries experience in their primary teeth and 59% of those aged 12 to 19 years have caries experience in their permanent teeth (Dye 2007). Prevalence studies in South America, Asia and Europe have indicated that caries may affect between 20% and 100% of the population (Bagramian 2009). Increasing levels of dental caries are observed in some developing countries, especially those where community-based preventive oral care programmes are not established (Petersen 2004). Studies also suggest that the growing retention of teeth has also been accompanied by a rise in dental caries among ageing adults in different parts of the world (Selwitz 2007). This has major implications especially in high-income countries experiencing an increase in life expectancy.

Description of the intervention

Fluoride is naturally present in the soil, in water and the atmosphere at varying levels depending on geographic location. In areas of Africa, Asia, the Middle East, Southern Europe and the Southern United States, ground waters have been found to contain particularly high concentrations of fluoride (up to 6.9 parts per million (ppm)) (WHO 2006). Water that is artificially fluoridated (also known as community water fluoridation) is set at the 'optimum level', considered to be around 1 ppm (Dean 1941; WHO 2011). The European Union water quality directive specifies 1.5 ppm as the maximum level for human consumption (European Union 1998). Community water fluoridation was initiated in the US in 1945 and is currently practiced in about 39 countries around the world (Browne 2005). It is considered to be a key strategy for preventing dental caries. In Western Europe around 3% of the population receive water with added fluoride (Cheng 2007), mainly in England, Ireland, and Spain. In the United States, over 70% of the population on public water systems receive fluoridated water (CDC 2008) as do a similar proportion of Australians (NHMRC 2007). The rationale behind the role of community water fluoridation is that it benefits both children and adults by effectively preventing caries, regardless of socioeconomic status or access to care. It is believed to have played an important role in the reductions in tooth decay (40% to 70% in children) and of tooth loss in adults (40% to 60%) in the US (Burt 1999). Fluoridation (natural or artifical) is an intervention occurring at the environmental level meaning individual compliance is not relied upon. Interventions at this level can have greater impact upon populations than those at the individual and clinical levels (Frieden 2010).

How the intervention might work

Fluoride impedes the demineralisation of the enamel and also enhances its remineralization (Ten Cate 1991). This function is very important in caries prevention as the progression of cavities depends on the balance of the demineralisation and remineralisation processes (Selwitz 2007). The presence of fluoride in drinking water therefore confers the advantage of providing a constant exposure to fluoride ions in the oral cavity. The effectiveness of fluoridated water (artificially or naturally) is well documented (McDonagh 2000; NHMRC 2007; Truman 2002) and alternative fluoride sources such as toothpastes and varnishes have also been proven to be effective (Marinho 2013; Walsh 2010). Some adverse effects of fluoridated water that have been explored are widely perceived to be dependent on dose, duration and/or time of exposure (Browne 2005). Supra-optimal levels of fluoride (occuring naturally) have been linked to severe dental fluorosis and skeletal fluorosis. Dental fluorosis occurs due to the hypomineralisation of the dental enamel caused by the chronic ingestion of sufficiently high concentrations of fluoride while the dentition is still forming (Pendrys 2001). It can appear on the teeth as white flecks, brown staining or pitting of the enamel and in severe cases could cause aesthetic concern. Other postulated harms such as thyroid cancer, goitre and Down's syndrome are supported by studies lacking in quality and have shown no evidence of strong association with water fluoridation (McDonagh 2000). The need for reduced incidence of adverse outcome due to high levels of fluoride exposure has resulted in recommendation of optimum water fluoride levels to minimise potential harms while maximising the benefits of fluoridation.

Why it is important to do this review

The use of water fluoridation as a means of improving dental health has been endorsed by many national and international health institutions, including the World Health Organization (MRC 2000). It has been hailed by the US Surgeon General as "one of the most effective choices communities can make to prevent health problems while actually improving the oral health of their citizens" (ADA 2013). Despite evidence of effectiveness, opponents have raised concerns about ethical issues and its potential harms (Cheng 2007), as a result of which the practice has remained controversial in some quarters. A

comprehensive systematic review of water fluoridation has previously been published (McDonagh 2000). The review showed a benefit in terms of a reduction in caries as well as an increased risk of dental fluorosis. However, there was insufficient high quality evidence to draw conclusions with regard to other potential harms or health disparities. The review findings have often been misinterpreted and have been used to support arguments on both sides of the water fluoridation debate (Cheng 2007). In addition, little comment has been made on the applicability of the evidence to today's society. Many of the caries studies presented in the McDonagh 2000 review were conducted prior to the widespread use of fluoride toothpastes in the late 1970's and the introduction and uptake of other preventative strategies, such as fluoride varnish. Given the continued interest in this topic, from both health professionals, policy makers and the public, it is important to update and maintain a systematic review that reflects contemporary evidence.

This review is being undertaken in collaboration with the Centre for Reviews and Dissemination of the University of York, United Kingdom as an update for their review published in 2000 (McDonagh 2000). It has also formed the development of a community guide, funded by the US Centers for Disease Control and Prevention (www.cdc.gov).

Objectives

1. To evaluate the effects of water fluoridation (artificial or natural) for the prevention of dental caries.
2. To evaluate the effects of water fluoridation (artificial or natural) on dental fluorosis.

The original systematic review (McDonagh 2000) included five objectives. For the purposes of the current review, the original objectives 1 to 3, which included disparities in caries levels across different social groupings, are covered by objective 1 (above). The fourth objective is covered by objective 2 (above) and the fifth objective which explored the differential effects of natural and artificial fluoridation is not covered in the current review.

Methods

Criteria for considering studies for this review

Types of studies

For objective 1

For caries data, only prospective studies with a concurrent control, comparing at least two populations, one receiving fluoridated the other non-fluoridated water and at least two points in time evaluated, were included. For the purposes of this review, water with a fluoride concentration of less than 0.4 parts per million (ppm) or less (arbitrary cut-off) was classified as non-fluoridated.

For objective 2

For the assessment of fluorosis, any study design, with concurrent control, comparing populations exposed to different water fluoride concentrations was included.

Types of participants

Populations of all ages receiving fluoridated water (naturally or artificially) and populations receiving non-fluoridated water.

Types of interventions

For objective 1

Caries data: A change in the level of fluoride in the water supply of at least one of the study areas, within three years of the baseline survey. Exposure to fluoridated water or non-fluoridated water (less than 0.4 ppm) could be in conjunction with other sources of fluoride (e.g. fluoridated toothpaste) provided the other sources were similar across groups. Where specific information on the use of other sources of fluoride were not supplied, populations in studies conducted after 1975 in industrialised countries were assumed to have been exposed to fluoridated toothpaste.

For objective 2

Fluoride at any concentration present in drinking water.

Types of outcome measures

Primary outcomes

Any measure of dental caries including.

- Change in the number of decayed, missing and filled deciduous and permanent teeth and surfaces (dmft/DMFT and dmfs/DMFS).
- Incidence of dental caries.
- Percentage of caries-free children.

An a priori set of rules regarding the prioritisation of caries measures had been developed previously (Marinho 2013). These would have been adopted if appropriate.

Secondary outcomes

Any measure of dental fluorosis including.

- Percentage of fluorosed children.
- Dean's Fluorosis Index.

- TSIF (Tooth Surface Index of Fluorosis).
- TFI (Thylstrup and fejerskov index).
- Modified DDE (Developmental Defects of Enamel).

We aimed to record the prevalence of fluorosis for each tooth type if reported in the studies. In measuring the percentage prevalence of fluorosis, all children with fluorosis according to the index used were classified as 'fluorosed' as opposed to normal. As measured by the common epidemiologic indices for dental fluorosis (Rozier 1994), children with a DDE, TSIF, TFI score greater than zero or Dean's classification of 'questionable' or higher were classified as fluorosed. If other indices had been used, the percentage prevalence of fluorosis as reported by the original investigators using other methods (e.g. photographic method or other index) would have been considered and adopted. Any fluorosed teeth scored ≥ 3 (TFI), ≥ 2 (TSIF) and 'mild' or worse (Dean's) were considered to be of aesthetic concern. Analysis on dental fluorosis of aesthetic concern was restricted to TFI, TSIF and Dean's indices as it is not easily determined from the modified DDE index.

Data on any other negative effects (e.g. skeletal fluorosis, hip fractures, cancer, congenital malformations, mortality) reported in the included studies were also recorded. The above inclusion criteria are the same as the criteria stated in McDonagh 2000 and were adopted since this review is an update of McDonagh 2000.

Search methods for identification of studies

The original review involved searching a wide range of databases from their starting date to June/October 1999 (Appendix 1). Full details of all the strategies initially used have been published previously (McDonagh 2000).

For the identification of studies included or considered for this updated review, we developed detailed search strategies combining controlled vocabulary and free text terms for each database searched. These were based on the search strategy developed for MEDLINE (Appendix 4) but revised appropriately for each database to take account of differences in controlled vocabulary and syntax rules.

Electronic searches

We searched the following electronic databases:

- The Cochrane Oral Health Group's Trials Register (to 19 February 2015) (see Appendix 2);
- The Cochrane Central Register of Controlled Trials (CENTRAL) (2015, Issue 1) (see Appendix 3);
- MEDLINE via OVID (1946 to 19 February 2015) (see Appendix 4);
- EMBASE via OVID (1980 to 19 February 2015) (see Appendix 5);
- Proquest (all databases) (to 19 February 2015) (Appendix 6);
- Web of Science Conference Proceedings (1990 to 19 February 2015) (see Appendix 7);
- ZETOC Conference Proceedings (1993 to 19 February 2015) (see Appendix 8).

There were no restrictions on language of publication and non-English studies were translated, unless a translator could not be found through The Cochrane Collaboration.

Searching other resources

We searched the following databases for ongoing trials (see Appendix 9):

- US National Institutes of Health Trials Register (http://clinicaltrials.gov) (to 19 February 2015);
- The WHO Clinical Trials Registry Platform (http://apps.who.int/trialsearch/default.aspx) (to 19 February 2015).

Only handsearching conducted as part of the Cochrane Worldwide Handsearching Programme and uploaded to CENTRAL was included (see the Cochrane Masterlist for the details of journals searched to date). We reviewed the reference lists of identified trials and review articles for additional appropriate studies.

Data collection and analysis

Selection of studies

Two review authors independently and in duplicate will screened the titles and abstracts (when available) of all reports identified through the electronic search update. For all studies appearing to meet the inclusion criteria, or for which there was insufficient data in the title and abstract to make a clear decision, we obtained the full report. The full reports obtained from the electronic and other methods of searching were again assessed independently by two review authors to establish whether the studies met the inclusion criteria or not. Disagreements were resolved by discussion. Where resolution was not possible, a third review author was consulted. Studies rejected at this or subsequent stages will be recorded in the 'Characteristics of excluded studies' table, and reasons for exclusion recorded.

Data extraction and management

Two review authors extracted data independently using specially designed data extraction forms (produced in Excel). The data extraction forms were piloted on several papers and modified as required before use. Any disagreements were discussed and a third review author consulted where necessary.

For each study we aimed to record the following data.

- Year of publication, country of origin and source of study funding.
- Details of the participants including demographic characteristics (socio-economic status (SES), ethnicity), deciduous/permanent dentition and criteria for inclusion and exclusion.
- Details of the type of intervention, comparator and co-interventions.
- Details of the outcomes reported, including method of assessment, and time intervals.

- Details of confounding factors considered (potential confounders of relevance to this review include sealant use, life-time exposure to fluoridated water, sugar consumption, SES, ethnicity and the use of other fluoride sources).
- Details on comparability of groups with regard to confounding factors.
- Details on methods used to control for confounding.
- Details regarding both unadjusted and adjusted effect estimates.

Assessment of risk of bias in included studies

McDonagh 2000 used specially designed validity assessment checklists, providing a 'validity score' and assigning a 'level of evidence' for each study. In this update, we aimed to assess all included studies (including those from the previous review by McDonagh 2000) for risk of bias using the Cochrane risk of bias assessment tool for non-randomised controlled studies (Higgins 2011). Domains assessed for each included study were: sampling, confounding, blinding of outcome assessment, completeness of outcome data, risk of selective outcome reporting and risk of other potential sources of bias. We did not include random sequence generation or allocation concealment as these were not relevant for study designs included and are covered by the domain for confounding. For the primary and secondary outcome the following factors had been identified as important confounders: other sources of fluoride, sugary diet, social class, ethnicity and residential history.

A description of the risk of bias domains was tabulated for each included trial, along with a judgement of low, high or unclear risk of bias.

A summary assessment of the risk of bias for the primary outcome (across domains) across studies was undertaken (Higgins 2011). Within a study, a summary assessment of low risk of bias would be given when there was a low risk of bias for all key domains, unclear risk of bias when there was an unclear risk of bias for one or more key domains, and high risk of bias when there was a high risk of bias for one or more key domains.

Measures of treatment effect

The following caries indices were included in the analyses: dmft, DMFT, and proportion caries free in both dentitions. For dmft and DMFT analyses we calculated the difference in mean change scores between fluoridated and control groups. For the proportion caries free we calculated the difference in the proportion caries free between the fluoridated and control groups.

For fluorosis data we calculated the log odds and presented as probabilities for interpretation.

Data on other harms are presented as a narrative.

Dealing with missing data

Where outcome data were missing from the published report, or could not be calculated from the information presented in the report of a trial, we attempted to contact the authors to obtain the data and clarify any uncertainty. The analyses generally included only the available data (ignoring missing data). When the number of participants evaluated was not reported, outcome data was not included in the analyses. Where standard deviations were missing for DMFT and dmft data we used the equation: log(sd)=0.17+0.56xlog(mean) to estimate the standard deviations for both the before and after mean caries values. This equation was estimated from available data where the standard deviations were given (R^2=0.91). No other imputations were undertaken.

Sensitivity analyses were undertaken to determine the effect of the imputed standard deviations.

Assessment of heterogeneity

We planned to explore differences in fluoridation technique, fluoride concentration, outcome measurement index and technique as possible sources of heterogeneity. Initial consideration of heterogeneity would be via the DerSimonian-Laird model (commonly referred to as a random-effects meta-analysis). When between study variance was deemed to be both robustly estimated and substantial (judged as the estimate being larger than twice its standard error), the random-effects model was favoured over a fixed-effect approach. Any heterogeneity would have been further investigated via Baujat and normal quantile-quantile (Q-Q) plots, alongside influence diagnostics (for example DFFITS, Cook's distance, hat values and leave-one-out methods) as appropriate. However, due to the limited data and lack of clarity in reporting we were unable to undertake any of these analyses for the caries data. Fluoride concentration was explored as part of the fluorosis analysis.

Assessment of reporting biases

If more than 10 trials had been identified for any meta-analysis of the primary outcome caries, publication bias would have been assessed according to the recommendations as described in the *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins 2011). Should asymmetry be identified in the contour enhanced funnel plots, possible causes would have been investigated. The number of studies presented in each caries meta-analyses precluded this.

Data synthesis

Caries

The primary analyses was based on all included studies, irrespective of risk of bias .

For the analyses of mean dmft and DMFT severity data, Revman was used (not shown) to calculate mean change score for water fluoridation and control group separately, and the summary effect estimates across age groups for each study. The resulting effect estimates for the water fluoridation and control groups were then entered into Revman in the review (see Analysis 1.1; Analysis 1.2) for each study to calculate the mean difference in change scores for the review. We decided to display this data using the average n for the before and after data for each study to give an indication of the size of the

studies. The raw data and summary statistics are shown in Table 1; Table 2. Where SDs are missing for the dmft, DMFT data we used the equation: *log(SD)=0.17+0.56xlog(mean)* to estimate the SDs for both before and after mean caries values. A sensitivity analysis was undertaken omitting all the data for studies/age groups where the standard deviation was imputed.

For the caries free data for both dentitions the risk differences were calculated in Revman (not shown) for water fluoridation and control groups separately, for each study undertaking a meta analyses across age groups. These summary effect estimates and standard deviations were then combined in a meta analysis in Revman (not shown) as continuous data to provide summary estimates of the change in the proportion caries free for both groups. For each dentition, the resulting data was then combined as a meta-analysis in the review. Once again we decided to display this data using the average n for the before and after data for each study to give an indication of the size of the studies. Table 3; Table 4 provides the raw data and summary estimates of the risk differences for each water fluoridation and control group separately, for each study, across age groups.

Fluorosis

In line with previous systematic reviews, the primary analysis was carried out on data where fluoride exposure was 5ppm or less, for reasons of applicability and robustness of evidence (most naturally occurring fluoride will be less than this threshold, and the paucity of information from higher exposures leading to less precise estimates). Fluorosis was analysed separately for fluorosis of aesthetic concerns and any level of fluorosis. We used random effects models with random intercept and random slope to model the log odds of fluorosis as a function of fluoride exposure. In this model we allow the intercept and slope to vary from study to study. The slope of the linear relationship between fluoride level (the predictor) and the log odds of fluorosis is the value of the coefficient for fluoride level plus the study specific random effect for that specific study. Fluoride exposure was centred upon the grand mean, and results presented as probabilities to aid interpretation.

Subgroup analysis and investigation of heterogeneity

Since the data from non-randomised studies are more prone to bias and are often heterogeneous (Loke 2007), we intended to undertake separate meta-analyses (where appropriate) and present results according to different study designs. We also planned to use meta-regression to investigate and explain sources of heterogeneity among studies (potential confounders of relevance to this review include sealant use, life-time exposure to fluoridated water, sugar consumption, SES, ethnicity and the use of other fluoride sources) where possible. Dental caries results would be analysed using meta-regression in order to assess the impact of potential sources of heterogeneity and estimate the underlying effect of water fluoridation. Due to the small number of studies and lack of clarity in the reporting within the caries studies, sub-group analyses were not undertaken

Sensitivity analysis

We would have undertaken sensitivity analysis based on risk of bias if sufficient trials had been included. Further sensitivity analysis were to be undertaken to determine if the results of the meta-analysis were influenced by the timing of baseline measurement, as appropriate. Sensitivity analyses were undertaken to determine the effect of the imputed standard deviations.

Presentation of main results

A 'Summary of findings' table was developed for the primary and secondary outcomes of this review using GRADEPro software. The quality of the body of evidence was assessed with reference to the overall risk of bias of the included studies, the directness of the evidence, the inconsistency of the results, the precision of the estimates, the risk of publication bias, the magnitude of the effect and whether or not there was evidence of a dose response.

Results

Description of studies

Results of the search

The search for literature resulted in 4677 records after de-duplication. These records were screened independently and in duplicate by two reviewers. Any disagreements were resolved by a third reviewer. After screening 158 articles were obtained, combined with 113 articles from additional sources (McDonagh 2000; NHMRC 2007 and an unpublished paper (Blinkhorn (unpublished)) and read in detail. Eleven await classification while 271 articles have been assessed for eligibility. Of the 271 articles assessed for eligibility, 144 studies (152 publications) met the inclusion criteria for the review. However, only 107 studies (15 caries studies; 92 studies reporting data on either all fluorosis severities or fluorosis of aesthetic concern) presented sufficient data for inclusion in the quantitative syntheses. The search, screening results and selection of included studies are illustrated in the PRISMA flow diagram (Figure 1).

Included studies

Caries

Nineteen prospective observational studies (22 publications) published between 1956 and 2015 met the inclusion criteria for the caries outcome. Eighteen of these studies looked at the effect of the initiation of water fluoridation programme on dental caries (Adriasola 1959, Arnold 1956, Ast 1951, Backer-Dirks 1961; Beal 1971, Beal 1981, Blinkhorn (unpublished); Brown 1965, DHSS England 1969, DHSS Scotland 1969, DHSS Wales 1969, Gray 2001, Guo 1984, Hardwick 1982, Kunzel 1997, Loh 1996; Pot 1974; Tessier 1987) and one study focused on the effect of cessation of fluoridation on caries (Maupome 2001). Only one study (Hardwick 1982) followed the same participants over time, evaluating 12 years old children in a fluoridated and a non-fluoridated area and following them for 4 years. All other studies evaluated specific age groups within three years of a change in fluoridation status and undertook a follow-up evaluation of the same age groups (different children) at a least

one other time point. A low/non-fluoridated area was used as a control. These have been analyses as controlled before-and-after studies.

The studies were conducted in multiple centres in Europe (Backer-Dirks 1961; Beal 1971; Beal 1981; DHSS England 1969; DHSS Scotland 1969, DHSS Wales 1969; Gray 2001; Hardwick 1982; Kunzel 1997; Pot 1974), North America (Arnold 1956; Ast 1951; Brown 1965; Maupome 2001;Tessier 1987), South America (Adriasola 1959), Australia (Blinkhorn (unpublished)) and Asia (Guo 1984; Loh 1996). Five studies were funded by research grants from research organisations, health authorities and government organisations (Beal 1971; Blinkhorn (unpublished); Booth 1991; Kunzel 1997; Maupome 2001), one study was funded in collaboration with members of the committee pro-fluoridation (Adriasola 1959) while the other studies did not state their funding sources.

Participants, aged 3 to 16 years, were mostly recruited from schools; period of time between baseline and final measurement ranged from 2 to 12 years.

The intervention groups in all 'fluoride initiation' studies were exposed to naturally low fluoride at baseline and artificially fluoridated water at follow-up while the control groups were exposed to naturally low fluoride at both time points. In studies where it was not stated clearly, fluoride concentration was reported as 'high' or 'fluoridated' for the intervention group and 'low' or 'non-fluoridated' for the control group. For the 'fluoride cessation' study meeting our inclusion criteria, the intervention group was exposed to artificially fluoridated water at baseline and naturally low fluoride at follow-up while the control group remained artificially fluoridated at both time points.

Measures of dental caries reported were dmft (decayed missing and filled deciduous teeth), DMFT (decayed missing and filled permanent teeth), DMFS (decayed missing and filled surfaces in permanent teeth), and proportion of children caries free (deciduous and permanent dentition).

Disparities in caries

Three prospective observational studies (four publications) met the inclusion criteria for disparities in caries but did not provide data suitable for analysis (Beal 1971; Holdcroft 1999; Gray 2001). They all assessed the effect of the initiation of water fluoridation on caries in different SES groups receiving fluoridated and non-fluoridated water. All three studies evaluated specific age groups within three years of a change in fluoridation status and undertook a follow-up evaluation of the same age groups (different children) at a least one other time point. A low/non-fluoridated area was used as a control. All were conducted in the UK. Caries measures reported were deft (Beal 1971), dmft (Gray 2001; Holdcroft 1999) and percentage children caries free (Beal 1971; Gray 2001).

Dental fluorosis

For dental fluorosis, 124 studies (129 publications) were included. These were published between 1941 and 2013. Of these studies, 28% were conducted in Europe, 23% in Asia, 19% in North America, 13% in South America, 10% in Africa, 5% in Australia and 2% in multiple centres in Europe and Asia. Forty studies were supported by research grants from government organisations and health authorities, non-governmental organisations, research organisations, universities or a combination of these sources (Adair 1999; Alarcon-Herrera 2001; AlDosari 2010; Angelillo 1999; Awadia 2000; Azcurra 1995; Butler 1985 ; Chen 1989; Clark 1993; Correia Sampaio 1999; de Crousaz 1982; Garcia-Perez 2013; Hernandez-Montoya 2003; Ibrahim 1995; Indermitte 2007; Indermitte 2009; Kanagaratnam 2009; Kumar 1999; Kumar 2007; Mackay 2005; Milsom 1990; Nanda 1974; Narwaria 2013; Nunn 1992; Pontigo-Loyola 2008; Ray 1982; Riordan 2002; Ruan 2005; Rwenyonyi 1999; Stephen 2002; Szpunar 1988; Tsutsui 2000; Villa 1998; Vuhahula 2009; Wang 1999; Wang 2012; Warren 2001; Whelton 2004; Whelton 2006; Wondwossen 2004); 6 studies were funded by: a sugar association (McInnes 1982), water company (Firempong 2013; Warnakulasuriya 1992), dental industry (Machiulskiene 2009; Wenzel 1982), or associated with a dental industry through authorship (McGrady 2012). Sources of support were not explicitly stated in 79 studies.

Out of the 124 studies meeting the inclusion criteria for fluorosis we aimed to extract cross-sectional data. Ninety studies reported sufficient data for inclusion in the analysis for all severities of dental fluorosis (Appendix 10). Forty studies were included in the analysis for fluorosis of aesthetic concern (Appendix 10). The remaining 32 studies did not report sufficient data for inclusion in the analysis, typically due to failure to indicate water fluoride concentration of the study areas or inappropriate measure of fluorosis reported (e.g. mean value or CFI). Where studies reported fluorosis outcomes as CFI only, the data could not be used. The Community Fluorosis Index (CFI) is a composite score calculated by summing the scores of Dean’s Index and dividing the total by the sample size. This gives an indication of the experience and severity of fluorosis at a population level but individual level data cannot be derived from it alone. Four of these studies reported two-time point data (Chen 1993; Heifetz 1988; Kumar 1999; Selwitz 1995) and could not be analysed alongside the single time point studies.

Dean's index, TFI, TSIF, DDE were reported in 41%, 19%, 10%, 6% of the included studies respectively while 23% of the studies either reported on other indices, specific enamel defects or did not state the index used at all.

Other harms

Four studies reporting on dental fluorosis outcome also presented data on other harms associated with water fluoridation (Table 6). The outcomes reported were skeletal fluorosis (Chen 1993; Jolly 1971; Wang 2012) and skeletal maturity (Wenzel 1982). Outcomes were assessed in participants using radiographs (Chen 1993; Jolly 1971; Wenzel 1982) or the diagnostic criteria of endemic skeletal fluorosis (WS 192-2008) (Wang 2012).

Excluded studies

Of the 271 studies that were assessed for eligibility, 119 studies were excluded. The reasons for exclusion were mostly due

to the following:

Caries

- Absence of two time point data for one or both study groups (Acharya 2003; Ajayi 2008; Antunes 2004; Archila 2003; ARCPOH 2008; Armfield 2004; Armfield 2005; Armfield 2007; Armfield 2010; Arora 2010; Bailie 2009; Baldani 2002; Baldani 2004; Binbin 2005; Blagojevic 2004; Bradnock 1984; Carmichael 1980; Carmichael 1984; Carmichael 1989; Evans 1995; Gillcrist 2001; Jones 1997; Jones 2000a; Jones 2000b; Kirkeskov 2010; Kumar 2001; Lee 2004; Murray 1984; Murray 1991; Peres 2006; Provart 1995; Rihs 2008; Riley 1999; Rugg-Gun 1977; Sagheri 2007; Sales-Peres 2002 ; Saliba 2008; Sampaio 2000; Tagliaferro 2004; Tiano 2009; Tickle 2003; Zimmermann 2003)
- Unsuitable control group (Attwood 1988; Hobbs 1994; Kalsbeek 1993; Seppa 1998; Wragg 1999)
- Absence of concurrent control group (Buscariolo 2006; Kunzel 2000a; Wong 2006)
- Difference between study groups in the time that outcome was measured (Blayney 1960; Kunzel 2000)
- Mixed fluoridation status of study areas (Spencer 2008)

Fluorosis

- Outcome not presented by study group (Akosu 2008; Aleksejuniene 2004; Alimskii 2000; Bao 2007; Baskaradoss 2008; Bo 2003; Borinskii 2009; Bottenberg 2004; Budipramana 2002; Burt 2000; Buzalaf 2004; Carvalho 2007; Casey 2000; Catani 2007; Chen 2009; Chen 2012; Cheng 2000; Chikte 2002; Clark 2006; de Lourdes Azpeitia-Valadez 2009; Dini 2000; Do 2007; Dobaradaran 2008; Evans 2009; Faye 2008; Gushi 2005; Han 2011; Hoffmann 2004; Hopcraft 2003; Khan 2004; Kozlowski 2002; Kukleva 2007; Mandinic 2010; Meyer-Lueckel 2006; Mondal 2012; Nirgude 2010; Ramires 2006; Shitumbanuma 2007)
- Unsuitable control group (Aldosari 2004); Compares fluorosis outcome between improved and unimproved water (Liu 2006; Liu 2009; Niu 2012; Ruan 2004; Wang 2008; Ncube 2005; Pandey 2002; Pandey 2005; Pandey 2010; ; Sohu 2007 ; Sun 2007; Vuhahula 2008; Wang 2005; Wei 2010; Wu 2006; Wu 2008; Zhu 2009)
- Outcome of interest not reported (Anuradha 2002; Wongdem 2001)
- Difference between study groups in the time that outcome was measured (Buchel 2011)

Other

- Cost analysis study (Campain 2010; Ciketic 2010); Unpublished dissertations (Ito 2007; Zietsman 2003); Conference abstract (Bihari 2008; Nayak 2009; Quan 2003)

Risk of bias in included studies

The review authors' judgements about each risk of bias item for each included study is summarised in Figure 2.

Caries outcome

Of the studies included for this outcome, all were judged as being at high risk of bias overall.

Sampling

Thirteen of the studies were judged as being at low risk of bias in terms of sampling (Arnold 1956; Ast 1951; Backer-Dirks 1961; Beal 1981; Blinkhorn (unpublished); Brown 1965; DHSS England 1969; DHSS Scotland 1969; Gray 2001; Guo 1984; Hardwick 1982; Pot 1974; Tessier 1987). For these studies, sampling was achieved either randomly or by sampling the entire eligible population of the study area. Seven studies were judged to be at unclear risk of bias for sampling (Adriasola 1959; Beal 1971; DHSS Wales 1969; Holdcroft 1999; Kunzel 1997; Loh 1996; Maupome 2001). This judgement was based on insufficient or unavailable information in most cases however in the study by Kunzel 1997, there was an unexplained exclusion of disabled children. In the DHSS Scotland 1969 study, different age criteria was used for each group resulting in an imbalance between the groups. The reason for this was not explained. No studies were found to be of high risk for selection bias for this outcome.

Confounding

All studies were found to be at high risk of bias for confounding. Confoundng factors for this outcome were considered to be SES, use of fluoride from sources other than water and dietary habits. Studies would only have been judged as being at low risk of confounding bias if they had successfully controlled for all three factors. Six of the studies attempted to control for none of these factors (Adriasola 1959; Ast 1951; Brown 1965; Guo 1984; Loh 1996; Pot 1974). Eight controlled for SES but not for other sources of fluoride or for dietary habits (Arnold 1956; Backer-Dirks 1961; Beal 1971; Beal 1981; DHSS England 1969; DHSS Scotland 1969; DHSS Wales 1969; Gray 2001). In the study by Tessier 1987, there may have been varied exposure to the water fluoride supply between the groups. Hardwick 1982 matched for SES and reported the use of fluoride from other sources to be broadly similar across groups but did not report on dietary habits. Maupome 2001 reported on dietary habits and the use of fluoride from other sources but these factors were not adjusted for in the analysis.

Detection bias

The majority of the studies did not blind outcome assessors. This is perhaps unsurprising when considering the efforts that may be required to blind assessors for this type of study. Only two studies (Backer-Dirks 1961; Hardwick 1982) were judged at low risk of bias for this domain. Backer-Dirks 1961 utilised radiographs in order to blind assessors and in the study by Hardwick 1982, children were brought to a central examination centre for assessment.

Incomplete outcome data

Equal numbers of the studies were judged as being at low (Beal 1971; Beal 1981; Brown 1965; Gray 2001; Guo 1984; Hardwick 1982; Kunzel 1997; Maupome 2001) or unclear (Adriasola 1959; Arnold 1956; Backer-Dirks 1961; Beal 1971;

Blinkhorn (unpublished); Holdcroft 1999; Loh 1996; Pot 1974) risk of bias for this domain. Four studies were found to be at high risk. In two studies (Ast 1951; Maupome 2001), the outcome data for participants was substantially lower than at baseline. In the study by Brown 1965 which ran from 1948-1959, children aged 6 to 8 years were sampled and initially examined up until 1957 but were no longer included after 1957 as no significant differences were found to exist in that age group. In the DHSS Scotland 1969 study, data was not presented for all children examined.

Selective reporting

Eight of the studies were found to be at high risk of bias for selective reporting. Four studies recorded data on fluorosis but this was not reported (Arnold 1956; DHSS England 1969; DHSS Scotland 1969; DHSS Wales 1969). Two studies did not report standard deviations (Backer-Dirks 1961; Tessier 1987) and Adriasola 1959 did not report complete baseline data for proportion of caries free children aged 6, 7, 11 and 15 years. Ten studies were found to be at low risk of bias for this domain with all expected data having been reported (Arnold 1956; Beal 1971; Beal 1981; Blinkhorn (unpublished); Brown 1965; Gray 2001; Guo 1984; Hardwick 1982; Kunzel 1997; Maupome 2001; Pot 1974). For two of the studies, the risk of bias remains unclear either due to the outcomes of interest not being clearly stated (Loh 1996) or the full study report not being avaible (Holdcroft 1999).

Other bias

Twelve studues were found to be at high risk of other bias, for ten of these studies this was due to an apparent lack of reliability or consistency of the outcome assessments in terms of either calibration of examiners or tests for inter and intra rater reliability (Arnold 1956; Ast 1951; Beal 1971; Beal 1981; Brown 1965; DHSS England 1969; DHSS Scotland 1969; DHSS Wales 1969; Guo 1984; Tessier 1987). In the study by Gray 2001, the baseline fluoridation status of the children was determined by the location of the school they attended which may not have taken into account any children attending schools in fluoridated areas but residing outside of those areas. In the cessation study by Maupome 2001, baseline data was obtained between 14 and 19 months after the fluoride ceased to be added to the water supply.

Fluorosis outcome

Of the studies included for this outcome, 120 were found to be at high risk of bias and four at unclear risk (Ellwood 1995; Levine 1989; Milsom 1990; Stephen 2002) overall. No studies were judged as being low risk. Sampling bias for this outcome was either low (40%) or unclear (55%) with a small number of studies at high risk. The majority of studies (more than 85%) were at high risk for confounding and high risk of detection bias (more than 75%). Overall studies were found to be of low risk of bias for incomplete outcome data (more than 60%) and selective reporting bias (more than 70%). There was more variation regarding other bias with almost 50% of studies being at low risk and 40% at high risk. The reason for studies being at high risk of other bias in most cases was that studies did not report on the reliability or consistency of the outcome assessments.

Effects of interventions

Caries

Nineteen studies met the inclusion criteria (18 fluoride initiation studies and one fluoride cessation studies), with 15 providing sufficient data for analysis of caries levels following a change in fluoridation status. Four studies provided insufficient data for analysis (Backer-Dirks 1961; DHSS Scotland 1969; Loh 1996; Pot 1974).

Initiation of water fluoridation

Change in dmft/dmfs

Nine studies, with data from 44268 participants, provided data for dmft (Adriasola 1959; Arnold 1956; Beal 1971; Beal 1981; Blinkhorn (unpublished); DHSS England 1969; DHSS Wales 1969; Guo 1984; Kunzel 1997). All studies were judged to be at high risk of bias and only two (22%) studies were conducted post-1975. Data collection following initiation of water fluoridation ranged from 2 to 12 years.

The mean difference in change in dmft was 1.81 (95% CI 1.31 to 2.31; P-value of effect <0.00001) Figure 6. Although there was considerable heterogeneity (P<0.00001; I^2=91%) we decided to pool the data as all the mean difference estimates were significant, and ranged from 0.42 to 2.70. Some of the heterogeneity is expected due to the large size of the studies ensuring narrow confidence intervals.

Sensitivity analysis, excluding studies with imputed standard deviations gave rise to a similar effect estimate, mean difference in change score 1.83 (95% CI 0.68 to 2.98; 5 studies).

There is very low quality evidence of a mean reduction of 1.81 in dmft due to water fluoridation compared with the control groups (low/non-fluoridated areas). At final assessment, the dmft means for the control groups ranged from 1.21 to 7.8, with a median of 5.1. This indicates a substantial reduction in dmft of 35% in the water fluoridation groups over and above that for the control groups.

There was no data for dmfs.

Change in DMFT/DMFS

Ten studies, with data from 78764 participants, provided data for DMFT (Arnold 1956; Beal 1981; Blinkhorn (unpublished); Brown 1965; DHSS England 1969; DHSS Wales 1969; Guo 1984; Hardwick 1982; Kunzel 1997; Tessier 1987). All studies were judged to be at high risk of bias and only three studies (30%) were conducted post-1975. Data collection following initiation of water fluoridation ranged from 2 to 11 years. The mean difference in change in DMFT was 1.16 (95% CI 0.72 to 1.61; P-value of effect <0.00001) Figure 7. It should be noted that in Guo 1984 the before mean DMFT values for both the

control and water fluoridation groups were low at 0.8, and this increased in both groups, however the increase was greater for the control group. This explains why the changes are both negative. The data for Hardwick 1982 is mean DMFT increment data for both groups from the paper, following the same children over time. A lower increment was observed for the water fluoridation group and as they are caries increments they have been entered as negative values.

Although there was considerable heterogeneity (P<0.00001; I^2=97%), once again we decided to pool the data as all but one of the mean difference estimates were significant (ranging from -0.14 to 2.51). Some of the heterogeneity is expected due to the large numbers in the studies ensuring narrow confidence intervals.

Sensitivity analysis, excluding studies with imputed standard deviations gave rise to a slightly larger effect estimate, mean difference in change score 1.32 (95% CI 0.53 to 2.11; 4 studies).

There is very low quality evidence of a mean reduction of 1.16 in DMFT due to water fluoridation compared with the control groups (low/non-fluoridated areas). At final assessment, the DMFT means for the control groups ranged from 0.71 to 5.5, with a median of 4.4. This indicates a substantial reduction in DMFT of 26% in the water fluoridation groups over and above that for the control groups.

Only one study, with data from 343 participants, presented data on DMFS (Hardwick 1982). The study presented increment data for both groups, with a lower increment being observed for the water fluoridation group (mean difference 2.46 (95% CI 1.11 to 3.81). The study provides very low quality evidence of a mean reduction of 2.46 in DMFS due to water fluoridation compared with the control groups (low/non-fluoridated areas).

Change in proportion of children caries free: deciduous dentition

Ten studies, with data from 39966, provided data for the proportion of caries free children for the deciduous dentition (Adriasola 1959; Ast 1951; Beal 1971; Beal 1981; Blinkhorn (unpublished); DHSS England 1969; DHSS Wales 1969; Gray 2001; Guo 1984; Kunzel 1997). All studies were judged to be at high risk of bias. Three studies (30%) were published post-1975. There was a 0.15 absolute reduction in the proportion of caries free children with mean difference 0.15 (95% CI 0.11 to 0.19)) Figure 8. There was considerable heterogeneity (P<0.00001; I^2=84%), but the value of Tau^2 from the random effects analysis was low (<0.001; mean differences ranged from 0.05 to 0.25). We therefore decided to pool the data.

There is very low quality evidence of proportion of caries free children increased in the areas with water fluoridation 0.15. At final assessment, the proportion of caries free children at follow-up in the low/non-fluoridated areas ranged from 0.06 to 0.67, with a median of 0.22; an increase of 0.15 could be considered substantial.

Change in proportion of children caries free: permanent dentition

Eight studies, with data from 53538 participants, provided data for the proportion of caries free children for the permanent dentition (Adriasola 1959; Beal 1981; Blinkhorn (unpublished); DHSS England 1969; DHSS Wales 1969; Guo 1984; Kunzel 1997). All studies were judged to be at high risk of bias and only two (25%) were conducted post-1975. There was a 0.14 absolute reduction in the proportion of caries free children with mean difference 0.14 (95% CI 0.05 to 0.23) Figure 9. There was considerable heterogeneity (P<0.00001; I^2=98%), but the value of Tau from the random effects analysis was low at 0.02 (mean differences ranged from -0.03 to 0.30). We therefore decided to pool the data.

There is very low quality evidence of proportion of caries free children increased in the areas with water fluoridation 0.14. At final assessment, the proportion of caries free children at follow-up in the low/non-fluoridated areas ranged from 0.01 to 0.67, with a median of 0.14; the increase of 0.14 doubles this.

Other caries measures

There were four studies (Backer-Dirks 1961; DHSS Scotland 1969; Loh 1996; Pot 1974) meeting the inclusion criteria that were not included in the quantitative analysis. All five studies were at high risk of bias and excluded from the analysis due to insufficient data and/or different measures of caries. In two of the studies, caries measures reported were dentinal approximal lesions (Backer-Dirks 1961) and percentage with false teeth (Pot 1974) while the other two studies did not report on the number of participants (DHSS Scotland 1969; Loh 1996). Three of the studies assessing children between the ages of 4 and 15 years showed a reduction in caries following the initiation of water fluoridation (Backer-Dirks 1961; DHSS Scotland 1969; Loh 1996). Pot 1974 assessed participants between 5 and 55 years of age and showed an increase in percentage with dentures following fluoridation.

Cessation of water fluoridation

Change in DMFT/DMFS

Only one study, at high risk of bias, presented data on DMFS (Maupome 2001). The fluoride cessation study by Maupome 2001 was conducted over 3 years. The study was conducted in a population with “generally low caries experience, living in an affluent setting with widely accessible dental services”. The results did not demonstrate an increase in caries in the children in the fluoride ended group compared with the still-fluoridated group, in fact there was a statistically significant decrease in caries severity (including incipient and cavitated lesions) for the fluoride ended group, which was not found in the still fluoridated group, for both of the age groups examined. A complex pattern of disease was found when different caries indices were looked at.

No studies meeting the inclusion criteria reported on change in dmft nor proportion of children caries free (deciduous/permanent dentition) following the cessation of water fluoridation.

Disparities across social class

Three studies (Beal 1971, Gray 2001, Holdcroft 1999), meeting the review's inclusion, reported on the effect of water fluoridation on disparities in caries across social class (Table 5). The number of participants was only reported in two of the studies (Beal 1971, Gray 2001). The total number of participants measured for caries in these studies was 35399. The studies focused on the initiation of water fluoridation in study areas that were reasonably comparable. Measures of caries reported in the studies were dmft, deft and % caries free subjects. All three studies were judged to be at high risk of bias.

Beal 1971 studied three areas, in two of which water fluoridation as initiated (one classed as 'poor' and the other 'industrial'). The control group was classed as 'industrial'. Given the lack of a validated measure of deprivation, and without knowing the composition of the groups under comparison, it is not possible to draw conclusion from this study.

Holdcroft 1999 and Gray 2001 both used the Jarman score measure of social class. In the Holdcroft 1999 study there is insufficient information regarding fluoride levels at baseline or follow -up and the number of participants measured at each time point unclear. In both studies the Jarman scores at baseline for the control (non-fluoridated areas) were all less than zero. The Jarman scores at baseline in the fluoridated areas ranged from -7.85 to 15.03 in the Holdcroft 1999 and -23.09 to 21.57 in the study by Gray 2001.

Given the reasons listed above we are unable to draw robust conclusions regarding the initiation of water fluoridation and its effect on disparities in caries across social class.

Fluorosis

Aesthetic concern

Fluoride levels of 5ppm or less

Forty studies reporting data from 59,630 participants were included in the analysis of fluorosis of aesthetic concern. The reported fluoride exposure ranged from 0 to 4.9ppm with a mean of 0.80ppm (sd 0.90).

In order to assess the assumption of linearity we plotted the log odds of the prevalence of fluorosis with fluoride level and with log of fluoride level (not shown). A positive linear relationship could be assumed in both cases, indicating that as fluoride levels increase so does the prevalence of fluorosis; The reported fluoride level was used as a predictor rather than the log of reported fluoride exposure. This was then centred by taking away the grand mean (0.80) from the reported fluoride level.

Caterpillar plots (not shown) of the residuals for slope and intercept indicated that many of the studies differed significantly from the average (random effects at zero) at the 0.05 level of significance. The effect of fluoride exposure was positive and statistically significant; a higher prevalence of fluorosis is associated with increased fluoride exposure (OR = 2.90, 95% CI 2.05 to 4.10). Controlling for study effects, we would expect the odds of fluorosis to increase by a factor of 2.90 for each one unit increase in fluoride exposure.

The random intercept and random slope model indicated that the effect of fluoride exposure differed across studies. The statistically significant negative covariance of -0.82 implies that studies with a higher than average probability of fluorosis tend to have a more shallow slope.

The results presented so far have been based on study specific values. This is indicated in the following graphic, where the random effects of intercept and slope are set to zero, in effect the plotted prevalence of fluorosis in ‘an average’ study. An alternative approach is to calculate the prevalence of fluorosis in all studies combined, the marginal probability of fluorosis. The study specific values indicate the probability of fluorosis in terms of ‘any given participant’ whereas the marginal probabilities indicate the probability of fluorosis ‘among the participants’.

Figure 4

The marginal probabilities of fluorosis at different fluoride levels are given below.

Fluoride exposure (ppm)	Probability of fluorosis (95% CI)
0.1	0.08 (0.05 to 0.12)
0.2	0.09 (0.06 to 0.13)
0.4	0.10 (0.06 to 0.15)
0.7	0.12 (0.08 to 0.17)
1	0.15 (0.11 to 0.21)
1.2	0.18 (0.13 to 0.24)
2	0.31 (0.23 to 0.40)
4	0.59 (0.46 to 0.71)

All fluoride levels

The analysis of fluorosis of aesthetic concern at all reported fluoride exposure was based on 60,030 observations from 40 studies. The reported fluoride levels ranged from 0 to 7.6ppm with a mean of 0.85ppm (sd 1.03).There was very little difference in the results from the analysis restricted to 5ppm or less. The effect of fluoride exposure is positive and statistically significant; a higher prevalence of fluorosis is associated with increased fluoride exposure (OR = 2.84, 95% CI 2.00 to 4.03). Controlling for study effects, we would expect the odds of fluorosis to increase by a factor of 2.84 for each one

unit increase in fluoride level (1ppm F).

There is very low quality evidence that there is a significant relationship between fluorosis prevalence (aesthetic concern) and fluoride exposure. The quality of the evidence reflects the observational nature of the studies, high risk of bias in the included studies and substantial between-study variation (as indicated by the random effects).

Any fluorosis

Fluoride levels of 5ppm or less

Ninety studies reporting data from 180,530 participants were included in this analysis. The reported fluoride levels in the studies ranged from 0 to 5ppm, with a mean of 1.22 ppm(sd 0.92). When restricted to studies reporting fluoride exposure of 5ppm or less, there is a clearer positive relationship between the proportion of children with fluorosis and fluoride level.

The relationship between the log odds of fluorosis and fluoride level and log fluoride level were both approximately linear. Consequently the reported fluoride exposure was used as a predictor rather than the log of reported fluoride exposure. This was then centred by taking away the grand mean (1.22) from the reported fluoride exposure level.

The effect of fluoride exposure is positive and statistically significant; a higher prevalence of fluorosis is associated with increased fluoride exposure (OR = 3.60, 95% CI 2.86 to 4.53). Controlling for study effects, we would expect the odds of fluorosis to increase by a factor of 3.60 for each one unit increase in fluoride exposure (1ppm F).

The random intercept and random slope model indicated that the effect of fluoride exposure differed across studies. The statistically significant negative covariance of -1.05 implies that studies with a higher than average probability of fluorosis tend to have a more shallow slope.

The results presented so far have been based on study specific values. This is indicated in the following graph, where the random effects of intercept and slope are set to zero, in effect the plotted prevalence of fluorosis in ‘an average’ study.

Figure 3

The marginal probabilities of fluorosis are presented in the table below.

Fluoride exposure (ppm)	Probability of fluorosis (95% CI)
0.1	0.28 (0.23 to 0.33)
0.2	0.30 (0.25 to 0.34)
0.4	0.33 (0.28 to 0.38)
0.7	0.40 (0.35 to 0.44)
1	0.47 (0.42 to 0.52)
1.2	0.52 (0.47 to 0.56)
2	0.68 (0.62 to 0.73)
4	0.83 (0.77 to 0.88)

All fluoride levels

Ninety studies reporting data from 182,233 participants were included in this analysis. The reported fluoride levels ranged from 0 to 14ppm with a mean fluoride level of 1.28 ppm (sd 1.11). There was little change in the pooled estimates when all fluoride levels were included in the analysis. The effect of fluoride exposure is positive and statistically significant; a higher prevalence of fluorosis is associated with increased fluoride exposure (OR = 3.13, 95% CI 2.55 to 3.85). Controlling for study effects, we would expect the odds of fluorosis to increase by a factor of 3.13 for each one unit increase in fluoride exposure (1ppm F).

The statistically significant negative covariance of -0.87 implies that studies with a higher than average probability of fluorosis tend to have a shallower slope. The between study variance increases as fluoride level increases.

There is very low quality evidence that there is a significant relationship between fluorosis prevalence (all level of fluorosis) and fluoride exposure. The quality of the evidence reflects the observational nature of the studies, high risk of bias in the included studies and substantial between-study variation (as indicated by the random effects).

Other dental fluorosis studies

A total of 32 studies met the inclusion criteria but were not reported in a way that allowed for further analysis (Appendix 10).

Other harms

Four studies reporting on dental fluorosis also presented data on the association of water fluoridation with skeletal fluorosis (Chen 1993, Jolly 1971, Wang 2012) and skeletal maturity (Wenzel 1982) in participants between the age of 12 and >66 years. Three of the studies included 595175 participants (Chen 1993, Wang 2012, Wenzel 1982) and fluoride concentration in all four studies ranged from <0.2 to 9.4 ppm. The studies were all at high risk of bias and their results were not analysed further (Table 6).

Discussion

Summary of main results

Summary of main results

Of the 144 studies meeting the inclusion criteria, 107 studies provided sufficient data for quantitative synthesis. Fourteen studies provided adequate data for the assessment of the effect of the initiation of a water fluoridation programme on dental caries, one study focused on the effect of the cessation of water fluoridation. Although three studies evaluated disparities in dental caries across social class, no data were suitable for further analysis. Ninety studies provided sufficient data for inclusion in the analysis of dental fluorosis of any level (40 in the analysis of fluorosis of aesthetic concern).

The evidence for all outcomes measured is very low quality (Summary of findings table 1).

The results from the caries severity data indicate that the initiation of water fluoridation results in reductions in the order of 1.8 dmft and 1.2 DMFT for the deciduous and permanent dentitions. This translates to 35% and 26% reductions compared to the median control group mean values. There were also increases in the percent caries free, of 15% in the deciduous and 14 % in the permanent dentition.

There is insufficient information to determine whether initiation of a water fluoridation programme results in a change in disparities in caries levels across SES.

There is insufficient information to determine the effect of stopping water fluoridation programmes on caries levels.

With regard to fluorosis, for a fluoride level of 0.7 ppm the percentage of participants with fluorosis of aesthetic concern was estimated to be approximately 12%. This increases to 40% when considering fluorosis of any level, however, this includes fluorosis that can only be detected under very controlled, clinical conditions and other enamel defects.

Harms other than dental fluorosis were rarely reported in the included studies. There is insufficient evidence to draw conclusions. The broader literature speculates about harms associated with higher levels of fluoride in water (e.g., cancer, lowered intelligence, endocrine dysfunction). However, there has been insufficient evidence to draw conclusions (MRC 2000).

Overall completeness and applicability of evidence

The applicability of the evidence on water fluoridation to today's societies is unclear and highly likely to vary according to setting.

The evidence included in the review pertains to caries in children only. Only one study examined the effect of water fluoridation on adults (Pot 1974); the reported outcome for this study was the percentage of participants with dentures. There is no data to determine the effect of water fluoridation on caries levels in adults.

Approximately 64% of the included caries studies evaluating the initiation of water fluoridation were conducted prior to 1975.

In developed countries, the widespread use of fluoride toothpastes from the mid to late 1970's, along with increased access to other caries preventive strategies such as fluoride varnishes and dental sealants may mean that the benefit of water fluoridation is reduced in such populations. However, a review by Marinho 2003, evaluating the effect of topical fluorides for preventing dental caries in children and adolescents, found no evidence that the effect of topical fluoride was dependent on background exposure to other fluoride sources. They did find evidence that the relative effect of topical fluoride may be greater in those who have higher baseline levels of caries.

Globally, caries levels have been reducing. In 1980 the global DMFT for 12 years olds was estimated to be 2.43 (Leclercq 1987). In 2011, this global estimate had reduced to 1.67 DMFT (although there is variation by WHO region, Table 7). Within the studies included in the review, the mean values for DMFT at follow-up in the non-fluoridated areas were higher, ranging from 0.7 to 5.5.

Figure 5 shows global dental caries levels (DMFT) among 12 years olds. Out of the 189 countries providing data, 148 (78%) have a DMFT of 3 or less. Areas where a large percentage of the population (greater 60%) receive fluoridated water (either natural or artificial fluoridation) include: North America, Australasia, parts of South America (namely Brazil, Columbia and Chile), the Republic of Ireland, Malaysia. Whilst these areas tend to have low to very low DMFT (Figure 5), there are many other parts of the world where fluoridated water is not widespread that also have low caries levels. Equally, there are areas with high distribution of water fluoridation and moderate caries levels.

The applicability of the evidence around water fluoridation has to be considered in the context of reductions in caries levels overtime, the uptake of other strategies proven to prevent caries, and global changes in patterns of food consumption (Kearney 2010). Specifically, sugar consumption has risen dramatically since the start of the 20th Century when it was approximately 5.1kg per capita. The consumption of sugar continues to rise with the average sugar consumption now estimated at 23kg per capita; the greatest rates of growth are currently seen in Asia, the Middle East and Africa (SucDen 2015). In addition, in many parts of the world more industrially processed foods are consumed with less food being prepared and cooked in the home, using locally sourced water (Slimani 2009). Variation in fluoride concentrations in water across regions and countries, and the increase in processed foods and beverages and their transportation, make it difficult to assess dietary fluoride intake. Such changes may mean that, although the tap water is fluoridated in a particular area, some members of the population do not consume a sufficient volume to provide a benefit to their oral health.

Ten of the 14 studies used in the analysis of water fluoridation initiation schemes included lifetime residents only. Whilst this is a valid approach it evaluates the absolute effect rather than the benefit to the whole population. The effect size shown in the review may, therefore, be larger than that found in the population, depending on population movement/migration.

There is limited reporting of harms other than dental fluorosis in the included studies. The broader literature speculates about harms associated with higher levels of fluoride in water (e.g., cancer, lowered intelligence, endocrine dysfunction). However,

there has been insufficient evidence to draw conclusions (MRC 2000).

Quality of the evidence

The quality of the evidence for all outcomes was considered to be very low.

With regard to the caries outcomes, all included studies were observational. The quality of the evidence was downgraded due to an overall high risk of bias in the included studies (excluding domains associated with randomisation, allocation concealment, blinding of participants). The main areas of concern were confounding and lack of blind outcome assessment. The evidence was additionally downgraded for indirectness due to the fact that about 64% of the caries studies evaluating the initiation of water fluoridation were conducted prior to 1975 (Overall completeness and applicability of evidence). Also, there were no included studies evaluating caries levels in adults. There was statistically significant heterogeneity present in all four caries analyses (Analysis 1.1; Analysis 1.2; Analysis 1.3; Analysis 1.4), with I^2 statistics of 84% or greater. However, given that the direction of effect was the same for all but one of the outcomes in one of the studies, we have not downgraded with regard to inconsistency. The study showing an effect in the opposite direction was the most recently conducted study, with low baseline caries levels and, as yet, the shortest duration of follow-up (Blinkhorn (unpublished)). These factors could all influence the effect estimate.

With regard to dental fluorosis, again, all studies were observational and the quality of the evidence was downgraded due to an overall high risk of bias. The evidence was also downgraded for inconsistency due to substantial between-study variation.

Potential biases in the review process

In four studies included in the analysis of water fluoridation for preventing caries (dmft and DMFT), the standard deviation was imputed. This was not prespecified in the protocol. The equation for imputing the standard deviations was estimated from available data where the standard deviations were given. Sensitivty analysis, excluding those studies for which the standard deviation had been imputed gave similar results.

An arbitrary cut-off date of 1975 was used as an indication of when fluoridated toothpaste use was widespread in industrialised countries were assumed to have been exposed to fluoridated toothpaste. There is no indication in the included studies as to the extent to which this is true.

We only reported on dmft in children 8 years old and younger. This decision was based on clinical judgement but was not prespecified in the protocol. The cut-off is unlikely to alter the review's findings as very little data excluded due to this cut-off.

When analysing the fluorosis data, our primary analysis focused on fluoride concentrations of 5ppm or less. Again, this was an arbitrary cut-off; there was little difference in the results obtained when all fluoride concentrations were examined.

Agreements and disagreements with other studies or reviews

The most widely recognised systematic review of water fluoridation was published in 2000 (McDonagh 2000). Our review aimed to update this review but has adopted different methods in certain areas. Importantly, these included changes to the evaluation of the cessation of water fluoridation programmes and the evaluation of disparities in caries levels.

The McDonagh 2000 review included 26 studies looking at the effect of water fluoridation on oral health. No pooling of data was undertaken. The mean difference in change in dmft/DMFT and increase in proportion of caries-free children were presented for selected ages/age groups. The range of mean reduction in dmft/DMFT score was from 0.5 to 4.4, with a median of 2.25 dmft/DMFT. In our review, we did undertake statistical pooling, imputing standard deviations where necessary. Rather than selecting specific ages from the data provided in the included studies, we undertook the analyses by dentition, utilising all data for deciduous teeth for children aged 8 years and younger, and all available data for permanent teeth. Mean reductions of 1.81 in dmft and 1.16 in DMFT, due to water fluoridation, were shown.

In terms of the proportion of caries free children following water fluoridation, the McDonagh 2000 review reports a range of mean differences of -0.05 to an increase of 0.64, with a median of 0.15. The pooled estimate obtained in our review demonstrates an increase in proportion of caries free children in the areas with water fluoridation of 0.15 for deciduous teeth and 0.14 for permanent teeth.

With regard to the cessation of water fluoridation programmes, the review by McDonagh 2000 included eight studies, whereas our review included only one (Maupome 2001). This difference is due to the inappropriate choice of control group in the cessation studies. In a controlled before and after study, the groups at baseline should be comparable. Therefore, in the water fluoridation cessation studies, the two groups should both be fluoridated areas, one of which (the 'intervention' group) subsequently has the fluoride removed from the water. The area that remains fluoridated acts as the control. In majority of the cessation studies, a non-fluoridated area was used as the control at baseline. The intervention and control groups, therefore, are not comparable at the start of the study. Whilst the McDonagh 2000 review suggests that caries prevalence increases following the withdrawal of water fluoridation, this result was not confirmed in the study included in our review.

When addressing the issue of whether water fluoridation results in a reduction in disparities in caries levels across different groups of people, the McDonagh 2000 review included 15 studies, all except two of which were cross-sectional surveys. The authors concluded that, based on a small number of low quality, heterogeneous studies, there was "some evidence that water fluoridation reduces the inequalities in dental health across social classes in five and 12 year-olds, using the dmft/DMFT measure. This effect was not seen in the proportion of caries-free children among five year-olds." They highlight that there was insufficient data to evaluate the effects in children of other ages. There was no data with regard to disparities in caries levels amongst adults.

In our review, we only included studies reporting caries data if they were prospective with a concurrent control, and at least

two points in time evaluated. The cross-sectional studies, whilst able to provide information on whether water fluoridation is associated with a reduction in disparities, are not able to address the question of whether water fluoridation results in a reduction in disparities in caries levels. There was insufficient data to determine whether initiation of a water fluoridation programme results in a change in disparities in caries levels across different groups of people.

The results from our review of the dental fluorosis data are fairly comparable with those of the McDonagh 2000 review. In the earlier review, the estimated percentage of the population with dental fluorosis of aesthetic concern fluorosis at a fluoride concentration of 0.7ppm 9% (95% CI 4% to 17%). In our review this was slightly higher at 12% (95% CI 8% to 17%).

Authors' conclusions

Implications for practice

There is very little contemporary evidence evaluating the effectiveness of water fluoridation for the prevention of caries.

The data indicates that water fluoridation is effective at reducing caries levels in both the deciduous and permanent dentition in children; this is based on very low quality evidence. The quality of the evidence is influenced by the observational nature of the study designs, the high risk of bias within the studies, heterogeneity and the applicability of the evidence to current lifestyles. The decision to implement a water fluoridation programme relies upon an understanding of the population's oral hygiene, the availability and uptake of other caries prevention strategies, diet and consumption of tap water, and the movement/migration of the population. There is insufficient evidence to determine whether water fluoridation results in a change in disparities in caries levels across SES. There was no evidence to determine the effectiveness of water fluoridation for preventing caries in adults.

There is a significant association between both dental fluorosis of aesthetic concern and all types of dental fluorosis and fluoride level. However, this evidence is again very low quality due to the observational nature of the studies, high risk of bias and between-study variation.

The fluorosis studies are generally more recent than the caries studies and the results may potentially be influenced by other sources of fluoride. These additional sources are seldom reported. In addition majority of the studies reporting on dental fluorosis were conducted in areas with high natural fluoride levels as opposed to optimal artificially fluoridated areas

Implications for research

More contemporary studies are needed.

Because all the included studies examined the effectiveness of water fluoridation in children, research on the effectiveness among adults is needed. Standardized reporting techniques and measurements for caries and fluorosis would improve comparability of results across studies.

More research also is needed to understand the contribution of fluoride from sources other than water; the consumption of tap water within a population; the effect of water fluoridation over and above other caries preventive measures, namely dental sealants and fluoride varnishes; the impact of water fluoridation on disparities in oral health; other harms associated with water fluoridation (particularly in areas with naturally high levels of fluoride).

Acknowledgements

We wish to thank the staff of the Cochrane Oral Health Group for managing the literature searches and the editorial process. We would also like to thank the editors for comments and referees Colwyn Jones, Derek Richards, Elizabeth Treasure and Evangelos Kontopantelis for peer review comments; Chengge Hua, Chunjie Li, Ignacio Araya, Monica Ballesteros, Paul Tramini and Zhao Shaofeng for translation support.

Contributions of authors

All authors contributed equally to the writing of the protocol and will complete the review.

Declarations of interest

This review is supported by a grant from the US Centers for Disease Control and Prevention. No other interests to declare.

Differences between protocol and review

- Analysed dmft data only for children 8 years and younger
- Used estimates for studies where standard deviation was not given.
- Analysis of dental fluorosis data
- For risk of bias, 'sampling' was assessed while 'sequence generation' and 'allocation concealment' were not assessed

Published notes

Characteristics of studies

Characteristics of included studies

Acharya 2005

Methods	**FLUOROSIS STUDY** Country of study: India Geographic location: Davangere- Nallur, Naganur, Doddabathi, Kundawada and Holesirigere Year of study: Not stated Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: School children aged 12 to 15 years; Lifetime residency Exclusion criteria: Absence on the day of the survey Other sources of fluoride: Not stated Social class: Socioeconomic position was similar in all villages Ethnicity: Not stated Residential history: Lifetime residents Other confounding factors: Not stated
Interventions	All natural fluoridation Group 1: 0.43 ppm Group 2: 0.72 ppm Group 3: 1.1 ppm Group 4: 1.22 ppm Group 5: 3.41 ppm
Outcomes	Dental fluorosis (Dean's Index) Age at assessment: 12 to 15 years
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	The 5 villages selected were out of a possible 90. There was insufficent detail reported to determine how selection took place.
Confounding	High risk	The use of other fluoride sources was not accounted for
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	Low risk	Outcome of interest reported
Other bias	Low risk	No other apparent bias

Adair 1999

Methods	**FLUOROSIS STUDY** Country of study: USA Geographic location: Warren County, Georgia Year of study: Not stated Year of change in fluoridation status: Not stated Study design: Cross-sectional
Participants	Inclusion criteria: Children attending sole elementary and middle schools in study area. Exclusion criteria: Children whose homes were served with well water. Other sources of fluoride: Parents completed questionnaire regarding dentrifice use, home water source and current use of systemic fluoride supplements. All subjects received school water fluoridated at 0.5ppm. Other sources of fluoride: Not stated Social class: Not stated Ethnicity: Not stated Residential history: Not considered Other confounding factors: Not stated
Interventions	Group 1: 0.5 - 1.2 ppm (both natural and artifical fluoridation) Group 2: <0.1 ppm (natural fluoridation)
Outcomes	Dental fluorosis (Dean's Index); caries data collected but not presented in this review due to study design Age at assessment: 8-10 and 11-13 years
Funding	NIDR Grant DE-06113
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	Participants were children attending the sole elementary and middle/high schools in Warren county. There was insufficient detail reported to determine how selection took place
Confounding	High risk	SES was not accounted for
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data for over 80% of participants were reported
Selective reporting (reporting bias)	High risk	Outcome of interest reported. However, data is not presented clearly enough to be considered reliable
Other bias	High risk	Exposure to fluoride water could not be controlled for. Some children have fluoride water at school across groups. Some had non-fluoridated well water at home.

Adriasola 1959

Methods	**CARIES STUDY** Country of study: Chile Geographic location: Curico (F), San Fernando (non-F), Year study started: 1953 Year study ended: 1956 Year of change in fluoridation status: 1953 Study design: CBA
Participants	Inclusion criteria: Children aged 3-15; Children from 2 primary schools in the study areas Exclusion criteria: None stated Other sources of fluoride: Not stated Social class: Based on knowledge of their demographics, culture and social economy, it was assumed that the study areas were comparable Ethnicity: Not stated Residential history: Not stated Other confounding factors: None stated
Interventions	**Initiation of water fluoridation** Group 1: Low fluoride content (ppm not reported; natural fluoridation) Group 2: Low fluoride content (ppm not reported; natural fluoridation)
Outcomes	% caries free participants Age at baseline measure: 3 to 8 years and 11, 12 and 15 years (unclear if deciduous or permanent dentition) Age at final measure: 3 to 8 years and 11, 12 and 15 years (unclear if deciduous or permanent dentition)
Funding	In collaboration with members of the committee Pro-Fluoridation
Notes	Data extracted from Adriasola 1959 differs from that presented in CRD review (additional data extracted) Paper translated from Spanish

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	Following on from the 1953 survey, the authors re-established contact with local authorities, teachers and health educators in 1956 and in a period of two months examined children in Curicco and San Fernando attending private and public technical schools, kindergartens, primary and secondary schools. There was insufficient detail reported to determine how selection took place.
Confounding	High risk	Study groups assumed comparable for SES. No details were reported on the use of fluoride from other sources or on the dietary habits of the children
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Unclear risk	Different children examined at before and after time points. Unclear if all eligible children examined at each time point
Selective reporting (reporting bias)	High risk	Baseline data for proportion of children caries free incomplete for ages 6, 7, 11 and 15 years
Other bias	Low risk	No other apparent bias

Al-Alousi 1975

Methods	FLUOROSIS STUDY Country of study: England Geographic location: Anglesey (F), Leeds (non-F) Year of study: 1973 Year of change in fluoridation status: 1955 Study design: Cross-sectional
Participants	Inclusion criteria: Lifetime residents of study areas Children aged 12-16. Exclusion criteria: Missing, fractured or crowned teeth .Refusal to participate (1 school in Leeds). Other sources of fluoride: Not stated Social class: Not stated Ethnicity: Not stated Residential history: Lifetime residents Other confounding factors: Not stated
Interventions	Group 1: 0.9 ppm (artificial fluoridation) Group 2: <0.01 ppm (natural fluoridation)
Outcomes	Dental Fluorosis Age at assessment: 12 to 16 years
Funding	Not stated
Notes	Data extracted from Al-Alousi 1975 differs from that presented in CRD review

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	Children were selected from schools in Leeds in a quasi-random way whereby every nth child (n=total children in school/20) from the register was selected. Eligible children in Angelsea were selected from schools randomly.
Confounding	High risk	SES was not accounted for and the use of other fluoride sources was not accounted for
Blinding of outcome assessment (detection bias)	High risk	A clinical investigation and double blinded photographic examination were conducted. However, the results reported are those of the unblinded clinical investigation
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	Unclear risk	Outcome of interest reported
Other bias	High risk	Diagnoses had to be "agreed" on by the two examiners and there was no mention of any sort of calibration of the examiners. This may have resulted in measurement bias

Alarcon-Herrera 2001

Methods	FLUOROSIS STUDY Country of study: Mexico Geographic location: Durango Year of study: Not stated Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: Aged 6-12 years; children who had established permanent residence in the area Exclusion criteria: Not stated Other sources of fluoride: Not stated Social class: Not stated Ethnicity: Not stated Residential history: Permanent residents Other confounding factors: Not stated
Interventions	All natural fluoridation Group 1: Non-detectable-1.5 ppm Group 2: 1.51-4.99 ppm Group 3: 5.0-8.49 ppm Group 4: 8.5-11.9 ppm Group 5: >12 ppm
Outcomes	Dental fluorosis (Dean's Index) Age at assessment: 6 to 12 years
Funding	Project grant from the Mexican National Council of Science and Technology Conacyt-Sivilla, Project 9502160
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	Through a polystage conglomerate random sampling, 380 families were selected and prorated into 77 to 80 families per concentration area zone. The division yielded a total of 1,437 individuals from the five different areas
Confounding	High risk	SES was not accounted for and the use of other fluoride sources was not accounted for
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	Low risk	Outcome of interest reported
Other bias	Unclear risk	No information examiner calibration with regard to detection of the outcome variable

Albrecht 2004

Methods	FLUOROSIS STUDY Country of study: Hungary Geographic location: Bár and Dunaszekcső Year of study: 2004 Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria:Healthy schoolchildren, aged 6-18 years, lifelong residents in the communities Bár or Dunaszekcső, only permanent teeth were investigated Exclusion criteria: Any systemic disease Other sources of fluoride: Not stated Social class: Not stated Ethnicity: Not stated Residential history: Lifetime residents Other confounding factors: Not stated
Interventions	All natural fluoridation Group 1: 1.7 ppm Group 2: 2 ppm
Outcomes	Dental fluorosis (Dean's index and TSIF) Age at assessment: 6 to 18 years
Funding	Not stated
Notes	Paper translated from Hungarian

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	There was insufficient detail reported to determine how selection took place
Confounding	High risk	SES was not accounted for and the use of other fluoride sources was not accounted for
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	Low risk	Outcome of interest reported
Other bias	Low risk	No other apparent bias

AlDosari 2010

Methods	FLUOROSIS STUDY Country of study: Saudi Arabia Geographic location: Riyadh Year of study: 2010 Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria:Saudi nationality; Lifetime residence in the area Exclusion criteria: Non-Saudi nationality; absence from school on the day of dental examination Other sources of fluoride: Not stated Social class: Both schools from urban and rural areas were included in the sample frame. Ethnicity: Saudi nationals. No further details Residential history: Lifetime residents Other confounding factors: Not stated
Interventions	All natural fluoridation Group 1: 0-0.3 ppm Group 2: 0.31-0.6 ppm Group 3: 0.61-1 ppm Group 4: 1.01-1.5 ppm Group 5: 1.51-2 ppm Group 6: 2.01-2.5 ppm Group 7: ≥2.51 ppm
Outcomes	Dental fluorosis (TF index) Age at assessment: 6 to 18 years
Funding	Supported by a grant from King AbdulazizCity for Science and Technology, Riyadh, Saudi Arabia.
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	A list of zones was considered as the sampling frame for the schools and municipalities were randomly chosen from each zone to represent the urban area. Additionally, rural areas in the municipality with at least one school were surveyed. However there was insufficient detail reported to determine how selection of schools and children within those schools took place
Confounding	High risk	The use of other fluoride sources was not accounted for
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	High risk	Over 95 % of the subjects sampled were examined. However, it is not clear why fluorosis was not scored in permanent teeth of the 6-7 year olds
Selective reporting (reporting bias)	High risk	The authors did not report or justify not presenting fluorosis data for the age group 15-18 years
Other bias	Unclear risk	Clinical examination was carried out by two dentists, but no information on whether the examiners were calibrated with regard to detection of the outcome variableis given.

Angelillo 1999

Methods	FLUOROSIS STUDY Country of study: Italy Geographic location: Areas around Naples (F) and Catanzaro (non-F). Year of study: 1997 Year of change in fluoridation status: NA Study design: Cross sectional
Participants	Inclusion criteria: Lifetime residents of study areas (children only). Children aged 12. Used community water supply as main sources of drinking water. Exclusion criteria: Partially erupted teeth Orthodontic banding. Other sources of fluoride: Tooth brushing habits (frequency of tooth brushing), fluoride tablets, fluoride dentrifices. Social class: Parents employment status Ethnicity: Not stated Residential history: Lifetime residents Other confounding factors: Sweet consumption, climate
Interventions	All natural fluoridation Group 1: >=2.5 ppm Group 2: <=0.3 ppm
Outcomes	Dental fluorosis; caries data evaluated in study but not included in review due to study design Age at assessment: 12 years
Funding	Partially supported by a grant of Acquedotto Vesu- viano S.p.A.
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	Schools were selected at random as were classes with the schools. All eligible children within the selected class were recruited to the study
Confounding	High risk	There is a reported imbalance between groups in the use of fluoride supplements, toothbrushing behaviour and in SES
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data for the majority of participants presented
Selective reporting (reporting bias)	Low risk	Outcome of interest reported
Other bias	Unclear risk	The two examiners involved had previously been trained and calibrated, but details not presented

Arif 2013

Methods	FLUOROSIS STUDY Country of study: India Geographic location: Nagaur district Year of study: 2013 Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria:Only villages where the mean fluoride concentration was >1.0 mg/L were selected for the dental fluorosis survey. No other information provided for participants Exclusion criteria: Not stated Other sources of fluoride: Not stated Social class: Not stated Ethnicity: Not stated Residential history:Not stated Other confounding factors: Not stated
Interventions	54 villages receiving water with different natural fluoride concentrations ranging from 0.9 - 5.8 ppm
Outcomes	Dental fluorosis (Dean's index) Age at assessment: Not stated
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	Only villages where the mean fluoride concentration was >1.0ppm were selected. There was insufficient detail reported to determine how selection took place
Confounding	High risk	SES was not accounted for and the use of other fluoride sources was not accounted for
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Unclear risk	Insufficient information to determine whether Data presented for all participants as study details were poorly reported
Selective reporting (reporting bias)	Low risk	Outcome of interest not reported in paper but made available by authors via email
Other bias	High risk	Fluoride concentration for the different villages overlap making the data impossible to interpret

Arnold 1956

Methods	**CARIES STUDY** Country of study: USA Geographic location: Grand Rapids (F), Muskegon (non-F) Year study started: 1944 Year study ended: 1951 (after which time the control group became fluoridated; evaluated until 1954) Year of change in fluoridation status: 1945 Study design: CBA
Participants	Inclusion criteria: Children aged 4-16 years; Used city water supplies since birth Exclusion criteria: Children who lived outside study areas for more than 3 months of any one year Other sources of fluoride: Author states that there were no concerted efforts to commence special caries control programmes e.g. topical fluoride programmes, in either of the cities since the study began Social class: Not stated Ethnicity: Not stated Residential history: Lifetime residents Other confounding factors: Not stated
Interventions	**Initiation of water fluoridation** Group 1: 1 ppm (artificial fluoridation) Group 2: <0.2 ppm (natural fluoridation)
Outcomes	DMFT, deft Age at baseline measure: 5 to 13 years (deciduous dentition); 6 to 16 years (permanent dentition) Age at final measure: 5 to 13 years (deciduous dentition); 6 to 16 years (permanent dentition)
Funding	Not stated
Notes	Data extracted from Arnold 1956 differs from that presented in CRD review (additional data extracted)

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	Children were selected through schools. Almost all eligible children in the areas of study were examined
Confounding	High risk	No efforts were made to stop topical fluoride application in either control or test group. However it is not known if the areas differed in terms of the programmes/services on offer. No details on the dietary habits of the children were reported on
Blinding of outcome assessment (detection bias)	High risk	No blinding of assessors
Incomplete outcome data (attrition bias)	Unclear risk	Quote: “samples consist of all available children in certain grades (or in sections of the grades)” Number of children examined each year presented, however, numbers vary across each age group and each year (not a continuous study sample)
Selective reporting (reporting bias)	High risk	It is noted in the results that fluorosis observations have been made but no details are given as to the methods and data (just % increase). Also, standard deviation not reported
Other bias	High risk	Calibration of examiners not mentioned

Ast 1951

Methods	**CARIES STUDY** Country of study: USA Geographic location: Newburgh (F), Kingston (non-F) Year study started: 1945 Year study ended: 1952 ear of change in fluoridation status: 1945 Study design: CBA
Participants	Inclusion criteria: All 5-12 year old children present at school on days of examination; lifetime residents of study areas Exclusion criteria: None stated Other sources of fluoride: Not stated Social class: Not stated Ethnicity: Not stated Residential history: Lifetime residents Other confounding factors: Not stated
Interventions	**Initiation of water fluoridation** Group 1 baseline: <0.1 ppm (natural fluoridation) Group 1 post intervention: 1-1.2 ppm (artificial fluoridation) Group 2: <0.1 ppm (natural fluoridation)
Outcomes	DMFT rate per 100 erupted permanent teeth; % caries free children (deciduous dentition) Age at baseline measure: 5 years (deciduous dentition); 6 to 12 years (permanent dentition) Age at final measure: 5 years (deciduous dentition); 6 to 12 years (permanent dentition)
Funding	Not stated
Notes	Data extracted from Ast 1951 differs from that presented in CRD review (additional data extracted)

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	All 5-12 year old school children present in the schools within the study areas on the days of examination were included in the study
Confounding	High risk	SES was not accounted for, the use of other fluoride sources was not accounted for nor were the dietary habits of the children
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	High risk	The number of participants for whom outcome data was reported (FI 3054; Non-FI 2812) varied from the number of participants reported to have been included in the study (FI 3200; Non-FI 3100)
Selective reporting (reporting bias)	High risk	Baseline dates of children in the intervention (1944-45) and control (1945-46) groups varied, which would result in incomparability of data from both study groups
Other bias	High risk	There was no mention of examiner calibration

Awadia 2000

Methods	FLUOROSIS STUDY Country of study: Tanzania Geographic location: Arusha and Moshi Year of study: 1996 Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria:Age 9 to 14 years; lifelong residence in respective towns or villages Exclusion criteria: Not stated Other fluoride sources: Toothpaste use - Arusha: 94%, Arusha Meru: 100%, Moshi: 97.1% and Kibosho: 40%. Magadi use – Arusha: 31(47%), Arusha Meru: 1(2.9%), Moshi: 41 (58.6%), Kibosho: 83(97.6%) Social class: Peasant mothers: Arusha=1 (1.5%), Arusah Meru=NR, Moshi=7(10%), Kibosho=33(38.8%); Other: Arusha=65(98.5%), Arusha Meru=35(100%), Moshi=63(90%), Kibosho=52(61.2%) Ethnicity: Arusha area (Arusha and Arusha Meru) – mainly ethnic Asians; Kilimanjaro region (Moshi and Kibosho) - Africans Residential history: Lifetime residents Other confounding factors: Not stated
Interventions	All natural fluoridation Group 1: 0.2 ppm Group 2: 0.3 ppm Group 3: 3.6 ppm
Outcomes	Dental fluorosis (TF index) Age at assessment: 9 to 14 years
Funding	Supported by the Norwegian State Educational Loan fund, NUFU project 61/96, and the committee for Research and Postgraduate Training, Faculty of Dentistry, University of Bergen, Norway
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	Schools in all villages (except in Arusha Meru) as well as participants were randomly selected. For schools where participants were not randomly selected, including the school in Arusha Meru, all the registered school children were chosen to participate
Confounding	High risk	There was a reported imbalance between groups in terms of SES and use of fluoride from other sources
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	High risk	Outcome of interest not fully reported, rather presented as a median score
Other bias	High risk	Only one examiner was involved; no testing for intra-rater reliability with regard to detection of the outcome variable.

Azcurra 1995

Methods	FLUOROSIS STUDY Country of study: Argentina Geographic location: Sampacho (F) and Porteña (non-F) in the Cordoba province. Year of study: 1993 Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: Children aged 6-7 (1st grade) and 12-13 (7th grade) years at primary school. Exclusion criteria: None stated Other sources of fluoride: Frequency of tooth brushing. Group 1: aged 6-7 – 56% brush at least once a day (28/50) Group 1: aged 12-13 – 74% brush at least once a day (37/50) Group 2: aged 6-7 – 46% brush at least once a day (23/50) Group 2: aged 12-13 – 50% brush at least once a day (25/50) Social class: Determined by occupation and highest attained level of schooling attained by main breadwinner in family. Classified as high, medium, and low social class. Group 1: aged 6-7 –80% low SES (40/50) Group 1: aged 12-13 – 82% low SES (41/50) Control: aged 6-7 – 74% low SES (37/50) Control: aged 12-13 – 80% low SES (40/50) Residential history: Not stated Other confounding factors: Not stated
Interventions	All natural fluoridation Group 1: 9.05 ppm Group 2: 0.19 ppm
Outcomes	Dental fluorosis (Dean's Index); caries data evaluated in study but not included in review due to study design Age at assessment: 6-7 years and 12-13 years
Funding	Part of this work was subsidized by the Ministry of Science and Technology (SeCyT) of the National University of Córdoba , Córdoba, Argentina
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	Stratified random selection was used. Following stratification by age, gender and SES,100 school children were randomly selected from each village
Confounding	High risk	Although SES was considered during sampling, it was not controlled for within the analysis. No details were reported on the use of fluoride from other sources
Blinding of outcome assessment (detection bias)	High risk	Blinding not stated, however the two calibrated operators, as authors of the study, were likely to have knowledge of the study areas
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	Low risk	Outcome of interest was fully reported on and balanced across both groups
Other bias	Low risk	No other apparent biases

Backer-Dirks 1961

Methods	**CARIES STUDY** Country of study: Holland Geographic location: Tiel (F), Culemborg (non-F) Year study started: 1952 Year study ended: 1959 Year of change in fluoridation status: 1953 Study design: CBA
Participants	Inclusion criteria: Children aged 11-15; Lifelong residents of the study areas; Used the piped water supply; 100 children of each age examined Exclusion criteria: Not stated Other fluoride sources: Not stated Social class: Areas similar in social class structure and proportional numbers of subjects selected from each school type Ethnicity: Not stated Residential history: Lifetime residents Other confounding factors: Not stated
Interventions	**Initiation of water fluoridation** Group 1: 1.1 ppm (artificial fluoridation) Group 2: 0.1 ppm (natural fluoridation)
Outcomes	Average number of all approximal lesions; average number of approximal dental lesions Age at baseline measure: 11 to 15 years (permanent dentition) Age at final measure: 11 to 15 years (permanent dentition)
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	A proportion of children were chosen at random from different types of schools (public school, roman catholic, protestant)
Confounding	High risk	No details were reported on the use of fluoride from other sources on on the dietary habits of the children
Blinding of outcome assessment (detection bias)	Low risk	Quote: “The radiographs made in Tiel and Culemborg were put into unlabelled envelopes, and examined at random”. Each examiner evaluated the same number of radiographs without knowledge of the origin of the films
Incomplete outcome data (attrition bias)	Unclear risk	It is not clear whether the outcome data was reported for all participants
Selective reporting (reporting bias)	High risk	Outcome of interest reported, however, standard deviation was not reported
Other bias	Low risk	No other bias apparent

Beal 1971

Methods	**CARIES STUDY** Country of study: England Geographic location: Balsall Heath and Northfield, Birmingham (F) and Dudley (non-F). Year study started: 1967 Year study ended: 1970 Year of change in fluoridation status: 1964 Study design: CBA
Participants	Inclusion criteria: Children aged 5 attending schools that participated in each year of the study. Exclusion criteria: None stated Other sources of fluoride: Not stated Social class: "*The socio-economic composition of the districts has been described previously...*". Balsall Heath is a poor area of the city with high proportion of immigrants; Northfield and Dudley are both industrial areas with comparable populations, but more immigrants in Dudley. Ethnicity: All areas have some proportion of immigrants Residential history: No attempt was made to select continuously resident children from the samples. Other confounding factors: Not stated
Interventions	Initiation of water fluoridation Group 1: 1 ppm (artificial fluoridation) Group 2: 1 ppm (artificial fluoridation) Group 3: <0.1 ppm (natural fluoridation)
Outcomes	dmft; % caries free children Age at baseline measure: 5 years (deciduous dentition) Age at final measure: 5 years (deciduous dentition)
Funding	MRC grant funded trial
Notes	"*The children, who were 5 years old in 1967, were aged about 3 years when the fluoride in their drinking water reached the recommended level; they had erupted all their deciduous, and these would be expected to have derived only slight benefit at this time. These children do not represent a true baseline; any dental advantage that this group had received, compared with the true but unexamined baseline before fluoride was added would have the effect of decreasing the observed reduction, if any, over subsequent years.*"

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	There was insufficient detail reported to determine how selection took place
Confounding	High risk	No details were reported on the use of fluoride from other sources on on the dietary habits of the children
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Unclear risk	Different children examined at before and after time points. Unclear if all eligible children examined at each time point
Selective reporting (reporting bias)	Low risk	Reporting of outcome of interest balanced across groups
Other bias	High risk	No detail of who performed examinations, their training/consistency.

Beal 1981

Methods	CARIES STUDY Country of study: England Geographic location: Scunthorpe (F) and Corby (non-F) Year study started: 1969 Year study ended: 1975 Year of change in fluoridation status: 1968 Study design: CBA
Participants	Inclusion criteria: Lifetime residents in study areas; Children aged 5, 8 and 12 Exclusion criteria: Teeth extracted for orthodontic purposes Other sources of fluoride: Not stated Social class: Both areas have iron/steel as main industry-socio-economic; composition of the two areas similar Ethnicity: Not stated Residential history: Lifetime residents Other confounding factors: Not stated
Interventions	*Fluoride initiation* Group 1: 0.9 ppm (artificial fluoridation) Group 2: 0.35 ppm (natural fluoridation)
Outcomes	dmft, DMFT, % caries free subjects (deciduous teeth), % caries free subjects (permanent teeth), Age at baseline measure: 5, 8 and 12 years Age at final measure: 5, 8 and 12 years
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	Schools were chosen by random selection and every child of eligible age in these schools was examined
Confounding	High risk	No details were reported on the use of fluoride from other sources on on the dietary habits of the children
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data for all participants appears to be presented
Selective reporting (reporting bias)	Low risk	Outcome of interest reported
Other bias	High risk	The authors reported that was no difference in level of reproducibility of the examiners, however, as statistical significance was set at p<0.01 rather than 0.05, there may have actually been a difference.

Beltran-Aguilar 2002

Methods	FLUOROSIS STUDY Country of study: USA Geographic location: Not stated Year of study: 1986 Year study ended: 1987 Year of change in fluoridation status: Not stated Study design: Cross-sectional
Participants	Inclusion criteria:Aged 12 to 14 years; availability of data on type of water system and fluorosis; having residences served by the same type of public water system with respect to fluoride status; determinable date of public water system fluoridation initiation and residence at area before initiation of water fluoridation; availability of continuous residence history if more than one residence; fewer than 5 residences; ascertainable exposure to fluoride drops or tables; served by public water systems with ascertainable fluoride status in residences. Other fluoride sources: Tablets 623 (14.9%), Drops 627 (14.5%), Both 317 (8.4%) Suboptimal Fluoride- Drops Only= 507 (23.0), Tablets Only=512 (22.5), Both Drops and Tablets= 279 (13.2);Optimal Fluoride- Drops Only=103 (6.8), Tablets Only=98 (6.0), Both Drops and Tablets =32 (2.2), Natural Fluoride -Drops Only= 13 (5.5), Tablets Only=17 (7.5),Both Drops and Tablets=6 (2.5) Exclusion criteria: Any criteria in discord with the inclusion criteria Social class: Not stated Ethnicity: Not stated Residential history:All the children were continuous residents of areas with the reported water systems Other confounding factors: Not stated
Interventions	Group 1: <0.7 ppm (natural fluoridation) Group 2: 0.7 to 1.2 ppm (artificial fluoridation) Group 3: 0.7 to 4 ppm (natural fluoridation)
Outcomes	Dental fluorosis (Dean's index) Age at assessment: 12 to 14 years
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	The sampling frame was specified and the sample represented 41 percent of all 12 to 14 year olds and more than 4 million schools children, there is no evidence that any eligible children were excluded
Confounding	High risk	The use of other fluoride sources was similar in those that consumed water with optimal and natural fluoride but very different from those in the suboptimal fluoride group. SES was not accounted for
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Unclear risk	Children with missing outcome data were excluded. It is not clear whether there was an imbalance across groups in excluded children
Selective reporting (reporting bias)	Low risk	Outcome of interest reported
Other bias	High risk	There is an overlap in fluoride concentration between the exposure groups (0.7-1.2 and 0.7-4.0) which is likely to dilute the observable effect of exposure to intervention across groups. It is unclear whether the examiners were calibrated as the paper provides insuficient information and we were unable to access associated reports which may have contained examination protocols

Birkeland 2005

Methods	FLUOROSIS STUDY Country of study: Sudan Geographic location: Triet el Biga, Abu Delaig and Abu Groon Year of study: Not stated Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria:Residence in the village since the age of 1 year Exclusion criteria: Not stated Other fluoride sources: Not stated Social class: Similar socio-economic conditions Ethnicity: Similar ethnicity Residential history: Lifetime residents Other confounding factors: Not stated
Interventions	All natural fluoridation Group 1: 0.3 - 1.4 ppm Group 2: 0.8 - 2.2 ppm Group 3: 2 - 4.2 ppm
Outcomes	Dental fluorosis (TF index) Age at assessment: 11 to 13 years
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	The schools were selected from an unspecified sampling frame and insufficient detail was reported to determine how selection of schools took place. However children were selected at random from the schools
Confounding	High risk	No details were reported on the use of fluoride from other sources
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	Low risk	Outcome of interest reported
Other bias	High risk	There is inconsistency in the number of water samples tested (Triet el Biga – 6, Abu Delaig – 11, Abu Groon – 8) and an overlap in range of fluoride concentrations between the three study areas. Also examinations were done by a dental assistant and it is not clear whether reliability testing was carried out

Blinkhorn (unpublished)

Methods	CARIES STUDY Country of study: Australia Geographic location: Gosford city (newly-F), Wyong Shire (F), Ballina and Byron (non-F) Year study started: 2008 Year study ended: 2012 Year of change in fluoridation status: 2008 Study design: Interrupted time series
Participants	Inclusion criteria: Children aged 5-7 years (data for 10-12 year olds also provided) Exclusion criteria: Not stated Other fluoride sources: Information on toothbrushing habit was collected but not reported in details Social class: Shires of Ballina and Byron are more rural and less industrialised than Wyong Shire and Gosford City. Information on parent's educational attainment and cardholder status was recorded but not reported in details Ethnicity: Aboriginal status was recorded but not reported in details Residential history: Not stated Other confounding factors: Information on sugary drink was collected but not reported in details
Interventions	Group 1: Fluoridated (data not included in review) Group 2: Newly fluoridated Group 3: Non-fluoridated
Outcomes	dmft, DMFT, % caries free (deciduous dentition), % caries free (permanent dentition) Age at baseline measure: 5 to 7 years Age at final measure: 5 to 7 years
Funding	Centre for Oral Health Strategy, New South Wales Health, the Australian Dental Association (New South Wales Branch) and Northern Sydney and Central Coast Local Health Service
Notes	All data unpublished

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	Children were drawn from Catholic and State Schools in the three areas and schools were randomly selected from a master list until the individual school rolls for primary school children aged 5-7 years added up to around 900.
Confounding	High risk	Multivariate analysis of dmft was done taking educational attainment of parents, toothbrushing behaviour and sugary drink consumption into account however this was done by year, not by study area and there is insufficient information to determine whether these confounding factors were balanced across study groups
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Unclear risk	Though response rate was unbalanced across groups, data was presented for all examined participants
Selective reporting (reporting bias)	Low risk	Data fully reported for deciduous dentition
Other bias	Low risk	No other apparent bias

Booth 1991

Methods	FLUOROSIS STUDY Country of study: England Geographic location: Huddersfield (F), Dewsbury (non-F) Year of study: 1989 Year of change in fluoridation status: 1989 Study design: Cross-sectional
Participants	Inclusion criteria: All 3 year old white children. Lifetime residents of study areas. Positive informed consent. Exclusion criteria: Children who had moved out of the area. Children who were ill. Other sources of fluoride: Children taking fluoride tablets excluded from study. Social class: Areas matched using socio-economic data from the 1981 census and recent unemployment data. Parents asked about occupation of head of household during interview. Ethnicity: White children only Residential history: Lifetime residents Other confounding factors: Not stated
Interventions	Group 1: 1 ppm (artificial fluoridation) Group 2: <0.3 ppm (natural fluoridation)
Outcomes	Dental fluorosis (modified developmental defects of enamel index), caries data evaluated in study but excluded from review due to study design Age at assessment: 3 years
Funding	North Western Regional Health Authority
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	Eligible children were identified from a list of all children in the health district and were randomly sampled from each population. The numbers required were based on a pilot study (no reference provided). No further details reported
Confounding	Low risk	Fluoride from other sources was controlled for using inclusion/exclusion criteria and there was no significant difference in SES between the groups
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data is presented for the majority of those recruited (attending appointments)
Selective reporting (reporting bias)	Low risk	All expected data reported
Other bias	Low risk	No other apparent bias

Brothwell 1999

Methods	FLUOROSIS STUDY Country of study: Canada Geographic location: Wellington and Dufferin (neighbouring counties), South-Western Ontario Year of study: 1996-1997 (academic year) Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: Children resident in Wellington-Dufferin-Guelph Health Unit area. Parental consent. Children aged 7-8 years. Exclusion criteria: Children with non-erupted or insufficiently erupted central incisors. Children absent on day of examination. Other sources of fluoride: Amount of toothpaste usually used (*48.9% use > pea sized amount, 365/747*), fluoride supplements (*14.5% take supplements, 107/740*), age started brushing, use of mouthwash (*4% routinely use fluoridated mouthwash, 30/752*), breast/bottle fed, whether toothpaste used when brushing. Social class: Household income, highest level of education received. "*It is likely that respondents under-represented the disadvantaged segment of the population. How the low response rate in this subgroup affects the estimates of prevalence is unknown; however, it is unlikely to be a major source of bias.*" Ethnicity: Not stated Residential history: "*The questionnaire assessed […] years at current residence*"39% lifelong residents (293/752); 64.8% (487/752 resided at tested source since before age 3 (fluorosis-sensitive period – multivariate analysis restricted to these 487 participants) Other confounding factors: breast-feeding duration
Interventions	Group 1: >=0.7 ppm (natural fluoridation) Group 2: <0.7 ppm (natural fluoridation)
Outcomes	Dental fluorosis (TSIF score >1) Age at assessment: 7 to 8 years
Funding	Not stated
Notes	Data extracted from Brothwell 1999 differs from that presented in CRD review

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	Children were selected via schools however insufficient detail was reported regarding sampling
Confounding	High risk	Bivariate analysis showed that fluoridated mouthwash use and professional fluoride treatments were significantly associated with fluorosis prevalence, however, the data were not reported/presented in a manner which demonstrates adjustment for imbalance at baseline occurred, or was measured well and controlled for.
Blinding of outcome assessment (detection bias)	Low risk	Testing of water samples for fluoridation level was conducted after screening examination (at the University of Toronto); examination s conducted by a single dental hygienist (in school clinics). It does not appear that despite the lack of any attempt to blind being reported, that blinding would have had any effect on reducing bias.
Incomplete outcome data (attrition bias)	High risk	Significant missing data (e.g. 34 participants from the water sample)
Selective reporting (reporting bias)	High risk	Comment: There is much that is either not reported in a sufficient manner to be able to glean the necessary information from (i.e. TSIF scores against fluoridation levels of water samples), or has significant missing data (e.g. 34 participants from the water sample) and so is difficult to draw the conclusions required for this review. No evidence of protocol in advance of obtaining data/undertaking analysis.
Other bias	Low risk	Reporting dental fluorosis as TSIF score >1 rather than ≥1 puts the results at risk of misclassification bias

Brown 1965

Methods	CARIES STUDY Country of study: Canada Geographic location: Brantford (F), Stratford (Natural F), Sarnia (non-F), Ontario Year study started: 1948 Year study ended: 1959 Year of change in fluoridation status: 1945 Study design: CBA
Participants	Inclusion criteria: Children aged 19-14; lifetime residents (absence of <6 weeks since birth); all primary and secondary schools in study areas Exclusion criteria: None stated Other sources of fluoride: Not stated Social class: Not stated Ethnicity: Not stated Residential history: lifetime residents Other confounding factors: Not stated
Interventions	Initiation of water fluoridation Group 1: 'optimal' level - ppm not stated (artificial fluoridation) Group 2: 'low' level - ppm not stated (natural fluoridation) Group 3: 'low' level - ppm not stated (natural fluoridation)
Outcomes	DMFT, % caries free subjects (permanent teeth) Age at baseline measure: 9 to 11 years and 12 to 14 years Age at final measure: 9 to 11 years and 12 to 14 years
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	The study sample was selected by random sampling (by school and grade) described in "A Suggested Methodology for Fluoridation Surveys in Canada" (Depatment of National Health and Welfare 1952)
Confounding	High risk	SES was not accounted for and the use of other fluoride sources was not accounted for
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	High risk	Children 6 to 8 years were sampled and initially examined up until 1957 but were no longer included after 1957 as no significant differences were found to exist in that age group
Selective reporting (reporting bias)	Low risk	Outcome of interest reported
Other bias	High risk	Inorder to maintain a uniform scale of observation, all examinations were done by the same examiner and intra-examiner reproducibility not reported

Butler 1985

Methods	FLUOROSIS STUDY Country of study: USA Geographic location: 16 Texas communities (selected to reflect a wide range of fluoride levels in drinking water) Year of study: 1980 Year study ended: 1981 Year of change in fluoridation status: unclear if natural or artifical fluoridation Study design: Cross-sectional
Participants	Inclusion criteria: Lifetime residents of study areas, enrolled in grades 2-6 (aged 7-13) and 9-12 (aged 14-19) in public schools. Exclusion criteria: None stated Other sources of fluoride: Fluoride toothpaste, fluoride drops, number of fluoride treatments. Social class: Mother's education Ethnicity: White/Spanish/Black (ethnicity judged by surname?) Residential history: Lifetime residents Other confounding factors: Home air conditioning, air temperature, no. of months breastfed, children in the family, mother's age at child's birth, Total dissolved solids in drinking water and zinc in drinking water, age.
Interventions	Unclear as to whether the fluoridation is natural in all areas Group 1: 0.2 ppm Group 2: 0.2 ppm Group 3: 0.3 ppm Group 4: 0.7 ppm Group 5: 1.0 ppm Group 6: 1.0 ppm Group 7: 1.1 ppm Group 8: 1.8 ppm Group 9: 1.9 ppm Group 10: 1.9 ppm Group 11: 2.1 ppm Group 12: 2.1 ppm Group 13: 2.3 ppm Group 14: 2.3 ppm Group 15: 2.4 ppm Group 16: 3.3 ppm
Outcomes	Dental fluorosis (CFI score; prevalence of observed mottling (moderate)) Age at assessment: 7 to 19 years
Funding	Supported by grants from the US Environmental Protection Agency
Notes	Data extracted from Butler 1985 differs from that presented in CRD review

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	All eligible children were invited to participate
Confounding	Unclear risk	While some confounders were measured well and some controlled for in the analysis. However, it is not clear whether the necessary adjustment was done to the data relevant to this review
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	High risk	Comment: Reporting balanced across all groups; however not all data presented in a form that can be interrogated. Despite collecting data on the CFI's 6 categories of severity of mottling, only data for moderate mottling is presented independently of the overall CFI score for each group. Furthermore, identified confounders are not presented for each group, but for the portion of the study sample as a whole (despite being possible from authors having collected the data)
Other bias	High risk	Each child received a dental examination performed by one of the authors, however, calibration was not mentioned

Chandrashekar 2004

Methods	**FLUOROSIS STUDY** Country of study: India Geographic location: Davangere district Year of study: 2002 Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria:Lifetime residency; age 12-15 years Exclusion criteria: Not stated Other fluoride sources: Not stated Social class: Similar socio-economic conditions Ethnicity: Not stated Residential history:Lifetime residents Other confounding factors: Not stated
Interventions	All natural fluoridation Group 1: 0.22 ppm Group 2: 0.43 ppm Group 3: 0.74 ppm Group 4 0.93 ppm Group 5: 1.1 ppm Group 6: 1.22 ppm Group 7: 1.63 ppm Group 8: 2.08 ppm Group 9: 2.33 ppm Group 10: 2.64 ppm Group 11: 2.91 ppm group 12: 3.41 ppm
Outcomes	Dental fluorosis (TF index) Age at assessment: 12 to 15 years
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	Villages satisfying eligibility criteria were randomly selected and children were accessed via schools. It is not clear however how the children within the schools were selected
Confounding	High risk	No details were reported on the use of fluoride from other sources
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Unclear risk	The number of participants analysed was not reported
Selective reporting (reporting bias)	High risk	Dean's fluorosis index was measured but not reported
Other bias	Low risk	No other apparent bias

Chen 1989

Methods	FLUOROSIS STUDY Country of study: Taiwan Geographic location: Shenkang Hsiang, Changwa Year of study: 1987-1988 Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: Children aged 6-16; lifetime residents of study areas; always used water wells as primary source of drinking water Exclusion criteria: Not stated Other fluoride sources: Not stated Social class: Not stated Ethnicity: Not stated Residential history: Lifetime residents Other confounding factors: Author states that project communities have approximately the same location, climate, diet, food habits and customs, mean average daily temp = 25^{o}C, range = 13-37^{o}C
Interventions	All natural fluoridation Group 1: 4.2 - 4.9 ppm Group 2: 2.1 - 2.8 ppm Group 3: 1.4 - 2.1 ppm Group 4: 0.7 - 1.4 ppm Group 5: 0.4 - 0.7 ppm Group 6: <0.4 ppm
Outcomes	Dental fluorosis prevalence (Dean's index); caries data evaluated in study but not included in review due to study design Age at assessment: 6 to 16 years
Funding	National Science Council, Taiwan, ROC (NSC-77-0412-B-039-05)
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	All eligible participants in the were included in the study
Confounding	High risk	SES was not accounted for and the use of other fluoride sources was not accounted for
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Unclear risk	5172 children recruited and examined children, however, data presented for 5072 participants. Unclear if missing data balanced across groups
Selective reporting (reporting bias)	Low risk	Outcome of interest reported
Other bias	Unclear risk	Examiners were calibrated before actual assessments of caries and fluorosis were initiated, however, kappa values were not reported

Chen 1993

Methods	FLUOROSIS STUDY Country of study: China Geographic location: Anquan (low F) and Hubei (high F) villages, Fenshun county, Guangdong Provinces Year of study: 1984 Year study ended: 1991 Year of change in fluoridation status: 1984 Hubei, 1986 Anquan Study design: Before-and-after
Participants	Inclusion criteria: Native born children aged 8-12 for dental fluorosis Exclusion criteria: Not stated Other sources of fluoride: Not stated Social class: Author states that economic and living habits are similar in all study areas Ethnicity: Not stated. Residential history: Only native born children were assessed. Other confounding factors: Not stated
Interventions	Water source from wells changed to river water Group 1: Hubei 4.1mg/l (1984 pre-intervention – Natural from wells); 0.8mg/l (1984 at point of intervention – Natural from river); 3.1mg/l*(1991, 7 years post-intervention – Natural from river.) * Increase due to damaged walls of well at bottom of river bed allowing hot spring water with high fluoride content to amalgamate. No regular monitoring took place after changing water supply and therefore unclear when water fluoride content increased in Hubei. Group 2: Anquan 12.5mg/l (1984 pre-intervention – Natural from wells); 0.3mg/l (1986 at point of intervention – Natural from river); 0.4mg/l (1991, 5 years post-intervention – Natural from river)
Outcomes	Dental fluorosis (Dean's index); skeletal fluorosis Age at baseline measure: 8 to 12 years (dental fluorosis) and 16 to 65 years (skeletal fluorosis) Age at final measure: 8 to 12 years (dental fluorosis) and 16 to 65 years (skeletal fluorosis)
Funding	Not stated
Notes	Data extracted from Chen 1993 differs from that presented in CRD review Discrepancies between text and table with regard to fluoride concentration

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	All eligible children were included in the study examined for dental fluorosis and for skeletal fluorosis, adults aged 16-65 were randomly sampled to have roentgenograms taken in pelvis
Confounding	High risk	The use of other fluoride sources was not accounted for
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	High risk	For both study areas, n=800 (Anquan) and n=1331 (Hubei), however, data not reported for all participants
Selective reporting (reporting bias)	Low risk	Outcome of interes reported
Other bias	High risk	No mention of examiner calibration. Also, "by investigation, it was found that the walls of the well for storing water at the bottom of river bed and water pipe were damaged, the hot spring water with high fluoride content gushed into the well and pipe. Because there was no regular monitoring on the water fluoride after changing water sources, it was unclear when the water fluoride content increased in Hubei".

Clark 1993

Methods	FLUOROSIS STUDY Country of study: Canada Geographic location: Kelowna (F) and Vernon (non-F), British Columbia. Year of study: Not stated Year of change in fluoridation status: 1954 Study design: Cross-sectional
Participants	Inclusion criteria: Children in selected schools. Exclusion criteria: Children with fixed orthodontic appliances. Missing anterior teeth. Other sources of fluoride: Not stated Social class: Two communities selected because of regional and socio-economic similarities. Ethnicity: Not stated Residential history: Was recorded information in questionnaire and verified by telephone, but doesn't appear to have been prohibitive for inclusion in study Other confounding factors: There were 274 participants that had been exposed to fluoride supplements
Interventions	Group 1: 1.2ppm (artificial fluoridation) Group 2: <0.1ppm (natural fluoridation)
Outcomes	Dental fluorosis (TSIF) Age at assessment: School aged
Funding	Supported by the British Columbia Health Research Foundation
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	Primary schools were stratified into low, medium and high SES categories from a specified sampling frame. Schools were then randomly selected and all eligible children within the selected schools were included in the studies
Confounding	High risk	The use of other fluoride sources was not accounted for
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	Low risk	Outcome of interest reported
Other bias	High risk	Kappa value of 0.44 suggests a moderate degree of inter-examiner agreement

Clarkson 1989

Methods	FLUOROSIS STUDY Country of study: Ireland and England Geographic location: Cork (low and high FI – 2 separate areas) and Manchester (low F). Year of study: Not stated Year of change in fluoridation status: Not stated Study design: Cross-sectional
Participants	Inclusion criteria: Children aged 8 and 15 Exclusion criteria: Not stated Other sources of fluoride: Not stated Social class: Not stated Ethnicity: Not stated Residential history: Not stated Other confounding factors: Not stated
Interventions	Group 1: 'optimal' level - ppm not stated (artificial fluoridation) Group 2: 'low' level - ppm not stated (natural fluoridation) Gruop 3: 'low' level - ppm not stated (natural fluoridation)
Outcomes	Enamel defects (DDE) Age at assessment: 8 and 15 years
Funding	Not stated
Notes	Data extracted from Clarkson 1989 differs from that presented in CRD review

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	Sampling was by stratified random selection of eligible children in the study areas. Stratification based on school size and gender
Confounding	High risk	The use of other fluoride sources was not accounted for
Blinding of outcome assessment (detection bias)	High risk	To assess reproducibility, 46 children were examined twice without the examiner's knowledge, however, there is no indication of the examiner being blind to fluoridation status of participants.
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	Low risk	Outcome of interest was fully reported and balanced across group
Other bias	Low risk	No other apparent bias

Clarkson 1992

Methods	FLUOROSIS STUDY Country of study: Ireland Geographic location: Ireland Year of study: 1984 Year of change in fluoridation status: 1964 Study design: Cross-sectional
Participants	Inclusion criteria: Children aged 8 & 15 Exclusion criteria: None stated Other sources of fluoride: Increase in use of fluoride containing toothpaste and infant formula made with fluoridated water Social class: Not stated Ethnicity: Not stated Residential history: Not stated Other confounding factors: Problems of consistent levels in the fluoridated supply during the 1960s and early 1970s
Interventions	Group 1: 'optimal' level - ppm not stated (artificial fluoridation) Group 2: 'low' level - ppm not stated (natural fluoridation)
Outcomes	Dental fluorosis (Deans index), Enamel defects (DDE) Age at assessment: 8 and 15 years
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	A stratified proportional random sampling procedure was used with size of school with fluoridation status and sex as stratifying factors"
Confounding	High risk	SES was not accounted for and the use of other fluoride sources was not accounted for
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Unclear risk	The number of participants recruited was not reported and there was a variation in the number of children examined for enamel defects and children interviewed on perception of defects. It is not clear whether data was presented for all recruited participants
Selective reporting (reporting bias)	Low risk	The outcome of interest was fully reported on and balanced across groups
Other bias	Low risk	No other apparent bias

Cochran 2004

Methods	FLUOROSIS STUDY Country of study: Ireland, England, Greece, Netherlands, Finland, Iceland Portugal. Geographic location: Cork, Haalem, Athens, Reykjavik, Oulu, Knowsley, Almada/Setubal Year of study: 1997-1998 Year of change in fluoridation status: varies Study design: Cross-sectional
Participants	Inclusion criteria:Not stated Exclusion criteria: Not stated Other sources of fluoride: Information about use of fluoride supplements, age at which toothpaste was first used and the amount and type of toothpasted used were collected but not reported. Social class: The sampling ensured a wide socioeconomic spread of participants. Ethnicity: Not stated Residential history: Parents were given questionnaires to supply information on history of living a fluoridated area. No further details reported. Other confounding factors: Not stated
Interventions	Group 1: <0.01 ppm (natural fluoridation) Group 2: 0.05 ppm (natural fluoridation) Group 3: 0.08 ppm (natural fluoridation) Group 4: <0.1 ppm (natural fluoridation) Group 5: 0.13 ppm (natural fluoridation) Group 6: 1 ppm (artificial fluoridation)
Outcomes	Dental fluorosis (TF index); enamel defects (DDE) Age at assessment: 8 years
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	The sampling frame was specified but the eligibility criteria were not stated. It is not clear whether the number of children photographed as a percentage of the total population of children in the age group (12-23%) is representative
Confounding	High risk	Data was collected on the use of fluoride from other sources but not reported on.
Blinding of outcome assessment (detection bias)	Low risk	Fluorosis was assessed using photographs and was done without reference to the area from which they were collected.
Incomplete outcome data (attrition bias)	Low risk	Quote: "A total of 5250 transparencies was taken, of which 114 (2.2%) were not suitable for analysis" Unlikely to influence results
Selective reporting (reporting bias)	Unclear risk	Outcome of interest fully reported, however data relating to confounding varibles is collected but not reported
Other bias	Unclear risk	Reliability testing was carried out. The Kappa statistic from all the study sites showed substantial to excellent agreement with the 'gold standard' except one study site that showed moderate agreement (0.49) (Cochran 2004a). It is not clear what effect this moderate agreement would have on the results given that agreement at the other study sites was substantial to excellent.

Colquhoun 1984

Methods	FLUOROSIS STUDY Country of study: New Zealand Geographic location: Auckland Year of study: 1983 Year of change in fluoridation status: 1953 Study design: Cross-sectional
Participants	Inclusion criteria: School children aged 7-12 years Exclusion criteria: Children with mottling who were known to have grown up in areas different in fluoridation status from where they were examined Other sources of fluoride: Fluoride toothpaste use accounted for 76% of toothpaste sales in New Zealand in 1980. Though there had been a marked increase in fluoride toothpaste use since 1970, there was no trend toward a greater severity of dental fluorisis among younger children. Social class: Results stratified on social class - incidence of advanced dental fluorosis inversely related to social class but prevalence of dental fluorosis slightly higher in lower social class Ethnicity: Ethnic composition of study areas was similar except for higher proportion of Maori and Pacific Island people in the lower socioeconomic areas Residential history: Proportion of children at each clinic who were not life-long residents of the suburb was not ascertained, but there was no reason to suppose that proportions differed between areas Other confounding factors: Not stated
Interventions	Group 1: 1 ppm (artificial fluoridation) Group 2: 'low' level - ppm not stated (natural fluoridation)
Outcomes	Dental fluorosis (diffuse opacities) Age at baseline measure: 7 to 12 years
Funding	Not stated
Notes	Data extracted from Colquhoun 1984 differs from that presented in CRD review

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	A population of 458 school children in the fluoridated area had initially been investigated so the author made further observations on school children of the same age in six additional dental clinics chosen at random. Additional 342 children of same age were examined from the non-fluoridated area but it was not reported as to how they were selected.
Confounding	High risk	Some children had used fluoride tablets but not excluded from the analysis. The fluoridated area had participants that were of low, middle and high SES while the non-fluoridated area had only participants of low SES
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	Low risk	Outcome of interest reported
Other bias	High risk	Intra- and inter-examiner reliability not mentioned

Correia Sampaio 1999

Methods	FLUOROSIS SYUDY Country of study: Brazil Geographic location: Rural areas of Paraiba Year of study: 1997 Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: Lifetime residents of study areas. Children attending public schools (aged 6-11) Exclusion criteria: Children who refused to be examined; Those without permanent teeth; Undetermined birth place Other sources of fluoride: No topical or systemic fluoride programme implemented in schools. Children interviewed about oral health habits and use of toothpaste Social class: All study areas are of low socio-economic status Ethnicity: Not stated Residential history: Lifetime residents Other confounding factors: Nutritional status
Interventions	Group 1: >1.0 ppm (natural fluoridation) Group 2: 0.7-1.0 ppm (natural fluoridation) Control: <0.7 ppm (natural fluoridation)
Outcomes	Dental fluorosis (TF index) Age at assessment: 6 to 11 years
Funding	Brazilian Ministry of Education CAPES (1666/95-4)
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	All eligible children attending schools in the study area were included
Confounding	Unclear risk	It was reported that the areas of study were generally low SES. Data was collected on the use of fluoride toothpaste and brushing habits but showed that those brushing their teeth less frequently had higher levels of fluorosis. It was also reported that the levels of fluorosis in the area had not changed since the introduction of fluoride toothpastes
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	Low risk	Outcome of interest was fully reported and balanced across group
Other bias	Low risk	No other apparent biases

Cutress 1985

Methods	FLUOROSIS STUDY Country of study: New Zealand Geographic location: Auckland, Frankton & Rodney Year of study: Not stated Year of change in fluoridation: 1953 Study design: Cross-sectional
Participants	Inclusion criteria: Children returning parental consent forms and completed questionnaires. Lifetime residents of study areas. Children aged 9. Exclusion criteria: None stated Other sources of fluoride: Ingestion of fluoride tablets Social class: Not stated Ethnicity: European (80% F, 84% non F), Polynesian (16%F, 11% non-F), Asian (2% F, 1% Non-F), Mixed (2% F, 4% non-F). Residential history: Lifetime residents Other confounding factors: Not stated
Interventions	Group 1: 1.0 ppm (artificial fluoridation) Group 2: <0.3 ppm (natural fluoridation)
Outcomes	Any enamel defect Age at assessment: 9 years
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	Schools in the fluoridated area were randomly selected. All schools in the control area were selected. No detail was reported on how the children were selected for study
Confounding	High risk	There was an imbalance in lifetime residents using fluoride tables in the fluoridated area compared to the non-fluoridated area. SES was not accounted for
Blinding of outcome assessment (detection bias)	Low risk	Children were taken to the exam centre by bus to prevent the examiner from identifying residence or fluoridation status
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	Low risk	Outcome of interest was fully reported on and balanced across group
Other bias	Low risk	No other apparent bias

Cypriano 2003

Methods	FLUOROSIS STUDY Country of study: Brazil. Geographic location: Porto Feliz, Ipero, Itaoca and Barra do Chapeu (F); Bom Sucesso do Itarare and Itapirapua Paulista (Non-F) Year of study: 2003 Year of change in fluoridation status: 1981 Study design: Cross-sectional
Participants	Inclusion criteria: Pre-school children aged 5 to 6 years and students aged 7 to 12 years. Exclusion criteria: Individuals outside the 5 to 12 years age bracket Other sources of fluoride: Not stated Social class: Not stated. Ethnicity: Not stated Residential history: Not stated Other confounding factors: Not stated
Interventions	Group 1: 'optimal' level - ppm not stated (artificial fluoridation) Group 2: 'low' level - ppm not stated (natural fluoridation)
Outcomes	Dental fluorosis (Community fluorosis index) Age at assessment: 5 to 12 years
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	Seven counties of 48 were randomly selected by raffle based on size and the presence or absence of fluoridated water. Children were then randomly selected from schools
Confounding	High risk	SES was not accounted for and the use of other fluoride sources was not accounted for
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data for all participants appears to be presented
Selective reporting (reporting bias)	High risk	Fluorosis data was not reported for children between 5 and 6 and no explanations were provided.
Other bias	Low risk	No other apparent bias

de Crousaz 1982

Methods	FLUOROSIS STUDY Country of study: Switzerland Geographic location: Bale-Ville (F), Friburg and Neuchatel (non-F) Year of study: 1979 Year of change in fluoridation status: 1961 Study design: Cross-sectional
Participants	Inclusion criteria: Not stated for control areas, for fluoride area only. Exclusion criteria: Children born outside Switzerland Other sources of fluoride: Not stated Social class: Not stated Ethnicity: Not stated Residential history: Lifetime residents Other confounding factors: Not stated
Interventions	Group 1: 1 ppm (artificial fluoridation) Group 2: 'Low' level - ppm not stated (natural fluoridation)
Outcomes	Dental fluorosis (TFI) Age at assessment: 6 to 13 years
Funding	Subsidy from SSO research funds
Notes	Data extracted from de Crousaz 1982 differs from that presented in CRD review

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	The children were accessed via schools however the sampling frame was unspecified
Confounding	High risk	SES was not accounted for and the use of other fluoride sources was not accounted for
Blinding of outcome assessment (detection bias)	Low risk	Examiners worked independently without knowledge of the origin of the children
Incomplete outcome data (attrition bias)	High risk	Data was not presented for all participants and missing outcome data varied greatly across study groups
Selective reporting (reporting bias)	Low risk	All expected outcomes were reported
Other bias	High risk	Examiners were calibrated and trained but kappa values for reliability not reported. The authors assume that a combination of clinical and photographic examination are sufficient for the verification of intra-and inter-examiner reproducibility, so kappa values may not have been calculated

DHSS England 1969

Methods	**FLUOROSIS STUDY** Country of study: England Geographic location: Watford (F), Sutton (non-F) Year of study: 1956 Year study ended: 1967 Year of change in fluoridation status: 1956 Study design: CBA
Participants	Inclusion criteria: Lifetime residents of study areas; Consumed piped water at home and at school Exclusion criteria: Children that were not continuous residents Other sources of fluoride: None stated Social class: None stated, however, study areas and associated control area had be situated near to each other and be of the same character (e.g. industrial, semi-industrial, rural or residential) Ethnicity: None stated Residential history: Lifetime residents Other confounding factors: Information on oral hygiene was recorded
Interventions	**Initiation of water fluoridation** Group 1 at baseline: 'low' level - ppm not stated (natural fluoridation) Group 1 post intervention 0.89 - 0.99 ppm (artificial fluoridation) Group 2: 'low level' - ppm not stated (natural fluoridation)
Outcomes	dmft, DMFT, % caries free subjects (deciduous teeth), % caries free subjects (permanent teeth) Age at baseline measure: 3 to 14 years Age at final measure: 3 to 14 years
Funding	Not stated
Notes	Data extracted from DHSS England 1969 differs from that presented in CRD review (additional data extracted)

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	Representative groups of children of all ages included in the study were examined in each area and as far as possible the same standards of examination were maintained in the pairs of areas for which the dental findings were to be compared (HMSO 1962)
Confounding	High risk	No details were reported on the use of fluoride from other sources on on the dietary habits of the children
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data for all participants appears to be presented
Selective reporting (reporting bias)	High risk	Enamel defects, white or stained, which might be confused with fluoride mottling were also noted but not presented in the report
Other bias	High risk	No mention of calibration and reliability testing of the examiners

DHSS Scotland 1969

Methods	**CARIES STUDY** Country of study: Scotland Geographic location: Kilmarnock (F), Ayr (non-F) Year study started: 1961 Year study ended: 1968 Year of change in fluoridation status: 1956 Study design: CBA
Participants	Inclusion criteria: Lifetime residents of study areas; Consumed piped water at home and at school Exclusion criteria: Not stated Other sources of fluoride: Not stated Social class: Not stated Ethnicity: Not stated Residential history: Continuous residents Other confounding factors: Not stated
Interventions	**Initiation of fluoridation** Group 1: 1ppm (artificial fluoridation) Group 2: 'low' level - ppm not reported (natural fluoridation)
Outcomes	dmft, % caries free subjects (primary teeth) Age at baseline measure: 5 years Age at final measure: 5 years
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	Representative groups of children of all ages included in the study were examined in each area and as far as possible the same standards of examination were maintained in the pairs of areas for which the dental findings were to be compared (HMSO 1962)
Confounding	High risk	The effect of sugary diet consumption and use of fluoride from other sources were not taken into account
Blinding of outcome assessment (detection bias)	High risk	Blind outcome assessment not reported
Incomplete outcome data (attrition bias)	High risk	A cross section of children were examined each year together with some children in nurseries and nursery schools but findings for the later were not presented
Selective reporting (reporting bias)	High risk	Enamel defects, white or stained, which might be confused with fluoride mottling were also noted but not presented in the report
Other bias	High risk	No mention of calibration of examiners and reliability testing

DHSS Wales 1969

Methods	**CARIES STUDY** Country of study: Wales Geographic location: Gwalchmai zone (F), Holyhead (mainly Fl -gets most of water from Gwalchmai, but occasionally also receives water from Bodafon) and Bodafon zone (Non-F) Year study started: 1956 Year study ended: 1965 Year of change in fluoridation status: 1955 Study design: CBA
Participants	Inclusion criteria: Continuous residents of study areas; Consumed piped water both at home and school; Up to 15 years (Gwalchmai and Bodafon); up to 11 years (Holyhead) at home and at school Exclusion criteria: Not stated Other sources of fluoride: Not stated Social class: None stated, however, study areas and associated control area had be situated near to each other and be of the same character (e.g. industrial, semi-industrial, rural or residential) Ethnicity: Not stated Residential history: Continuous residents Other confounding factors: Information on oral hygiene was recorded
Interventions	**Initiation of water fluoridation** Group 1 baseline: 'low' level - ppm not stated (natural fluoridation) Group 1 post intervention: 0.8 - 0.9ppm (artificial fluoridation) Group 2 baseline: 'low' level - ppm not stated (natural fluoridation) Group 2 post intervention: 0.8 - 0.9ppm (artificial fluoridation) Group 3: 'low' level - ppm not stated (natural fluoridation)
Outcomes	dmft, DMFT, % caries free subjects (deciduous teeth), % caries free subjects (permanent teeth) Age at baseline measure: 3 to 14 years Age at final measure: 3 to 14 years
Funding	Not stated
Notes	Data extracted from DHSS Wales 1969 differs from that presented in CRD review (additional data extracted)

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	Pre-school children examined were a reasonably good cross-section of Anglesey children of that age, however, different age criteria were used for school children in different study areas (up to 15 years - Gwalchmai and Bodafon; up to 11 years - Holyhead). The reason for this was not reported. (HMSO 1962)
Confounding	High risk	No details were reported on the use of fluoride from other sources on on the dietary habits of the children
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data for all participants appears to be presented
Selective reporting (reporting bias)	High risk	Enamel defects, white or stained, which might be confused with fluoride mottling were also noted but not presented in the report
Other bias	High risk	No mention of calibration and reliability testing of examiners

Downer 1994

Methods	FLUOROSIS STUDY Country of study: England, Scotland and Ireland Geographic location: Dublin (F), North London, Edinburgh and Glasgow (non-F). Year of study: Not stated Year of change in fluoridation status: 1965 Study design: Cross-sectional
Participants	Inclusion criteria: Children aged 12 years. Lifetime residents of study areas. Exclusion criteria: Not stated Other sources of fluoride: Not stated Social class: Not stated, however, sampling in the fluoridated areas was done to achieve a mix of participants from different SES Ethnicity: Not stated Residential history: Lifetime residents Other confounding factors: Not stated
Interventions	Group 1: 0.9 ppm (artificial fluoridation) Group 2: 'low' level - ppm not stated (natural fluoridation) Group 3: 'low' level - ppm not stated (natural fluoridation) Group 4: 'low' level - ppm not stated (natural fluoridation)
Outcomes	Enamel defects (DDE); caries data also evaluated within the study but excluded from review due to study design Age at assessment: 12 years
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	Of the secondary schools in Glasgow and Dublin, 25% were randomly selected to participate and participants selected at random Sampling in London was aimed at examining all 12 year old children in secondary schools in 3 districts and 14 out of 19 schools. The reason for non-participation of five out of the 19 eligible schools in the non-fluoridated area was logistical and the authors state that this was (Quote:) "*unlikely to have caused sampling bias*" (Blinkhorn 1992). In Edinburgh a random selection of 20% of children in 20 out of 50 eligible schools, drawn at random, formed the sample.
Confounding	High risk	No details were reported on the use of fluoride from other sources
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	Low risk	Outcome of interest was fully reported on and balanced across group
Other bias	Low risk	No other apparent bias

Driscoll 1983

Methods	**FLUOROSIS STUDY** Country of study: USA Geographic location: 7 rural Illinois communities within 75 miles of each other Year of study: 1980 Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: Children in grades 3-10 (age 8-16). Lifetime residents of study areas. Consumed public water. Parental consent Exclusion criteria: Not stated Other sources of fluoride: Not stated Social class: Relatively small, rural communities; were chosen because they shared several similar characteristics. Ethnicity: <5% non white Residential history: Lifetime residents Other confounding factors: Same climatic zone
Interventions	Group 1: 3.84 - 4.07 ppm (natural fluoridation) Group 2: 2.84 - 3.77 ppm (natural fluoridation) Group 3: 2.08 ppm (natural fluoridation) Group 4: 1.06 ppm (natural fluoridation)
Outcomes	Dental fluorosis (Dean's Index; CFI; TSIF was also used but reported in a later paper); caries data was measured but excluded from this review due to study design Age at assessment: 8 to 16 years
Funding	Not stated
Notes	None of the communities had made any change in its water source that was likely to alter the fluoride concentration during the period relevant to the study

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	There was insufficient detail reported to determine how selection took place
Confounding	High risk	SES and the use of fluoride from other sources was not accounted for
Blinding of outcome assessment (detection bias)	High risk	Different examiners carried out measurements in order to avoid bias, however, this may not have been sufficient to avoid detection bias
Incomplete outcome data (attrition bias)	Low risk	All findings were based only on those children assessed for both fluorosis and majority of the children fall under this category. Also, the higher-than-optimal study area had considerably fewer children compared to the other areas due to small size of the communities and other similar communities in same geographic area were not available. This was not considered sufficient to introduce bias
Selective reporting (reporting bias)	Low risk	All expected outcomes reported
Other bias	Low risk	No other apparent bias

Ekanayake 2002

Methods	FLUOROSIS STUDY Country of study: Sri Lanka Geographic location: Uda Walawe Year of study: 2001 Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: Completion of the 14th but not the 15th birthday; availability in school on the day of the examination Exclusion criteria: Not stated Other sources of fluoride: Not stated Social class: Almost all belonged to the low socio-economic group . Ethnicity: Not stated Residential history: Resident at present address since birth Other confounding factors: No details were reported. Nearly 75% of the subjects had used fluoride toothpaste from the age of about 9-12 months (discussion section)
Interventions	All natural fluoridation Group 1: ≤0.3 ppm Group 2: 0.31 - 0.49 ppm Group 3: 0.5 - 0.7 ppm Group 4: >0.7 ppm
Outcomes	Enamel defect (DDE) Age at assessment: 14 years
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	Six schools were selected on the basis of them being sufficiently large for study. All eligible children present on day of study were examined
Confounding	High risk	While it is stated in the paper that "Less than 75% of the participants started teeth brushing with fluoride toothpaste from 9-12 months of age", the use of other fluoride sources was not controlled for, neither was it reported by fluoridation status
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Unclear risk	6.25% of the children examined were not included in the analysis. The authors did not report their fluoride exposure and it is not clear whether their exclusion may have introduced bias
Selective reporting (reporting bias)	Low risk	Outcome of interest reported
Other bias	Low risk	No other apparent bias

Eklund 1987

Methods	**FLUOROSIS STUDY** Country of study: USA Geographic location: Lordsburg (high-F), Deming (lower-F), New Mexico. Year of study: Not stated Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: Resident in study areas for the first 6 years of life Subjects aged approximately 30-60 years old. Consumed city water supplies. Exclusion criteria: Not stated Other sources of fluoride: Not stated Social class: Areas similar on education and income level - number of years of education similar between areas. Ethnicity: 89.6 % of Lordsburg subjects Hispanic, 74.2% of Deming Hispanic Residential history: Residence for the first 6 years of life Other confounding factors: Not stated
Interventions	All natural fluoridation Group 1: 3.5 ppm Group 2: 0.7 ppm
Outcomes	Dental fluorosis (Dean's index); Caries data also evaluated within the study but excluded from review due to study design Age at assessment: 27 to 65 years
Funding	Not stated
Notes	Data extracted from Eklund 1987 differs from that presented in CRD review

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	Efforts were made to recruit all eligible adults in all the communities and 80-90% of eligible people consented and participated.
Confounding	High risk	No details were reported on the use of fluoride from other sources.
Blinding of outcome assessment (detection bias)	Unclear risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	Low risk	Outcome of interest was fully reported on and balanced across group
Other bias	Low risk	No other apparent bias

Ellwood 1995

Methods	**FLUOROSIS STUDY** Country of study: Ireland and Wales Geographic location: Chester (non-F), Bala (non-F), Anglesey (F), Cork (F). Year of study: 1991 Year study ended: Not reported Year of change in fluoridation status: NA Study design: Cross-sectional study
Participants	Inclusion criteria: Lifetime residents of study areas (children only). Agreement to participate. Exclusion criteria: Fixed orthodontic appliances Other sources of fluoride: Tooth brushing behaviour - age started brushing, weekly tooth brushing frequency. Social class: Children from all three groups were from schools with a similar social profile Ethnicity: Not stated Residential history: Lifetime residents Other confounding factors: Not stated
Interventions	Group 1: 0.7 ppm (artificial fluoridation) Group 2: 0.9 ppm (artificial fluoridation) Group 3: <0.1 ppm (natural fluoridation)
Outcomes	Enamel defect (DDE) Age at assessment: 14 years
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	There was insufficient detail reported to determine how selection took place
Confounding	Low risk	SES and reported tooth brushing frequency was similar across groups
Blinding of outcome assessment (detection bias)	Low risk	Photographs were taken, identified randomly and examined without reference to subject details
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	Low risk	Outcome of interest was fully reported on and balanced across group
Other bias	Low risk	No other apparent bias

Ellwood 1996

Methods	**FLUOROSIS STUDY** Country of study: England and Wales Geographic location: Anglesey (F), Chester and Bala (non-F) Year of study: 1991 Year of change in fluoridation status: 1955 Study design: Cross sectional
Participants	Inclusion criteria: Children in their 3rd year of secondary education. Lifelong residents of study areas. Exclusion criteria: Children with fixed orthodontic appliances, absence at the time of examination Other sources of fluoride: Not stated Social class: Not stated, however, the schools in the non-fluoridated areas had similar catchment areas as those from the fluoridated. No further details reported Ethnicity: Not stated Residential history: Lifetime residents Other confounding factors: Not stated
Interventions	Group 1: 0.7 (artificial fluoridation) Control: <0.1 (natural fluoridation)
Outcomes	Dental fluorosis (TF index); Caries data also evaluated within the study but excluded from review due to study design Age at assessment: 14 years
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	Three schools from Anglesey were selected and for the control group, schools with catchment areas as similar as possible to those from Anglesey were chosen from Chester and Bala using national census statistics.There was no random selection of schools in Anglesey and it is not clear whether the selected schools were a representative sample
Confounding	High risk	SES was not accounted for and the use of other fluoride sources was not accounted for
Blinding of outcome assessment (detection bias)	Low risk	Photographs were taken, randomly mixed and scored without reference to subject details
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	Low risk	Outcome of interest was fully reported on and balanced across group
Other bias	Low risk	No other apparent bias

Ermis 2003

Methods	**FLUOROSIS STUDY** Country of study: Turkey Geographic location: Izmir and Isparta Year of study: Not stated Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: Lifelong residence; use of the public water supply continuously as source of drinking water; absence of nutrition deficiency. Exclusion criteria: Not stated Other sources of fluoride: Not stated Social class: The selected schools were public secondary schools.. Ethnicity: Not stated Residential history: Lifetime residents Other confounding factors: Toothbrushing frequency : Did not brush – 22 (7.9%) ; Irregularly – 49 (17.6%) ; Once a day – 115 (41.4%); more than once – 92 (33.1%).
Interventions	All natural fluoridation Group 1: 0.3 - 0.4 ppm Group 2: 1.42 - 1.54 ppm Group 3: 1.55 - 1.66 ppm
Outcomes	Dental fluorosis prevalence (TSIF); Caries data also evaluated within the study but excluded from review due to study design due to study design Age at assessment: 12 to 14 years
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	Four schools were selected using a random sampling technique from a list of all public secondary schools. Within these schools eligible children were selected randomly
Confounding	Unclear risk	Toothbrushing habits differed between participants, however it is not clear whether they varied across study groups
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	High risk	Fluorosis prevalence was measured but only reported for the high fluoride areas and not for the low fluoride area
Other bias	Low risk	No other apparent bias

Firempong 2013

Methods	FLUOROSIS STUDY Country of study: Ghana Geographic location: Bongo district (Zone A - Atampiisi, Soeboko and Aliba; Zone B - Nayire, Boyrigo, Anabisa, Amagre and Tigre; C: Soe, Kuyeligo, Kunduo; Zone D - Yakanzanway, Gurigo, Ababorobiisi, Zaasi, Anafobiisi) Year of study: 2008-2009 Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: Lived the the area for the first seven years of childhood. Using water from a constant source which could still be traced. Exclusion criteria: Medically confirmed dental problem different from dental fluorosis. History of tobacco or kola use. Other sources of fluoride: Information on frequency of toothbrushing (p=0.101) and type of oral health product (p=0.179) were collected and there was no difference between the four zones. Social class: The children had similar educational background Ethnicity: Not stated Residential history: Lifetime residents for first seven years of childhood Other confounding factors: Not stated
Interventions	All natural fluoridation Group 1: 0.95 ppm Group 2: 1 ppm Group 3: 1.86 ppm Group 4: 2.36 ppm
Outcomes	Dental fluorosis (Dean's index) Age at assessment: 7 to 18 years
Funding	Supported by the Regional Laboratory of the Ghana Water Company/Aqua Viten Rands Limited in Tamale, Ghana
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	It is stated that eligible children were randomly selected but insufficient detail has been provided to make a clear judgement
Confounding	High risk	While there appears to be little difference in the use of oral hygiene habits across groups, SES was not accounted for
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	Low risk	Outcome of interest reported
Other bias	High risk	Quote: "A professional examiner was engaged to carry out all the testing measurements..." Comment: Intra-examiner reliability test not reported and may not have been conducted

Forrest 1956

Methods	FLUOROSIS STUDY Country of study: England Geographic location: West Mersey (5.8ppm), Burnham-on-Crouch (3.5ppm), Harwich (2/1.6ppm), Slough (0.9ppm) Saffron Walden and District (non-F), Stoneleigh and Malden West (non-F) Year of study: 1954 Year of change in fluoridation status: NA Study design: Cross sectional
Participants	Inclusion criteria: Lifetime residents of study areas. Children aged 12-14 Exclusion criteria: Not stated Other sources of fluoride: Not stated Social class: Not stated Ethnicity: Not stated Residential history: Lifetime residents Other confounding factors: Not stated
Interventions	All natural fluoridation Group 1: 5.8 ppm Group 2: 3.5 ppm Group 3: 2.0 ppm Group 4: 0.9 ppm Group 5: 0.1 - 0.2 ppm Group 6: 0.1 ppm
Outcomes	Dental fluorosis (Dean's index); Caries data also evaluated within the study but excluded from review due to study design due to study design Age at assessment: 12 to 14 years
Funding	Not stated
Notes	Data extracted from Forrest 1956 differs from that presented in CRD review

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	Areas were selected opportunistically. Entire populations of children in some areas were selected for study but insufficient detail is given on how they were accessed
Confounding	High risk	SES and the use of other fluoride sources was not sufficiently reported and controlled for
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	High risk	Results are presented for the majority of participants. However, while the results are presented in full for 4 of the 5 areas the area of highest FI ppm appears to have 10% of participants missing from results
Selective reporting (reporting bias)	Low risk	Outcome of interest reported
Other bias	High risk	There is risk of measurement bias as examiner calibration was not mentioned

Forrest 1965

Methods	FLUOROSIS STUDY Country of study: Wales Geographic location: Gwalchmai (F) and Bodafon (non-F), Anglesey. Year of study: 1963 Year of change in fluoridation status: 1955 Study design: Cross-sectional
Participants	Inclusion criteria: Children aged 8 from a selection of schools. Exclusion criteria: Schools in Holyhead. Schools in Llangefni and Beaumaris as changed supply from fluoridated to non-fluoridated in 1961. Other sources of fluoride: Not stated Social class: Not stated Ethnicity: Not stated Residential history: Not clearly stated, however, the participants were chosen for being the only ones who had had fluoride for most of their lives. Other confounding factors: Not stated
Interventions	Group 1: 1 ppm (artificial fluoridation) Group 2: <=0.2 ppm (natural fluoridation)
Outcomes	Outcome: Enamel defects Age at assessment: 8 years
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	Schools were selected for study and then children within these schools, however it is not clear how the children were examined
Confounding	High risk	SES and the use of fluoride from other sources were not reported on
Blinding of outcome assessment (detection bias)	Low risk	The examiners were unaware of the children's fluoridation status since they all resided in the same county.
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	Low risk	Outcome of interest was fully reported on and balanced across group
Other bias	Low risk	No other apparent bias

Franzolin 2008

Methods	FLUOROSIS STUDY Country of study: Brazil Geographic location: Sao Paulo Year of study: Not stated Year of change in fluoridation status: 1975 Study design: Cross-sectional
Participants	Inclusion criteria: Residence at the same geographical area as the school since birth. Exclusion criteria: Not stated Social class: Homogenous population comprising entirely of public school students.. Ethnicity: White – 243 (67.5%); Black – 41 (11.4%); Admixture – 73 (20.3%); Asian – 3 (0.8%) Residential history: Lifetime residents Other confounding factors: Not stated
Interventions	Group 1: 'optimal' level - ppm not stated (artificial fluoridation via ater treatment station) Group 2: 'optimal' level - ppm not stated (artificial fluoridation via direct fluoridation in well) Group 3: 'low' level - ppm not stated (natural fluoridation)
Outcomes	Dental fluorosis (TF index); Caries data collected, however, excluded from the review due to study design Age at assessment: 12 years
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	Multi-stage random sampling was used whereby schools were selected randomly and the children within them
Confounding	High risk	SES was not accounted for and the use of other fluoride sources was not accounted for
Blinding of outcome assessment (detection bias)	Low risk	The examiner and recorder were reported to have been blinded to the type of water supply of the schools
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	Low risk	Outcome of interest reported
Other bias	Unclear risk	Examinations carried out by a single, previously calibrated examiner, however, kappa score not reported

Garcia-Perez 2013

Methods	FLUOROSIS STUDY Country of study: Mexico Geographic location: Morelos Year of study: 2013 Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: Children who had been born in the community, lived in the community a year after they born, or had not moved in or out of the community for more than 6 months Exclusion criteria: Systemic diseases requiring premedication, absence on the days of the oral examination and children who had brackets Other sources of fluoride: Bottled water often containing 0.3-0.6 ppm fluoride levels; dentifrice use, number of times brushing teeth per day Social class: Both communities had a low socioeconomic level Ethnicity: Not stated Residential history: Lifetime residents Other confounding factors: Not stated
Interventions	All natural fluoridation Group 1: 0.56 - 0.76 ppm Group 2: 1.45 - 1.61 ppm
Outcomes	Dental fluorosis (TF index); Caries data also evaluated within the study but excluded from review due to study design Age at assessment: 12 years
Funding	Partially funded by the Metropolitan Autonomous University, Xochimilco (Universidad Autonoma Metropolitana, UAM-X) and the National Council of Science and Technology (Consejo Nacional de Ciencia y Tecnologia, CONACYT).
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	There was insufficient detail reported to determine how selection took place
Confounding	Low risk	Both villages were of low SES, participants were lifetime residents and there was no difference in toothbrushing frequency or bottled water consumption
Blinding of outcome assessment (detection bias)	Unclear risk	Insufficient information
Incomplete outcome data (attrition bias)	Unclear risk	Data presented as percentages making it difficult to determine if all participants are accounted for
Selective reporting (reporting bias)	High risk	Fluorosis prevalence was not reported for all severities of dental fluorosis
Other bias	Low risk	No other apparent bias

Gaspar 1995

Methods	FLUOROSIS STUDY Country of study: Brazil Geographic location: Piracicaba (F), Iracemapolis (non-F) Year of study: Not stated Year of change in fluoridation status: 1974 Study design: Cross-sectional
Participants	Inclusion criteria: Children aged 10-14. Lifetime residents of study areas Exclusion criteria: Not stated Other sources of fluoride: Not stated Ethnicity: Not stated Social class: Not stated Residential history: Lifetime residents Other confounding factors: Not stated
Interventions	Group 1: <0.2 ppm (natural fluoridation) Group 2: 0.7 ppm (artificial fluoridation)
Outcomes	Dental fluorosis prevalence (TF index) Age at assessment: 10 to 14 years
Funding	Not stated
Notes	Data from CRD review (unverified data)

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	Unable to make a judgement as study was unavailable
Confounding	High risk	SES and the use of other fluoride sources do not appear to have been accounted for in analysis
Blinding of outcome assessment (detection bias)	Unclear risk	Unable to make a judgement as study was unavailable
Incomplete outcome data (attrition bias)	Unclear risk	Unable to make a judgement as study was unavailable
Selective reporting (reporting bias)	Unclear risk	Unable to make a judgement as study was unavailable
Other bias	Unclear risk	Unable to make a judgement as study was unavailable

Goward 1982

Methods	FLUOROSIS STUDY Country of study: England Geographic location: Two adjacent districts of Leeds with different fluoride levels. Year of study: 1979 Year of change in fluoridation status: 1968 Study design: Cross sectional
Participants	Inclusion criteria: Lifetime residents of study areas (children only). Children aged 5. Exclusion criteria: Not clear Other sources of fluoride: Children using systemic or topical fluoride supplements excluded from the study. Social class: Not stated Ethnicity: Not stated Residential history: Lifetime residents Other confounding factors: difference in breast fed vs bottle fed children
Interventions	Group 1: 0.9 ppm (artificial fluoridation) Group 2: <0.1 ppm (natural fluoridation)
Outcomes	Dental fluorosis (defined by Al-Alousi) Age at time of measurement: 5 years
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	There was insufficient detail reported to determine how selection took place
Confounding	High risk	SES was not accounted for
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	Low risk	Outcome of interest reported
Other bias	High risk	No information on calibration of examiners

Gray 2001

Methods	**CARIES STUDY** Country of study: England Geographic location: Dudley, Sedgeley & Cosely, Halesowen, Brierly Hill & Kingswinford (F), Stourbridge (non-F) Year study started: 1988 Year study ended: 1997 Year of change in fluoridation status: 1987 Study design: CBA
Participants	Inclusion criteria: Children living in study area since 1988 Exclusion criteria: Not stated Other sources of fluoride: Not stated Social class: Participants were all from state funded primary schools and might have been socioeconomically similar Ethnicity: Not stated Residential history: Lifetime residents Other confounding factors: Not stated
Interventions	**Initiation of water fluoridation** Group 1: 1 ppm (artificial fluoridation) Group 2: 1 ppm (artificial fluoridation) Group 3: 1 ppm (artificial fluoridation) Group 4: 1 ppm (artificial fluoridation) Group 5: 0.3 ppm (natural fluoridation)
Outcomes	% caries free (deciduous teeth) Age at baseline measure: 5 years Age at final measure: 5 years
Funding	Not stated
Notes	Data extracted from Gray 2001 differs from that from Gray 2000 (unpublished) which was originally presented in CRD review

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	According to Pitts 1997, representative samples were drawn from a whole population of Dudley health authority
Confounding	High risk	No details were reported on the use of fluoride from other sources on on the dietary habits of the children
Blinding of outcome assessment (detection bias)	High risk	Quote: "...blinding was not possible"
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	Low risk	Outcome was reported
Other bias	High risk	At baseline the fluoridation status of the children was determined by the location of their school

Grimaldo 1995

Methods	FLUOROSIS STUDY Country of study: Mexico Geographic location: San Luis Potasi Year of study: Not stated Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: Lifetime residents at same address. Children aged 11-13 in selected schools. Parental consent. Exclusion criteria: Not stated Other sources of fluoride: Not stated Social class: Not stated Ethnicity: Not stated Residential history: Lifetime residents Other confounding factors: Local diet rich in calcium, reduces fluoride absorption.
Interventions	All natural fluoridation Group 1: >2.0 ppm Group 2: 1.2 - 2.0 ppm Group 3: 0.7 - 1.2 ppm Group 4: <0.7 ppm
Outcomes	Dental fluorosis (Dean's index) Age at assessment: 11 to 13 years
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	The authors report that schools and participants from the study areas were selected at random. No further details are reported
Confounding	High risk	SES and the use of fluoride from other sources was not accounted for
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	High risk	There was a variation in the numbers of children reported to have been examined for dental fluorosis compared to the number of children initially reported to be receiving different water fluoride levels
Selective reporting (reporting bias)	Low risk	Outcome of interest was fully reported on and balanced across group
Other bias	High risk	No indication that the examiners were calibrated

Grobler 1986

Methods	FLUOROSIS STUDY Country of study: South Africa Geographic location: Nourivier (low F), Tweeriviere (high F) in North Western Cape province Year of study: Not stated Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: Lifetime residents of study areas. Children aged 12-13 Exclusion criteria: Not stated Other sources of fluoride: Both communities had virtually no dental care or fluoride therapy Social class: Similar socio-economic status in two study areas (reported by authors) Ethnicity: Similar ethnicity in two study areas (reported by authors) Residential history: Lifetime residents Other confounding factors: Areas similar in nutrition and dietary habits (reported by authors). Temperature 27-32 C
Interventions	All natural fluoridation Group 1: 3.7 ppm Grpup 2: 0.62 ppm
Outcomes	Outcome: Fluorosis prevalence (Deans index); caries data collected but not presented in this review due to study design Age at assessment: 12-13
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	All available subjects were included in the study population. Insufficent information was reported on the sampling frame
Confounding	Low risk	SES was similar across groups and there was virtually no dental care or fluoride therapy in the population at the time
Blinding of outcome assessment (detection bias)	High risk	Insufficient information. Examinations were made at the children's schools but no mention of blind assessment.
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	Low risk	All expected outcomes reported
Other bias	High risk	Examinations were done by a single examiner but no mention of intra-examiner calibration

Grobler 2001

Methods	FLUOROSIS STUDY Country of study: South Africa Geographic location: Leeu Gamka, Kuboes and Sanddrif Year of study: Not stated Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: Continuous residence since birth; having virtually no dental care or fluoride therapy including the use of fluoride-containing toothpaste; absence of any obvious under-nutrition and no dietary habits that could significantly contribute to the ingestion of fluorine. Exclusion criteria: Not stated Other sources of fluoride: Participants had virtually no dental care or fluoride therapy, including the use of fluoride-containing toothpaste Social class: Similarly low socioeconomic status across groups reflected in the fact that they all lived in sub-economic housing units Ethnicity: Mixed ethnic origin – Khoi, Caucasian and Negroid roots which over hundreds of years have developed into a homogenous ethnic group Residential history: Lifetime residents Other confounding factors: Not stated
Interventions	All natural fluoridation Group 1: 0.19 ppm Group 2: 0.48 ppm Group 3: 3 ppm
Outcomes	Outcome: Fluorosis prevalence (Deans index); Caries data also evaluated within the study but excluded from review due to study design Age at assessment: 10-15
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	All available children in the specified study areas were examined
Confounding	Low risk	SES was similar across groups and there was virtually no exposure to fluoride from other sources
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	Low risk	Outcome of interest reported
Other bias	Low risk	No other apparent bias

Guo 1984

Methods	**CARIES STUDY** Country of study: Taiwan Geographic location: Chung-Hsing New Village (F), Tsao-Tun (non-F). Year of study: 1971 Year study ended: 1984 Year of change in fluoridation status: 1971 Study design: CBA
Participants	Inclusion criteria: Lifetime residents of study areas Exclusion criteria: Children who migrated from other areas during study period. Other sources of fluoride: Not Stated Social class: Not stated Ethnicity: Not stated Residential history: Lifetime residents Other confounding factors: Similar climate - mean daily air temp = 24 C
Interventions	**Initiation of water fluoridation** Group 1 baseline: 0.07 ppm (natural fluoridation) Group 1 post intervention: 0.6 ppm (artificial fluoridation) Group 2: 0.08 ppm (natural fluoridation)
Outcomes	dmft, DMFT, % caries free (deciduous), % caries free (permanent) Age at baseline measure: 5, 8, 12 and 15 years Age at final measure: 5, 8, 12 and 15 years
Funding	Not stated
Notes	Data extracted from Guo 1984 differs from that presented in CRD review

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	All eligible children in the study areas were included in the study
Confounding	High risk	SES and the use of fluoride from other sources was not accounted for
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	Low risk	Outcome of interest reported
Other bias	High risk	Examinations were carried out by the dentists from the University hospital and recorded on the same type of record forms but there is no mention of examiner calibration

Haavikko 1974

Methods	FLUOROSIS STUDY Country of study: Finland Geographic location: Espoo (low F), Elimaki (high F), Hanko (optimal F), Lohja (low F). Year of study: 1969 Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: Children who had been resident in study areas for the first 6 years of life. Children aged 10-11. Exclusion criteria: None stated Other sources of fluoride: Not stated Social class: Not stated Ethnicity: Not stated Residential history: Continuous residence for the first 6 years Other confounding factors: Food sources of fluoride
Interventions	All natural fluoridation Group 1: 1.08 ppm Group 2: 0.41 ppm Group 3: 0.11 ppm Group 4: 0.05 ppm
Outcomes	Dentl fluorosis (Dean's index) Age at assessment: 10 to 11 years
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	Eligible children were selected at random from the health records. No further details regarding the sampling frame were reported
Confounding	High risk	SES and the use of fluoride from other sources were not reported on
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	Low risk	Outcome of interest was fully reported on and balanced across group
Other bias	High risk	Both dentists carried out the diagnosis of enamel defects but there was no mention of examiner calibration

Harding 2005

Methods	FLUOROSIS STUDY Country of study: Ireland Geographic location: Cork city (F), Cork county (non-F). Year of study: Not stated Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: Age 5; location of the school attended and fluoridation status of water supply. Exclusion criteria: Absence on the day of examination; too apprehensive to participate or <5; incorrectly received a form; incomplete form; existing medical condition Other sources of fluoride: Fluoride prevalence of children with different nutritional and brushing habits were reported: Breast-fed: 30 (28%) vs. Not breast-fed: 38 (21%); Brushing before 12 months: F=47 (22.6%) vs NF=19 (22.1%); Started brushing with toothpaste between 12 and 18 months: F = 79 (38%), NF = 25 (29.1%); Started brushing with toothpaste between 19 and 24 months: F=37 (17.8%), NF=21 (24.4%); Started brushing with toothpaste after 24 months: F=41 (19.7%); NF=18 (20.9%) Social class: Schools were chosen to provide a socio-economic spread; 7 urban and 10 rural schools. Ethnicity: Not stated Residential history: Lifetime residents Other confounding factors: Food sources of fluoride
Interventions	Group 1: 0.8-1 ppm (artificial fluoridation) Group 2: 'low' level - ppm not stated (natural fluoridation)
Outcomes	Dental fluorosis (TSIF) Age at assessment: 5 years
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	A stratified sample for 5 year olds was drawn from study areas on the basis of age, location, school attended and fluoridation status. Schools were chosen to provide a socio-economic spread.
Confounding	Low risk	SES range (by school) was sampled. There were similar levels of tooth paste use across the groups
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Of the 311 participants examined, outcome data was not presented for 17 participants due to partial fluoride history; unlikely to influence the results
Selective reporting (reporting bias)	Low risk	Outcome of interest reported
Other bias	High risk	Clinical examination was carried out by one examiner trained extensively by a gold standard but no report of calibration nor intra-examiner reliability tests

Hardwick 1982

Methods	**CARIES STUDY** Country of study: England Geographic location: Alsager, Middlewich, Nantwich (F), Northwich (non-F). Year study started: 1974 Year study ended: 1978 Year of change in fluoridation status: 1975 Study design: Prospective cohort
Participants	Inclusion criteria: 12 year old children living in study area. Consent from relevant country authorities and teachers at schools included in the study. Exclusion criteria: None stated Other sources of fluoride: 152 fluoride group: 142(94%) used only fluoride dentrifices & 125 (83%) used at least once a day. 194 control group, 185 (95%) used only fluoride dentrifices, 147 (76%) used at least once per day. Two children in fluoride group and 4 children in control had ever used fluoride tablets. Social class: Control and experimental groups matched on urban and rural characteristics Ethnicity: Not stated Residential history: Not stated Other confounding factors: Not stated
Interventions	**Initiation of water fluoridation** Group 1 baseline: <0.1 ppm (natural fluoridation) Group 1 post intervention: 1.0 ppm (artificial fluoridation) Group 2: <0.1 ppm (natural fluoridation)
Outcomes	DMFT, DMSF Age at baseline measure: 12 years Age at final measure: 16 years
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	All eligible children were invited to participate
Confounding	High risk	Use of fluoride from other sources was broadly equal between the groups. The groups were matched on SES however, no information was reported on the dietary habits of the children
Blinding of outcome assessment (detection bias)	Low risk	Quote: “The children were transported to a central examination centre in small numbers and were then randomly mixed with children from the other group. Furthermore, the children were requested not to wear school uniform and, in case they forgot, donned a large operating gown to hide their clothes”
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	Low risk	Outcome of interest reported
Other bias	Low risk	No other apparent bias

Heifetz 1988

Methods	FLUOROSIS STUDY Country of study: USA Geographic location: 7 rural towns within 75 miles of each other in Illinois. Year of study: 1980-1985 Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: Children aged 8-10 and 13-15 Continuous residence in study community. Exclusion criteria: Not stated Other sources of fluoride: Food and drinks produced in fluoride areas. Social class: Study areas shared similar socioeconomic characteristics Ethnicity: Not stated Residential history: Continuous residence Other confounding factors: Not stated
Interventions	All natural fluoridation Group 1: 3.8 - 4.1 ppm Group 2: 2.8 - 3.8 ppm Group 3: 2.1 ppm Group 4: 1.1 ppm
Outcomes	Dental fluorosis (TSIF); Caries data also evaluated within the study but excluded from review due to study design Age at assessment: 13 to 15 years
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	There was insufficient detail reported to determine how selection took place
Confounding	High risk	Participants consumed food and drinks produced in fluoride areas. However, it is not clear whether there was a difference in consumption among different areas. Insufficient detail is provided regarding use of fluoride from other sources
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	Low risk	Outcome of interest was fully reported on and balanced across group
Other bias	Low risk	No other apparent bias

Heintze 1998

Methods	FLUOROSIS STUDY Country of study: Brazil Geographic location: Garca (F), Itrapolis (non-F), Sao Paulo state Year of study: 1995 Year of change in fluoridation status: 1973 and 1975 Study design: Cross-sectional
Participants	Inclusion criteria: Subjects aged 5 - 24 years. Subjects from all social strata. Subjects that used tap water and took urine samples from all three daytime periods Exclusion criteria: Not stated. Subjects that used tap water. Other sources of fluoride: Subjects asked about use of toothpaste or mouthrinses containing fluoride. Ninety-eight percent of the individuals used toothpaste containing fluoride and 16.5% used a fluoride mouthrinse daily or weekly Social class: Cities similar in socio-economic and socio-demographic conditions, subjects from all social strata included. Ethnicity: Not stated Residential history: Not stated Other confounding factors: Garca altitude = 526, mean temp = 22 C, pop. = 41351; Itapolis: altitude = 491m, mean temp = 23 C, pop.=30 111
Interventions	Group 1: 0.9 ppm (artificial fluoridation) Group 2: 0.02 ppm (natural fluoridation)
Outcomes	Dental fluorosis (TF index) Age at assessment: 5 to 24 years
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	Participants were accessed via health centres, schools and factories and all eligible participants were included in the study
Confounding	High risk	Study areas were matched for SES. Information was collected on the use of fluoride paste and mouthrinse, however this was not reported according to exposure of water fluoridation
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Unclear risk	Data presented as percentages making it difficult to determine if all participants are accounted for
Selective reporting (reporting bias)	Low risk	Outcome of interest reported
Other bias	Unclear risk	Dental fluorosis was recorded by a trained and calibrated examiner, however, details of intra-examiner reliability not provided

Heller 1997

Methods	FLUOROSIS STUDY Country of study: USA Geographic location: National survey of oral health of US school children Year of study: 1986 Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: Lifetime residents of study areas .Aged 7-17. Completion of survey (parents). Exclusion criteria: None stated Other sources of fluoride: Written questionnaire included question regarding child's use of fluoride drops, fluoride tablets, professional topical fluoride treatments and school fluoride rinses Social class: Not stated Ethnicity: Not stated Residential history: Continuous residency Other confounding factors: Results standardised to age and sex distribution of US schoolchildren who participated in survey
Interventions	Group 1: >1.2 ppm (natural fluoridation) Group 2: 0.7-1.2 ppm (artificial fluoridation) Group 3: 0.3-0.7 ppm (natural fluoridation) Group 4: <0.3 ppm (natural fluoridation)
Outcomes	Dental fluorosis (Dean's index); Caries data also evaluated within the study but excluded from review due to study design Age at assessment: 7 to 17 years
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	Stratified sampling was carried out and oral examination was conducted for 78% of all sampled students
Confounding	High risk	Results were not adjusted for SES and the use of fluoride from other sources
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	Low risk	Outcome of interest was fully reported on and balanced across group
Other bias	Low risk	No other apparent bias

Hernandez-Montoya 2003

Methods	FLUOROSIS STUDY Country of study: Mexico Geographic location: Not stated Year of study started: 2001 Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: Having at least 1 year residence in the study area Exclusion criteria: Not stated Other sources of fluoride: Not stated Social class: Not stated Ethnicity: Not stated Residential history: ≥1 year residence in study area Other confounding factors: In all study areas, parents reported the use of fluoride toothpaste.
Interventions	All natural fluoridation Group 1: 0.74 ppm Group 2: 1.3 ppm Group 3: 3.56 ppm Group 4: 4.07 ppm Group 5: 5.19 ppm Group 6: 5.57 ppm Group 7: 7.59 ppm
Outcomes	Dental fluorosis (Dean's index); Caries data also evaluated within the study but excluded from review due to study design Age at assessment: 9 to 11 years
Funding	Financial and logistical support from the Health Institute of the State of Aguascalientes, Institute Tecnologico de Aguascalientes and COSNET
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	Random sampling was performed considering the total population exposed to fluoridated water at each study area
Confounding	High risk	SES was not accounted for
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Unclear risk	Some participants were excluded from the analysis and no reason provided
Selective reporting (reporting bias)	Low risk	Outcome of interest reported
Other bias	Unclear risk	Outcome was assessed by a working group previously trained and calibrated. Insufficient information on reliability testing

Holdcroft 1999

Methods	**CARIES STUDY** Country of study: England Geographic location: North Birmingham and Sandwell (F), North Staffordshire, Herefordshire and Shropshire (non-F) Year study started: 1985/6 Year of change in fluoridation status: 1986 Study design: CBA
Participants	Inclusion criteria: Not stated Exclusion criteria: Not stated Other sources of fluoride: Not Stated Social class: Measured using Jarman scores Ethnicity: Not stated Residential history: Not stated Other confounding factors: not stated
Interventions	**Initiation of water fluoridation** Group 1: Not stated Group 2: Not stated
Outcomes	dmft Age at baseline measure: Not stated Age at final measure: Not stated
Funding	Not stated
Notes	Data from original CRD review (unverified data)

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	Unable to make a judgement as study was unavailable
Confounding	High risk	Data does not appear to have been controlled for SES and use of fluoride from other sources
Blinding of outcome assessment (detection bias)	Unclear risk	Unable to make a judgement as study was unavailable
Incomplete outcome data (attrition bias)	Unclear risk	Unable to make a judgement as study was unavailable
Selective reporting (reporting bias)	Unclear risk	Unable to make a judgement as study was unavailable
Other bias	Unclear risk	Unable to make a judgement as study was unavailable

Hong 1990

Methods	FLUOROSIS STUDY Country of study: Taiwan Geographic location: Chung-hsing New village (F) and Tsao-tun (non-F) Year of study: Not stated Year of change in fluoridation status: 1978 Study design: Cross sectional
Participants	Inclusion criteria: Children aged 6-15. Resident in village since initiation of fluoridation Exclusion criteria: Children who migrated from other areas during study period Other sources of fluoride: Not stated Social class: Two communities alike in social and living customs Ethnicity: Not stated Residential history: Resident since fluoride initiation Other confounding factors: Two areas have virtually identical climates, only 3km apart
Interventions	Group 1: 0.6 ppm (artificial fluoridation) Group 2: 0.08 ppm (natural fluoridation)
Outcomes	Dental fluorosis (Dean's index) Age at assessment: 6 to 15 years
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	The participating sample consisted of children from 6 to 15 years in the study areas. No other information was provided on sample selection
Confounding	High risk	The use of fluoride from other sources was not accounted for
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	Low risk	Outcome of interest was fully reported on and balanced across group
Other bias	Low risk	No other apparent bias

Ibrahim 1995

Methods	FLUOROSIS STUDY Country of study: Sudan Geographic location: Abu Gronn (F), Treit El Biga (low F) Year of study: 1992 Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: At least one erupted permanent maxillary incisor Lifetime residents of study areas. Age 7-16 Exclusion criteria: Not stated Other sources of fluoride: Not stated Social class: Author states that areas have more or less the same socio-economic background Ethnicity: Author states that areas have more or less the same ethnic background Residential history: Lifetime residents Other confounding factors: Altitude = 300m for both areas and mean temp = 25-35 C. In lowfluoride area boys had significantly more fluorosis than girls
Interventions	All natural fluoridation Group 1: 2.56 ppm Group 2: 0.25 ppm
Outcomes	Dental fluorosis (Community fluorosis index) Age at assessment: 7 to 16 years
Funding	Norwegian Universities Committee for Development Research and Education
Notes	Data extracted from Ibrahim 1995 differs from that presented in CRD review

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	Insufficient information was reported on sampling - the sampling frame was unspecified
Confounding	High risk	The use of fluoride from other sources was not accounted for
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	Low risk	Outcome of interest reported
Other bias	High risk	No mention of calibration of examiners and reliability testing

Indermitte 2007

Methods	FLUOROSIS STUDY Country of study: Estonia Geographic location: Tartu city Year of study: Not stated Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: 12 year old children, continuous residence, only districts supplied by definite tube wells of known fluoride concentration were selected Exclusion criteria: Not stated Social class: Selected districts were of same eco-environmental, ethnic as well as socioeconomic standards Ethnicity: Not stated Residential history: Lifetime residents Other confounding factors: Not stated
Interventions	All natural fluoridation Group 1: 0.2 ppm Group 2: 0.3 ppm Group 3: 1.2 ppm Group 4: 1.6 ppm Group 5: 2.4 ppm Group 6 3.9 ppm
Outcomes	Dental fluorosis (index not reported); Age at assessment: 12 years
Funding	The study was supported by the Target Funding Projects No. 0180052s07 and No. 0182648s04 of the Ministry of Education and Science of Estonia and by Estonian Society of Stomatololgy
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	Areas of study were sampled purposively and limited information is reported on the selection of individuals
Confounding	High risk	The use of fluoride from other sources was not accounted for
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	Low risk	Outcome of interest reported
Other bias	High risk	Examination carried out by a trained examiner with an assistant but no mention of calibration and reliability testing

Indermitte 2009

Methods	FLUOROSIS STUDY Country of study: Estonia Geographic location: Not stated Year of study: Not stated Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: Not stated Exclusion criteria: Not stated Other sources of fluoride: Not stated Social class: Not stated Ethnicity: Not stated Residential history: Lifetime residents Other confounding factors: Not stated
Interventions	All natural fluoridation Group 1: <1 ppm Group 2: 1 - 1.5 ppm Group 3: 1.51 - 2 ppm Group 4: 2.1 - 3 ppm Group 5: 3.1 - 4 ppm Group 6: >4 ppm
Outcomes	Dental fluorosis (Dean's index) Age at assessment: 7 to 15 years
Funding	The study was supported by the Estonian Society of Stomatology and Estonian Science Foundation grant No 7403
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	Sampling was partly based on data from two previous studies which provide insufficient sampling information while the sub-sample was selected from town of Tartu, where the fluoride content in drinking water varied significantly between regions
Confounding	High risk	SES and the use of fluoride from other sources was not accounted for
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	Low risk	Outcome of interest reported
Other bias	High risk	Clinical examination by a 'trained' dentist. Insufficient information on intra examiner reliability testing

Ismail 1990

Methods	FLUOROSIS STUDY Country of study: Canada Geographic location: Public and Private schools in Trois Rivieres (F) and Sherbrooke (non-F), Quebec Year of study: 1987 Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: Children randomly selected from private and public schools separately. Children aged 11-17. Resident in study areas for first 6 years Exclusion criteria: None stated Other sources of fluoride: Fluoride tablet use around 13% in F areas and 67% in non-F area Social class: Stratified on school type: private or public (authors state private school likely to be higher social class) Ethnicity: Not stated Residential history: Resident from 0 to 6 years Other confounding factors: Not stated
Interventions	All natural fluoridation Group 1: 1.0 ppm Group 2: <0.1 ppm
Outcomes	Dental fluorosis prevalence (TSIF); Caries data collected, however, not presented in this review due to study design Age at assessment: 11 to 17 years
Funding	National Health Research and Development Program, Health and Welfare (6605-1316-53)
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	A two-stage stratified sample was selected from each city. In the first stage, private and public schools were randomly selected. In the second stage, students were randomly selected from the private and public schools separately
Confounding	High risk	There was an imbalance of the use of fluoride supplements between groups with more supplements being consumed by those living in the non-fluoridated area
Blinding of outcome assessment (detection bias)	Low risk	Quote: "Examiners were blind to the content of questionnaire" and by implication, fluoridation status of participants
Incomplete outcome data (attrition bias)	Low risk	Data appear to be presented for all participants
Selective reporting (reporting bias)	Low risk	All expected outcomes reported
Other bias	Low risk	No other apparent bias

Jackson 1975

Methods	FLUOROSIS STUDY Country of study: Wales Geographic location: Anglesey (F), Bangor and Caernarfon (non-F) Year of study: 1974 Year of change in fluoridation status: 1955 Study design: Unclear
Participants	Inclusion criteria: Lifetime residents of study areas. Continuous use of public water supply. School children aged 15 years. Parental consent Exclusion criteria: Children who had ever received fluoride tablets, left the study area, did not consume piped water supply for entire life, unavailable at time of sampling Other sources of fluoride: Children who had received fluoride tablets excluded Social class: Not stated Ethnicity: Not stated Residential history: Lifetime residents Other confounding factors: Not stated
Interventions	Group 1: 0.9 ppm (artificial fluoridation) Group 2: <0.1 ppm (natural fluoridation)
Outcomes	Mottling; Caries data collected, however, not presented in this review due to study design Age at assessment: 15 years
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	It is stated that children were randomly sampled, however information on sampling is insufficient
Confounding	High risk	Children who had received fluoride tablets were excluded, however SES was not taken into account
Blinding of outcome assessment (detection bias)	Low risk	Participants were taken to a central exam centre by taxi and examiners were unaware of the area from which a child came.
Incomplete outcome data (attrition bias)	Unclear risk	Data presented for approximately 30% of participants sampled from each study area (Anglesey-28%, Bangor-32%)
Selective reporting (reporting bias)	Low risk	All expected outcomes were reported
Other bias	High risk	Even though the examiners carried out their investigations independently, no sort of calibration seemed to have been carried out

Jackson 1999

Methods	FLUOROSIS STUDY Country of study: USA Geographic location: Connersville (non-F) Brownsburg (optimal-F), Lowell (high-F), Indiana Year of study: 1992 Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: Lifetime residents of study areas. Consumed public water from birth or supply with comparable water level. Children aged 7-14. Parental and personal consent Exclusion criteria: Factors in medical history that would contraindicate a dental examination. Full mouth fixed orthodontic appliance Other sources of fluoride: In non-F areas 58% use fluoride supplements, in optimal-F area 20 % use F supplements and in high-F area 9% use F supplements. Also fluoride from mouthrinses, gels, other topical applications Social class: Not stated Ethnicity: Approximately 2% non-white (stated for baseline survey) Residential history: Lifetime residents Other confounding factors: Areas all in same climatic zone
Interventions	All natural fluoridation Group 1: 4.0 ppm Group 2: 1.0 ppm Group 3: 0.2 ppm
Outcomes	Dental fluorosis (TSIF) Age at assessment: 7 to 10 years and 11 to 14 years
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	There was insufficient detail reported to determine how selection took place
Confounding	High risk	Information on the use of other fluoride sources was collected, however, the results were not adjusted for this factor. SES was not accounted for
Blinding of outcome assessment (detection bias)	Low risk	The examiner was unaware of the residency status of the participants
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	Low risk	Outcome of interest reported
Other bias	Low risk	No other apparent bias

Jolly 1971

Methods	FLUOROSIS STUDY Country of study: India Geographic location: The Punjab Year of study: Not stated Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: School Children Exclusion criteria: None stated Other sources of fluoride: Not stated Social class: Not stated Ethnicity: Not stated Residential history: Not stated Other confounding factors: Not stated
Interventions	All naturally fluoridated Group 1: 0.7 ppm Group 2: 1.4 ppm Group 3: 2.4 ppm Group 4: 2.4 ppm Group 5: 2.5 ppm Group 6: 3.0 ppm Group 7: 3.0 ppm Group 8: 3.3 ppm Group 9: 3.3 ppm Group 10: 3.6 ppm Group 11: 4.3 ppm Group 12: 5.0 ppm Group 13: 5.09 ppm Group 14: 5.49 ppm Group 15: 7.02 ppm Group 16: 8.5 ppm Group 17: 9.5 ppm
Outcomes	Mottled enamel Age at assessment: 5 to 15 years
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	There was insufficient detail reported to determine how selection took place
Confounding	High risk	SES and the use of other fluoride sources was not accounted for
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Unclear risk	Number of participants examined was not reported and the outcome was reported as a proportion
Selective reporting (reporting bias)	Unclear risk	The outcome of interest was reported as a proportion; and without absolute numbers nor the number of participants examined (n) it is unclear what the proportion represents.
Other bias	High risk	No mention of examiner calibration

Kanagaratnam 2009

Methods	FLUOROSIS STUDY Country of study: New Zealand Geographic location: Auckland Year of study: Not stated Year of change in fluoridation status: Not stated Study design: Cross-sectional
Participants	Inclusion criteria: Only children who returned signed consent form and questionnaire completed by parents. Exclusion criteria: Schools with <five 9-year old children were excluded because of resource, time and efficiency constraints Other sources of fluoride: Data presented on fluoride tablet supplementation, brushing with toothpaste frequency, amount of toothpaste used and toothpaste swallowed, however, the use of other sources of fluoride had no effect on the proportion of children with diffuse opacities. Social class: High (decile 8–10) = 124 (40) fluoridated, 57 (19) non-fluoridated; Middle (decile 4–7) = 127 (41) fluoridated, 133 (44) non-fluoridated; Low (decile 1–3) = 59 (19) fluoridated, 112 (37) non-fluoridated; A schools decile indicates the extent to which it draws its students from low socioeconomic communities. Ethnicity: More children of European descent and fewer children of Asian descent attended schools within non-fluoridated areas compared with fluoridated areas Residential history: Lifetime residents and intermittent residents, however, data on lifetime residents alone presented in this review due to confounding Other confounding factors: Not stated
Interventions	Group 1: 0.1 - 0.3 ppm (natural fluoridation) Group 2: 0.7 - 1 ppm (artificial fluoridation)
Outcomes	Dental fluorosis (Dean's index); Caries data collected, however, not presented in this review due to study design Age at assessment: 7 to 15 years
Funding	Funded by AUT University, Counties Manukau District Health Board and New Zealand Dental Research Foundation
Notes	Fluoride concentrations were not reported in the study but deduced from discussion section and anecdotal evidence

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	The number of schools and students from each school were probabilistically sampled to reflect the overall decile and school size distribution representative of Auckland schools yet produce a sample that was balanced between fluoridated and non-fluoridated regions.
Confounding	Unclear risk	While the sample included participants from a range of SES, the numbers in these groups were not equal. There were significantly fewer children in high decile schools in non-fluoridated areas and low decile schools in fluoridated areas
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data appear to be presented for all participants
Selective reporting (reporting bias)	Low risk	All expected outcomes reported
Other bias	Low risk	No other apparent bias

Kotecha 2012

Methods	FLUOROSIS STUDY Country of study: India Geographic location: Not stated Year of study: Not stated Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: All age groups Exclusion criteria: Those who could not be studied in the second visit. Other sources of fluoride: Not stated Social class: Not stated Ethnicity: Not stated Residential history: Not stated Other confounding factors: Not stated
Interventions	All natural fluoridation Group 1: <1.5 ppm Group 2: >1.5 ppm
Outcomes	Dental fluorosis (index not reported); Caries data also evaluated within the study but excluded from review due to study design; Age at assessment: All age groups
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	Eleven out of 261 villages having high fluoride content in the drinking water and 11 villages of the 1490 having normal fluoride drinking water were randomly selected for water sampling.
Confounding	High risk	SES and the use of fluoride from other sources was not accounted for
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	High risk	Data for 75% of population of the study areas presented and attrition was not balanced across groups
Selective reporting (reporting bias)	Low risk	All expected outcomes were reported
Other bias	High risk	Measurement done by trained tutors and assistant professors, however, it is not clear whether the personnel measuring the outcome were calibrated.

Kumar 1999

Methods	FLUOROSIS STUDY Country of study: USA Geographic location: Newburgh City (F), Newburgh Town (FI 1984), New Windsor (non-F), Kingston (non-F). Year study started: 1986 Year study ended: 1995 Year of change in fluoridation status: 1984 Study design: CBA
Participants	Inclusion criteria: Children aged 7-14 Lifetime residents of study areas. Exclusion criteria: Not stated Other sources of fluoride: Fluoridation + early brushing or tablet use, fluoride tablet + early brushing, early brushing, fluoride tablet all associated with increased risk of fluorosis scored very mild to severe compared to children exposed to none of these additional sources. Social class: Not stated Ethnicity: No difference in odds of fluorosis in African-Americans compared to white and other races Residential history: Lifetime residents Other confounding factors: Not stated
Interventions	Group 1: 1 ppm (artificial fluoridation) Group 2: 1 ppm (artificial fluoridation) Group 3: 'low' level - ppm not stated (natural fluoridation) Group 4: 'low' level - ppm not stated (natural fluoridation) Group 5: 'low' level - ppm not stated (natural fluoridation)
Outcomes	Dental fluorosis (Dean's index); Caries data also evaluated within the study but excluded from review due to study design; Age at baseline measure: 7 to 14 years Age at final measure: 7 to 14 years
Funding	Supported by a grant from the National Institute of Dental Researcy (R01 DE 1088801)
Notes	Group 1 (Newburgh City) had between fluoridated since 1945; Group 2 (Newburgh Town) was fluoridated in 1984. Data for 1995 only was available for Group 5 (Ulster)

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	There was insufficient detail reported to determine how selection took place
Confounding	Unclear risk	While the authors reported that SES was considered, this information was not reported
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	Low risk	Outcome of interest reported and balanced across group
Other bias	High risk	There were great methodological differences between the before- and after-study in questionnaire design and examiner and the examiners were not reported to have been calibrated

Kumar 2007

Methods	FLUOROSIS STUDY Country of study: India Geographic location: Not stated Year study started: 1999-2000 Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: Not stated Exclusion criteria: Not stated Other sources of fluoride: Not stated Social class: Not stated Ethnicity: Not stated Residential history: Not stated Other confounding factors: Other sources of fluoride not stated
Interventions	All natural fluoridation Group 1: 0.6 ppm Group 2: 1.1 ppm Group 3: 1.1 ppm Group 4: 1.1 ppm Group 5: 1.2 ppm Group 6: 1.3 ppm Group 7: 1.7 ppm Group 8: 1.7 ppm Group 9: 1.8 ppm Group 10: 1.9 ppm Group 11: 2.1 ppm Group 12: 2.9 ppm Group 13: 4.6 ppm
Outcomes	Dental fluorosis (Smith's classification) Age at assessment: 5 to 14 years
Funding	Indian Council of Medical Research
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	A stratified random sampling procedure was adopted for selection of water sources and villages
Confounding	High risk	SES and the use of fluoride from other sources was not accounted for
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	Low risk	Outcome of interested reported
Other bias	High risk	Examiner calibration was not mentioned

Kunzel 1976

Methods	**FLUOROSIS STUDY** Country of study: Cuba Geographic location: La Salud (low F), Mir (medium F), San Augustin and Blanqizal (high F) Year of study: 1973 Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: Children resident in study areas. Exclusion criteria: Not stated Other sources of fluoride: Not stated Social class: Not stated Ethnicity: Not stated Residential history: Not stated however, most of the children were born in the area Other confounding factors: Not stated
Interventions	All natural fluoridation Group 1: 2.3 - 3.6 ppm Group 2: 1.1 - 1.6 ppm Group 3: 0.6 - 0.8 ppm Group 4: 0.1 ppm
Outcomes	Dental fluorosis (Dean's index); Caries data also evaluated within the study but excluded from review due to study design; Age at assessment: 9 to 10 years
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	There was insufficient detail reported to determine how selection took place
Confounding	High risk	SES and the use of fluoride from other sources was not accounted for
Blinding of outcome assessment (detection bias)	Low risk	Quote: "The dental examinations were carried out while the fluoride content of the water consumed was unknown"
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	Low risk	All expected outcome reported
Other bias	Low risk	No other apparent biases

Kunzel 1997

Methods	**CARIES STUDY** Country of study: Germany Geographic location: Chemnitz (F), Plauen (non-F) Year study started: 1959 Year study ended: 1971 Year of change in fluoridation status: 1959 Study design: CBA
Participants	Inclusion criteria: Children born in study areas Exclusion criteria: Children who had moved into the 2 study areas; Disabled children Other sources of fluoride: Number of topical applications of fluoride toothpastes, solutions and gel was low - water fluoridation was the only preventive measure Social class: Not stated Ethnicity: Not stated Residential history: Lifetime residents Other confounding factors: Increasing annual sugar consumption in both areas
Interventions	**Initiation of water fluoridation** Group 1 baseline: 0.2 ppm (natural fluoridation) Group 1 post intervention: 1 ppm (artificial fluoridation) Group 2: 0.2 ppm (natural fluoridation)
Outcomes	dmft, DMFT, % caries free (deciduous dentition), % caries free (permanent dentition) Age at baseline measure: 6 to 15 olds Age at final measure: 6 to 15 year olds
Funding	Supported by the German Federal Ministry of Education, Science, Research and Technology, grant 01 ZZ 9502
Notes	Data extracted from Kunzel 1997 differs from that presented in CRD review (additional data extracted) Study presents data on both initiation and cessation of water fluoridation but cessation data excluded from this review due to unsuitable control group

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	Sampling details had previously been published (Kunzel 1980), however, the exclusion of disabled children as stated in this study, puts the representativeness of the sample in doubt
Confounding	High risk	SES was not accounted for
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data appear to be presented for all participants
Selective reporting (reporting bias)	Low risk	Standard deviation was not reported
Other bias	Low risk	No other biases apparent

Leverett 1986

Methods	**FLUOROSIS STUDY** Country of study: USA Geographic location: Rochester, NY and several surrounding towns (F); four towns in western New York state (non-F) Year of study: 1981 Year of change in fluoridation status: 1963 Study design: Cross sectional
Participants	Inclusion criteria: Children resident in study areas. Children aged 7-17yrs Exclusion criteria: None stated Other sources of fluoride: Not stated Social class: Not stated Ethnicity: Not stated Residential history: Children in both non-F and F areas were “not necessarily lifetime residents of their communities” Other confounding factors: None stated
Interventions	Group 1: 1.0 ppm (artificial fluoridation) Group 2: <=0.3 ppm (natural fluoridation)
Outcomes	Dental fluorosis (Dean’s index) Age at assessment: 7 to 17 years
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	There was insufficient detail reported to determine how selection of children within schools took place
Confounding	High risk	SES and the use of fluoride from other sources was not accounted for
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	Low risk	Outcome of interest reported
Other bias	High risk	The examiners do not seem to have been calibrated

Levine 1989

Methods	**FLUOROSIS STUDY** Country of study: England Geographic location: Birmingham (F), Leeds (non-F) Year of study: 1987 Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: Lifetime residents of study areas (children only). Schools with catchment areas inside study areas. Children aged 9-10 Exclusion criteria: Asian and West Indian children. Non-continuous residents. Teeth with fractures, restorations Other sources of fluoride: Children who had received fluoride supplements at any time excluded Social class: Schools selected that served similar socio-economic populations (social class groups 3,4,5) Ethnicity: Asian and West Indian children excluded Residential history: Lifetime residents Other confounding factors: Not stated
Interventions	Group 1: 1 ppm (artificial fluoridation) Group 2: <0.1 ppm (natural fluoridation)
Outcomes	Enamel defect- hypoplasia (TSIF) Age at assessment: 9 to 10 years
Funding	Not stated
Notes	Data extracted from Levine 1989 differs from that presented in CRD review

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	There was insufficient detail reported to determine how selection took place
Confounding	Low risk	Children using fluoride supplements were excluded and sampling ensured that groups were comparable in terms of SES
Blinding of outcome assessment (detection bias)	Low risk	Photographic examination was blinded. Quote: "The colour transparencies were coded and placed in a random sequence before being projected and viewed"
Incomplete outcome data (attrition bias)	Low risk	Attrition was balanced across groups as results for 18 (2.9%) and 12 (2.4%) children from the non-FI and FI area respectively were not available for photographic assessment.
Selective reporting (reporting bias)	Unclear risk	There was selective reporting on the central incisor and the reason was not stated
Other bias	Low risk	No other apparent bias

Lin 1991

Methods	FLUOROSIS STUDY Country of study: China Geographic location: Xinyuan (F), Langan and Jiayi (non-F) Year of study: Not stated Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: School children aged 7 to 14 years Exclusion criteria: Not stated Other sources of fluoride: Not stated Social class: Low socioeconomic status, mean annual income of about 200 yuan Ethnicity: Not stated Residential history: Not reported Other confounding factors: Not stated
Interventions	All natural fluoridation Group 1: 0.88 ppm Group 2: 0.34 ppm
Outcomes	Dental fluorosis Age at assessment: 7 to 14 years
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	Random stratified sampling was used
Confounding	High risk	The use of fluoride from other sources was not accounted for
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Unclear risk	It is unclear whether data presented for all participants assessed for dental fluorosis
Selective reporting (reporting bias)	Low risk	Outcome of interest reported
Other bias	High risk	The examiners do not seem to have been calibrated

Loh 1996

Methods	**CARIES STUDY** Country of study: Singapore and Malacca (West Malaysia) Geographic location: Singapore (F), Malacca (non-F) Year study started: 1957 Year study ended: 1966 Year of change in fluoridation status: 1958 Study design: CBA
Participants	Inclusion criteria: Chinese and Malay children aged 7-9 years Exclusion criteria: Not stated Other sources of fluoride: Not stated Social class: Not stated Ethnicity: Chinese and Malay children - results presented separately Residential history: Unclear Other confounding factors: Not stated
Interventions	**Initiation of water fluoridation** Group 1: 0.7 ppm (artificial fluoridation) Group 2: 'low' level - ppm not stated (natural fluoridation)
Outcomes	DMFT Age at baseline measure: 7 to 9 years Age at final measure: 7 to 9 years
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	There was insufficient detail reported to determine how selection of schools and children within those schools took place
Confounding	High risk	No details were reported on the use of fluoride from other sources, SES or on the dietary habits of the children
Blinding of outcome assessment (detection bias)	High risk	Blinding was not undertaken
Incomplete outcome data (attrition bias)	Unclear risk	Numbers of children examined at each time point are approximate
Selective reporting (reporting bias)	Unclear risk	The outcomes of interest were not clearly stated a priori and while dental caries was reported, dental fluorosis appears to have been measured on a different age group but not reported in useful format
Other bias	Low risk	No other bias detected

Louw 2002

Methods	FLUOROSIS STUDY Country of study: South Africa Geographic location: Sanddrif, Williston, Kuboes, Fraserburg, Brandvlei, Kenhardt, and Leeu Gamka Year of study: Not stated Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: Aged 11-13, similar nutrition and dietary habits, similar ethnic and socioeconomic status Exclusion criteria: Not stated Other sources of fluoride: No dental care or fluoride therapy, including the use of fluoride containing toothpaste Social class: Similarly low SES reflected in living in subeconomic housing units Ethnicity: Mixed - Khoi, Caucasian and Negroid roots that developed into a homogenous ethnic group Residential history: Lifetime residents Other confounding factors: Similar nutrition and dietary habits -mostly bread and potatoes with sporadic intake of vegetables and meet, all located in arid rural sections of South Africa
Interventions	All natural fluoridation Group 1: 0.19 ppm Group 2: 0.36 ppm Group 3: 0.48 ppm Group 4: 1 ppm Group 5: 1.66 ppm Group 6: 2.64 ppm Group 7: 3 ppm
Outcomes	Dental fluorosis prevalence (Dean's index) Age at assessment: 11 to 13 years
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	There was insufficient detail reported to determine how selection took place
Confounding	Low risk	SES was reported as comparable and the participants were not in receipt of dental care, fluoride supplements or paste
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data presented for all (99%) participants
Selective reporting (reporting bias)	Low risk	Expected outcome reported
Other bias	Low risk	No other apparent bias

Machiulskiene 2009

Methods	**FLUOROSIS STUDY** Country of study: Lithuania Geographic location: Vilkaviskis and Jonuciai Year of study: 2004 Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: Never having taken part in any caries preventive programme; Lifetime residency in the area and informed consent to participate Exclusion criteria: One school in Vilkaviskis was not eligible to participate in the study as a result of current caries prevention programmes, involving fluoride rinses and fissure sealants, tooth surfaces from which recordings could not be made because of the presence of fixed orthodontic appliances Social class: Children affected by parental unemployment – 1.1 ppm fluoride group 39%, 0.3ppm fluoride group 23%. More children in the 1.1 ppm fluoride group reported parental unemployment, however, the two towns were initially considered similar from a socioeconomic point of view. Ethnicity: Not stated Residential history: Lifetime residents Other confounding factors: Other sources of fluoride not stated
Interventions	All natural fluoridation Group 1: 0.3 ppm Group 2: 1.1 ppm
Outcomes	Dental fluorosis (TF index); Caries data also evaluated within the study but excluded from review due to study design Age at assessment: 13 years (mean)
Funding	Funded by Unrestricted grant from Colgate Palmolive (USA).
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	All eligible secondary schools and students within them were invited to participate
Confounding	High risk	The use of fluoride from other sources was not accounted for
Blinding of outcome assessment (detection bias)	High risk	Insufficient information. The measurement and recording of outcome were by different personnel, but they were not reported to have been blinded.
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	Low risk	All expected outcome reported
Other bias	Low risk	No other apparent bias

Mackay 2005

Methods	**FLUOROSIS STUDY** Country of study: New Zealand Geographic location: Not stated Year of study: 2002 Year of change in fluoridation status: Not stated Study design: Cross-sectional
Participants	Inclusion criteria: Not stated Exclusion criteria: Not stated Other sources of fluoride: Ingestion of toothpaste before the age of three = 40%, Use of fluoride tablets up to (and including) age three = 49 (11.2%) Ethnicity: Not stated Social class: High SES school (deciles 8 to 10) = 192 (44%), Medium SES school (deciles 4 to 7) = 121 (27.8%), low SES school (deciles 1 to 3) = 128 (28.2%) Residential history: The study included both continuous and intermittent residents, however, only data from continuous residents included in analysis Other confounding factors: Not stated
Interventions	Group 1: 0.1 - 0.3 ppm (natural fluoridation) Group 2: 0.8 ppm (artificial fluoridation)
Outcomes	Enamel defects (DDE); Caries data also evaluated within the study but excluded from review due to study design Age at assessment: 8.7 to 11.1 years
Funding	New Zealand Dental Research Foundation.
Notes	Fluoride concentration deduced from discussion section and anecdotal evidence

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	A random sample of 600 Year 5 children enrolled with the Southland District Health Board's school dental service was invited to participate in the study
Confounding	High risk	A statistical model conducted showed that hypoplastic defects were influenced by ingestion of toothpaste before age four but the results were not adjusted for this factor
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Unclear risk	Out of the 600 participants invited to the study, 436 (74.5%) children were examined.
Selective reporting (reporting bias)	Low risk	All expected outcome reported
Other bias	Low risk	No other apparent bias

Macpherson 2007

Methods	**FLUOROSIS STUDY** Country of study: Sweden Geographic location: Kungsbacken (F), Halmsted (non-F) Year of study: 2002-2003 Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: Presence of two individual anterior labial-view photographs of any upper anterior teeth present (Conway 2005), similar date of birth (difference in age due to undertaking fieldwork in study areas a year apart) Exclusion criteria: Not stated Other sources of fluoride: Age started brushing at 6-12 m & 12 m (p- 0.99). Frequency of brushing ≤1/day/≥2/day (p-0.42). Toothpaste F <1000 ppm/≥1000 ppm (p-0.49). Amount of toothpaste ≤pea size/ >pea size (p-0.09). Fluoride tablets previously No/Yes p<0.001 Fluoride tablets now No/ Yes (p-0.001) Ethnicity: Not stated Social class: Low education: F=47, NF=56; High education: F=64, NF=73. Both groups were similar with respect to parents' education attainment. P=0.87 Residential history: Children from Kungsbacka were generally exposed to fluoridated water in early childhood and those from Halmstad were not exposed to fluoridated water during infancy (discussion section) Other confounding factors: Not stated
Interventions	All natural fluoridation Group 1: 0.1 ppm Group 2: 1.3 ppm
Outcomes	Dental fluorosis (TF index; Photographic assessment) Age at assessment: 7 to 10 years
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	Cluster random sample of parents of eligible children aged 7 to 10 years from the same birth cohort
Confounding	High risk	Use of fluoride paste and frequency of brushing was similar across groups, however, current use of fluoride supplements as well as past use was significantly higher in the control group. This information is used to provide adjusted odds ratios however, for the purposes of this review only the raw data has been used which remains subject to confounding factors
Blinding of outcome assessment (detection bias)	Low risk	Assessors were blind to the source area of each slide
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	Unclear risk	Photographic assessment as well as TF index of dental fluorosis were measured but only photographic assessment reported
Other bias	Low risk	No other apparent bias

Mandinic 2009

Methods	FLUOROSIS STUDY Country of study: Serbia Geographic location: Valjevo and Vranjska Banja Year of study: Not stated Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: Not stated Exclusion criteria: Not stated Other sources of fluoride: To determine fluoride exposure, the fluoride concentration database and consumption database were used. Ethnicity: Not stated Social class: Not stated Residential history: To determine fluoride exposure, the fluoride concentration database and consumption database were used Other confounding factors: Dietary sources of fluoride – potato, beans
Interventions	All natural fluoridation Group 1: 0.1 ppm Group 2: 11 ppm
Outcomes	Dental fluorosis (Dean's index) Age at assessment: 12 years
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	There was insufficient detail reported to determine how selection took place - sampling frame was unspecified
Confounding	High risk	Fluoride exposure and consumption were measured but not reported SES was not accounted for
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	Low risk	Expected outcome reported
Other bias	Low risk	No other apparent bias

Marya 2010

Methods	**FLUOROSIS STUDY** Country of study: India Geographic location: 30 villages from district Gurgaon and district Hissar Year of study: Not stated Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: Only continuous residents; selected individuals had to have all their permanent teeth (except third molars) erupted Exclusion criteria: Not stated Other sources of fluoride: Not stated Ethnicity: Not stated Social class: Environmental factors like eating habits, nutritional status, consumption of water, living conditions were almost uniform in all seven groups studied. Residential history: Continuous residents Other confounding factors: Not stated
Interventions	All natural fluoridation Group 1: 0.5 ppm Group 2: 0.87 ppm Group 3: 1.51 ppm Group 4: 2.45 ppm Group 5: 5.27 ppm Group 6: 8.5 ppm
Outcomes	Dental fluorosis (Dean's index) Age at assessment: 12 to 16 years
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	There was insufficient detail reported to determine how selection took place
Confounding	Unclear risk	Environmental factors like eating habits, nutritional status, consumption of water, living conditions were almost uniform in all seven groups studied, however, it is unclear as to whether this extends to exposure to fluoride from other sources
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	Low risk	Expected outcome reported
Other bias	Low risk	No other apparent bias

Masztalerz 1990

Methods	**FLUOROSIS STUDY** Country of study: Poland Geographic location: Neisse (high-F), Breslau (F), Militsch and Gryfów (non-F) Year of study: Not stated Year of change in fluoridation status: Not stated Study design: Cross sectional
Participants	Inclusion criteria: None stated Exclusion criteria: Children who were not lifetime residents and had those who did not yet have permanent canine teeth. Other sources of fluoride: Not stated Social class: Not stated Ethnicity: Not stated Residential history: Lifelong residents Other confounding factors: Fluoride in the air - high in Greifenberg
Interventions	Appears to be natural fluoridation however this is not clear Group 1: 4 - 7 ppm Group 2: 0.7 - 0.9 ppm Group 3: <0.2 ppm
Outcomes	Dental fluorosis (index unclear) Age at time of measurement: 12 years
Funding	Not stated
Notes	Paper translated from German

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	The authors report that all eligible children were to be studies however, the sampling frame was not specified
Confounding	High risk	SES and the use of fluoride from other sources was not accounted for (except from air pollution though this is unclear)
Blinding of outcome assessment (detection bias)	High risk	Insufficient information. No details on blinding are reported, no standard index for measurement of fluorosis appears to have been used.
Incomplete outcome data (attrition bias)	Low risk	Data presented for 88% of participants
Selective reporting (reporting bias)	Low risk	Data appears present
Other bias	Low risk	No other bias detected

Maupome 2001

Methods	**CARIES STUDY** Country of study: Canada Geographic location: British Columbia Year study started: 1993/4 Year study ended: 1996/7 Year of change in fluoridation status: 1992 Study design: CBA
Participants	Inclusion criteria: Not stated Exclusion criteria: Not stated Other sources of fluoride: Data on oral hygiene and exposure to diverse fluoride technologies were collected but not reported. However, the authors stated that British Columbia had relatively homogeneous exposure to fluorides, widespread use of fluoride toothpastes and good adherence to oral hygiene regimens and good access to oral health care Social class: Participants showed similar SES at baseline Ethnicity: Not stated Residential history: Information on the regression analysis suggests that both lifetime and non-lifetime residents might have been included Other confounding factors: Not reported
Interventions	**Fluoride cessation** Group 1: 'optimal' level - ppm not stated (artificial fluoridation) to non-fluoridated Group 2: 'optimal' level - ppm not stated (artificial fluoridation)
Outcomes	DMFS Age at baseline: Grades 2, 3, 8 and 9 Age at final measurement: Grades 2, 3, 8 and 9
Funding	NHRDP operating grant 6610-2225-002 supported this study
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	Study is a multi-site study and is both a repeated cross-sectional prevalence survey and a longitudinal investigation. Children were examined in their schools but no other sampling details reported
Confounding	High risk	At baseline data for lifetime and non-lifetime residents were reported; Information on diet (snacks) and other fluoride sources were collected but the results were not adjusted for these factors
Blinding of outcome assessment (detection bias)	High risk	Use of different examiners for different study sites who where not blinded to fluoridation status
Incomplete outcome data (attrition bias)	High risk	About 90% of all eligible children were examined at baseline; 64.2% at follow-up with variation across groups
Selective reporting (reporting bias)	Low risk	Expected outcome was presented
Other bias	High risk	Baseline data was collected 14 to 19 months after cessation of fluoridation. This gap between the actual cessation of fluoridation and the beginning of data collection might be a source of bias since the exposure had been modified from fluoridated to non-fluoridated water

Mazzotti 1939

Methods	FLUOROSIS STUDY Country of study: Mexico Geographic location: All areas in Mexico, 11 states, 107 cities Year of study: 1938 Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: Not stated Exclusion criteria: Not stated Other sources of fluoride: Not stated Social class: Not Stated Ethnicity: Not stated Residential history: Not stated Other confounding factors: Not stated
Interventions	Groups: 0-4 unclear ppm
Outcomes	Dental fluorosis (index unclear) Age at assessment: Not stated
Funding	Not stated
Notes	Paper translated from Spanish

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	There was insufficient detail reported to determine how selection took place
Confounding	High risk	No details were reported on SES or fluoride from other sources
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Unclear risk	Insufficient information to determine whether there was attrition
Selective reporting (reporting bias)	Low risk	Expected outcome was reported
Other bias	Unclear risk	Overall poor reporting on any information to thoroughly assess any risk of bias

McGrady 2012

Methods	FLUOROSIS STUDY Country of study: Thailand Geographic location: Chiang Mai Year of study: 2007 Year study ended: Not stated Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: Life long residency; good general health with both maxillary incisors fully erupted and free from fixed orthodontic applicances Exclusion criteria: Non-lifetime residents; unsuitable dentition Other sources of fluoride: Non-fluorosed - i. Breast & formula: 88/305 (28.8%) ii. Formula only: 14/57 (24.6%) iii. F content paste: < 1000 ppm) – 13/59 (22%) 1000 ppmF: 150/501 (29.9%) iv. Toothbrushing freq:1/day – 45/130 (34.6%) 2 : 99/360 (27.5%) 3+: 19/70 (27.1%) v. Age toothbrush start: 4 years+ : 20/76 (26.3%) 3-4 years: 43/138 (31.2%) 2-3 years: 48/178 (27%) 1-2 years: 35/126 (27.8%) 0-1 year: 8/23 (34.8%) Ethnicity: Not stated Social class: Not stated Residential history: Continuous residents Other confounding factors: Not stated
Interventions	All natural fluoridation Group 1: <0.2 ppm Group 2: 0.2-0.59 ppm Group 3: 0.6 -0.89 ppm Group 4: =>0.9 ppm
Outcomes	Dental fluorosis (TF index) Age at assessment: 8 to 13 years
Funding	IAP is funded by a Clinician Scientist Award from the National Institute for Health Research (UK). The Colgate Palmolive Dental Health Unit is funded by an unrestricted grant from Colgate Palmolive. Possible conflicts of interest: RPE is an employee of a manufacturer of oral care products.
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	High risk	The study was based on a convenience sample population with varying exposures to fluoride.
Confounding	High risk	The data on fluoride from other sources was not presented in a usable format and outcome data was not adjusted for it. SES was not accounted for
Blinding of outcome assessment (detection bias)	Low risk	The examiners were blinded to the probable fluoride exposure and the images were presented for examination in a randomized order
Incomplete outcome data (attrition bias)	High risk	Data for 148 (21%) examined participants not analysed
Selective reporting (reporting bias)	Low risk	Outcome of interest reported
Other bias	Low risk	No other bias apparent

McInnes 1982

Methods	FLUOROSIS STUDY Country of study: South Africa Geographic location: Kenhardt (F), Keimoes (non-F), North western Cape Province Year of study: Not stated Year of change in fluoridation status: NA Study design: Cross sectional
Participants	Inclusion criteria: Lifetime residents of study area; Pre-school children aged 1-5 Exclusion criteria: None stated Other sources of fluoride: Majority of babies were breastfed - would not be exposed to fluoride from water used in preparation of infant formula. Social class: Reported as being the same across groups. Experimental and control groups were reported as being similar (parents were land or railway labourers) Ethnicity: All children same ethnic origin - European-African-Malay origin Residential history: Lifetime residents Other confounding factors: Same climatic conditions in both areas
Interventions	All natural fluoridation Group 1: 2.2 - 4.1 ppm Group 2: 0.2 ppm
Outcomes	Dental fluorosis (Dean's index) Age at time of measurement: 1 to 5 years
Funding	Part funded by South African Sugar Association
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	There was insufficient detail reported to determine how selection took place
Confounding	High risk	Malnutrition and SES was reported to be similar across groups but without supporting data. No details on other sources of fluoride were reported
Blinding of outcome assessment (detection bias)	High risk	Blinding was not undertaken
Incomplete outcome data (attrition bias)	Low risk	Data appear to be presented for all participants
Selective reporting (reporting bias)	Low risk	All expected data appears present
Other bias	Low risk	No other apparent bias

Mella 1992

Methods	FLUOROSIS STUDY Country of study: Chile Geographic location: Students attending 2 boarding institutions in Santiago, who lived in areas throughout Chile Year of study: Not stated Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: Students at boarding institution, exposure estimated from home fluoride level. Lived for first 6 years in home town Exclusion criteria: Children who could not remember the areas in which they spent the first 6 years of their life Other sources of fluoride: Not stated Social class: Distribution of subjects by high, moderate, low social class – no significant differences between fluoride groups Ethnicity: Not stated Residential history: First 6 years of life Other confounding factors: Years lived in city of birth
Interventions	All natural fluoridation Group 1: >0.3 ppm Group 2: <=0.3 ppm
Outcomes	Dental fluorosis (Dean's index) Age at assessment: 19 years
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	High risk	All subjects were selected from two boarding schools. Insufficient detail was reported to determine how sampling took place
Confounding	High risk	The use of fluoride from other sources was not accounted for
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	Unclear risk	Unclear why only very mild, mild and moderate severities of dental flurosis reported for both groups
Other bias	Low risk	No other apparent bias

Mella 1994

Methods	FLUOROSIS STUDY Country of study: Chile Geographic location: Iquique (F), Santiago (non-F), Valparaiso-Vina (F), Temuco (low-F) Year of study: 1983 Year of change in fluoridation status: Not stated Study design: Cross-sectional
Participants	Inclusion criteria: 4 schools in study areas Exclusion criteria: Not stated Other sources of fluoride: Not stated Social class: 2 schools in each area, one from low social class, one from medium/high social class, results presented separately by social class Ethnicity: Not stated Residential history: Not stated Other confounding factors: Not stated
Interventions	Group 1: 2.2 ppm (natural fluoridation) Group 2: 0.0 ppm (natural fluoridation) Group 3: 1.0 ppm (artificial fluoridation) Group 4: 0.3 ppm (natural fluoridation)
Outcomes	Dental fluorosis (Dean's index) Age at assessment: 7 and 12 years
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	There was insufficient detail reported to determine how selection took place. Four schools from a list of schools benefiting from school feeding programs were selected from each city, however it is not reported as to how these were chosen and how the children within the schools were chosen
Confounding	High risk	The use of fluoride from other sources was not accounted for
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	Low risk	Outcome of interest reported
Other bias	Low risk	No other apparent bias

Milsom 1990

Methods	FLUOROSIS STUDY Country of study: England Geographic location: Nantwich (F), Northwich (non-F) Year of study: 1988 Year of change in fluoridation status: 1975 Study design: Cross-sectional
Participants	Inclusion criteria: Children aged 8 years attending state maintained schools. Lifetime residents of study areas. Parental consent Exclusion criteria: Parishes not bounded on all sides by parishes with optimally fluoridated water for fluoride areas Other sources of fluoride: Age at which tooth brushing first began Social class: Measured by parental occupation - social class makeup of study areas almost identical (data presented in paper) Ethnicity: Not stated Residential history: Lifetime residents Other confounding factors: Not stated
Interventions	Group 1: 1 ppm (artificial fluoridation) Group 2: <0.3 ppm (natural fluoridation)
Outcomes	Enamel defect (DDE) Age at assessment: 8 years
Funding	Financial support from the North Western Regional Health Authority
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	The study included all eligible children who lived in the non-fluoridated area and those in the fluoridated area were selected by a two-stage random sampling technique
Confounding	Low risk	There was no difference in SES across groups and children with exposure to fluoride supplements were excluded
Blinding of outcome assessment (detection bias)	Low risk	Participants were taken to the exam centre by bus, examiner was unaware of the schools in attendance and fluoridation status
Incomplete outcome data (attrition bias)	Low risk	Data appear to be presented for all participants
Selective reporting (reporting bias)	Low risk	Outcome of interest appears present
Other bias	Unclear risk	Data was collected on age of commencement of tooth brushing but not reported.

Montero 2007

Methods	FLUOROSIS STUDY Country of study: Venezuela Geographic location: Maria May, Roscio and Madre Emilia Year of study: Not stated Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: Not stated Exclusion criteria: Not stated Other sources of fluroide: Not stated Ethnicity: Not stated Social class: Not stated Residential history: Not stated Other confounding factors: Not stated
Interventions	All natural fluoridation Group 1: 0.13 ppm Group 2: 0.31 ppm Group 3: 1.58 ppm
Outcomes	Dental fluorosis (Dean's index); Caries data also evaluated in study but excluded from review due to study design Age at assessment: 8 to 12 years
Funding	Not stated
Notes	Paper translated from Spanish

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	Random sampling was used
Confounding	High risk	SES and the use of fluoride from other sources was not accounted for
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data appear to be presented for all participants
Selective reporting (reporting bias)	Low risk	All expected outcome presented
Other bias	Low risk	No other apparent bias

Nanda 1974

Methods	FLUOROSIS STUDY Country of study: India Geographic location: 23 villages in Lucknow (North Central India) Year of study: Not stated Year of change in fluoridation status: NA Study design: Cross sectional
Participants	Inclusion criteria: Lifetime residents of study areas. Children from 103 urban & 66 rural schools. All permanent teeth (excluding third molars) present Exclusion criteria: None stated Other sources of fluoride: Dietary fluoride intake Social class: Not stated Ethnicity: Not stated Residential history: Lifelong residents Other confounding factors: Climate
Interventions	All natural fluoridation Group 1: >1.21 ppm Group 2: 0.81 - 1.2 ppm Group 3: 0.41 - 0.8 ppm Group 4: 0 - 0.4 ppm
Outcomes	Dental fluorosis (Dean's index) Age at time of measurement: 6 to 17 years
Funding	Supported by PL-480 grants from the Bureau of Health Manpower Education, Division of Dental Health Public Health Service under the aegis of the Indian Council of Medical Research, New Delhi
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	There was insufficient detail reported to determine how selection took place
Confounding	High risk	SES was not accounted for
Blinding of outcome assessment (detection bias)	High risk	Blinding was not undertaken
Incomplete outcome data (attrition bias)	Unclear risk	Unclear due to poor reporting of participant numbers and data
Selective reporting (reporting bias)	High risk	Poor reporting of outcome data
Other bias	High risk	No other bias detected

Narbutaite 2007

Methods	FLUOROSIS STUDY Country of study: Lithuania Geographic location: Klaipeda and Kaunas Year of study: 1997 Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: Not stated Exclusion criteria: Not stated Other sources of fluoride: Not stated Ethnicity: Not stated Social class: Both cities were said to be the two largest cities in Lithuania and are of a similar size and socio-economic structure. Residential history: Lifetime residents Other confounding factors: Not stated
Interventions	All natural fluoridation Group 1: 0.22 ppm Group 2: 1.7 - 2.2 ppm
Outcomes	Dental fluorosis (TF index); Caries data also evaluated within the study but excluded from review due to study design Age at assessment: 12 years
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	Among the ordinary secondary schools, 8 out of 23 in Klaipeda (the HF area) and 8 out of 30 in Kaunas (the LF area), were selected to cover the regions. However, it is not clear how these schools were selected
Confounding	High risk	No details were reported on the use of fluoride from other sources
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	Low risk	All expected outcome were reported
Other bias	High risk	All examinations were carried out by one examiner who was a specialist with additional training in dental fluorosis diagnosis but not mention of reliability testing; Water was taken from three sampling sites in the HF area and one in the LF area and no explanation was provided for the inconsistency

Narwaria 2013

Methods	FLUOROSIS STUDY Country of study: India Geographic location: Karera - Dumduma, Bangama, Hazinager, Sillarpur, Sirsod, Nichroli, Toda Karera, Toda Rampur, Kali Pahadi, Zuzai Year of study: Not stated Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: Primary school children; mostly 5-12 years Exclusion criteria: Not stated Other sources of fluoride: Not stated Ethnicity: Not stated Social class: Not stated. Residential history: Not stated Other confounding factors: Not stated
Interventions	All natural fluoridation Group 1: 1.65 ppm Group 2: 1.84 ppm Group 3: 1.84 ppm Group 4: 1.88 ppm Group 5: 1.91 ppm Group 6: 2.15 ppm Group 7: 2.22 ppm Group 8: 2.53 ppm Group 9: 3.91 ppm
Outcomes	Dental fluorosis (Dean's index) Age at assessment: 5 to 12 years
Funding	Funding for travelling and lab facilities provided by Special Assistance Program (SAP)-I UGC, New Delhi
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	Ten villages were selected for study using the eligibility criteria. Within the villages, all government schools were included and children were randomly selected from each class
Confounding	High risk	SES and the use of fluoride from other sources was not accounted for
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	Low risk	Outcome of interested reported
Other bias	High risk	Examination was performed by two trained dentists. No mention of calibration nor reliability testing

Nunn 1992

Methods	**FLUOROSIS STUDY** Country of study: England Geographic location: Hartlepool, Newcastle and Middlesborough Year of study: 1989 Year of change in fluoridation status: NA Study design: Cross-sectional study
Participants	Inclusion criteria: Lifetime residents of study areas. Children in selected schools aged 15-16 years Exclusion criteria: Children with fractured incisor teeth, orthodontic bracket or surface otherwise obscured Other sources of fluoride: Not stated Social class: Occupation of head of household recorded. Participants of low and high SES were recruited when possible Ethnicity: Ethnicity recorded but no expansion on variable Residential history: Lifetime residents Other confounding factors: Not stated
Interventions	Group 1: 1 - 1.3 ppm Group 2: 1 ppm Group 3: 0.2 ppm
Outcomes	Enamel defect Age at assessment: 12 years
Funding	Financial assistance from the British Council
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	There was insufficient detail reported to determine how selection took place
Confounding	High risk	The use of fluoride from other sources was not accounted for. Balance of SES between groups is unclear
Blinding of outcome assessment (detection bias)	Low risk	Photographs of the maxillary central incisors of participants were cut out from the print and identified with a code which would lprevent identification by the examiners
Incomplete outcome data (attrition bias)	High risk	In England data for 68% of examined participants were reported due to camera failure in a school of SE group
Selective reporting (reporting bias)	Low risk	Expected outcome appears present
Other bias	Low risk	No other apparent bias

Nunn 1994

Methods	**FLUOROSIS STUDY** Country of study: England Geographic location: North East England Year of study: 1990-1991 Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: Lifetime residents of study areas (England only). Children aged 12. Parental consent (England only) Exclusion criteria: None stated Other sources of fluoride: Not stated, but expected higher use of toothpaste in higher SE groups Social class: Children divided into high and low social class Ethnicity: Not stated Residential history: UK participants were lifetime residents. Sri Lankan participants were asked at the time of examination to confirm continuity of residence. Other confounding factors: Not stated
Interventions	Group 1: 0.1 ppm Group 2: 0.5 ppm Group 3: 1.0 ppm
Outcomes	Enamel defect (DDE) Age at assessment: 12 years
Funding	Not stated
Notes	Different methodology used in England and Sri Lankan study centres, therefore reported under different study ID's (England - Nunn 1994 and Sri Lankan - Nunn 1994a)

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	Schools were selected by the district dental officer in order to achieve a target of about 150 eligible 12 year old children in each sub-group. There is insufficient information as to how the children within the schools were selected
Confounding	High risk	There was a higher reported use of toothpaste in the higher SES groups
Blinding of outcome assessment (detection bias)	Low risk	The examiner was largely unaware of fluoride and socioeconomic status of the children
Incomplete outcome data (attrition bias)	Low risk	Participants sampled were less than 80% in the three study areas and not balanced across groups, however, data presented for all recruited participants
Selective reporting (reporting bias)	Low risk	Expected outcome was presented
Other bias	Low risk	No other apparent bias

Nunn 1994a

Methods	**FLUOROSIS STUDY** Country of study: Sri-Lanka Geographic location: Sri Lanka Year of study: 1990-1991 Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: Children aged 12. Exclusion criteria: None stated Other sources of fluoride: Not stated, but expected higher use of toothpaste in higher SE groups Social class: Children divided into high and low social class Ethnicity: Not stated Residential history: Sri Lankan populations were non-mobile and confirmed continuous residence when asked at the time of examination Other confounding factors: Not stated
Interventions	Group 1: 0.1 ppm Group 2: 0.5 ppm Group 3: 1.0 ppm
Outcomes	Enamel defect (DDE) Age at assessment: 12 years
Funding	Not stated
Notes	Different methodology used in England and Sri Lankan study centres, therefore reported under different study ID's (England - Nunn 1994 and Sri Lankan - Nunn 1994a)

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	Schools were selected by the district dental officer in order to achieve a target of about 150 eligible 12 year old children in each sub-group. There is insufficient information as to how the children within the schools were selected
Confounding	High risk	Imbalance of SES between groups. Two of the 3 study areas recruited only children of low SES and one area recruited both low and high SES children
Blinding of outcome assessment (detection bias)	High risk	The examiner was aware of the fluoride and socio-economic status of the children
Incomplete outcome data (attrition bias)	Low risk	Participants sampled were less than 80% in the three study areas and not balanced across groups, however, data presented for all recruited participants
Selective reporting (reporting bias)	Low risk	Expected outcome was presented
Other bias	Low risk	No other apparent bias

Ockerse 1941

Methods	FLUOROSIS STUDY Country of study: South Africa Geographic location: Upington, Kenhardt and Pofadder Year of study: 1939 Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: Children attending schools in study areas. Children aged 6-17 Exclusion criteria: None stated Other sources of fluoride: Not stated Social class: Not stated Ethnicity: Not stated Residential history: Participants were born and lived up to the age of 8 in the study areas Other confounding factors: Study areas at same altitude, same climate, similar countryside and vegetation, differences in drinking water composition discussed
Interventions	All natural fluoridation Group 1: 2.46 ppm (av) Group 2: 6.8 ppm Group 3: 0.38 ppm
Outcomes	Mottled enamel; Caries data also evaluated within the study but excluded from review due to study design Age at assessment: 6 to 17 years
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	High risk	Areas thought to be most affected by caries and mottling were selected and visited. Selection of 'at risk' population is likely to have introduced bias
Confounding	High risk	SES and the use of other fluoride sources were not accounted for
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	High risk	Caries data reporting may have been a post-hoc decision
Other bias	High risk	Data was collected on age of commencement of tooth brushing but not reported. There was no mention of examiner training nor calibration

Pontigo-Loyola 2008

Methods	**FLUOROSIS STUDY** Country of study: Mexico Geographic location: Urban - Tula Centro and San Marcos; Rural – El Llano Year of study: 1999 Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: Not stated Exclusion criteria: Having fixed orthodontic appliances; metal crowns; refusal to be examined; unavailable for oral exam. Other sources of fluoride: Not stated Ethnicity: Not stated Social class: Not stated. Residential history: Birth to ≥6 years Other confounding factors: Not stated
Interventions	All natural fluoridation Group 1: 1.38 ppm Group 2: 1.42 ppm Group 3: 3.07 ppm
Outcomes	Dental fluorosis (Modified Dean's index) Age at assessment: 12 and 15 years
Funding	Data collection by the Universidad Autonoma del Estado de Hidalgo and data analysis was partially supported by a grant from the National Council of Science and Technology of Mexico.
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	All eligible participants were included in the study
Confounding	High risk	SES and the use of fluoride from other sources was not accounted for
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Unclear risk	Only 66.6% of the included participants were in the final study population. The reason for withdrawal was not reported
Selective reporting (reporting bias)	Low risk	Outcome of interest reported
Other bias	Low risk	No other apparent bias

Pot 1974

Methods	**CARIES STUDY** Country of study: Holland Geographic location: Tiel (F), Culemborg (non-F) Year study started: 1950 Year study ended: 1970 Year of change in fluoridation status: 1953 Study design: CBA
Participants	Inclusion criteria: Residents of study areas born between 1896 and 1945. Lifelong residents of study areas. Exclusion criteria: Subjects who left the study areas for more than 3 months after fluoridation was introduced; Other sources of fluoride: Not stated Social class: Not stated Ethnicity: Not stated Residential history: Lifetime residents Other confounding factors: Age - results for final survey presented in 5 year age groups- shows that higher proportion of younger subjects have prosthetic teeth in Culemborg compared to Tiel.
Interventions	Group 1: 1.1 ppm (artificial fluoridation) Group 2: 0.1 ppm (natural fluoridation)
Outcomes	Outcome: % with false teeth Age at baseline measure: 5-55 Age at final measure: 25-75
Funding	Not stated
Notes	Paper translated from Dutch

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	Participants were selected by random sampling from the city population registers
Confounding	High risk	SES and the use of other fluoride sources not stated
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Unclear risk	Data presented for all participants
Selective reporting (reporting bias)	Low risk	Outcome of interest reported
Other bias	High risk	There was no mention of examiner calibration nor reliability testing

Ray 1982

Methods	FLUOROSIS STUDY Country of study: India Geographic location: Rustampur and Ledhupur, 2 adjacent village in Varanasi District Year of study: Not stated Year of change in fluoridation status: NA Study design: Cross sectional
Participants	Inclusion criteria: None stated Exclusion criteria: None stated Other sources of fluoride: Not stated Social class: Study areas similar in respect to demographic and socio-economic characteristics Ethnicity: Not stated Residential history: Not stated Other confounding factors: Villages similar in respect to geoclimatic characteristics
Interventions	All natural fluoridation Group 1: >2 Group 2: 1-2 Group 3: <1
Outcomes	Dental Fluorosis (index not stated) Age at assessment: Not stated
Funding	Funded by the Indian Council of Medical Research
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	All eligible participants were included in the study
Confounding	High risk	No details were reported on the use of fluoride from other sources
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Unclear risk	Number of participants recruited not stated
Selective reporting (reporting bias)	Low risk	Outcome of interest reported
Other bias	High risk	No mention of how examination was conducted or whether the examiner was calibrated

Riordan 1991

Methods	**FLUOROSIS STUDY** Country of study: Australia Geographic location: Perth (F) and Bunbury (non-F), Western Australia Year of study: 1989 Year of change in fluoridation status: 1968 Study design: Cross-sectional
Participants	Inclusion criteria: Children born in 1978. Children attending government schools in study areas. Parental consent Exclusion criteria: Subjects with amelogenesis imperfecta or orthodontic banding Other sources of fluoride: Questionnaire investigated periods and duration of use of fluoride supplements, use of fluoride toothpaste, included age at which use of toothpaste commenced, whether child swallowed toothpaste Social class: Schools assigned socio-economic score - no significant difference in scores between study areas Ethnicity: Not stated Residential history: Not stated Other confounding factors: Not stated
Interventions	Group 1: 0.8 ppm (artificial fluoridation) Group 2: <0.2 ppm (natural fluoridation)
Outcomes	Dental fluorosis (TF index) Age at assessment: 12 years
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	Random selection of 14 Dental Therapy Centres; selection of one class/centre of children born in 1978
Confounding	High risk	Insufficient information to determine whether use of other fluoride sources was balanced across groups
Blinding of outcome assessment (detection bias)	High risk	Blind outcome assessment (with regard to residency) was not undertaken
Incomplete outcome data (attrition bias)	Low risk	7/376 and 3/338 not available for evaluation; unlikely to influence results
Selective reporting (reporting bias)	Low risk	All relevant outcome data reported
Other bias	Low risk	No other apparent bias

Riordan 2002

Methods	FLUOROSIS STUDY Country of study: New Zealand Geographic location: Auckland Year of study: 2000 Year of change in fluoridation status: Not stated Study design: Cross-sectional
Participants	Inclusion criteria: Only children who returned signed consent form and questionnaire completed by parents. Exclusion criteria: Schools with <five 9-year old children were excluded because of resource, time and efficiency constraints Other sources of fluoride: Data presented on fluoride tablet supplementation, brushing with toothpaste frequency, amount of toothpaste used and toothpaste swallowed, however, the use of other sources of fluoride had no effect on the proportion of children with diffuse opacities Social class: High (decile 8–10) = 124 (40) fluoridated, 57 (19) non-fluoridated; Middle (decile 4–7) = 127 (41) fluoridated, 133 (44) non-fluoridated; Low (decile 1–3) = 59 (19) fluoridated, 112 (37) non-fluoridated; A schools decile indicates the extent to which it draws its students from low socioeconomic communities. Ethnicity: More children of European descent and fewer children of Asian descent attended schools within non-fluoridated areas compared with fluoridated areas Residential history: Lifetime residents and intermittent residents, however, data on lifetime residents alone presented in this review due to confounding Other confounding factors: Not stated
Interventions	Group 1: 0.1 - 0.3 ppm (natural fluoridation) Group 2: 0.7 - 1 ppm (artificial fluoridation)
Outcomes	Dental fluorosis (Dean's index); Caries data also evaluated within the study but excluded from review due to study design Age at assessment: 7 to 15 years
Funding	Funded by AUT University, Counties Manukau District Health Board and New Zealand Dental Research Foundation
Notes	Fluoride concentrations were not reported in the study but deduced from discussion section and anecdotal evidence.

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	The number of schools and students from each school were probabilistically sampled to reflect the overall decile and school size distribution representative of Auckland schools yet produce a sample that was balanced between fluoridated and non-fluoridated regions
Confounding	High risk	There were significantly fewer children in high decile schools in non-fluoridated areas and low decile schools in fluoridated areas
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	Low risk	Outcome of interest reported
Other bias	Low risk	No other apparent bias

Ruan 2005

Methods	FLUOROSIS STUDY Country of study: China Geographic location: Urban - Bao Ji and Jing Bian Year of study: 2002 Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: Not stated Exclusion criteria: Absent or unavailable; non-permanent residents. Other sources of fluoride: No fluoride supply was provided by dental service and no fluoride supplement program was implemented in any of the communities Ethnicity: Not stated Social class:The selected schools served rural communities where socio-economic standards were comparable Residential history: Permanent residents Other confounding factors: Not stated
Interventions	All natural fluoridation Group 1: 0.4ppm Group 2: 1.0 ppm Group 3: 1.8 ppm Group 4: 3.5 ppm Group 5: 5.6 ppm
Outcomes	Dental fluorosis (TF index); Caries data also evaluated within the study but excluded from review due to study design Age at assessment: 12 and 13 years
Funding	The study was supported by the Norwegian State Educational Loan Fund
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	Thirteen schools were contacted and all children were invited to participate. The sampling frame for schools was not specified
Confounding	High risk	Even though fluoride supplement and fluoride supply by dental service were taken into account, the use of fluoride toothpaste (a common source) was not mentioned. It is not clear why it was not acknowledged or investigated
Blinding of outcome assessment (detection bias)	Low risk	The fluoride concentration of the local drinking-water supplies was unknown to the examiner at the time of the clinical examinations, which took place with the students seated on ordinary chairs outside the school building
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	High risk	Partial reporting of outcome - only reported prevalence of fluorosis with TF score ≥3 (fluorosis of aesthetic concern)
Other bias	Low risk	No other apparent bias

Rugg-Gunn 1997

Methods	FLUOROSIS STUDY Country of study: Saudi Arabia Geographic location: Jeddah (low F), Riyadh (moderate F) and Quassim (high F) adjacent rural areas with similar water supplies to rural area selected Year of study: 1992 Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: Lifetime residents of study areas. Boys aged 14. Parental consent Exclusion criteria: Photographs which failed to show whole buccal surface. Out of focus photographs Other sources of fluoride: Not stated Social class: Schools grouped according to the socio-economic status of residential areas in the urban community. Family income and parental education measured using questionnaire Ethnicity: Not stated Residential history: Lifetime residents Other confounding factors: Nutritional status
Interventions	All natural fluoridation Group 1: 2.7 ppm Group 2: 0.8 ppm Group 3: <0.3 ppm
Outcomes	Dental fluorosis (index unclear) Age at assessment: 14 years
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	Quote: "All school were grouped according to SES of the residential area in the urban community only and schools sampled randomly"
Confounding	High risk	Shools were grouped according to the SES of residential areas however it is not clear whether the study areas were balanced in this regard. No detail was reported on the use of fluoride from other sources
Blinding of outcome assessment (detection bias)	Unclear risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data appears to be presented for all participants
Selective reporting (reporting bias)	Low risk	Fluorosis data fully reported
Other bias	High risk	No other apparent bias

Russell 1951

Methods	FLUOROSIS STUDY Country of study: USA Geographic location: Colorado Springs (F), Bolder (non-F), Colorado Year of study: 1950 Year of change in fluoridation status: NA Study design: Cross sectional
Participants	Inclusion criteria: White native residents listed in school census record for 1920, 1930 or 1940 and as resident in current city directory. Mothers living in study area at time of birth. Aged 20-44. Residence and usage of local water unbroken except for periods not exceeding 60 days during calcification and eruption of permanent teeth. Exclusion criteria: None stated Other sources of fluoride: Not stated Social class: Workers in two communities followed similar occupations and had similar average salaries Ethnicity: Native born white 98% of Boulder pop. And 96% of Colorado Springs population. This study only reports upon White participants (not clear if this is coincidence or purpose) Residential history: Lifetime residents Other confounding factors: Colorado Springs 3 times size of Bolder, similar altitude and climate, neither population ageing nor young., both are highly literate, water systems similar
Interventions	All natural fluoridation Group 1: 2.5 ppm Group 2: <0.1 ppm
Outcomes	Dental fluorosis (Dean's index); Caries data also evaluated within the study but excluded from review due to study design Age at time of measurement: 20 to 44 years
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	Samples came from official registries in the areas (school, electoral, marriage etc…). Authors estimate 5/6ths of eligible persons participated.
Confounding	Unclear risk	Considering the age of the study, other sources of fluoride are unlikely to affect the results. Although no measure of SES is provided, populations are reported as homogenous.
Blinding of outcome assessment (detection bias)	High risk	Blinding was not undertaken
Incomplete outcome data (attrition bias)	Low risk	Data for all participants appears present.
Selective reporting (reporting bias)	High risk	Only data on flurosis of aesthetic concern reported as opposed to all severities
Other bias	High risk	All examinations were made by the senior author, however, there was no mention of examiner calibration

Rwenyonyi 1998

Methods	FLUOROSIS STUDY Country of study: Uganda Geographic location: 4 areas of Uganda located at different altitudes Year of study: Not stated Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: Lifetime residents of study areas Exclusion criteria: None stated Other sources of fluoride: Not stated Social class: Not stated Ethnicity: Not stated Residential history: Lifetime residents Other confounding factors: Mother's interviewed about water intake and food habits of child during early childhood. Altitude
Interventions	All natural fluoridation Group 1: 2.5 ppm (low altitude) Group 2: 2.5 ppm (high altitude) Group 3: 0.5 ppm (low altitude) Control: 0.5 ppm (high altitude)
Outcomes	Dental fluorosis (index not stated) Age at assessment: 10 to 14 years
Funding	The Norwegian Universities' Committee for Development Research and Education and the Committee for Research and Postgraduate Training, University of Bergen
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	Children were selected from schools for study in a quasi-random way
Confounding	High risk	While SES and use of fluoride toothpaste are reported as being similar across groups, there appears to be a higher intake of tea (and therefore fluoride from water) among the participants in Kasese (0.5 ppm) than Kisoro (2.5 ppm)
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data appear to be presented for all participants
Selective reporting (reporting bias)	Unclear risk	Outcome of interest is reported mainly in graphic form and is unclear
Other bias	Low risk	Examinations were carried out by a single examiner. Intra-rater reliability was tested (kappa >0.8)

Rwenyonyi 1999

Methods	FLUOROSIS STUDY Country of study: Uganda Geographic location: Kasese (low F), Kisoro (high F) Year of study: 1996/ 1997 Year of change in fluoridation status: NA Study design: Cross sectional
Participants	Inclusion criteria: Children aged 10-14 (born between 1982 and 1987). Lifetime residents of study areas. Consumed drinking water from same source for first 6 years of life. Parental consent Exclusion criteria: Absence from the village for more than 1 month per year Other sources of fluoride: Fluoride exposure from liquid estimated by daily liquid intake - subjects from fluoride area had higher intake of water, consumed more boiled water and consumed less tea than subjects from control area, higher consumption of fluoride from Trona in control group Social class: Most families were small scale farmers and all appeared to be of similar social class Ethnicity: All children were ethnic Bantu Africans from the Bafumbria and Bakonjo tribes Residential history: Lifelong residents Other confounding factors: Vegetarianism (associated with fluorosis), altitude (results presented separately for different altitudes) - no association found between altitude and fluorosis
Interventions	All natural fluoridation Group 1: 2.5 (altitude= 2800 m) Group 2: 2.5 (altitude = 1750 m) Group 3: 0.5 (altitude = 2200 m) Group 4: 0.5 (altitude = 900 m)
Outcomes	Dental fluorosis (TF index) Age at time of measurement: mean age 12.2yrs (sd. 1.3)
Funding	Norwegian Universities Committee for Development Research and Education and the Committee for Research and Postgraduate Trianing, University of Bergen
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	Quasi-random stratified sample of all eligible children
Confounding	High risk	SES was broadly similar, however, multivariate analysis revealed that unaccounted for factors to be associated with fluorosis. These included: daily intake of water (amount), altitude, water storage, vegetarianism and infant formula use
Blinding of outcome assessment (detection bias)	Low risk	Examiners were blind to fluoride concentrations at the start of the study and tests were carried out on the water after the children's teeth were examined.
Incomplete outcome data (attrition bias)	Low risk	Data appear to be presented for all participants
Selective reporting (reporting bias)	Low risk	All data appears to have been reported
Other bias	Low risk	No other bias was detected.

Saravanan 2008

Methods	FLUOROSIS STUDY Country of study: India Geographic location: Tamil Nadu Year of study: Not stated Year of change of fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: The coverage of children was confined only to primary schools as each village had a primary school and 99% of the children of primary school age group in the study area were attending schools. Exclusion criteria: High school children were not included as only 85% of the children of high school age group (11-16 years) in the study area were attending schools Other sources of fluoride: Not stated Ethnicity: Not stated Social class: The majority of people in the study setting are from lower socio-economic class Residential history: Lifetime residents Other confounding factors: Not stated
Interventions	All natural fluoridation Group 1: <0.1 ppm Group 2: <0.1 ppm Group 3: 0.25 ppm Group 4: 0.56 ppm Group 5: 0.66 ppm Group 6: 0.67 ppm
Outcomes	Dental fluorosis (Dean's index) Age at assessment: 5 to 10 years
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	All eligible children were invited to participate
Confounding	High risk	No details were reported on the use of fluoride from other sources
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Around 1.1% of the school children were eventually excluded because of absenteeism. It is not clear what fluoride areas they belonged to, however, these participants are unlikely to be systematically different from those that completed the study.
Selective reporting (reporting bias)	Low risk	Outcome of interest reported
Other bias	Unclear risk	High school children were not included as only 85% of the children of high school age group (11-16 years) in the study area were attending schools; Examiners were calibrated and intra-and inter-examiner reliability assessed, however, Kappa scores not reported

Scheinin 1964

Methods	FLUOROSIS STUDY Country of study: Finland Geographic location: Artjarvi, Askola, Elimaki, Litti, Myrskyla, Parikkala, Taipalsaari, Valkeala, Vehkalahti Year of study: Not stated Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: Children aged 11 Exclusion criteria: Children resident in area for < 6 years. Fluoride concentration of drinking water unknown Other sources of fluoride: Not stated Social class: Not stated Ethnicity: Not stated Residential history: Residence for <6 years Other confounding factors: Not stated
Interventions	All natural fluoridation Group 1: 0 - 0.1 ppm Group 2: 0.11 - 0.39 ppm Group 3: 0.40 - 0.99 ppm Group 4: 1.0 - 1.59 ppm Group 5: 1.6 - ppm
Outcomes	Dental fluorosis (community fluorosis index); Caries data also evaluated within the study but excluded from review due to study design Age at assessment: 11 years
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	All eligible children were invited to participate
Confounding	High risk	SES and the use of fluoride from other sources were not accounted for
Blinding of outcome assessment (detection bias)	Low risk	Quote: "The dental examinations were carried out as a blind study, the examiners having no information of the preliminary fluoride determinations"
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	Low risk	Outcome of interest presented
Other bias	High risk	No mention of examiner calibration

Segreto 1984

Methods	FLUOROSIS STUDY Country of study: USA Geographic location: 16 Texas communities Year of study: 1978-1981 Year of change in fluoridation status: Unclear Study design: Cross-sectional
Participants	Inclusion criteria: Lifetime residents who may have resided at several different addresses in the same community. Absence from community for no more than 3 months during any calendar year. Grades 2 to 6, aged 7 to 12 and grades 9 to 12, aged 14 to 18, city water supply as principal source of drinking water throughout lifetime, non-usage of water treatment systems which result in defluoridation of water Exclusion criteria: Subjects with staining attributable to medication such as tetracycline. Other sources of fluoride: Not stated Social class: Not stated Ethnicity: Subjects were primarily those with Spanish surnames or white Residential history: Lifetime residents Other confounding factors: Not stated
Interventions	Unclear if natural or artificial fluoridation Group 1: 0.3 ppm Group 2: 0.3 ppm Group 3: 0.4 ppm Group 4: 1.0 ppm Group 5: 1.3 ppm Group 6: 1.3 ppm Group 7: 1.4 ppm Group 8: 2.3 ppm Group 9: 2.3 ppm Group 10: 2.5 ppm Group 11: 2.7 ppm Group 12: 2.7 ppm Group 13: 2.7 ppm Group 14: 2.9 ppm Group 15: 3.1 ppm Group 16: 4.3 ppm
Outcomes	Mottled enamel (Dean's index) Age at assessment: 7 to 12 years and 14 to 18 years
Funding	Not stated
Notes	Data extracted from Segreto 1984 differs from that presented in CRD review

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	Sixteen study sites which had a central well as main water supply and sufficient school population were selected
Confounding	High risk	SES and the use of fluoride from other sources were not accounted for
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	Low risk	Outcome of interest presented
Other bias	High risk	No mention of examiner calibration

Sellman 1957

Methods	FLUOROSIS STUDY Country of study: Sweden Geographic location: Malmo (low F), Simirshamn, Astorp and Nyvang (High F) Year of study: 1953 Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: Children aged 11-14 Exclusion criteria: Children missed due to illness. Children under 11 1/2 and over 14 1/2 Other sources of fluoride: All children received yearly systematic treatment by the School Dental Service Social class: Socio-economic distribution of Lifetime residents was similar in all study areas, however distribution was different for non-continuous residents as compared to continuous residents Ethnicity: Not stated Residential history: Only results of lifetime residents were presented Other confounding factors: Not stated
Interventions	All natural fluoridation Group 1: 1.0 ppm Group 2: 1.0-1.3 ppm Group 3: 1.3 ppm Control: 0.3-0.5 ppm
Outcomes	Outcome: Dental fluorosis (Dean's index) Age at baseline measure: 12-14 Age at final measure:
Funding	Not stated
Notes	Data extracted from Sellman 1957 differs from that presented in CRD review

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	There was insufficient detail reported to determine how selection took place
Confounding	High risk	All children received yearly systematic treatment by the School Dental Service, however, it is not clear whether the use of other fluoride sources was balanced across groups
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data appear to be presented for all participants
Selective reporting (reporting bias)	Low risk	All expected outcome reported
Other bias	High risk	No mention of examiner calibration and reliability testing

Selwitz 1995

Methods	FLUOROSIS STUDY Country of study: USA Geographic location: Kewanee (optimal), Monmouth (2x optimal), Abingdon, Elmwood (3x optimal), Bushneell, Ipava, Table Grove (4x optimal), Illinois Year of study: 1980 Year study ended: 1990 Year of change in fluoridation status: Unclear Study design: Repeated cross-sectional
Participants	Inclusion criteria: Children aged 8-10 & 14-16 years Written parental consent Lifetime residents of study areas. Continuous use of community water supply Exclusion criteria: None stated Other sources of fluoride: Not stated Social class: Not stated Ethnicity: Not stated Residential history: Lifetime residents Other confounding factors: Not stated
Interventions	Unclear if all is natural fluoridation, parts of the optimally fluoridated area may have been artificially adjusted Group 1: 4 ppm Group 2: 3 ppm Group 3: 2 ppm Group 4: 1 ppm
Outcomes	Dental fluorosis (% fluorosed surfaces (TSIF); Caries data also evaluated within the study but excluded from review due to study design Age at assessment: 8 to 10 years and 13 to 15 years
Funding	Not stated
Notes	Data extracted from Selwitz 1995 differs from that presented in CRD review

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	There was insufficient detail reported to determine how selection took place. Reference is made to a previous study (Leverett 1986) for further information on sampling, however this study also reported insufficient information on sampling
Confounding	High risk	SES and the use of fluoride from other sources were not accounted for
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Unclear risk	Data presented for all participants
Selective reporting (reporting bias)	Low risk	Outcome of interest presented
Other bias	Low risk	No other apparent bias

Selwitz 1998

Methods	FLUOROSIS STUDY Country of study: USA Geographic location: Kewanee (F), Holdrege and Broken Bow (non-F) Year of study: 1990-1998 Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: Lifetime residents of study areas. Parental consent Exclusion criteria: None stated Other sources of fluoride: Type of toothpaste currently used and used before age 6, use of dietary fluoride supplements, receipt of professionally applied fluoride treatments. Social class: Not stated Ethnicity: Not stated Residential history: Lifetime residents Other confounding factors: Private well water use
Interventions	All natural fluoridation Group 1: 1 ppm Group 2: <0.3 ppm
Outcomes	Denatl fluorosis (TSIF); Caries data also evaluated within the study but excluded from review due to study design Age at assessment: 8 to 10 years and 13 to 16 years
Funding	Not stated
Notes	Data extracted from Selwitz 1998 differs from that presented in CRD review

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	There was insufficient detail reported to determine how selection took place
Confounding	High risk	SES was not accounted for and there was a difference between groups in the use of fluoride supplements
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	Low risk	Outcome of interest presented
Other bias	Low risk	No other apparent bias

Shekar 2012

Methods	FLUOROSIS STUDY Country of study: India Geographic location: Nalgonda district Year of study: 2008 Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: Continuous residency; Availability on the day of examination. Exclusion criteria: Not stated Other sources of fluoride: Information on oral hygiene practices, dietary habits, source of drinking water, and amount of liquid consumed in a day, use of fluoridated tooth paste was collected but not reported Ethnicity: Not stated Social class: The majority of people in the study setting are from lower socio-economic class Residential history: Lifetime residents Other confounding factors: Not stated
Interventions	All natural fluoridation Group 1: <0.7 ppm Group 2: 0.7 - 1.2 ppm Group 3: 1.2 - 2 ppm Group 4: 2.1 - 4 ppm Group 5: >4 ppm
Outcomes	Dental fluorosis (Dean's index) Age at assessment: 12 and 15 years
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	Schools were selected for study using simple random sampling. All children within those schools were invited to participate
Confounding	High risk	SES was broadly similar across groups as was the use of fluoride toothpaste, however, no detail was reported regarding use of fluoride supplements
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	Low risk	Outcome of interest reported
Other bias	Low risk	No other apparent bias

Skotowski 1995

Methods	FLUOROSIS STUDY Country of study: USA Geographic location: Iowa Year of study: 1991 Year of change in fluoridation status: NA Study design: Case-control study
Participants	Inclusion criteria: Children aged 8-17. Patients attending Iowa College of Dentistry's Paediatric clinic. All permanent incisors and first molars present and erupted. Parent who could provide consent and details of fluoride exposure accompanied child. Exclusion criteria: Children with fixed orthodontic appliances. All permanent incisors and first molars present and erupted. Other sources of fluoride: Dietary fluoride supplement use, age began brushing with toothpaste, toothpaste usage in 8 years, mouthrinse usage, professional fluoride treatments Social class: Not stated Ethnicity: Not stated Residential history: Not stated Other confounding factors: Not stated
Interventions	All natural fluoridation Group 1: 3.1 ppm Group 2: 5.6 ppm
Outcomes	Dental fluorosis (TSIF) Age at assessment: 8 to 17 years
Funding	Not stated
Notes	Unclear as to whether fluoridation was natural or artificial. Children may have been from a variety of locations including naturally and artificially fluoridated areas. The reported fluoride levels are mean averages

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	High risk	The study population was a convenience sample of children receiving treatment at the clinic
Confounding	High risk	SES was not accounted for. When analysed for effect of duration of residence and use of other fluoride sources, the results were found to have been influenced by duration of exposure and toothpaste usage in 8 years, however the results were not adjusted for these factors
Blinding of outcome assessment (detection bias)	Low risk	Quote: “The examiner had no previous knowledge of subjects’ dental fluorosis status or fluoride exposures”
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	High risk	Fluorosis prevalence was not reported according to fluoridation status or fluoride concentration
Other bias	High risk	The examiner was not calibrated. Quote: "*Because of the burden that replicated examination would cause for the children and their parents, formal reliability assessments were not conducted*"

Spadaro 1955

Methods	FLUOROSIS STUDY Country of study: Italy Geographic location: Barcelona, Pozzo di Gotto, Sicily Year of study: 1954 Year of change in fluoridation status: Unclear Study design: Cross-sectional
Participants	Inclusion criteria: Children attending schools in study areas Exclusion criteria: None stated Other sources of fluoride: Not stated Social class: Not stated Ethnicity: Not stated Residential history: Not stated Other confounding factors: Not stated
Interventions	Unclear if natural or artificial fluoridation Group 1: 0.4 ppm Group 2: 1.9 ppm
Outcomes	Dental fluorosis (index not stated); caries data also evaluated within the study but excluded from review due to study design Age at assessment: 6 to 11 years
Funding	Not stated
Notes	Data from original CRD review (data unverified)

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	Unable to make a judgement as study was unavailable
Confounding	High risk	It does not appear that SES and use of fluoride from other sources were accounted for
Blinding of outcome assessment (detection bias)	Unclear risk	Unable to make a judgement as study was unavailable
Incomplete outcome data (attrition bias)	Unclear risk	Unable to make a judgement as study was unavailable
Selective reporting (reporting bias)	Unclear risk	Unable to make a judgement as study was unavailable
Other bias	Unclear risk	Unable to make a judgement as study was unavailable

Stephen 2002

Methods	FLUOROSIS STUDY Country of study: Scotland Geographic location: Burghead, Kinloss and Findhorn Year of study: Not stated Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: Not stated Exclusion criteria: Not stated Other sources of fluoride: Information on the use of fluoridated tooth paste was collected but not reported. Ethnicity: Not stated Social class: . The socioeconomic analyses showed that 17% of F subjects were in the 'high' SES. groups I or II, 75% in 'non-manual' group III, and 8% in 'manual' groups IV or V. For N-F children, the corresponding percentages were 23%, 60% and 17%, thus revealing a higher percentage of N-F subjects at either end of the SES scale. Residential history: The participants were either lifetime or school-lifetime (i.e. permanently present therein since commencing full-time schooling at age 4.5/5 years) residents. Other confounding factors: Information on oral hygiene practices, dietary habits, source of drinking water, and amount of liquid consumed in a day
Interventions	All natural fluoridation Group 1: 1 - 2.4 ppm Group 2: 0.03 ppm
Outcomes	Dental fluorosis (TF index); Caries data also evaluated within the study but excluded from review due to study design Age at assessment: 5 to 6 years (caries only) and 8 to 12 years (caries and fluorosis)
Funding	Supported by a Scottish Office Department of Health grant
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	There was insufficient detail reported to determine how selection took place, however it was reported that about one-fifth (21.9%) of the eligible participants were not examined because of non-consent (9.4%) and unavailability for examination (12.6%)
Confounding	Unclear risk	Matched by SES, details on the use of fluoride sources show that fluorosis prevalence was not influenced by the use of other fluoride sources. Similar use of fluoride supplements across groups. The age at which brushing with fluoridated paste began did not appear to affect the prevalence of fluorosis, however information on brushing history was only available for the parents who were able to recall
Blinding of outcome assessment (detection bias)	Low risk	Participants were examined without knowledge of their fluoridation status. Slides were viewed blind and scored randomly under standardised projection conditions by the assessors with a 10% random reviewing for inter and intra-observer agreement calculations
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	Low risk	Only lifetime residents between 8 and 12 years were assessed for fluorosis and data for all of them presented.
Other bias	Unclear risk	The study involves children between the age of 5-6, 8-12 years but the investigators only conducted fluorosis assessments on 8-12 year olds so data has been extracted for only children for which fluorosis assessment was conducted

Sudhir 2009

Methods	FLUOROSIS STUDY Country of study: India Geographic location: Andhra Pradesh Year of study: 2006-2007 Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: School children aged 13-15; lifelong residence of the region; use of the same source of drinking water from birth to 10 years of age; having permanent teeth with at least >50% of the crown erupted and no fillings on facial surface. Exclusion criteria: Migration from some other place; change of source of drinking water; drinking water from more than one source; having orthodontic brackets; having teeth with severe extrinsic stains. Other sources of fluoride: Information was collected on aids used for oral hygiene maintenance (fluoridated or nonfluoridated). No data on aids used for oral hygiene maintenance were reported. Ethnicity: Not stated Social class: Not stated Residential history: Lifetime residents Other confounding factors: The questionnaire consisted of information in 2 parts: The first part consisted of information on demographic data, permanent residential address, source of drinking water, duration of use of present source of drinking water, staple food, liquids routinely consumed.
Interventions	All natural fluoridation Group 1: <0.7 ppm Group 2: 0.7 - 1.2 ppm Group 3: 1.3 - 4 ppm Group 4: >4 ppm
Outcomes	Outcome: Fluorosis prevalence (TF index); Age at assessment: 13 to 15
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	A stratified random sampling technique was used. The entire geographical area of Nalgonda district was divided into 4 strata based on different levels of naturally occurring fluoride in drinking water supply. So in each stratum, or for each level, several villages were involved. Sample size was divided equally among all the 4 strata, and representation from both the sex was included in the sampling
Confounding	High risk	Data was collected on aids used for oral hygiene maintenance (fluoridated or nonfluoridated) but not reported
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Unclear risk	Data presented for all participants
Selective reporting (reporting bias)	Low risk	Ouctome of interest reported
Other bias	Low risk	No other apparent bias

Szpunar 1988

Methods	FLUOROSIS STUDY Country of study: USA Geographic location: Hudson, Redford, Richmond (F,)Cadillac (non-F) - Michigan Year of study: Not stated Year of change in fluoridation status: Not stated Study design: Cross-sectional
Participants	Inclusion criteria: Lifetime residents of study areas Children aged 6-12 Exclusion criteria: None stated Other sources of fluoride: Use of F supplements, dental attendance, time interval since last dental visit, age began brushing (parent & child), age at start of F rinsing, feeding method in 1st year of life. Social class: Not stated Ethnicity: Not stated Residential history: Lifetime residents Other confounding factors: Not stated
Interventions	Group 1: 1.2 ppm (artificial fluoridation) Group 2: 1.0 ppm (artificial fluoridation) Group 3: 0.8 ppm (artificial fluoridation) Group 4: 0.0 ppm (natural fluoridation)
Outcomes	Dental fluorosis (TSIF); caries data also evaluated in the study but not included inthe review due to study design Age at assessment: 6 to 12 years
Funding	NIH National Research Service Award
Notes	Data extracted from Szpunar 1988 differs from that presented in CRD review

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	Classroom teachers distributed and collected permission slips
Confounding	High risk	It does not appear that SES and the use of fluoride from other sources was accounted for
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Unclear risk	Data collected for 1103 participants but only lifetime resident data (n= 556) presented.
Selective reporting (reporting bias)	Low risk	Relevant fluorosis outcome data
Other bias	Low risk	No other apparent risk of bias.

Tabari 2000

Methods	FLUOROSIS STUDY Country of study: UK Geographic location: Northumberland and Newcastle upon Tyne Year of study: 1998 Year of change in fluoridation status: 1969 Study design: Cross-sectional
Participants	Inclusion criteria: Parental consent, lifetime residency. Exclusion criteria: Not stated Ethnicity: Not stated Other sources of fluoride: Data on the use of fluoride drops and tablets collected but not presented. Data on toothbrushing habit/frequency presented in detail and appeared to be similar in fluoridated and non-fluoridated areas Social class: The subjects from Newcastle tended to reside in more underprivileged areas than those in Northumberland. The mean Jarman UPA8 score was 16.3 (SD = 19.1) for subjects in Newcastle and 7.3 (SD=15.0) for Northumberland (p<0.001). However, the authors were reported to have chosen schools to provide children from a spectrum of SES backgrounds. Residential history: Lifetime residents Other confounding factors: Not stated
Interventions	Group 1: 1 ppm (artificial fluoridation) Group 2: 0.1 ppm (natural fluoridation)
Outcomes	Dental fluorosis (TF index); Age at assessment: 8 to 9 years
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	In Newcastle and Northumberland, 14 and 15 schools respectively were chosen. However, there is insufficient information on how the selection was done
Confounding	High risk	There was a significant difference in measure of deprivation between the two study areas
Blinding of outcome assessment (detection bias)	Low risk	Assessment was by the use of photographs in order to allow examination of teeth of children without the examiner being aware of which are the child was from
Incomplete outcome data (attrition bias)	Unclear risk	In the two groups, 78% and 79% of the eligible children had complete data. It is not clear whether those whose photographs were unacceptable (examined but not analysed) are systematically different from those who remained in the study.
Selective reporting (reporting bias)	Low risk	Outcome of interested reported
Other bias	Low risk	No other apparent bias

Tessier 1987

Methods	**CARIES STUDY** Country of study: Canada (province of Québec) Geographic location: Windsor (F) and Richmond (non-F) Year study started: 1977 Year study ended: 1986 Year of change in fluoridation status: 1978 Study design: CBA
Participants	Inclusion criteria: All 6 and 7 year-old schoolchildren, Exclusion criteria: Children living too far from the fluoridated water supply, or drinking fluoridated water 3 years or less Other sources of fluoride: Mouthwash and toothpaste; participants underwent similar fluoride rinse programmes Social class: Comparable study areas with similar socioeconomic status and lifestyles Ethnicity: Not stated Residential history: Not stated Other confounding factors: Similar access to dental care, oral hygiene and dental plaque
Interventions	Group 1: 'optimal' level - ppm not stated (artificial fluoridation) Control: 'low' level - ppm not stated (natural fluoridation)
Outcomes	DMFT, % caries prevalence Age at baseline measure: 6 and 7 years Age at final measure: 6 and 7 years
Funding	Not stated
Notes	Translated from French

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	All children aged 6 and 7 years in both study areas were selected
Confounding	High risk	Participants might have had varied exposures to fluoridated water
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	High risk	Standard deviation not reported
Other bias	High risk	No mention of examiner calibration and reliability testing

Tsutsui 2000

Methods	FLUOROSIS STUDY Country of study: Japan Geographic location: Not stated Year of study: 1987 Year of change in fluoridation status: Naturally occurring fluoride Study design: Cross-sectional
Participants	Inclusion criteria: Use of municipal water supply and lifelong residency of study area; difference of ≤0.2 ppm where home and school were located in different water supply areas; Exclusion criteria: Failure to meet any of the inclusion criteria; other reasons for exclusion were incomplete questionnaire and periodic application of topical fluoride Other sources of fluoride: Children that had received periodic applications of topical fluoride were excluded. No children had used fluoride mouthrinses. Use of fluoride-containing toothpaste was not determined as the market share was only 12% and thus not commonly used by children at the time Ethnicity: Not stated Social class: Not stated Residential history: Lifetime residents Other confounding factors: Not stated
Interventions	All natural fluoridation Group 1: 0 - 0.2 ppm Group 2: 0.2 - 0.4 ppm Group 3: 0.4 - 0.6 ppm Group 4: 0.6 - 0.8 ppm Group 5: 0.8 - 1 ppm Group 6: 1 - 1.4 ppm
Outcomes	Dental fluorosis (Dean's index); Caries data also evaluated within the study but excluded from review due to study design Age at assessment: 10 to 12 years
Funding	Niigata University
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	All eligible children were invited to participate
Confounding	High risk	SES was not accounted for
Blinding of outcome assessment (detection bias)	Low risk	The examiners had no knowledge of the concentration of fluoride in the drinking water where they carried out the examinations
Incomplete outcome data (attrition bias)	High risk	Out of 1967 children that were examined, data for 907 (46.1%) not presented.
Selective reporting (reporting bias)	Low risk	Outcome of interest reported
Other bias	Low risk	No other apparent bias

Venkateswarlu 1952

Methods	FLUOROSIS STUDY Country of study: India and Switzerland Geographic location: Villages in the Visakhapatnam area (India), 3 villages in Switzerland Year of study: Not stated Year of change in fluoridation study: NA Study design: Cross-sectional
Participants	Inclusion criteria: Children aged 3-14. Areas with <= 2ppm F in water supplies Exclusion criteria: None stated Other sources of fluoride: Not stated Social class: Not stated Ethnicity: Not stated Residential history: Other confounding factors: Not stated
Interventions	All natural fluoridation Group 1: 0.3 ppm Group 2: 0.5 ppm Group 3: 0.5 ppm Group 4: 0.9 ppm Group 5: 0.9 ppm Group 6: 0.9 ppm Group 7: 0.9 ppm Group 8: 1 ppm Group 9: 1.3 ppm Group 10: 1.4 ppm Group 11: 0.5 - 0.8 ppm Group 12: 0.4-1.6 ppm
Outcomes	Dental fluorosis (Dean's index); Caries data also evaluated within the study but excluded from review due to study design Age at assessment: 3 to 14 years
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	Children aged 3 to 14 years belonging to the study areas were examined, as far as possible, at least 100 children per village. It is not clear how exactly these children were selected
Confounding	High risk	SES and the use of fluoride from other sources were not accounted for
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	High risk	Twelve Indian villages were involved in the study; data from one village (Malkapuram) with 102 participants not presented
Selective reporting (reporting bias)	Low risk	Outcomes of interest were fully reported
Other bias	High risk	Calibration of examiners not mentioned

Vignarajah 1993

Methods	FLUOROSIS STUDY Country of study: Antigua Geographic location: Urban and rural areas in Antigua Year of study: Not stated Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: Children aged 12-14. Lifetime residents of study areas Exclusion criteria: Restored or fractured tooth surfaces Other sources of fluoride: Toothpaste swallowing when younger, consumption of mixed sources of water, fluoride mouth rinses Social class: Not stated Ethnicity: Not stated Residential history: Lifetime residents Other confounding factors: Not stated
Interventions	All natural fluoridation Group 1: 0.6 - 1 ppm Group 2: 0.1 - 0.3 ppm
Outcomes	Dental fluorosis (TSIF) Age at assessment: 12 to 14 years
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	A stratified random technique using random number tables was used to select schools and children. Quote: “All the schools were first listed and then divided into two groups, urban and rural…”
Confounding	High risk	SES was not accounted for
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Unclear risk	Number of participants recruited not stated
Selective reporting (reporting bias)	Low risk	Outcome of interest presented
Other bias	Low risk	No other apparent bias

Villa 1998

Methods	FLUOROSIS STUDY Country of study: Chile Geographic location: Rancagua (non-F), Santiago (low-F), La Serena (medium F), San Felipe & Iquique (High F) Year of study: 1996 Year of change in fluoridation status: fluoride is naturally occuring Study design: Cross-sectional study
Participants	Inclusion criteria: Lifetime residents of study areas. Children aged 7,12 and 15 in selected schools in study areas Exclusion criteria: None stated Other sources of fluoride: Not stated Social class: Children selected from schools graded according to socio-economic status to give similar socio-economic distribution in each study area Ethnicity: Not stated Residential history: Lifetime residents Other confounding factors: Temperature
Interventions	All natural fluoridation Group 1: 0.07 ppm Group 2: 0.21 ppm Group 3: 0.55 ppm Group 4: 0.93 ppm Group 5: 1.10 ppm
Outcomes	Dental fluorosis (Deans index); Caries data also evaluated within the study but excluded from review due to study design Age at assessment: 15 years
Funding	Study was supported by the Chilean Council for Scientific and Technological Research (FONDECYT) through grant No. 1960993
Notes	Data extracted Villa 1998 differs from that presented in CRD review

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	Selection of schools for each community was made at random from the complete list of private schools and publicly supported elementary schools. All eligible children were invited to participate
Confounding	High risk	The use of fluoride from other sources was not accounted for
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	Low risk	Outcome of interest reported
Other bias	High risk	There may have been misclassification bias as fluorosis prevalence was reported without taking 'questionable' fluorosis prevalence into account

Vuhahula 2009

Methods	FLUOROSIS STUDY Country of study: Tanzania Geographic location: Arusha, Shinyanga, Manyara, Dodoma, Singida and Tabora Year of study: Not stated Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: Aged 12-18; lifelong residence Exclusion criteria: In order to avoid over-scoring, teeth that were tempered with by grinding or other forms of mutilations were excluded. Other sources of fluoride: Not stated Ethnicity: Not stated Social class: Not stated Residential history: Mostly lifelong residents Other confounding factors: Information on 'magadi' consumption was collected. However, participants seemed to be accessing 'magadi' from different sources making the correlation of fluoride in 'magadi' versus dental fluorosis complicated
Interventions	All natural fluoridation Group 1: 2.2 ppm Group 2: 2.4 ppm Group 3: 2.5 ppm Group 4: 4.2 ppm Group 5: 4.7 ppm Group 6: 5.6 ppm
Outcomes	Dental fluorosis (Dean's index) Age at assessment: 12 to 18 years
Funding	Funded by the Japanese International Cooperation Agency (JICA) of Tanzania
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	Regions were randomly chosen and then schools within them. Children were quota sampled from these schools
Confounding	High risk	SES and the use of fluoride from other sources were not accounted for
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	Low risk	Outcome of interest reported
Other bias	Low risk	No other apparent bias

Wang 1993

Methods	FLUOROSIS STUDY Country of study: China Geographic location: Hotan, Kaxgar and Aksu, in south Xinjiang Year of study: 1991 Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: Children aged from 8 to 15 living around the water source Exclusion criteria: Not stated Other sources of fluoride: Not stated Social class: Farmers and herdsmen in south Xinjiang Ethnicity: Minority, mainly Uygur ethnic group Residential history: Living in study area for a long time ("since many years ago") Other confounding factors: The combined effects of iodin deficiency and high fluorine, the habit of tea drinking
Interventions	All natural fluoridation Group 1: 1.58 ppm Group 2: 1.85-2.00 ppm Group 3: 0.48 ppm Group 4: 2.55 ppm Group 5: 0.43 ppm Group 6: 0.46 ppm Group 7: 0.43 ppm
Outcomes	Dental fluorosis (index not stated) Age at assessment: 15 years
Funding	Not stated in translation
Notes	Paper translated from Chinese

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	Children aged 8 to 15 living in the vicinity of the water sources were included. Insufficient sampling information
Confounding	High risk	The use of fluoride from other sources were not accounted for, residential history not clearly stated
Blinding of outcome assessment (detection bias)	High risk	Not reported
Incomplete outcome data (attrition bias)	Low risk	Data for all participants reported
Selective reporting (reporting bias)	Low risk	Outcome of interest presented
Other bias	Unclear risk	Unable to identify information pertaining to the training/reliability of outcome assessors

Wang 1999

Methods	FLUOROSIS STUDY Country of study: China Geographic location: Xindiliang Village (high F), Shiligetu Village (lower F) Year of study: 1999 Year of change in fluoridation status: NA Study design: Cross sectional study
Participants	Inclusion criteria: Not stated Exclusion criteria: Not stated Other sources of fluoride: Not stated Social class: Not stated Ethnicity: Not stated Residential history: Not stated Other confounding factors: Not stated
Interventions	All natural fluoridation Group 1: 1.3 ppm Group 2: 2-4 ppm
Outcomes	Dental fluorosis and skeletal fluorosis (3 grade classification for both) Age at assessment: all ages
Funding	Japan International Cooperation Agency
Notes	Removal of fluoride from the water in these areas was attempted in the 1980's but failed to be applied continuously

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	Households in the villages of study were arbitrarily chosen so that 25% were included in the study
Confounding	High risk	The use of fluoride from other sources was not accounted for
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	Low risk	Outcome of interest presented
Other bias	High risk	There was no mention of examiner calibration

Wang 2012

Methods	FLUOROSIS STUDY Country of study: China Geographic location: Not stated Year of study: 2008-2009 Year of change in fluoridation status: NA Study design: Cross sectional
Participants	Inclusion criteria: Not stated Exclusion criteria: Not stated Other sources of fluoride: Not stated Social class: Not stated Ethnicity: Not stated Residential history: : In the mild, moderate and severe endemic areas, the authors made reference to native-born residents but it is not clear what proportion of them constituted the entire population Other confounding factors: Not stated
Interventions	All natural fluoridation Group 1: 1.3 ppm Group 2: 2-4 ppm
Outcomes	Dental Fluorosis (Dean's index) and skeletal fluorosis Age at assessment: 8 to 12 years for dental fluorosis and > 16 years for skeletal fluorosis
Funding	Supported by the Chinese government for Endemic Disease Control in 2008-2009 years
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	Villages were selected at random and in the selected villages, all eligible children were invited to participate
Confounding	High risk	SES and the use of fluoride from other sources were not accounted for
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	Unclear risk	Outcome of interest reported
Other bias	High risk	No mention of examiner calibration

Warnakulasuriya 1992

Methods	FLUOROSIS STUDY Country of study: Sri Lanka Geographic location: Four geographic areas at same altitude & temp from 4 districts in Sri Lanka (Galewala, Wariyapola, Kekirawa & Rambukkana) Year of study: 1986 Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: Lifetime residents of study areas Children aged 14 Exclusion criteria: Children who lived more than 15 miles from school Children absent on day of examination Other sources of fluoride: Fluoride containing toothpaste or other fluoride therapies had not been used by or on these children during time of development of primary dentition. Tea consumption high. Social class: Wide ranges of socio-economic differences not expected Ethnicity: Not stated Residential history: Lifetime residents Other confounding factors: Not stated
Interventions	All natural fluoridation Group 1: <0.39 ppm Group 2: 0.4 - 0.59 ppm Group 3: 0.6 - 0.79 ppm Group 4: 0.8 - 0.99 ppm Group 5: >1.0 ppm
Outcomes	Fluorosis (Dean's index); caries data evaluated in study but not included in review due to study design Age at assessment: 14 years
Funding	National Water Supply, Sri Lanka
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	All eligible children in each school were invited to participate
Confounding	Unclear risk	It was considered by the study authors that fluoride supplements or paste were not widely used among the population of study. It was also considered that SES was broadly similar across groups, however no supporting information is provided
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data presented for all participants
Selective reporting (reporting bias)	Low risk	Outcome of interest presented
Other bias	Low risk	No other apparent bias

Warren 2001

Methods	FLUOROSIS STUDY Country of study: US Geographic location: Iowa Year of study: 1997-2000 Year of change in fluoridation status: Unclear Study design: Cross-sectional data from within cohort study
Participants	Inclusion criteria: Not stated Exclusion criteria: Not stated. Other sources of fluoride: Fluoride dentifrice use = 159/637 (25%), Dietary fluoride supplement use = 131/637 (20.6%). There was no difference in fluorosis prevalence between those who used other sources of fluoride and those who did not Ethnicity: Not stated Social class: Not stated Residential history: Mostly lifelong residents Other confounding factors: Not stated
Interventions	Group 1: <0.7 ppm (natural fluoridation) Group 2: 0.7-1.2 ppm (artificial fluoridation) Group 3: >1.2 ppm (natural fluoridation)
Outcomes	Fluorosis prevalence (TSIF) Age at assessment: 4.5 to 5 years
Funding	Supported by NIH grants 2ROI-DE09551, 2P30-10126, and CRC-RROOO5
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	Children included in the present study were part of the Iowa Fluoride Study cohort, which had been followed prospectively since birth. Full details were not reported
Confounding	High risk	SES was not accounted for
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Unclear risk	Outcome data available for 559 out of the 637 (87.8%) participants due to lack of information on water fluoride concentration
Selective reporting (reporting bias)	Low risk	Outcome of interest reported
Other bias	Low risk	No other apparent biase

Wenzel 1982

Methods	FLUOROSIS STUDY Country of study: Danish Geographic location: Naestved (F), Greve (F), Ry (non-F), Year of study: Not stated Year of change in fluoridation status: Not stated Study design: Cross-sectional
Participants	Inclusion criteria: Lifetime residents of study areas. Girls aged 12-15 Exclusion criteria: Children with orthodontic appliances, history of additional fluoride use Other sources of fluoride: Only children without fluoride use were included. No attempt was made to distinguish between users and non-users of fluoridated dentrifrice. Social class: Not stated Ethnicity: Not stated Residential history: Lifetime residents Other confounding factors: Not stated
Interventions	Group 1: <0.2 ppm Group 2: 1.0 ppm Group 3: 2.4 ppm
Outcomes	Fluorosis (TF index); skeletal maturity Age at assessment: 12 to 14 years
Funding	Sponsored by Colgate Palmolive, Denmark
Notes	Data extracted Wenzel 1982 differs from that presented in CRD review

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	There was insufficient detail reported to determine how selection took place
Confounding	High risk	SES was not accounted for
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data for all participants presented
Selective reporting (reporting bias)	Low risk	Outcome of interest presented
Other bias	High risk	No information on examiner calibration

Whelton 2004

Methods	FLUOROSIS STUDY Country of study: Republic of Ireland Geographic location: Not stated Year of study: 2001/2002 Year of change in fluoridation status: 1964 Study design: Cross-sectional
Participants	Inclusion criteria: Not stated Exclusion criteria: Not stated. Other sources of fluoride: Participants in the fluoridated group may have had additional exposure to fluoride tablets, fluoride mouthrinses Ethnicity: Not stated Social class: Possesion of a medical card is used in this study as a surrogate for disadvantage. ROI (Medical Card vs. No medical card): 25.2% vs. 74.4%; Figures do not add up to 100%, however, authors report that figures include children for whom MC/LIB details were missing Residential history: Subjects' home water supply had to have been fluoridation continuously since birth and for the non-fluoridation group; subjects' home water supply had never been fluoridated. No further details reported Other confounding factors: Not stated
Interventions	Group 1: 0.8-1 ppm (artificial fluoridation) Group 2: 'low' level - ppm not reported (natural fluoridation)
Outcomes	Fluorosis prevalence (Dean's index); caries data (dmft/DMFT) evaluated in study but not included in review due to study design Age at assessment: 5, 8, 12 and 15 years
Funding	Funded by the Department of Health and Children and the Health Boards in Ireland
Notes	The authors carried out and reported power calculation for the primary outcome (DMFT) but not for the fluorosis outcome;

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	A cluster sampling technique was used with schools as the clustering unit and children in Junior Infants, Second Class, Sixth Class and Junior Certificate were selected
Confounding	High risk	Residents of fluoridated RoI may have had exposure to other fluoride sources and fluorosis results were not adjusted to control for SES. For the outcome of caries, diet was not considered as a confounder
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Unclear risk	Outcome data presented as a percentage; unclear if all participants accounted for
Selective reporting (reporting bias)	Low risk	Outcome of interest reported
Other bias	High risk	Non-response rate for RoI was high at 68% and may have been influenced by fluoridation status.

Whelton 2006

Methods	FLUOROSIS STUDY Country of study: Republic of Ireland and Northern Ireland Geographic location: Not stated Year of study: 2001/2002 Year of change in fluoridation status:1964 Study design: Cross-sectional
Participants	Inclusion criteria: Not stated Exclusion criteria: Not stated. Other sources of fluoride: Participants in the fluoridated group may have had additional exposure to fluoride tablets, fluoride mouthrinses Ethnicity: Not stated Social class: Possesion of a medical card is used in this study as a surrogate for disadvantage. ROI (Medical Card vs. No medical card): 25.2% vs. 74.4%; Figures do not add up to 100%, however, authors report that figures include children for whom MC/LIB details were missing Residential history: Subjects' home water supply had to have been fluoridation continuously since birth and for the non-fluoridation group; subjects' home water supply had never been fluoridated. No further details reported Other confounding factors: Not stated
Interventions	Group 1: 0.8-1 ppm (artificial fluoridation) Group 2: 'low' level - ppm not reported (natural fluoridation)
Outcomes	Fluorosis prevalence (Dean's index); caries data (dmft/DMFT) evaluated in study but not included in review due to study design Age at assessment: 5, 8, 12 and 15 years
Funding	Funded by the Department of Health and Children and the Health Boards in Ireland
Notes	The authors carried out and reported power calculation for the primary outcome (DMFT) but not for the fluorosis outcome;

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	A cluster sampling technique was used with schools as the clustering unit and children in Junior Infants, Second Class, Sixth Class and Junior Certificate in RoI and Primary 1, Primary 4, Year 1 and Year 4 in NI.
Confounding	High risk	The use of fluoride from other sources and the dietary habits of the children were not accounted for
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data for all participants presented
Selective reporting (reporting bias)	Low risk	Fluorosis and caries outcome reported
Other bias	High risk	Non-response rate differed according to study area (RoI was 68% and 53% in NI).

Wondwossen 2004

Methods	FLUOROSIS STUDY Country of study: Ethiopia Geographic location: Not stated Year of study: 1997 Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: Not stated Exclusion criteria: Not stated Other sources of fluoride: Not stated Ethnicity: Not stated Social class: The villages are of approximately the same size and socioeconomic standards and were selected purposively for the study. Residential history: Subjects' home water supply had to have been fluoridation continuously since birth and for the non-fluoridation group; subjects' home water supply had never been fluoridated. No further details reported Other confounding factors: Not stated
Interventions	All natural fluoridation Group 1: 0.3 - 2.2 ppm Group 2: 10 - 14 ppm
Outcomes	Fluorosis prevalence (TF index); caries data evaluated in study but not included in review due to study design Age at assessment: 12 to 15 years
Funding	Supported by the Norwegian State Educational Loan Fund, NUFU Project 61/96 and the Committee for Research and Postgraduate Training, Faculty of Dentistry, University of Bergen, Norway and the Faculty of Medicine (Fluoride Project), University of Addis Ababa, Ethiopia
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	Participants were chosen from a census, however, insufficient detail was reported on individual selection
Confounding	High risk	The use of fluoride from other sources was not accounted for
Blinding of outcome assessment (detection bias)	High risk	Quote: "Intra-oral examination was conducted at the health centers of the areas by two examiners" Blinding not undertaken
Incomplete outcome data (attrition bias)	Low risk	Data for all participants presented
Selective reporting (reporting bias)	Low risk	Outcome of interest reported
Other bias	Low risk	No other apparent bias

Zheng 1986

Methods	FLUOROSIS STUDY Country of study: China Geographic location: Guangzhou and Fangcun (F), Fushan and Zhaoqing (non-F) Year of study: Not stated Year of change in fluoridation status: Not stated Study design: Cross-sectional
Participants	Inclusion criteria: Students who were 7, 9, 12, 15, 17 years old were included. Exclusion criteria: Not stated Other sources of fluoride: Not stated, but time point of 1975 in Guangdong province of China would be also assumed to have been exposed to fluoridated toothpaste. Social class: Not stated Ethnicity: Chinese Residential history: Lifetime residents Other confounding factors: Not stated
Interventions	Group 1: 0.6-1.2 ppm (artificial fluoridation) Group 2: 0.4-1.2 ppm (artificial fluoridation) Group 3: 0.2 ppm (natural fluoridation) Group 4: 0.2 ppm (natural fluoridation)
Outcomes	Outcome: Fluorosis prevalence (Dean's index) Age at assessment: 12-17
Funding	Not stated
Notes	Data extracted from Zheng 1986 differs from that presented in CRD review Translated from Chinese

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Unclear risk	Insufficent information to make a judgement
Confounding	High risk	It does not appear that SES was accounted for
Blinding of outcome assessment (detection bias)	High risk	Not reported
Incomplete outcome data (attrition bias)	High risk	Fluorosis data for all participants reported
Selective reporting (reporting bias)	High risk	The authors seem to have collected caries data at baseline but reported only the follow-up data
Other bias	Unclear risk	Unable to identify information pertaining to the training/reliability of outcome assessors

Zimmermann 1954

Methods	FLUOROSIS STUDY Country of study: USA Geographic location: Aurora, Illinois (F), Montgomery & Prince Georges counties, Maryland (non-F) Year of study: 1953 Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria: Lifetime residents of study areas White children aged 12-14 Exclusion criteria: Children who had left study areas for periods of time other than for holidays Other sources of fluoride: Not stated Social class: Not stated Ethnicity: White children only Residential history: Continuous residents Other confounding factors: Not stated
Interventions	All natural fluoridation Group 1: 0.2 ppm Group 2: 1.2 ppm
Outcomes	Fluorosis (Deans index); caries data evaluated in study but not included in review due to study design Age at assessment: 12 to14 years
Funding	Not stated
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Sampling	Low risk	All eligible children were invited to participate
Confounding	Low risk	SES and the use of fluoride from other sources were not accounted for
Blinding of outcome assessment (detection bias)	High risk	Insufficient information
Incomplete outcome data (attrition bias)	Low risk	Data for all participants presented
Selective reporting (reporting bias)	Low risk	Outcome of interest presented
Other bias	High risk	There was no mention of examiner calibration

Footnotes

Characteristics of excluded studies

Acharya 2003

Reason for exclusion	No fluorosis data

Ajayi 2008

Reason for exclusion	No fluorosis data

Akosu 2008

Reason for exclusion	

Aldosari 2004

Reason for exclusion	

Aleksejuniene 2004

Reason for exclusion	

Alimskii 2000

Reason for exclusion	

Antunes 2004

Reason for exclusion	

Anuradha 2002

Reason for exclusion	

Archila 2003

Reason for exclusion	

ARCPOH 2008

Reason for exclusion	

Armfield 2004

Reason for exclusion	

Armfield 2005

Reason for exclusion	

Armfield 2007

Reason for exclusion	

Armfield 2010

Reason for exclusion	

Arora 2010

Reason for exclusion	

Attwood 1988

Reason for exclusion	Inappropriate design for studying cessation of water fluoridation

Bailie 2009

Reason for exclusion	

Baldani 2002

Reason for exclusion	

Baldani 2004

Reason for exclusion	

Bao 2007

Reason for exclusion	

Baskaradoss 2008

Reason for exclusion	

Bihari 2008

Reason for exclusion	No fluorosis data

Binbin 2005

Reason for exclusion	

Blagojevic 2004

Reason for exclusion	

Blayney 1960

Reason for exclusion	Inappropriate design: data measured at different time points for fluoridated and non-fluoirdated areas.

Bo 2003

Reason for exclusion	

Borinskii 2009

Reason for exclusion	

Bottenberg 2004

Reason for exclusion	

Bradnock 1984

Reason for exclusion	

Buchel 2011

Reason for exclusion	

Budipramana 2002

Reason for exclusion	

Burt 2000

Reason for exclusion	

Buscariolo 2006

Reason for exclusion	

Buzalaf 2004

Reason for exclusion	

Campain 2010

Reason for exclusion	

Carmichael 1980

Reason for exclusion	

Carmichael 1984

Reason for exclusion	

Carmichael 1989

Reason for exclusion	

Carvalho 2007

Reason for exclusion	

Casey 2000

Reason for exclusion	Not a research paper

Catani 2007

Reason for exclusion	

Chen 2009

Reason for exclusion	

Chen 2012

Reason for exclusion	

Cheng 2000

Reason for exclusion	

Chikte 2002

Reason for exclusion	

Ciketic 2010

Reason for exclusion	Cost-effectiveness study

Clark 2006

Reason for exclusion	

de Lourdes Azpeitia-Valadez 2009

Reason for exclusion	

Dini 2000

Reason for exclusion	

Do 2007

Reason for exclusion	

Dobaradaran 2008

Reason for exclusion	

Evans 1995

Reason for exclusion	

Evans 2009

Reason for exclusion	

Faye 2008

Reason for exclusion	

Gillcrist 2001

Reason for exclusion	

Gushi 2005

Reason for exclusion	

Han 2011

Reason for exclusion	Absence of two-time point caries data and no fluorosis data

Hobbs 1994

Reason for exclusion	Inappropriate design for studying cessation of water fluoridation

Hoffmann 2004

Reason for exclusion	

Hopcraft 2003

Reason for exclusion	

Ito 2007

Reason for exclusion	

Jones 1997

Reason for exclusion	

Jones 2000a

Reason for exclusion	

Jones 2000b

Reason for exclusion	

Kalsbeek 1993

Reason for exclusion	Inappropriate design for studying cessation of water fluoridation

Khan 2004

Reason for exclusion	

Kirkeskov 2010

Reason for exclusion	No change in fluoridation status

Kozlowski 2002

Reason for exclusion	

Kukleva 2007

Reason for exclusion	

Kumar 2001

Reason for exclusion	

Kunzel 2000

Reason for exclusion	Data collection time point does not cover the intervention period

Kunzel 2000a

Reason for exclusion	Data collection time point does not cover the intervention period

Lee 2004

Reason for exclusion	

Liu 2006

Reason for exclusion	

Liu 2009

Reason for exclusion	

Mandinic 2010

Reason for exclusion	

Meyer-Lueckel 2006

Reason for exclusion	

Mondal 2012

Reason for exclusion	

Murray 1984

Reason for exclusion	

Murray 1991

Reason for exclusion	

Nayak 2009

Reason for exclusion	No comparison made

Ncube 2005

Reason for exclusion	

Nirgude 2010

Reason for exclusion	No useful data

Niu 2012

Reason for exclusion	

Pandey 2002

Reason for exclusion	

Pandey 2005

Reason for exclusion	

Pandey 2010

Reason for exclusion	

Peres 2006

Reason for exclusion	

Provart 1995

Reason for exclusion	

Quan 2003

Reason for exclusion	

Ramires 2006

Reason for exclusion	

Rihs 2008

Reason for exclusion	

Riley 1999

Reason for exclusion	

Ruan 2004

Reason for exclusion	

Rugg-Gun 1977

Reason for exclusion	

Sagheri 2007

Reason for exclusion	

Sales-Peres 2002

Reason for exclusion	

Saliba 2008

Reason for exclusion	

Sampaio 2000

Reason for exclusion	

Seppa 1998

Reason for exclusion	Inappropriate design for studying cessation of water fluoridation

Shitumbanuma 2007

Reason for exclusion	

Sohu 2007

Reason for exclusion	

Spencer 2008

Reason for exclusion	

Sun 2007

Reason for exclusion	

Tagliaferro 2004

Reason for exclusion	

Tiano 2009

Reason for exclusion	

Tickle 2003

Reason for exclusion	

Vuhahula 2008

Reason for exclusion	

Wang 2005

Reason for exclusion	

Wang 2008

Reason for exclusion	

Wei 2010

Reason for exclusion	

Wong 2006

Reason for exclusion	No concurrent control

Wongdem 2001

Reason for exclusion	

Wragg 1999

Reason for exclusion	Inappropriate design for studying cessation of water fluoridation

Wu 2006

Reason for exclusion	

Wu 2008

Reason for exclusion	

Zhu 2009

Reason for exclusion	

Zietsman 2003

Reason for exclusion	

Zimmermann 2003

Reason for exclusion	

Footnotes

Characteristics of studies awaiting classification

Agarwal 2014

Methods	
Participants	
Interventions	
Outcomes	
Notes	

Berndt 2010

Methods	FLUORISIS STUDY Country of study: Namibia Geographic location: Ombili, Ondera, Vryheid, Kakuse Year of study: October 2004 Year of change in fluoridation status: NA Study design: Cross-sectional
Participants	Inclusion criteria:Aged 8 to 21 years; Other fluoride sources: Forty seven (39.3%) reported oral hygiene practice with fluoridated toothpaste (1400ppm); 8 (6.7%) used traditional 'natural' toothbrush. Different ethnic groups differed markedly in their oral hygiene behaviour (p=0.02) Exclusion criteria: Not stated Social class: Not stated Ethnicity: !Kung (45%), Heikum (35%), Damara (13%), Bantu (7%) Residential history: Residents of Ombili had been resident since 1991 and the residents of the other farms were lifetime residents Other confounding factors: Not stated
Interventions	All natural fluoridation Group 1: 0.28 ppm Group 2: 0.38 ppm Group 3: 1.06 ppm Group 4: 1.43 ppm
Outcomes	Dental fluorosis (Dean's index) Age at assessment: 8 to 21 years
Notes	

Hussain 2013

Methods	
Participants	
Interventions	
Outcomes	
Notes	

Marya 2014

Methods	
Participants	
Interventions	
Outcomes	
Notes	

Shanthi 2014

Methods	
Participants	
Interventions	
Outcomes	
Notes	

Skinner 2013

Methods	
Participants	
Interventions	
Outcomes	
Notes	

Slade 2013

Methods	
Participants	
Interventions	
Outcomes	
Notes	

Sukhabogi 2014

Methods	
Participants	
Interventions	
Outcomes	
Notes	

Vilasrao 2014

Methods	
Participants	
Interventions	
Outcomes	
Notes	

Wang 2014

Methods	
Participants	
Interventions	
Outcomes	
Notes	

Wong 2014

Methods	
Participants	
Interventions	
Outcomes	
Notes	

Footnotes

Characteristics of ongoing studies

Footnotes

Summary of findings tables

1 Summary of findings

Initiation of water fluoridation compared with low/non-fluoridated water for the prevention of dental caries						
Patient or population: People of all ages Settings: community setting Intervention: Initiation of water fluoridation Comparison: low/non-fluoridated water						
Outcomes	Illustrative comparative risks* (95% CI)		Relative effect (95% CI)	No of Participants (studies)	Quality of the evidence (GRADE)	Comments
	Risk in area with low/non-fluoridated water	Risk in area with initiation of water fluoridation				

Caries in deciduous teeth (dmft)[1] Scale from: 0 to 20 Follow-up: range from 3-12 years	The mean dmft at follow-up in the low/non- fluoridated areas ranged from 1.21 to 7.8 (median 5.1)	The mean dmft in the areas with water fluoridation was 1.81 lower (1.31 lower to 2.31 lower)		44268[2] (9 observational studies)	⊕⊖⊖⊖ Very low[3,4,5]	This indicates a reduction in dmft of 35% in the water fluoridation groups over and above that for the control groups.
Caries score in permanent teeth (DMFT)[6] Scale from: 0 to 32 Follow-up: range from 8-11 years	The mean DMFT at follow-up in the low/non- fluoridated areas ranged from 0.7 to 5.5 (median 4.4)	The mean DMFT in the areas with water fluoridation was 1.16 lower (0.72 lower to 1.61 lower)		78764[2] (10 observational studies)	⊕⊖⊖⊖ Very low[3,4,5]	This indicates a reduction in DMFT of 26% in the water fluoridation groups over and above that for the control groups.
Change in proportion of caries free children (deciduous teeth) Scale: 0 to 1 Follow-up: range 3-12 years	The proportion of caries free children at follow-up in the low/non- fluoridated areas ranged from 0.06 to 0.67 (median 0.22)	The proportion of caries free children increased in the areas with water fluoridation 0.15 (0.11 to 0.19)		39966[2] (10 observational studies)	⊕⊖⊖⊖ Very low[3,4,5]	
Change in proportion of caries free children (permanent teeth) Scale: 0 to 1 Follow-up: range 8-12 years	The proportion of caries free children at follow-up in the low/non- fluoridated areas ranged from 0.01 to 0.67 (median 0.14)	The proportion of caries free children increased in the areas with water fluoridation 0.14 (0.05 to 0.23)		53538[2] (8 observational studies)	⊕⊖⊖⊖ Very low[3,4,5]	
Disparities in caries by socio-economic status (SES)				>35399[7] (3 observational studies)	⊕⊖⊖⊖ Very low[3]	There is insufficient information to determine whether initiation of a water fluoridation programme results in a change in disparities in caries levels across SES.
Harms: Dental fluorosis of aesthetic concern[8] (measured by Dean's, TFI, TSIF)[9]	For a fluoride level of 0.7 ppm the percentage of participants with fluorosis of aesthetic concern was estimated to be 12% (95% CI 8% to 17%). Controlling for study effects, we would expect the odds of fluorosis to increase by a factor of 2.90 (95% CI 2.05 to 4.10) for each one unit increase in fluoride level (1ppm F).			59630 (40 observational studies)	⊕⊖⊖⊖ Very low[3,10]	The estimate for any level of fluorosis at 0.7ppm was 40% (95% CI 35% to 44%; 90 studies). This includes fluorosis that can only be detected under clinical conditions and other enamel defects.
Harms: other	Insufficient information to draw conclusions.					

GRADE Working Group grades of evidence
High quality: Further research is very unlikely to change our confidence in the estimate of effect.
Moderate quality: Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate.
Low quality: Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.
Very low quality: We are very uncertain about the estimate.

Footnotes

1. dmft - decayed, missing and filled deciduous teeth

2. Total number of participants measured. Analysis undertaken on average number of participants measured at baseline and follow-up for each study.

3. Studies at high risk of bias; quality of the evidence downgraded

4. Substantial heterogeneity present, however, given that the direction of effect was the same in all but on of the studies/outcomes we did not downgrade due to heterogeneity.

5. Indirectness of evidence due to lack of contemporary evidence; quality of the evidence downgraded. 64% of the studies conducted prior 1975; the use of fluoridated toothpaste, the availability of other caries prevention strategies, diet and tap water consumption are all likely to have changed in the populations in which the studies were conducted. No data on the effect of water fluoridation in adults was identified. Ten of the 14 studies used in the analysis of water fluoridation initiation schemes included lifetime residents only; the effect size shown in the review may, therefore, be larger than that found in the population, depending on population movement/migration.

6. DMFT - decayed, missing and filled permanent teeth

7. Number of participants not stated in one study

8. Data comes from studies of both naturally occurring and artificially fluoridated areas (i.e. not just areas where water fluoridation has been initiated). Fluorosis of aesthetic concern only with levels of reported fluoride exposure of 5ppm or less.

9. TFI - Thylstrup-Fejerskov Index: TSIF - Tooth Surface Index of Fluorosis

10. Substantial heterogeneity; quality of the evidence downgraded

2 Summary of findings

Cessation of water fluoridation compared with fluoridated water for the prevention of dental caries			
Patient or population: People of all ages **Settings: community setting** **Intervention: Cessation of water fluoridation** **Comparison: fluoridated water**			
Outcomes	**No of Participants (studies)**	**Quality of the evidence (GRADE)**	**Comments**
Caries in permanent teeth (DMFS)[1] Follow-up: 3 years	9249[2] (1 observational study)	⊕⊖⊖⊖ Very low[3]	Insufficient evidence to determine the effect of the cessation of water fluoridation on caries
Caries in deciduous teeth (dmft/dmfs)[4]			No evidence to determine the effect of the cessation of water fluoridation on caries
Change in proportion of caries free children (deciduous or permanent teeth)			No evidence to determine the effect of the cessation of water fluoridation on caries
Disparities in caries by socio-economic status (SES)			No evidence to determine the effect of the cessation of water fluoridation on disparities
Harms			No evidence to determine cessation of a water fluoridation programme is associated with any harms
GRADE Working Group grades of evidence **High quality:** Further research is very unlikely to change our confidence in the estimate of effect. **Moderate quality:** Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate. **Low quality:** Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate. **Very low quality:** We are very uncertain about the estimate.			

Footnotes

1 DMFS - decayed missing and filled surfaces in permanent teeth

2 Total number of participants measured

3 Study at high risk of bias; quality of evidence downgraded

4 dmft/dmfs - decayed, missing and filled deciduous teeth/surfaces

Additional tables

1 dmft data and underlying calculations

STUDY ID	AGE	FLUORIDATED AREA						NON/LOW FLUORIDATED AREA					
		BASELINE (BEFORE/AT INITIATION)			FOLLOW-UP			BASELINE			FOLLOW-UP		
		MEAN	SD	N	MEAN	SD	N	MEAN	SD	N	MEAN	SD	N
ADRIASOLA 1959	5	8.9	5.03	186	6.4	4.18	340	8.1	4.77	174	7.8	4.67	140
	5	**Mean (sd) change in dmft: 2.5 (7.04)**						**Mean (sd) change in dmft: 0.3 (6.72)**					

ARNOLD 1956[a]	4	4.19	3.30	323	2.13	2.26	168	5.05	3.66	20	4.46	3.42	63
	5	5.37	3.79	1633	2.27	2.34	853	6.82	4.33	402	5.25	3.74	351
	6	6.43	4.19	1789	2.98	2.73	750	7.17	4.46	462	5.67	3.91	294
	7	6.29	4.14	1806	4.03	3.23	423	6.66	4.28	408	5.77	3.95	223
	8	5.78	3.95	1647	4.12	3.27	470	6.06	4.06	376	5.32	3.77	275
	4-8	**Mean (sd) change in dmft: 2.75 (4.99)**						**Mean (sd) change in dmft: 1.18 (5.8)**					
BEAL 1971	5	4.91	4.86	182	2.45	3.24	182	4.97	4.12	217	5.09	4.84	229
	5	**Mean (sd) change in dmft: 2.46 (5.8)**						**Mean (sd) change in dmft: -0.12 (6.27)**					
BEAL 1981	5	4.29	3.50	196	1.8	2.48	170	4.28	3.58	205	3.49	3.62	180
	8	5	2.89	189	3.42	2.84	167	5.36	3.06	163	4.97	3.00	186
	5/8	**Mean (sd) change in dmft: 2.02 (4.18)**						**Mean (sd) change in dmft: 0.57 (4.6)**					
BLINKHORN 2015	5-7	2.02	3.13	781	0.72	1.63	844	2.09	2.91	523	1.21	2.27	612
	5-7	**Mean (sd) change in dmft: 1.3 (3.56)**						**Mean (sd) change in dmft: 0.88 (3.74)**					
DHSS 1969 (Eng)[a]	3	2.7	2.58	43	0.6	1.11	133	1.4	1.79	44	1.2	1.64	144
	4	3.6	3.03	66	1.3	1.71	131	2.6	2.53	47	1.8	2.06	162
	5	5.4	3.80	148	1.6	1.92	111	5	3.64	110	2.8	2.63	119
	6	5.7	3.92	182	2.5	2.47	130	5.4	3.80	127	4.1	3.26	107
	7	6.4	4.18	192	2.7	2.58	172	6	4.03	121	4.3	3.35	133
	3-7	**Mean (sd) change in dmft: 3.09 (4.3)**						**Mean (sd) change in dmft: 1.04 (4.22)**					
DHSS 1969 (Wales)[a,b]	3	3.9	3.17	310	1.4	1.79	171	4	3.21	146	3.3	2.89	105
	4	5.54	3.86	413	2.6	2.53	267	5.8	3.96	210	4.8	3.56	122
	5	5.5	3.84	556	2.9	2.69	284	5.5	3.84	256	4.8	3.56	138
	6	6.3	4.15	603	3.1	2.79	310	6.2	4.11	331	5.9	4.00	133
	7	6.85	4.35	640	3.65	3.05	266	7.3	4.50	346	6.8	4.33	130
	3-7	**Mean (sd) change in dmft: 2.87 (4.68)**						**Mean (sd) change in dmft: 0.64 (5.54)**					
GUO 1984	3	3	3.4	202	2.6	3.3	79	1.3	3.2	205	3.7	3.9	128
	4	4.6	4	354	4.5	4.7	164	5.6	4.6	246	7.1	4.6	164
	5	6.5	4.4	589	5.5	4.3	345	6.4	4.2	218	8.5	4.6	387
	6	6.7	4.4	695	6.2	4.8	297	5.8	4.2	309	9	4.3	354
	7	5.5	3.7	399	5.6	3.7	240	5.4	3.7	335	7.9	3.6	352
	8	4.2	3	392	4.4	2.9	279	3.5	2.7	343	6	3.1	350
	3-8	**Mean (sd) change in dmft: 0.23 (5.39)**						**Mean (sd) change in dmft: -2.47 (5.35)**					
KUNZEL 1992[a]	5	2.4	2.415006452	688	1.4	1.7857954	1306	3.3	2.886475039	172	2.9	2.684991275	597
	8	4.9	3.601718817	2438	2.8	2.632743187	3020	4.9	3.601718817	777	4.9	3.601718817	1078
	5-8	**Mean (sd) change in dmft: 2.1 (5.01)**						**Mean (sd) change in dmft: 0.13 (5.0)**					

Footnotes

Note: Only data up to the age of 8 years included for the deciduous dentition

a. Imputed standard deviation

b. Two fluoridated areas combined

2 DMFT data and underlying calculations

STUDY ID	AGE	FLUORIDATED AREA						NON/LOW FLUORIDATED AREA					
		BASELINE (BEFORE/AT INITIATION)			FOLLOW-UP			BASELINE			FOLLOW-UP		
		MEAN	SD	N	MEAN	SD	N	MEAN	SD	N	MEAN	SD	N
ARNOLD 1956[a]	6	0.78	1.29	1789	0.26	0.70	750	0.81	1.31	462	0.8	1.31	294
	7	1.89	2.11	1806	0.84	1.34	423	1.99	2.17	408	1.88	2.11	223
	8	2.95	2.71	1647	1.58	1.91	470	2.81	2.64	376	2.63	2.54	275
	9	3.9	3.17	1639	2.04	2.21	582	3.81	3.13	357	3.52	2.99	277
	10	4.92	3.61	1626	2.93	2.70	141	4.91	3.61	359	4.32	3.36	62
	11	6.41	4.19	1556	3.67	3.06	151	6.32	4.15	293	5.34	3.78	139
	12	8.07	4.76	1685	5.89	3.99	176	8.66	4.95	328	7.71	4.64	48
	13	9.73	5.29	1668	6.6	4.26	497	9.98	5.36	377	9.36	5.18	225
	14	10.95	5.65	1690	8.21	4.81	128	12	5.95	369	11.36	5.77	59
	15	12.48	6.08	1511	8.91	5.03	53	12.86	6.18	292	12.38	6.05	21
	16	13.5	6.35	1107	11.06	5.68	198	14.07	6.50	248	13.16	6.26	155
	6-16	**Mean (sd) change in DMFT: 0.90 (3.20)**						**Mean (sd) change in DMFT: 0.15 (3.51)**					
BEAL 1981	8	1.48	1.51	189	0.65	1.16	167	1.55	1.40	163	1.34	1.50	186
	12	3.53	3.32	192	2.74	2.33	189	4.28	2.47	188	4.11	2.95	197
	8/12	**Mean (sd) change in DMFT: 0.82 (2.50)**						**Mean (sd) change in DMFT: 0.20 (2.64)**					
BLINKHORN 2015[a]		0.59	1.10	777	0.45	0.95	642	0.99	1.47	436	0.72	1.23	455
		Mean (sd) change in DMFT: 0.14 (1.44)						**Mean (sd) change in DMFT: 0.28 (1.92)**					
BROWN 1960	9-11	4.07	2.20	595	1.52	1.80	502	4.21	2.63	571	3.68	2.35	521
	12-14	7.68	3.90	593	3.23	2.92	503	7.94	4.41	486	7.46	4.40	485
	9-14	**Mean (sd) change in DMFT: 3.03 (3.31)**						**Mean (sd) change in DMFT: 0.52 (4.18)**					
DHSS 1969 (Eng)[a]	8	2.4	2.42	199	1.08	1.54	95	2.4	2.42	148	1.85	2.09	79
	9	3.1	2.79	227	1.5	1.86	135	2.9	2.68	166	2.4	2.42	95
	10	3.6	3.03	134	2	2.18	115	3.8	3.12	160	3.1	2.79	80
	11	4.6	3.48	145	3	2.74	200	4.7	3.52	126	3.9	3.17	122
	12	5.6	3.88	111	3.52	2.99	134	6.1	4.07	51	4.99	3.64	99
	13	7.1	4.43	91	4.9	3.60	132	6.6	4.26	52	6.1	4.07	127
	14	8.4	4.87	70	5.77	3.95	90	7.9	4.71	36	6.74	4.31	108
	8-14	**Mean (sd) change in DMFT: 1.62 (3.92)**						**Mean (sd) change in DMFT: 0.65 (4.39)**					
DHSS 1969 (Wales)[a,b]	8	2.00	2.18	607	1.31	1.72	283	1.95	2.15	351	2.16	2.28	125
	9	2.65	2.55	553	1.98	2.17	260	2.6	2.53	325	2.9	2.68	134
	10	3.35	2.91	502	2.59	2.52	241	3.2	2.84	308	3.6	3.03	133
	11	3.83	3.14	278	2.99	2.73	126	3.3	2.89	270	4.1	3.26	42
	12	4.65	3.50	186	4.38	3.38	108	3.95	3.19	265	6.16	4.09	108
	13	6	4.03	178	5.9	4.00	93	5.2	3.72	274	7.6	4.61	105
	14	6.95	4.38	158	6.73	4.30	93	5.6	3.88	243	7.64	4.62	96
	8-14	**Mean (sd) change in DMFT: 0.66 (3.72)**						**Mean (sd) change in DMFT: -0.73 (4.95)**					

GUO 1984	6	0.2	0.6	695	0.2	0.5	297	0.1	0.4	309	0.5	0.9	354
	7	0.4	0.8	399	0.4	0.9	240	0.3	0.7	335	1.2	1.4	352
	8	0.5	1	392	0.5	1	279	0.4	0.8	343	1.6	1.5	350
	9	0.7	1.1	388	0.8	1.4	275	0.7	1.1	310	2.2	2	352
	10	0.7	1.3	346	1.1	1.5	310	0.8	1.5	323	2.4	2	436
	11	0.8	1.5	330	1.6	1.9	307	0.9	1.4	451	3	2.7	365
	12	1.1	1.7	468	1.7	2.4	208	0.9	1.5	841	3.4	3	493
	13	1.4	2	469	2.1	2.9	232	1.2	1.6	801	3.8	3.3	504
	14	1.2	1.8	322	2.6	2.9	221	1	1.5	795	4.4	3.8	490
	15	1.7	2.5	164	2.2	2.3	38	1.2	1.7	121	4.2	4	63
	6-15	Mean (sd) change in DMFT: -0.11 (1.69)						Mean (sd) change in DMFT: -1.14 (2.59)					
HARDWICK 1982	12	Mean (sd) increment in DMFT: -3.76 (2.86)						Mean (sd) increment in DMFT: -4.85 (3.39)					
KUNZEL 1997[c,d]	6	0.3	0.7		0.2			0.5	0.8		0.4	0.89	
	7	0.7	1.1		0.3			0.9	1.2		1	1.48	
	8	1.3	1.4	2419	0.5	1.00	3016	1.3	1.4	777	1.8	2.06	1076
	9	1.9	1.5		0.9			1.8	1.6		2.4	2.42	
	10	2.4	1.8		1.2			2.4	1.8		3.2	2.84	
	11	3	2		1.6			2.8	1.8		3.9	3.17	
	12	3.7	2.3	1626	2	2.18	2426	3.5	2.1	563	4.8	3.56	925
	13	4.3	2.7		2.6			4.1	2.6		5.5	3.84	
	14	5.3	3.1		3.4			4.7	2.5		6.5	4.22	
	15	5.8	3.5	1995	4	3.22	1897	5.2	3.1	744	7.4	4.54	756
	8/12/15	Mean (sd) change in DMFT: 1.02 (2.94)						Mean (sd) change in DMFT: -0.85 (3.26)					
LOH 1996		1.6	1.8		2			1.9			3.1		
		4.4			2.1			3.7			4.5		
	Insufficient data to include in further analysis												
TESSIER 1987[a]	6-7	8.28		56	3.16		96	8.23		85	5.4		93
	6-7	Mean (sd) change in DMFT: 5.12 (6.16)						Mean (sd) change in DMFT: 2.83 (6.18)					

Footnotes

a. Imputed standard deviation

b. Two fluoridated areas combined

c. Imputed standard deviation for follow-up data only

d. N values only available for ages 8, 12 and 15 years.

3 Number of children caries free: deciduous teeth

STUDY ID	AGE	FLUORIDATED AREA				NON/LOW FLUORIDATED AREA			
		BASELINE (BEFORE/AT INITIATION)		FOLLOW-UP		BASELINE		FOLLOW-UP	
		n	N	n	N	n	N	n	N
Adriasola 1959[a]	3	26	151	82	216	9	77	26	135
	4	12	156	55	216	11	76	11	110
	5	4	186	45	340	7	174	14	140
	8	21	493	11	458	17	223	2	226
Ast 1951	5	63	274	108	217	73	259	107	324
Beal 1971[b]	5	62	297	138	314	35	217	55	229
Beal 1981	5	41	196	78	170	43	205	54	180
	8	18	189	31	167	12	163	18	186
Blinkhorn 2015	5-7	397	781	632	844	254	523	412	612
DHSS 1969 (Eng)	3	16	43	96	133	27	44	97	144
	4	23	66	84	131	16	47	89	162
	5	12	148	51	111	15	110	42	119
	6	16	182	47	130	13	127	18	107
	7	13	192	55	172	7	121	24	133
DHSS 1969 (Wales)	3	89	310	100	171	39	146	21	105
	4	78	413	114	267	32	210	27	122
	5	56	556	90	284	18	256	19	138
	6	29	603	78	310	20	331	15	133
	7	17	640	53	266	14	346	5	130
Gray 2001[b]	5	1465	2462	1903	2524	345	466	273	419
Guo 1984	3	67	202	31	79	54	205	39	128
	4	74	354	39	164	32	246	14	164
	5	61	589	47	345	18	218	19	387
	6	53	695	56	397	27	309	12	354
	7	41	399	21	240	29	335	11	352
	8	53	392	24	279	50	343	16	350
	8	278	392	204	279	273	343	104	350
Kunzel 1997	5	231	688	682	1306	39	172	192	597
	8	117	2438	746	3020	40	777	61	1078

Footnotes

Note: Only data up to the age of 8 years included for the deciduous dentition

a. Baseline data not available for ages 6 and 7years

b. Data from all fluoridated areas combined

4 Number of caries free children: permanent teeth

STUDY ID	AGE	FLUORIDATED AREA				NON/LOW FLUORIDATED AREA			
		BASELINE (BEFORE/AT INITIATION)		FOLLOW-UP		BASELINE		FOLLOW-UP	
		n	N	n	N	n	N	n	N
ADRIASOLA 1959[a]	8	21	493	11	458	17	223	2	226
	12	7	292	8	419	3	197	9	211
BEAL 1981	8	77	189	115	167	56	163	82	186
	12	51	192	41	189	13	188	14	197
BLINKHORN 2015	10 to 12	525	777	486	642	272	436	307	455
BROWN 1960[b]	9 to 11	34	595	220	502	35	571	42	521
	12 to 14	7	593	94	503	3	486	11	485
DHSS 1969 (Eng)	8	40	199	50	95	33	148	29	79
	9	25	227	57	135	20	166	20	95
	10	13	134	36	115	14	160	10	80
	11	12	145	12	200	3	126	12	122
	12	3	111	20	134	0	51	4	99
	13	3	91	9	132	2	52	8	127
	14	0	70	4	90	2	36	9	180
DHSS 1969 (Wales)	8	143	607	112	283	88	351	26	125
	9	73	553	78	260	49	325	15	134
	10	63	502	44	241	25	308	8	133
	11	30	278	15	126	35	270	0	42
	12	15	186	10	108	27	265	2	108
	13	7	178	0	93	14	274	1	105
	14	8	158	3	93	15	243	1	96
Guo 1984	5	575	589	338	345	214	218	358	387
	6	616	695	266	297	284	309	249	354
	7	305	399	189	240	272	335	162	352
	8	278	392	204	279	273	343	104	350
	9	242	388	167	275	195	310	98	352
	10	215	346	161	310	199	323	84	436
	11	213	330	133	307	245	451	65	365
	12	240	468	90	208	475	841	91	493
	13	227	469	88	232	434	801	77	504
	14	161	322	69	221	455	795	73	490
	15	78	164	11	38	66	121	11	63
Kunzel 1997	8	1021	2419	2147	3016	334	777	333	1076
	12	120	1626	801	2426	42	563	50	925
	15	118	1995	249	1897	27	744	18	756

Footnotes

a. Baseline data not available for ages 11 and 15 years

b. Data for 16 to 17 year olds presented but no N

5 Disparities in caries across social class

					Baseline				Final			
Study ID	Age	Group	Measure	Social class	F level	N	% caries free	dmft (SD)	F level	N	% caries free	dmft (SD)
Beal 1971[a]	5	Balsall health	Descriptive	Poor area	Low	115	9	5.16 (0.44)	1	132	48	1.94 (0.22)
		Northfield		Industrial area	Low	182	29	4.91 (0.36)	1	182	41	2.45 (0.24)
		Dudley		Industrial area	<0.1	217	16	4.97 (0.28)	<0.1	229	24	5.09 (0.32)
Gray 2000[b]	5	SE staffs	Jarman score	-23.09	Low	3435	66	1.21 (0.59)	1	3120	75	0.64 (1.46)
		Sandwell		18.1	Low	3950	51	1.93 (2.88)	1	3598	69	0.83 (1.68)
		Walsall		1.67	Low	3120	54	1.85 (2.31)	1	363	67	0.94 (1.77)
		Dudley		-13.68	Low	3657	58	1.6 (2.54)	1	3474	73	0.78 (1.75)
		N. Birmingham		21.57	Low	1965	72	0.88 (1.97)	1	1904	74	0.71 (1.65)
		N. Staffs		-3.59	Low	464	47	2.24 (3.04)	Low	1947	59	1.49 (2.46)
		Herefordshire		-13.01	Low	406	57	1.61 (2.55)	Low	305	50	1.79 (2.68)
		Shropshire		-12.34	Low	366	61	1.29 (2.22)	Low	311	60	1.33 (2.33)
		Kidderminster		-13.13	Low	904	58	1.74 (2.81)	Low	1053	61	1.4 (2.52)
Holdcroft 1999[b]	Not stated	N Birmingham	Jarman score	-7.85	Not stated	Not stated		2.18	High	Not stated		0.68
		Sandwell		15.03	Not stated	Not stated		2.55	High	Not stated		1.13
		N Staffordshire		-4.07	Not stated	Not stated		2.24	Not stated	Not stated		1.48
		Shropshire		-11.73	Not stated	Not stated		1.76	Not stated	Not stated		1.29
		Herefordshire		-11.97	Not stated	Not stated		2.56	Not stated	Not stated		1.53

Footnotes

a. Caries data reported as deft (SE)

b. Caries data reported as dmft (SD)

6 Harms: other

Study ID	Outcome	Age	Fluoride level	Assigned FI level	Number of subjects	Proportion with outcome
Chen 1993	Skeletal fluorosis	16 to 65	5.5	5.5	28	82.1
			3.1	3.1	114	71.1
			0.4	0.4	50	46
			3.1	3.1	50	86
Wang 2012[a]	Skeletal fluorosis	≥16	2.2	2.2	406298	10.8
			0.5	0.5	188400	4.8
Wenzel 1982[b]	Skeletal maturity	12 to 14	2.4	2.4	122	0.59(0.1)[c]
			<0.2	0.1	113	0.59(0.09)[c]
Jolly 1971[b]	Skeletal fluorosis	Not stated	0.7	0.7	Not stated	3.6
			1.4	1.4	Not stated	2.4
			2.4	2.4	Not stated	17
			2.4	2.4	Not stated	23
			2.5	2.5	Not stated	33
			3	3	Not stated	19.6
			3	3	Not stated	42.2
			3.3	3.3	Not stated	10
			3.3	3.3	Not stated	45
			3.6	3.6	Not stated	33.1
			4.3	4.3	Not stated	19.4
			5	5	Not stated	60
			5.1	5.1	Not stated	44.5
			5.5	5.5	Not stated	31.3
			7	7	Not stated	47.4
			8.5	8.5	Not stated	58.9
			9.4	9.4	Not stated	70.1

Footnotes

a. Participants were diagnosed based on the diagnostic criteria of endemic skeletal fluorosis (WS 192-2008)

b. Participants were examined radiologically

c. Reported outcome was mean (standard error) skeletal maturity

7 WHO Region specific weighted DMFT among 12 year olds

WHO Regions	DMFT
	2011
Africa	1.19
Americas	2.35
Eastern Mediteranean	1.63
Europe	1.95
South East Asia	1.87
Western Pacific	1.39
GLOBAL	1.67

Footnotes

http://www.mah.se/CAPP/Country-Oral-Health-Profiles/According-to-Alphabetical/Global-DMFT-for-12-year-olds-2011/

References to studies

Included studies

Acharya 2005

Acharya S. Dental caries, its surface susceptibility and dental fluorosis in South India. International Dental Journal 2005;55(6):359-64.

Adair 1999

Adair S, Hanes C, Russell C, Whitford G. Dental caries and fluorosis among children in a rural Georgia area. Pediatr Dent 1999;21(2):81-5.

Adriasola 1959

Adriasola G. First evaluation of the program of fluoridation of drinking water in Curico-San Fernando, Chile, 1956. Boletin de la Oficina Sanitaria Panamericana 1959;47:412-20.

Alvarez-Ubilla A. primera evluacion del programa de fluoacion del agua potable Curico-San Fernando. Odontologica Chilena 1959;41:1277-83.

Al-Alousi 1975

Al-Alousi W, Jackson D, Crompton G, Jenkins O. Enamel mottling in a fluoridated and a nonfluoridated community. Br Dent J 1975;138:9-15.

Alarcon-Herrera 2001

Alarcon-Herrera M, Martin-Dominguez I, Trejo-Vazquez R, Rodriguez-Dozal S. Well water fluoride, dental fluorosis, and bone fractures in the Guadiana Valley of Mexico. Fluoride 2001;34(2):139-49.

Albrecht 2004

Albrecht M, Maros E. [Dental fluorosis in children in Bár and Dunaszekcsó in the 6-18 age group]. Orvosi Hetilap 2004;145(5):229-32.

AlDosari 2010

AlDosari A, Akpata E, Khan N. Associations among dental caries experience, fluorosis, and fluoride exposure from drinking water sources in Saudi Arabia. Journal of Public Health Dentistry 2010;70(3):220-6.

Angelillo 1999

Angelillo I, Torre I, Nobile C, Villari P. Caries and fluorosis prevalence in communities with differentconcentrations of fluoride in the water. Caries Res 1999;33(2):114-22.

Arif 2013

Arif M, Hussain J, Kumar S. Assessment of fluoride level in groundwater and prevalence of dental fluorosis in didwana block of nagaur district, central rajasthan, India. International Journal of Occupational and Environmental Medicine 2013;4(4):178-84.

Arnold 1956

Arnold F, Dean H, Jay P, Knutson J. Effect of fluoridated public water supply on dental caries prevalence. Pub Health Rep 1956;71:652-8.

Ast 1951

Ast D, Finn S, Chase H. Newburgh-Kingston caries fluorine study; further analysis of dental findings including permanent and

diciduous dentitions after 4 years of water fluoridation. J Am Dent A 1951;42:188-195.

Awadia 2000

Awadia A, Birkeland J, Haugejorden O, Bjorvatn K. An attempt to explain why Tanzanian children drinking water containing 0.2 or 3.6 mg fluoride per liter exhibit a similar level of dental fluorosis. Clinical Oral Investigations 2000;4(4):238-44.

Awadia A, Birkeland J, Haugejorden O, Bjorvatn K. Caries experience and caries predictors--a study of Tanzanian children consuming drinking water with different fluoride concentrations.. Clinical Oral Investigations 2002;6(2):98-103.

Azcurra 1995

Azcurra A, Battellino L, Calamari S, de Cattoni S, Kremer M, Lamberghini F. [Dental health status of students living in places supplied with drinking water of very high and very low levels of fluorides]. Rev Saude Publica 1995;29(5):367-75.

Backer-Dirks 1961

Backer-Dirks O, Houwink B, Kwant G. The results of 6 1/2 years of artificial fluoridation of drinking water in the Netherlands. The Tiel-Culemborg experiment. Arch Oral Biol 1961;5:284-300.

Beal 1971

Beal J, James P. Dental caries prevalence in 5 year old children following five and a half years of water fluoridation in Birmingham. Brit Dent J 1971;130(7):284-8.

Beal 1981

Beal J, Clayton M. Fluoridation a clinical survey in Corby and Scunthorpe England UK. Public Health 1981;95(3):152-160.

Beltran-Aguilar 2002

Beltran-Aguilar E, Griffin S, Lockwood S. Prevalence and trends in enamel fluorosis in the United States from the 1930s to the 1980s. Journal of the American Dental Association 2002;133(2):157-65.

Birkeland 2005

Birkeland J, Ibrahim Y, Ghandour I, Haugejorden O. Severity of dental caries among 12-year-old Sudanese children with different fluoride exposure. Clinical Oral Investigations 2005;9(1):46-51.

Blinkhorn (unpublished)

Unpublished data only

Blinkhorn A, Byun R, Metha P, Kay M. A four year assessment of a new water fluoridation scheme in New South Wales, Australia. (Unpublished).

Booth 1991

Booth I, Mitropoulos C, Worthington H. A comparison between the dental health of 3-year old childrenliving in fluoridated Huddersfield and non-fluoridated Dewsbury in 1989. Comm Dent Health 1991;9:151-157.

Brothwell 1999

Brothwell DJ, Limeback H. Fluorosis risk in grade 2 students residing in a rural area with widely varying natural fluoride. Community Dent Oral Epidemiol 1999;27(2):130-136.

Brown 1965

Brown H, McLaren H, Poplove M. The Brantford-Sarnia-Stratford Fluoridation Caries Study - 1959 Report. J. Canad. Dental Assoc 1960;26(3):131-42.

Brown H, Poplove M. The Brantford-Sarnia-Stratford Fluoridation Caries Study: Final Survey 1963. Can J Pub Health 1965;56(8):319-324.

Butler 1985

Butler WJ, Segreto V, Collins E. Prevalence of dental mottling in school-aged lifetime residents of 16Texas communities. Am J Public Health 1985;75(12):1408-12.

Chandrashekar 2004

Chandrashekar J, Anuradha K. Prevalence of dental fluorosis in rural areas of Davangere, India. International Dental Journal 2004;54(5):235-9.

Chen 1989

Chen B. An epidemiological study on dental fluorosis and dental caries prevalence in communitieswith negligible, optimal and above-optimal fluoride concentrations in drinking water supplies. Chin DentJ 1989;8:117-27.

Chen 1993

Chen W, Xu R, Chen G, Zao J, Chen J,. Institution: health and Epidemic Prevention Station of Guangdong Province G. Changes in the prevalence of endemic fluorosis after changing water sources in two villages in Guangdong, China.. Bulletin of Environmental Contamination and Toxicology 1993;51(4):479-482.

Clark 1993

Clark D, Hann H, Williamson M, Berkowitz J.. Aesthetic concerns of children and parents inrelation to different classifications of the tooth surface iIndex of fluorosis. Community Dent OralEpidemiol 1993;21(6):360-4.

Clarkson 1989

Clarkson J, O'Mullane D. A modified DDE index for use in epidemiological studies of enamel defects. J Dent Res 1989;68(3):445-50.

Clarkson 1992

Clarkson J, O'Mullane D. Prevalence of enamel defects-fluorosis in fluoridated and non-fluoridatedareas in Ireland. Community Dent Oral Epidemiol 1992;20(4):196-9.

Cochran 2004

Cochran J, Ketley C, Arnadóttir I, Fernandes B, Koletsi-Kounari H, Oila A-M, et al. A comparison of the prevalence of fluorosis in 8-year-old children from seven European study sites using a standardized methodology. Community Dentistry and Oral Epidemiology 2004;32 Suppl 1:28-33.

Colquhoun 1984

Colquhoun J. Disfiguring dental fluorosis in Aukland, New Zealand. Fluoride 1984;17:234-242.

Correia Sampaio 1999

Correia Sampaio F, Ramm von der Fehr F, Arneberg P, Petrucci Gigante D, Hatloy A. Dental fluorosisand nutritional status of 6- to 11-year-old children living in rural areas of Paraiba, Brazil. Caries Res 1999;33(1):66-73.

Cutress 1985

Cutress T, Suckling G, Pearce E. Defects in tooth enamel in children in fluoridated and non-fluoridatedwater areas of the Auckland Region. NZ Dent J 1985;81:12-19.

Cypriano 2003

Cypriano S, Pecharki GD, de Sousa Mda L, Wada RS. [Oral health of schoolchildren residing in areas with or without water fluoridation in Sorocaba, Sao Paulo State, Brazil] [Portuguese]. Cadernos de Saude Publica 2003;19(4):1063-71.

de Crousaz 1982

de Crousaz P. Observations on enamel opacities in Switzerland in relation to water or salt fluoridation. SSO Schweiz Monatsschr Zahnheilkd 1982;92(4):332-44.

DHSS England 1969

DHSS Scottish Office, Welsh Office, Ministry of Housing and Local Government. The fluoridation studies in the United Kingdom and results achieved after 11 years. A report of the Committee on Research into Fluoridation. London: Her Majesty's Stationary Office. Reports on Public Health Medical Subjects 1969;No. 122.

Ministry of Health, Scottish Office & Ministry of Housing and Local Government. The Conduct of the Fluoridation Studies and the Results Achieved after Five Years. Reports on Public Health and Medical Subjects 1962;105(London, HMSO).

DHSS Scotland 1969

DHSS Scottish Office, Welsh Office, Ministry of Housing and Local Government. The fluoridation studies in the United Kingdom and results achieved after 11 years. A report of the Committee on Research into Fluoridation. London: Her Majesty's Stationary Office. Reports on Public Health Medical Subjects 1969;No. 122.

Ministry of Health, Scottish Office & Ministry of Housing and Local Government. The Conduct of the Fluoridation Studies and the Results Achieved after Five Years. Reports on Public Health and Medical Subjects 1962;105(London, HMSO).

DHSS Wales 1969

DHSS Scottish Office, Welsh Office, Ministry of Housing and Local Government. The fluoridation studies in the United Kingdom and results achieved after 11 years. A report of the Committee on Research into Fluoridation. London: Her Majesty's Stationary Office. Reports on Public Health Medical Subjects 1969;No. 122.

Ministry of Health, Scottish Office & Ministry of Housing and Local Government. The Conduct of the Fluoridation Studies and the Results Achieved after Five Years. Reports on Public Health and Medical Subjects 1962;105(London, HMSO).

Downer 1994

Blinkhorn A, Attwood D, Gavin G, O'Hickey S. Joint epidemioological survey on dental health of 12-year-old school children in Dublin and Glasgow. Community Dent Oral Epidemiol 1992 Oct;20(5):307-8.

Downer M, Blinkhorn A, Holt R, Wight C, Attwood D. Dental caries experience and defects ofdental enamel among 12-year-old children in north London, Edinburgh, Glasgow and Dublin. Community Dent Oral Epidemiol 1994;22(Pt1):283-5.

Driscoll 1983

Driscoll W, Horowitz H, Meyers R, Heifetz S, Kingman A, Zimmerman E. Prevalence of dentalcaries and dental fluorosis in

areas with optimal and above-optimal water fluoride concentrations. J Am Dent Assoc 1983;107(1):42-7.

Ekanayake 2002

Ekanayake L, van der Hoek W. Dental caries and developmental defects of enamel in relation to fluoride levels in drinking water in an arid area of Sri Lanka. Caries Research 2002;36(6):398-404.

Eklund 1987

Eklund S, Ismail A, Burt B, Calderon J. High-fluoridated drinking water, fluorosis and dental caries inadults [J Am Dent Assoc]. 1987 114;March(324-328).

Ellwood 1995

Ellwood R, O'Mullane D. Dental enamel opacities in three groups with varying levels of fluoride intheir drinking water. Caries Res 1995;29(2):137-42.

Ellwood 1996

Ellwood R, O'mullane D. The association between developmental enamel defects and caries inpopulations with and without fluoride in their drinking water. J Pub Health Dent 1996;56(2):76-80.

Ermis 2003

Ermis R, Koray F, Akdeniz B. Dental caries and fluorosis in low- and high-fluoride areas in Turkey. Quintessence International 2003;34(5):354-60.

Firempong 2013

Firempong C, Nsiah K, Awunyo-Vitor D, Dongsogo J. Soluble fluoride levels in drinking water-a major risk factor of dental fluorosis among children in Bongo community of Ghana. Ghana medical journal 2013;47(1):16-23.

Forrest 1956

Forrest J. Caries incidence and enamel defects in areas with different levels of fluoride in drinkingwater Br Dent J;1956(100):195-200.

Forrest 1965

Forrest J, James P. A blind study of enamel opacities and dental caries prevalence after eightyears of fluoridation of water. Br Dent J 1965;119(7):319-22.

Franzolin 2008

Franzolin Sde O, Goncalves A, Padovani C, Francischone L, Marta S. Epidemiology of fluorosis and dental caries according to different types of water supplies. Ciencia & Saude Coletiva 2008;15(Suppl 1):1841-7.

Garcia-Perez 2013

Garcia-Perez A, Borges-Yanez A. Fluorosis and Dental Caries in Mexican Schoolchildren Residing in Areas with Different Water Fluoride Concentrations and Receiving Fluoridated Salt. Caries research 2013;47(4):299-308.

Gaspar 1995

Gaspar M, Pereira A, Moreira B. Non-fluorosis and dental fluorosis opacities in areas with lower (0.2 ppm F) and optimum (0.7 ppm F) fluoride concentration in drinking water [Opacidades de esmalte de origem não fluorótica e fluorose dentária em áreas com baixa (0,2 ppm F) e ótima (0,7 ppm F) concentrações de flúor nas águas de abastecimento público]. Rev Bras Odontol 1995;52(2):13-8.

Goward 1982

Goward P. Mottling on deciduous incisor teeth. A study of 5-year-old Yorkshire children from districts with and without fluoridation. Br Dent J 1982;153(10):367-9.

Gray 2001

Gray M, Davies-Slowik J. Changes in the percentage of 5-year-old children with no experience of decay in Dudley towns since the implementation of fluoridation schemes in 1987. British Dental Journal 2001;190(1):30-2.

Gray M, Langford K. Notes on the results of the studies of 5 year old children conducted in the west Midland since 1985. Unpublished report 2000.

Grimaldo 1995

Grimaldo M, Borja Aburto VH, Ramirez AL, Ponce M, Rosas M, Diaz Barriga F. Endemic fluorosis inSan Luis Potosi, Mexico. I. Identification of risk factors associated with human exposure to fluoride. Environ Res 1965;68(1):25-30.

Grobler 1986

Grobler S, Vanwyk C, Kotze D. Relationship between enamel fluoride levels, degree of fluorosis and caries experience in communities with a nearly optimal and a high fluoride level in the drinking water. Caries Res 1986;20(3):284-8.

Grobler 2001

Grobler S, Louw A, van Kotze T. Dental fluorosis and caries experience in relation to three different drinking water fluoride

levels in South Africa. International Journal of Paediatric Dentistry 2001;11(5):372-9.

Guo 1984

Guo M, Hsieh C, Hong Y, Chen R. Effect of water fluoridation on prevalence of dental caries inChung-Hsing New Village Taiwan after 9 years. J Formosan Med Assoc 1984;83(10):1035-43.

Haavikko 1974

Haavikko K, Helle A. The prevalence and distribution of enamel defects in with different fluoridecontents in the drinking water. Proceedings of the Finnish Dental Society 1974;70(5):178-185.

Harding 2005

Harding M, Whelton H, O'Mullane D, Cronin M, Warren J. Primary tooth fluorosis in 5-year-old schoolchildren in Ireland. Eur J Paediatr Dent 2005;6(3):155-61.

Hardwick 1982

Hardwick J, Teasdale J, Bloodworth, G. Caries increments over 4 years in children aged 12 at the start of water fluoridation. British Dental Journal 1982;153(6):217-222.

Heifetz 1988

Heifetz S, Driscoll W, Horowitz H, Kingman A. Prevalence of dental caries and dental fluorosis inareas with optimal and above-optimal water-fluoride concentrations: a 5-year follow-up survey. J AmDent Assoc 1988;116(4):490-5.

Heintze 1998

Heintze s, Bastos J, Bastos R,. Urinary fluoride levels and prevalence of dental fluorosis in three Brazilian cities with differentfluoride concentrations in thedrinking water. Community Dentistry and Oral Epidemiology 1998;26:316-23.

Heller 1997

Heller K, Eklund S, Burt B. Dental caries and dental fluorosis at varying water fluorideconcentrations. J Pub Health Dent 1997;57(3):136-43.

Hernandez-Montoya 2003

Hernandez-Montoya V, Bueno-Lopez JI, Sanchez-Ruelas AM, Garcia-Servin J, Trejo-Vazquez R, Bonilla-Petriciolet A, et al. [Fluorosis and dental decay in children aged 9 to 11 years in the State of Aguascalientes, Mexico]. Revista Internacional de Contaminacion Ambiental 2003;19(4):197-204.

Holdcroft 1999

Holdcroft C. Five year old dental health in England, 1993-94. Unpublished report 1999.

Hong 1990

Hong C, Hong Y, Guo M, Hsieh C, Chen R. Prevalence of mottled enamel after 12 years ofwater fluoridation in Chung-Hsing New Village (Taiwan). J Formosan Med Assoc 1990;89(3):225-30.

Ibrahim 1995

Ibrahim Y, Affan A, Bjorvatn K. Prevalence of dental fluorosis in Sudanese children from two villageswith 0.25 and 2.56 ppm fluoride in the drinking water. Int J Paediatr Dent 1995;5(4):223-9.

Indermitte 2007

Indermitte E, Saava A, Russak S, Kull A. The contribution of drinking water fluoride to the risk of dental fluorosis in Estonia. Environmental Health Risk IV 2007;11:161-70. [10.2495/EHR070171]

Indermitte 2009

Indermitte EE, Saava AA, Karro EE. Exposure to high fluoride drinking water and risk of dental fluorosis in Estonia. International Journal of Environmental Research and Public Health 2009;6(2):710-21.

Ismail 1990

Ismail A, Brodeur J-M, Kavanagh M, Boisclair G, Tessier C, Picotte L. Prevalence of dental caries and dental fluorosis in students, 11-17 years of age, in fluoridated and non-fluoridated cities in Quebec (Canada).. Caries Research 1990;24(2):290-297.

Jackson 1975

Jackson D, James PM, Wolfe WB. Fluoridation in Anglesey. A clinical study. Br Dent J 1975;138(5):165-171.

Jackson 1999

Jackson R. Dental fluorosis in children residing in communities with different water fluoride levels: 33-month follow-up. Pediatric Dentistry 1999;21(4):248-254.

Jolly 1971

Jolly S, Prasad S, Sharma R, Rai B. Human Fluoride Intoxication in Punjab. Flouride 1971;4(2):64-79.

Kanagaratnam 2009

Kanagaratnam S, Schluter P, Durward C, Mahood R, Mackay T. Enamel defects and dental caries in 9-year-old children living in fluoridated and nonfluoridated areas of Auckland, New Zealand. Community Dentistry & Oral Epidemiology 2009;37(3):250-9.

Kotecha 2012

Kotecha P, Patel S, Bhalani K, Shah D, Shah V, Mehta K. Prevalence of dental fluorosis & dental caries in association with high levels of drinking water fluoride content in a district of Gujarat, India. The Indian journal of medical research 2012;135(6):873-7.

Kumar 1999

Kumar J, Swango P. Fluoride exposure and dental fluorosis in Newburgh and Kingston, New York:policy implications. Community Dent Oral Epidemiol 1999;27(3):171-180.

Kumar 2007

Kumar R, Khandare A, Brahmam G, Venkiah K, Reddy C, Sivakumar B. Assessment of current status of fluorosis in north-western districts of Tamil Nadu using community index for dental fluorosis. Journal of human ecology 2007;21(1):27-32.

Kunzel 1976

Kunzel W, Padron F. Caries and dental fluorosis in Cuban children. Caries Res 1976;10(2):104-12.

Kunzel 1997

Kunzel W, Fischer T. Rise and fall of caries prevalence in German towns with different F concentrations in drinking water. Caries Research 1997;31(3):166-73.

Leverett 1986

Leverett D. Prevalence of dental fluorosis in fluoridated and nonfluoridated communities--a preliminaryinvestigation. J Pub Health Dent 1986;46(4):184-7.

Levine 1989

Levine R, Beal J, Flemming C. A photographically recorded assesment of enamel hypoplasia influoridated and non fluoridated areas. Br Dent J 1989;166:249-52.

Lin 1991

Lin F-F, Zhao H-X, Lin J, Jian J-Y.. The relationship of a low-iodine an high-fluoride environment tosubclinical cretinism in Xinjiang. 1991 Xinjiang Institute for Endemic Disease Control and Research,Office of Leading Group for Endemic Disease Control of Hetian Prefectural Committee of theCommunist Party of China and County Health and Endemic Prevention Station, Yutian, Xinjiang.. Unpublished report submitted through NHS CRD web site. 1991.

Loh 1996

Loh, T. Thirty-eight years of water fluoridation – the Singapore scenario. Community Dental Health 1996;13(2):47-50.

Louw 2002

Louw AJ, Grobler SR, van WKTJ. Degree of fluorosis in areas of South Africa with differing levels of fluoride in drinking water. Gen Dent 2002;50(4):352-6.

Machiulskiene 2009

Machiulskiene V, Baelum V, Fejerskov O, Nyvad B. Prevalence and extent of dental caries, dental fluorosis, and developmental enamel defects in Lithuanian teenage populations with different fluoride exposures. European Journal of Oral Sciences 2009;117(2):154-60.

Mackay 2005

Mackay T, Thomson W. Enamel defects and dental caries among Southland children. New Zealand Dental Journal 2005;101(2):35-43.

Macpherson 2007

Macpherson L, Conway D, Gilmour W, Petersson L, Stephen K. Photographic assessment of fluorosis in children from naturally fluoridated Kungsbacka and non-fluoridated Halmstad, Sweden. Acta Odontologica Scandinavica 2007;65(3):149-55.

Mandinic 2009

Mandinic Z, Curcic M, Antonijevic B, Lekic C, Carevic M. Relationship between fluoride intake in Serbian children living in two areas with different natural levels of fluorides and occurrence of dental fluorosis. Food and chemical toxicology : an international journal published for the British Industrial Biological Research Association 2009;47(6):1080-4.

Marya 2010

Marya C, Dahiya V, Gupta A. Prevalence and severity of dental fluorosis in endemic fluoride areas of Haryana, India: An

epidemiologic study [Croatian, English]. Acta Stomatologica Croatica 2010;44(3):152-8.

Masztalerz 1990

Masztalerz A, Masztalerzowa Z, Szymanska M, Tomelka J. Fluoride and teeth [Fluor und Gebif3]. Epidemiologische Untersuchung 1990;51(4):234-7.

Maupome 2001

Maupome G, Clark D, Levy S, Berkowitz J. Patterns of dental caries following the cessation of water fluoridation. Community Dentistry & Oral Epidemiology 2001;29(1):37-47.

Mazzotti 1939

Mazzotti L, Gonzalez Rivera M. Dental fluorosis in Mexico. Rev d Inst salub y enferm trop 1939;1:105-21.

McGrady 2012

McGrady M, Ellwood R, Srisilapanan P, Korwanich N, Worthington H, Pretty I. Dental fluorosis in populations from Chiang Mai, Thailand with different fluoride exposures - Paper 1: assessing fluorosis risk, predictors of fluorosis and the potential role of food preparation. BMC Oral Health 2012 Jun;21(12):16. [10.1186/1472-6831-12-16]

McGrady MG, Ellwood RP, Srisilapanan P, Korwanich N, Taylor A, Goodwin M, et al.. Dental fluorosis in populations from Chiang Mai, Thailand with different fluoride exposures - Paper 2: The ability of fluorescence imaging to detect differences in fluorosis prevalence and severity for different fluoride intakes from water. BMC Oral Health 2012;12:33.

McInnes 1982

McInnes P, Richarson B, Cleaton-Jones P. Comparison of dental fluorosis and cariesin primary teeth of preschool-childrenliving in arid high and low fluoride villages. Community Dentistry and Oral Epidemiology 1982;10:182-6.

Mella 1992

Mella S, Atalah E, Aranda W, Montagna R. Prevalence of Dental Fluorosis in Chile - a Pilot-Study. Revista Medica De Chile 1992;120(8):866-71.

Mella 1994

Mella S, Molina X, Atalah E. Prevalence of Dental Fluorosis and Its Relation With Fluoride Content of Communal Drinking-Water [Prevalencia de fluorosis dental end,mica en relacion alcontenido de fluoruros en las aguas de abasto publico]. Revista Medica De Chile 1994;122(11):1263-70.

Milsom 1990

Milsom K, Mitropoulos C. Enamel defects in 8 year old children in fluoridated and non-fluoridated parts of Cheshire. Caries Res 1990;1990(24):286-9.

Montero 2007

Montero M, Rojas-Sanchez F, et al. "[Dental caries and fluorosis in children consuming water with different fluoride concentrations in Maiquetia, Vargas State, Venezuela]. [Spanish]". Investigacion Clinica 2007;48(1):5-19.

Nanda 1974

Nanda R, Zipkin I, Doyle J, Horowitz H. Factors affecting the prevalence of dental fluorosis in Lucknow, India. Archives of Oral Biology 1974;19:781-92.

Narbutaite 2007

Narbutaite J, Vehkalahti M, Milciuviene S. Dental fluorosis and dental caries among 12-yr-old children from high- and low-fluoride areas in Lithuania. European Journal of Oral Sciences 2007;115(2):137-42.

Narwaria 2013

Narwaria Y, Saksena D. Incidence of dental fluorosis in domestic animals of Shivpuri, Madhya Pradesh, India. J. Environ. Res. Develop July-September 2012;7(1A):426-30.

Narwaria Y, Saksena D. Prevalence of dental fluorosis among primary school children in rural areas of Karera Block, Madhya Pradesh. Indian journal of pediatrics 2013;80(9):718-20.

Nunn 1992

Nunn J, Murray J, Reynolds P, Tabari D, Breckon J. The prevalence of developmental defects ofenamel in 15-16-year-old children residing in three districts (natural fluoride, adjusted fluoride, lowfluoride) in the north east of England. Comm Dent Health 1992;9(3):235-47.

Nunn 1994

Nunn J, Rugg-Gunn A, Ekanayake L, Saparamandu K. Prevalence of developmental defects of enamel with different fluoride and socio-economic groups. International Dental Journal 1994;44:165- 17 3.

Nunn 1994a

Nunn J, Murray J, Reynolds P, Tabari D, Breckon J. The prevalence of developmental defects of enamel in 15-16-year-old

children residing in three districts (natural fluoride, adjusted fluoride, low fluoride) in the north east of England. Comm Dent Health 1992;9(3):235-47.

Ockerse 1941

Ockerse. Fluorosis in Kenhardt and Gordonia districts Cape Province, South Africa. J Am DentAssoc 1941;28:936-941.

Pontigo-Loyola 2008

Pontigo-Loyola A, Islas-Marquez A, Loyola-Rodriguez J, Maupome G, Marquez-Corona M, Medina-Solis C. Dental fluorosis in 12- and 15-year-olds at high altitudes in above-optimal fluoridated communities in mexico. Journal of Public Health Dentistry 2008;68(3):163-6.

Pot 1974

Pot T, Purdell-Lewis D, Groeneveld A. The influence of 17 years of water fluoridation upon the dentition of adults [De invloed van 17 jaren drinkwater-fluoirdering op het gebit van volwassenen]. Ned.T.Tandheelk 1974;81(1):5-12.

Ray 1982

Ray S, Ghosh S, Tiwari I, Nagchaudhuri J, Kaur P, Reddy D. Prevalence of dental fluorosis inrelation to fluoride in drinking water in two villages of Varanasi (U.P.). Indian J Public Health 1982;26(3):173-8.

Riordan 1991

Riordan P, Banks J. Dental fluorosis and fluoride exposure in Western Australia. Journal of Dental Research 1991;70(7):1022-8.

Riordan 2002

Riordan P. Dental fluorosis decline after changes to supplement and toothpaste regimens. Community Dentistry & Oral Epidemiology 2002;30(3):233-40.

Ruan 2005

Ruan J, Yang Z, Wang Z, Astrom A, Bardsen A, Bjorvatn K. Dental fluorosis and dental caries in permanent teeth: rural schoolchildren in high-fluoride areas in the Shaanxi province, China. Acta Odontologica Scandinavica 2005;63(5):258-65.

Rugg-Gunn 1997

Rugg-Gunn A, Al Mohammadi S, Butler T. Effects of fluoride level in drinking water, nutritionalstatus, and socio-economic status on the prevalence of developmental defects of dental enamel inpermanent teeth in Saudi 14-year-old boys. Caries Res 1997;31(4):259-67.

Russell 1951

Russell A, Elvove E. Domestic Water and Dental Caries. A study of the fluoride-dental caries relationship in an adult population. Public Health Reports 1951;66(43):1389-401.

Rwenyonyi 1998

Rwenyonyi M, Birkeland J, Bjorvatn K, Haugejorden O. Dental fluorosis in Ugandans related to fluoride in drinking water and altitude. J Dent Res 1998;77:1299.

Rwenyonyi 1999

Rwenyoyi C, Bjorvatn K, Birkeland J, Haugejorden O. Altitude as a risk Indicator of dental fluorosisin children residing in areas with 0.5 and 2.5 mg fluoride per litre in drinking water. Caries Research 1999;33:267-74.

Saravanan 2008

Saravanan S, Kalyani C, Vijayarani M, Jayakodi P, Felix A, Nagarajan S, et al. Prevalence of dental fluorosis among primary school children in rural areas of chidambaram taluk, cuddalore district, Tamil Nadu, India. Indian journal of community medicine : official publication of Indian Association of Preventive & Social Medicine 2008;33(3):146-50.

Scheinin 1964

Scheinin A, Kalijaervi E, Harjola O, Heikkinen K. Prevalence of Dental Caries and Dental Health in Relation to Variable Concentration of Fluorides in Drinking Water; a Clinical Study On Finnish School-Children. Acta Odontol Scand 1964;22:229-54.

Segreto 1984

Segreto V, Collins E, Camann D, Smith C. A current study of mottled enamel in Texas. J Am DentAssoc 1984;108(1):56-9.

Sellman 1957

Sellman S, Syrrist A, Gustafson G. Fluorine and dental health in Southern Sweden. Odont T 1957;65:61-93.

Selwitz 1995

Selwitz R, Nowjack Raymer R, Kingman A, Driscoll W. Prevalence of dental caries and dentalfluorosis in areas with optimal and above-optimal water fluoride concentrations: a 10-year follow-up survey. J Pub Health Dent 1995;55(2):85-93.

Selwitz 1998

Selwitz R, Nowjack Raymer R, Kingman A, Driscoll W. Dental caries and dental fluorosis amongschoolchildren who were lifelong residents of communities having either low or optimal levels offluoride in drinking water. J Pub Health Dent 1998;58(1):28-35.

Shekar 2012

Shekar C, Cheluvaiah M, Namile D. Prevalence of dental caries and dental fluorosis among 12 and 15 years old school children in relation to fluoride concentration in drinking water in an endemic fluoride belt of Andhra Pradesh. Indian Journal of Public Health 2012;56(2):122-8.

Skotowski 1995

Skotowski M, Hunt R, Levy S. Risk-Factors For Dental Fluorosis in Pediatric Dental Patients. JPub Health Dent 1995;55(3):154-9.

Spadaro 1955

Spadaro O, Pagano V. Fluorosis and dental caries in the community of Barcellona Pozzo di Gotto. Igiene Sanit. Pubbl 1955;11(7-8):403-10.

Stephen 2002

Stephen K, Macpherson L, Gilmour W, Stuart R, Merrett M. A blind caries and fluorosis prevalence study of school-children in naturally fluoridated and nonfluoridated townships of Morayshire, Scotland. Community Dentistry and Oral Epidemiology 2002;30(1):70-9.

Sudhir 2009

Sudhir K, Prashant G, Subba Reddy V, Mohandas U, Chandu G. Prevalence and severity of dental fluorosis among 13- to 15-year-old school children of an area known for endemic fluorosis: Nalgonda district of Andhra Pradesh. Journal of the Indian Society of Pedodontics and Preventive Dentistry 2009;27(4):190-6.

Szpunar 1988

Szpunar S, Burt B. Dental caries, fluorosis and fluoride exposure in Michigan schoolchildren. Journal of Dental Research 1988;67(5):802-6.

Tabari 2000

Tabari E, Ellwood R, Rugg-Gunn A, Evans D, Davies R. Dental fluorosis in permanent incisor teeth in relation to water fluoridation, social deprivation and toothpaste use in infancy. British Dental Journal 2000;189(4):216-20.

Tessier 1987

Tessier C. Effets de la fluoruration de l'eau a Windsor, Que. depuis 7 ans sur les enfants de 6 a 7 ans. Journal Dentaire Du Quebec Janvier 1987;XXIV:17-23.

Tsutsui 2000

Tsutsui A, Yagi M, et al. The prevalence of dental caries and fluorosis in Japanese communities with up to 1.4 ppm of naturally occurring fluoride. Journal of Public Health Dentistry 2000;60(3):147-53.

Venkateswarlu 1952

Venkateswarlu P, Narayanu Rao D, Ranganatha Rao K. Endemic fluorosis: Visakhaptnam and suburban areas; fluorine, mottled enamel and dental caries. Indian J M Res 1952;40(October):535-48.

Vignarajah 1993

Vignarajah S. Dental caries experience and enamel opacities in children residing in urban and ruralareas of Antigua with different levels of natural fluoride in drinking water. Comm Dent Health 1993;10(2):159-66.

Villa 1998

Villa A, Guerrero S, Villalobos J. Estimation of optimal concentration of fluoride in drinking waterunder conditions prevailing in Chile. Community Dent Oral Epidemiol 1998;26(4):249-55.

Vuhahula 2009

Vuhahula E, Masalu J, Mabelya L, Wandwi W. Dental fluorosis in Tanzania Great Rift Valley in relation to fluoride levels in water and in 'Magadi' (Trona). Desalination 2009;248(1-3):610-5.

Wang 1993

Wang. An investigation on the fluoride level in drinking water sources and the condition of fluorosis in some part of South Xinjiang. Endemic Diseases Bulletin 1993;8(3):57-60.

Wang 1999

Wang X, Kawahara K, Guo X. Fluoride contamination of groundwater and its impacts on human health in Inner Mongolia area. Journal of Water Services Research and Technology-Aqua 1999;48(4):146-53.

Wang 2012

Wang C, Gao Y, Wang W, Zhao L, Zhang W, Han H, et al. A national cross-sectional study on effects of fluoride-safe water supply on the prevalence of fluorosis in China. BMJ Open 2012;2(5):2012-001564.

Warnakulasuriya 1992

Warnakulasuriya K, Balasuriya S, Perera P, Peiris L. Determining optimal levels of fluoride in drinking-water for hot, dry climates - a case-study in Sri-Lanka. Community Dentistry and Oral Epidemiology 1992;20(6):364-7.

Warren 2001

Warren J, Levy S, Kanellis M. Prevalence of dental fluorosis in the primary dentition. Journal of Public Health Dentistry 2001;61(2):87-91.

Wenzel 1982

Wenzel A, Thylstrup A, Melsen B. Skeletal development and dental fluorosis in 12--14-year-old Danishgirls from a fluoride and a non-fluoride community. Scand J Dent Res 1982;90(2):83-8.

Whelton 2004

Whelton H, Crowley E, O'Mullane D, Donaldson M, Kelleher V, Cronin M. Dental caries and enamel fluorosis among the fluoridated and non-fluoridated populations in the Republic of Ireland in 2002. Community Dental Health 2004;21(1):37-44.

Whelton 2006

Whelton H, Crowley E, O'Mullane D, Donaldson M, Cronin M, Kelleher V. Dental caries and enamel fluorosis among the fluoridated population in the Republic of Ireland and non fluoridated population in Northern Ireland in 2002. Community Dental Health 2006;23(1):37-43.

Wondwossen 2004

Wondwossen F, Astrom A, Bjorvatn K, Bardsen A. The relationship between dental caries and dental fluorosis in areas with moderate- and high-fluoride drinking water in Ethiopia. Community Dentistry & Oral Epidemiology 2004;32(5):337-44.

Zheng 1986

Zheng C, et al. A Survey of Dental Caries in Guangzhou China After 18 Years of Community Water Fluoridation.. Chin J Prev Med 1986;20(2):79-82.

Zimmermann 1954

Zimmermann. Fluoride and nonfluoride enamel opacities involving fluorosis. Pub Health Rep 1954;69:1115-20.

Excluded studies

Acharya 2003

Acharya S, Anuradha KP. Correlation between water fluoride levels and dental caries in Davangere District, India. Indian Journal of Dental Research 2003;14(3):146-51.

Ajayi 2008

Ajayi DM, Denloye OO, Dosumu OO. The fluoride content of drinking water and caries experience in 15-19 year old school children in Ibadan, Nigeria. African Journal of Medicine & Medical Sciences 2008;37(1):15-9.

Akosu 2008

Akosu TJTJ, Zoakah AIAI. Risk factors associated with dental fluorosis in Central Plateau State, Nigeria. Community Dentistry and Oral Epidemiology 2008;36(2):144-8.

Aldosari 2004

Al Dosari A, Wyne A, Akpata E, Khan N. Caries prevalence and its relation to water fluoride levels among schoolchildren in Central Province of Saudi Arabia. Int Dent J 2004;54(6):424-8.

Aleksejuniene 2004

Aleksejuniene J, Holst D, Balciuniene I. Factors influencing the caries decline in Lithuanian adolescents--trends in the period 1993-2001. European Journal of Oral Sciences 2004;112(1):3-7.

Alimskii 2000

Alimskii AV, Alieva RK. [The indices of caries and dental fluorosis prevalence in schoolchildren born and permanently living in regions of Azerbaijan differing by the level of the drinking water fluorine content] [Russian]. Stomatologiia 2000;79(2):40-2.

Antunes 2004

Antunes JL, Narvai PC, Nugent ZJ. Measuring inequalities in the distribution of dental caries. Community Dentistry & Oral Epidemiology 2004;32(1):41-8.

Anuradha 2002

Anuradha KP, Chadrashekar J, Ramesh N. Prevalence of periodontal disease in endemically flourosed areas of Davangere

Taluk, India. Indian Journal of Dental Research 2002;13(1):15-9.

Archila 2003

Archila L, Bartizek RD, Gerlach RW, Jacobs SA, Biesbrock AR. Dental Caries in School-Age Children Residing in Five Guatemalan Communities. Journal of Clinical Dentistry 2003;14(3):53-8.

ARCPOH 2008

Australian Research Centre for Population Oral Health TUoASA. The benefits of water fluoridation across areas of differing socio-economic status. Australian Dental Journal 2008;53(2):180-3.

Armfield 2004

Armfield JM, Spencer AJ. Consumption of nonpublic water: implications for children's caries experience. Community Dentistry & Oral Epidemiology 2004;32(4):283-96.

Armfield 2005

Armfield JM. Public water fluoridation and dental health in New South Wales. Australian & New Zealand Journal of Public Health 2005;29(5):477-83.

Armfield 2007

Armfield JM, Spencer AJ. Community effectiveness of fissure sealants and the effect of fluoridated water consumption. Community Dental Health 2007;24(1):4-11.

Armfield 2010

Armfield JM. Community effectiveness of public water fluoridation in reducing children's dental disease. Public Health Reports 2010;125(5):655-64.

Arora 2010

Arora A, Evans RW. Dental caries in children: a comparison of one non-fluoridated and two fluoridated communities in NSW. New South Wales Public Health Bulletin 2010;21(11-12):257-62.

Attwood 1988

Attwood D, Blinkhorn A. Trends in dental health of ten-year-old schoolchildren in South-West Scotland UK after cessation of water fluoridation. Lancet 1988;2 (8605):266-7.

Blinkhorn A, Brown M, Attwood D, Downer M. The effect of fluoridation on the dental health of urban Scottish schoolchildren. J Epidemiol Community Health 1981;35:98-101.

Bailie 2009

Bailie RS, Stevens M, Armfield JM, Ehsani JP, Beneforti M, Spencer J. Association of natural fluoride in community water supplies with dental health of children in remote indigenous communities - implications for policy. Australian & New Zealand Journal of Public Health 2009;33(3):205-11.

Baldani 2002

Baldani MH, Narvai PC, Antunes JLF. [Dental caries and socioeconomic conditions in the State of Paraná, Brazil,1996]. Cadernos de saude publica / Ministerio da Saude, Fundacao Oswaldo Cruz, Escola Nacional de Saude Publica 2002;18(3):755-63.

Baldani 2004

Baldani MHMH, Vasconcelos AGGAG, Antunes JLFJL. [Association of the DMFT index with socioeconomic and dental services indicators in the state of Paraná, Brazil]. Cadernos de saude publica / Ministerio da Saude, Fundacao Oswaldo Cruz, Escola Nacional de Saude Publica 2004;20(1):143-52.

Bao 2007

Bao LL, Li YY, Zhang YY. [Dental caries and fluorosis among 12-year-old children with different fluoride exposure in Heilongjiang province]. Shanghai kou qiang yi xue = Shanghai journal of stomatology 2007;16(6):574-7.

Baskaradoss 2008

Baskaradoss JK, Clement RB, Narayanan A. Prevalence of dental fluorosis and associated risk factors in 11-15 year old school children of Kanyakumari District, Tamilnadu, India: a cross sectional survey. Indian Journal of Dental Research 2008;19(4):297-303.

Bihari 2008

Bihari S, Singh KK, Kumar A, Kumar N. Prevalence of fluorosis in Kachhariadih and Muslimtola villages of Nawadah district Bihar: A case study to mitigate sufferings. Fluoride 2008;41(3):248-.

Binbin 2005

Binbin W, Baoshan Z, Hongying W, Yakun P, Yuehua T. Dental caries in fluorine exposure areas in China. Environmental Geochemistry & Health 2005;27(4):285-8.

Blagojevic 2004

Blagojevic D, Stojsin I. [Effects of fluoride in drinking water on health of deciduous teeth] [Serbian]. Medicinski Pregled 2004;57(7-8):323-6.

Blayney 1960

Blayney J. A report on thirteen years of water fluoridation in Evanston, III. J Am Dent Assoc 1960;61:76-9.

Bo 2003

Bo ZZ, Mei HH, Yongsheng ZZ, Xueyu LL, Xuelin ZZ, Jun DD. Distribution and risk assessment of fluoride in drinking water in the west plain region of Jilin province, China. Environmental geochemistry and health 2003;25(4):421-31.

Borinskii 2009

Borinskii Iu N, Rumiantsev VA, Borinskaia E, Beliaev VV. [Fluoride content in potable water and drinks. Connection with dental caries prevention and dental fluorosis] [Russian]. Stomatologiia 2009;88(5):59-63.

Bottenberg 2004

Bottenberg P, Declerck D, Ghidey W, Bogaerts K, Vanobbergen J, Martens L. Prevalence and determinants of enamel fluorosis in Flemish schoolchildren. Caries Research 2004;38(1):20-8.

Bradnock 1984

Bradnock G, Marchment M, Anderson R. Social background fluoridation and caries experience in 5year old population. Br Dent J 1984;156:127-131.

Buchel 2011

Buchel K, Gerwig P, Weber C, Minning P, Wiehl P, Schild S, Meyer J. Prevalence of enamel fluorosis in 12-year-olds in two Swiss cantons. Schweiz Monatsschr Zahnmed 2011;121(7-8):647-56.

Budipramana 2002

Budipramana ES, Hapsoro A, Irmawati ES, Kuntari S. Dental fluorosis and caries prevalence in the fluorosis endemic area of Asembagus, Indonesia. International Journal of Paediatric Dentistry 2002;12(6):415-22.

Burt 2000

Burt BA, Keels MA, Heller KE. The effects of a break in water fluoridation on the development of dental caries and fluorosis. Journal of Dental Research 2000;79(2):761-9.

Buscariolo 2006

Buscariolo IA, Penha SS, Rocha RG. Chronic fluorine intoxication. Prevalence of dental fluorosis in schoolchildren. Revista de Ciencias Farmaceuticas Basica e Aplicada 2006;27(1):83-7.

Buzalaf 2004

Buzalaf MAR, de Almeida BS, Olympio KPK, Cardoso VED, Peres S. Enamel fluorosis prevalence after a 7-year interruption in water fluoridation in Jau, Sao Paulo, Brazil. Journal of Public Health Dentistry 2004;64(4):205-8.

Campain 2010

Campain A, Marino R, Wright F, Harrison D, Bailey D, Morgan M. The impact of changing dental needs on cost savings from fluoridation. Aust Dent J Mar 2010;55(1):37-44.

Carmichael 1980

Carmichael C, Rugg-Gunn A, French A, Cranage J. The effect of fluoridation upon the relationship between caries experience and social class in 5-year old children in Newcastle and Northumberland levels. Br Dent J 1980;150(9-12).

Carmichael 1984

Carmichael C, Rugg-Gunn A, French A, Cranage J. The effect of fluoridation upon the relationship between caries experience and social class in 5-year old children in Newcastle and Northumberland levels. Br Dent J 1980;150:9-12.

French A, Carmichael C, Rugg-gunn A, Furness J. Fluoridation and dental caries experience in 5-year-old children in Newcastle and Northumberland in 1981. Br Dent J Jan 21 1984;156(2):54-7.

Carmichael 1989

Carmichael C, Rugg-Gunn A, Ferrell R. The relationship between fluoridation, social class and caries experience in 5 year old children in Newcastle and Northumberland in 1987. Br Dent J 1989;167:57-61.

Carvalho 2007

Carvalho TS, Kehrle HM, Sampaio FC. Prevalence and severity of dental fluorosis among students from Joao Pessoa, PB, Brazil. Pesquisa Odontologica Brasileira = Brazilian Oral Research 2007;21(3):198-203.

Casey 2000

Casey SE, American Dietetic A. Impact of fluoride on dental health. Dental Assistant 2000;69(2):28-33; quiz 4-5.

Catani 2007

Catani DBDB, Hugo FNFN, Cypriano SS, Sousa MdLRdML, Cury JAJA. [Relationship between fluoride levels in the public water supply and dental fluorosis]. Revista de Saude Publica 2007;41(5):732-9.

Chen 2009

Chen PZ, Yun ZJ, Bian JC, Li HX, Ma AH, Gao HX, et al. Analysis on surveillance outcome of endemic fluorosis in Shandong Province from 1992 to 2006. Chinese Journal of Endemiology 2009;28(5):537-40.

Chen 2012

Chen H, Yan M, Yang X, Chen Z, Wang G, Schmidt-Vogt D, et al. Spatial distribution and temporal variation of high fluoride contents in groundwater and prevalence of fluorosis in humans in Yuanmou County, Southwest China. Journal of hazardous materials 2012;235-236:201-9.

Cheng 2000

Cheng HH, Liang AXA, Elly AA, Ling ZQZ, Li CRC. [Epidemiologic survey of dental fluorosis and caries in school students in Wensu county in Xinjiang]. Shanghai kou qiang yi xue = Shanghai journal of stomatology 2000;9(4):232-4.

Chikte 2002

Chikte U. Water fluoridation is the right thing to do. South African Medical Journal 2002;92(9):709-10.

Ciketic 2010

Ciketic S, Hayatbakhsh M, Doran C. Drinking water fluoridation in South East Queensland: a cost-effectiveness evaluation. Health Promot J Austr 2010;21(1):51-6.

Clark 2006

Clark DCDC, Shulman JDJD, Maupomé GG, Levy SMSM. Changes in dental fluorosis following the cessation of water fluoridation. Community Dentistry and Oral Epidemiology 2006;34(3):197-204.

de Lourdes Azpeitia-Valadez 2009

de Lourdes Azpeitia-Valadez M, Sanchez-Hernandez MA, Rodriguez-Frausto M. [Risk factors for dental fluorosis in children between 6 and 15 years old] [Spanish]. Revista Medica del Instituto Mexicano del Seguro Social 2009;47(3):265-70.

Dini 2000

Dini EL, Holt RD, Bedi R. Prevalence of caries and developmental defects of enamel in 9-10 year old children living in areas in Brazil with differing water fluoride histories. British Dental Journal 2000;188(3):146-9.

Do 2007

Do LG, Spencer AJ. Risk-benefit balance in the use of fluoride among young children. Journal of Dental Research 2007;86(8):723-8.

Dobaradaran 2008

Dobaradaran S, Mahvi AH, Dehdashti S, Abadi DRV. Drinking water fluoride and child dental caries in Dashtestan, Iran. Fluoride 2008;41(3):220-6.

Evans 1995

Evans D, Rugg-Gunn A, Tabari E. The effect of 25 years of water fluoridation in Newcastle assessed in four surveys of 5-year-old children over an 18-year period. British Dental Journal 1995;178(2):60-64.

Evans 2009

Evans RW, Hsiau AC, Dennison PJ, Patterson A, Jalaludin B. Water fluoridation in the Blue Mountains reduces risk of tooth decay. Australian Dental Journal 2009;54(4):368-73.

Faye 2008

Faye M, Diawara CK, Ndiaye KR, Yam AA. [Dental fluorosis and dental caries prevalence in Senegalese children living in a high-fluoride area and consuming a poor fluoridated drinking water] [French]. Dakar Medical 2008;53(3):162-9.

Gillcrist 2001

Gillcrist JA, Brumley DE, Blackford JU. Community fluoridation status and caries experience in children. Journal of Public Health Dentistry 2001;61(3):168-71.

Gushi 2005

Gushi LL, Soares Mda C, Forni TI, Vieira V, Wada RS, de Sousa Mda L. [Dental caries in 15-to-19-year-old adolescents in Sao Paulo State, Brazil, 2002] [Portuguese]. Cadernos de Saude Publica 2005;21(5):1383-91.

Han 2011

Han DH, Kim JB, Bae KH. A Comparison of Dental Caries Status in Cities With or Without Water fluoridation. Epidemiology 2011;22(1):S240-S.

Hobbs 1994

Hobbs D. Annual report of the Director of Dental Public Health to Powys Health Authority. Powys 1994.

Hoffmann 2004

Hoffmann RH, Cypriano S, Sousa Mda L, Wada RS. [Dental caries experience in children at public and private schools from a city with fluoridated water] [Portuguese]. Cadernos de Saude Publica 2004;20(2):522-8.

Hopcraft 2003

Hopcraft M, Morgan M. Dental caries experience in a young adult military population. Australian Dental Journal 2003;48(2):125-9.

Ito 2007

Ito D. A cross-sectional study to compare caries and fluorosis in 7-year-old schoolchildren from a fluoridated area with those in a neighbouring non-fluoridated area in Ontario [MR27307]. Canada: University of Toronto (Canada) 2007.

Jones 1997

Jones C, Taylor G, Woods K, Whittle G, Evans D, Young P. Jarman underprivileged area scores,tooth decay and the effect of water fluoridation. Comm Dent Health 1997;14(3):156-60.

Jones 2000a

Jones C, Worthington H. Water fluoridation, poverty and tooth decay in 12-year-old children. Unpublished, submitted by author 2000.

Jones 2000b

Jones CM. The effect of water fluoridation and social deprivation on tooth decay. International Journal of Health Promotion and Education 2000;38(4):146-50.

Kalsbeek 1993

Kalsbeek H, Kwant G, Groeneveld A, Dirks O, Vaneck A, Theuns H. Caries Experience of 15-Year-Old Children in the Netherlands After Discontinuation of Water Fluoridation. Caries Res 1933;27(3):201-5.

Khan 2004

Khan AA, Whelton H, O'Mullane D. Is the fluoride level in drinking water a gold standard for the control of dental caries? International Dental Journal 2004;54(5):256-60.

Kirkeskov 2010

Kirkeskov L, Kristiansen E, Boeggild H, von Platen-Hallermund F, Sckerl H, Carlsen A, et al. The association between fluoride in drinking water and dental caries in Danish children. Linking data from health registers, environmental registers and administrative registers. Community Dentistry and Oral Epidemiology 2010;38(3):206-12.

Kozlowski 2002

Kozlowski FC, Meneghim MC, Pereira AC, Ambrosano GMB. Dental caries and dental fluorosis prevalence after the water fluoridation. Journal of Dental Research 2002;81:B160-B.

Kukleva 2007

Kukleva MP, Isheva AV, Kondeva VK, Dimitrova MM, Petrova SG. Prevalence of dental fluorosis among 4- to 14-year-old children from the town of Dimitrovgrad (Bulgaria). Folia medica 2007;49(1-2):25-31.

Kumar 2001

Kumar JV, Green EL, Coluccio C, Davenport R. Oral health status of second grade school children in upstate New York. New York State Dental Journal 2001;67(2):26-31.

Kunzel 2000

Kunzel W, Fischer T, Lorenz R, Bruhmann S. Decline of caries prevalence after the cessation of water fluoridation in the former East Germany. Community Dentistry & Oral Epidemiology 2000;28(5):382-9.

Kunzel 2000a

Kunzel W, Fischer T. Caries prevalence after cessation of water fluoridation in La Salud, Cuba. Caries Research 2000;34(1):20-5.

Lee 2004

Lee M, Dennison PJ. Water fluoridation and dental caries in 5- and 12-year-old children from Canterbury and Wellington. New Zealand Dental Journal 2004;100(1):10-5.

Liu 2006

Liu SR, Li YX, Wu FP. Effect Assessment of Water Supply Improvement in the Fluorosis Prevalent Regions in Meizhou, China. Journal of Environment and Health 2006;23(1):55-7.

Liu 2009

Liu X-L, Ll X-Q. Drinking Water Type Fluorosis Control and Prevention in Shaanxi Province. Journal of Environment and Health 2009;26(11):994-5.

Mandinic 2010

Mandinic Z, Curcic M, Antonijevic B, Carevic M, Mandic J, Djukic-Cosic D, et al. Fluoride in drinking water and dental fluorosis. Science of the Total Environment 2010;408(17):3507-12.

Meyer-Lueckel 2006

Meyer-Lueckel H, Paris S, Shirkhani B, Hopfenmuller W, Kielbassa AM. Caries and fluorosis in 6- and 9-year-old children residing in three communities in Iran. Community Dentistry & Oral Epidemiology 2006;34(1):63-70.

Mondal 2012

Mondal NK, Pal KC, Kabi S. Prevalence and severity of dental fluorosis in relation to fluoride in ground water in the villages of Birbhum district, West Bengal, India. Environmentalist 2012;32(1):70-84.

Murray 1984

Murray J, Gordon P, Carmichael C, French A, Furness J. Dental caries and enamel opacities in 10-year old children in Newcastle. Br Dent J 1984;156:255-8.

Murray 1991

Murray J, Breckon J, Reynolds P, Tabari E, Nunn J.. The effect of residence and social class on dental caries experience in 15-16 year old children living in three towns (natural fluoride, adjusted fluoride and low fluoride) in the north east of England. Br Dent J 1991 Nov 23;171(10):319-22.

Nayak 2009

Nayak B, Roy MM, Das B, Pal A, Sengupta MK, De SP, et al. Fluoride Contamination of Groundwater: HEALTH EFFECTS OF GROUNDWATER FLUORIDE CONTAMINATION. Fluoride 2009;42(3):245-6.

Ncube 2005

Ncube EJ, Schutte CF. The Occurrence of Fluoride in South African Groundwater: A Water Quality and Health Problem. Water S A 2005;31(1):35-.

Nirgude 2010

Nirgude ASAS, Saiprasad GSG, Naik PRPR, Mohanty SS. An epidemiological study on fluorosis in an urban slum area of Nalgonda, Andhra Pradesh, India. Indian Journal of Public Health 2010;54(4):194-6.

Niu 2012

Niu ZH, Zhao JL. Analysis of monitoring data of drinking-water borne endemic fluorosis in Xinzhou of Shanxi province in 2010. Chinese Journal of Endemiology 2012;31(3):321-4.

Pandey 2002

Pandey J, Nagda G. Prevalence of Fluorosis in Ten Villages of Udaipur District of Rajasthan. Indian Journal of Environmental Sciences 2002;6(2):109-.

Pandey 2005

Pandey J. Fluoride distribution and fluorosis in some rural areas of Udaipur, Rajashtan. Journal International Medical Sciences Academy 2005;18(3):133-5.

Pandey 2010

Pandey AA. Prevalence of fluorosis in an endemic village in central India. Tropical Doctor 2010;40(4):217-9.

Peres 2006

Peres M, Antunes J, Peres K. Is water fluoridation effective in reducing inequalities in dental caries distribution in developing countries? Recent findings from Brazil. Sozial- und Praventivmedizin 2006;51(5):302-10.

Provart 1995

Provart S, Carmichael C. The relationship between caries, fluoridation and material deprivation in five year-old children in Country Durham. Comm Dent Health 1995;12:200-203.

Quan 2003

Quan DTH, Hung HT, Thanh TAD, Minh ND, Thien VC, Hai HD. Dental caries status of 12 and 15 year-old children after twelve years of water fluoridation in Ho Chi Minh City. Journal of Dental Research 2003;82:658-.

Ramires 2006

Ramires II, Maia LPLP, Rigolizzo DdSDS, Lauris JRPJR, Buzalaf MARMA. [External control over the fluoridation of the public water supply in Bauru, SP, Brazil]. Revista de Saude Publica 2006;40(5):883-9.

Rihs 2008

Rihs LBLB, de Sousa MdLRML, Wada RSRS. Root caries in areas with and without fluoridated water at the Southeast region of São Paulo State, Brazil. Journal of applied oral science : revista FOB 2008;16(1):70-4.

Riley 1999

Riley J, Lennon M, Ellwood R. The effect of water fluoridation and social inequalities on dental caries in 5-year-old children. Intl J Epidemiol 1999;28:300-305.

Ruan 2004

Ruan J-pJP, Liu Z-qZQ, Song J-lJL, Bjorvatn KK, Ruan M-sMS. [Effect of drinking water change upon the dental fluorosis]. Zhonghua kou qiang yi xue za zhi = Zhonghua kouqiang yixue zazhi = Chinese journal of stomatology 2004;39(2):139-41.

Rugg-Gun 1977

Rugg-Gunn A, Carmichael C, French A, Furness J. 1977;142:395-402.. Fluoridation in Newcastle and Northumberland: a clinical study of five year old children. Br Dent J 1977;142:395-402.

Sagheri 2007

Sagheri D, McLoughlin J, Clarkson JJ. A comparison of dental caries levels in two communities with different oral health prevention strategies stratified in different social classes. Journal of Public Health Dentistry 2007;67(1):1-7.

Sales-Peres 2002

Sales-Peres SH, Bastos JR.. [An epidemiological profile of dental caries in 12-year-old children residing in cities with and without fluoridated water supply in the central western area of the State of Sao Paulo, Brazil].[Portuguese]. Cadernos de Saude Publica 2002;18(5):1281-8.

Saliba 2008

Saliba NA, Moimaz SA, Casotti CA, Pagliari AV. Dental caries of lifetime residents in Baixo Guandu, Brazil, fluoridated since 1953--a brief communication. Journal of Public Health Dentistry 2008;68(2):119-21.

Sampaio 2000

Sampaio FCF, Hossain ANA, von der Fehr FRF, Arneberg PP. Dental caries and sugar intake of children from rural areas with different water fluoride levels in Paraíba, Brazil. Community Dentistry and Oral Epidemiology 2000;28(4):307-13.

Seppa 1998

Seppa L, Karkkainen S, Hausen H. Caries in the primary dentition, after discontinuation of water fluoridation, among children receiving comprehensive dental care. Community Dentistry & Oral Epidemiology 2000;28(4):281-8.

Seppa L, Larkkainen S, Hausen H. Caries frequency in permanent teeth beforeand after discontinuation of water fluoridation. Community Dentistry and Oral Epidemiology 1998;26:256-62.

Shitumbanuma 2007

Shitumbanuma V, Tembo F, Tembo JM, Chilala S, Ranst E. Dental fluorosis associated with drinking water from hot springs in Choma district in southern province, Zambia. Environmental Geochemistry and Health 2007;29(1):51-8.

Sohu 2007

Sohu D, Sharma JD, Jain P. GROUNDWATER QUALITY OF VILLAGES OF SANGANER TEHSIL: FOCUS ON FLUORIDE AND FLUOROSIS. Journal of Ecotoxicology & Environmental Monitoring 2007;17(3):227-33.

Spencer 2008

Spencer AJ, Do LG. Changing risk factors for fluorosis among South Australian children. Community Dentistry & Oral Epidemiology 2008;36(3):210-8.

Sun 2007

Sun DJ. Surveillance on endemic fluorosis of drinking water type in China: a two-year report of 2003 and 2004. Chinese Journal of Epidemiology 2007;26(2):161-4.

Tagliaferro 2004

Tagliaferro EP, Cypriano S, de Sousa Mda L, Wada RS. Caries experience among schoolchildren in relation to community fluoridation status and town size. Acta Odontologica Scandinavica 2004;62(3):124-8.

Tiano 2009

Tiano AV, Moimaz SA, Saliba O, Saliba NA. Dental caries prevalence in children up to 36 months of age attending daycare centers in municipalities with different water fluoride content. Journal of Applied Oral Science 2009;17(1):39-44.

Tickle 2003

Tickle M, Milsom KM, Jenner TM, Blinkhorn AS. The geodemographic distribution of caries experience in neighboring fluoridated and nonfluoridated populations. Journal of Public Health Dentistry 2003;63(2):92-8.

Vuhahula 2008

Vuhahula EAM, Masalu JRP, Mabelya L, Wandwi WBC, editors. Dental fluorosis in Tanzania Great Rift Valley in relation to fluoride levels in water and in `Magadi' (Trona). Water and sanitation in international development and disaster relief; WSIDDR; 2008 May;Edinburgh:Elsevier, 2009.

Wang 2005

Wang BB, Zheng BS, Wang HY, Ping YK, Tao YH. Relationship between fluorine concentration in drinking water and dental health of residents in fluorine exposure areas in Bazhou city. Chinese Journal of Endemiology 2005;24(1):70-2.

Wang 2008

Wang JH, Zheng ZX, Liu W, Liu Y, Gao R, Li ZR, et al. Endemic fluorosis: prevalence and prevention in Liaoning Province. Chinese Journal of Epidemiology 2008;27(6):663-7.

Wei 2010

Wei SY, Lu Q, Ding P, Ding SR, Pu GL, Chen P, et al. Outcome analysis on drinking-water type endemic fluorosis in Qinghai in 2008. Chinese Journal of Endemiology 2010;29(1):77-9.

Wong 2006

Wong HM, McGrath C, Lo ECM, King NM. Association between Developmental Defects of Enamel and Different Concentrations of Fluoride in the Public Water Supply. Caries Research 2006;40(6):481-6.

Wongdem 2001

Wongdem JGJ, Aderinokun GAG, Ubom GAG, Sridhar MKM, Selkur SS. Dental fluorosis and fluoride mapping in Langtang town, Nigeria. African journal of medicine and medical sciences 2001;30(1-2):31-4.

Wragg 1999

Wragg K. Dental Caries Experience of 5 year olds in South Derbyshire. Unpublished 1992.

Wu 2006

Wu JQ, Peng JW, Li TL, Wu HY, Li BL, Miao LJ. Investigating the current water-related endemic fluorosis in Shaoguan City of Guangdong Province. Chinese Journal of Epidemiology 2006;25(5):535-6.

Wu 2008

Wu JQ, Dai CF, Wu HY, Feng GH, Du GX. Results of the national surveillance on endemic fluorosis in Fengshun County of Guangdong Province in 2005 - 2006. Chinese Journal of Epidemiology 2008;27(6):673-4.

Zhu 2009

Zhu CS, Chen YF. Investigation of drinking water fluoride and fluorosis in Shaanxi Province from 2005 to 2007. Journal of Chinese Integrative Medicine 2009;7(5):181-3.

Zietsman 2003

Zietsman S. The relation between the fluoride content of drinking water and the occurrence of dental fluorosis in selected areas in South Africa: A medical geographical study [0807245]. South Africa: University of South Africa (South Africa) 2003.

Zimmermann 2003

Zimmermann E, Salas A, Maino A, Gaitieri M, Novarese I, Cachia A, et al. Caries experience in children living in areas supplied with artificially fluoridated drinking water (Rosario, Santa Fe). Journal of Dental Research 2003;82:24-.

Studies awaiting classification

Agarwal 2014

Agrawal M, Agrawal S, Adyanthaya B, Gupta H, Bhargava N, Rastogi R. Prevalence and severity of dental fluorosis among patients visiting a dental college in Jaipur, Rajasthan. Indian Journal of Research in Pharmacy and Biotechnology 2014;2(4):1339-44.

Berndt 2010

Berndt Ch, Meller Ch, Poppe D, Splieth Ch. Fluorosis, caries and oral hygiene in schoolchildren on the Ombili Foundation in Namibia. Oral Health Prev Dent 2010;8:269-75.

Hussain 2013

Hussain I, Arif M, Hussain J. Fluoride contamination in drinking water in rural habitations of Central Rajasthan, India. Environ Monit Assess 2012;184:5151-8.

Marya 2014

Marya C, Ashokkumar B, Dhingra S, Dahiya V, Gupta A. Exposure to high-fluoride drinking water and risk of dental caries and dental fluorosis in Haryana, India. APJPH 2014;26(3):295-303.

Shanthi 2014

Shanthi M, Reddy B, Venkataramana V, Gowrisankar S, Reddy B, Chennupati S. Relationship between drinking water fluoride levels, dental fluorosis, dental caries and associated risk factors in 9-12 years old school children of Nelakondapally Mandal of Khammam district, Andhra Pradesh, India: a cross-sectional survey. Journal of International Oral Health 2014;6(3):106-10.

Skinner 2013

Skinner J, Johnson G, Phelan C, Blinkhorn A. Dental caries in 14- and 15-year-olds in New South Wales, Australia. BMC Public Health 2013;13:1060.

Slade 2013

Slade G, Sanders A, Do L, Roberts-Thomson K, Spencer A. Effects of fluoridated drinking water on dental caries in Australian Adults. J Dent Res 2013;92:376.

Sukhabogi 2014

Sukhabogi J, Parthasarathi P, Anjum S, Shekar B, Padma C, Rani A. Dental fluorosis and dental caries prevalence among 12 and 15-year-old school children in Nalgonda district, Andhra Pradesh, India. Anals of Medical and Health Sciences Research Sep-Oct 2014;4(3):245-52.

Vilasrao 2014

Vilasrao G, Kamble K, Sabat R. Child fluorosis in Chhattisgarh, India: a community-based survey. Indian pediatrics November 15, 2014;51:903-5.

Wang 2014

Wang Y, Wang C-S, Xia Y-T, Wang P-H. Investigation on drinking water-borne endemic fluorosis in Jiangsu, 2013. Journal of Environment and Health 2014;31(6):516-8.

Wong 2014

Wong H, McGrath C, King N. Diffuse opacities in 12-year-old Hong Kong children--four cross-sectional surveys. Community dentistry and oral epidemiology 2014;42(1):61-9.

Ongoing studies

Other references

Additional references

ADA 2013

American Dental Association. Surgeon General Endorses Fluoridation. www.ada.org/news/8532.aspx (accessed August 2013).

Bagramian 2009

Bagramian RA, Garcia-Godoy F, Volpe AR. The global increase in dental caries. A pending public health crisis. American Journal of Dentistry 2009;22(1):3-8.

Browne 2005

Browne D, Whelton H, O'Mullane D. Fluoride metabolism and fluorosis. Journal of Dentistry 2005;33(3):177-86.

Burt 1999

Burt BA, Eklund SA. Dentistry, Dental Practice and the Community. Philadelphia, Pennsylvania: WB Saunders Company, 1999.

CDC 2005

Centers for Disease Control and Prevention (CDC). Surveillance for dental caries, dental sealants, tooth retention, edentulism and enamel fluorosis - United States, 1988-1994 and 1999-2002. MMWR Surveillance Summaries 2005;54(3):1-44.

CDC 2008

Centers for Disease Control and Prevention (CDC). 2008 Water Fluoridation Statistics. www.cdc.gov/fluoridation/statistics/2008stats.htm (accessed March 2012).

Cheng 2007

Cheng KK, Chalmers I, Sheldon TA. Adding fluoride to water supplies. BMJ 2007;335(7622):699-702.

Cochran 2004a

Cochran J, Ketley C, Sanches L, Mamai-Homata E, Oila A-M, Arnadottir I et al. A standardized photographic method for evaluating enamel opacities including fluorosis. Community Dent Oral Epidemiol April 2004;32(Suppl 1):19-27.

Dean 1941

Dean T, Jay P, Arnold F, Elvove E. Domestic water and dental caries. II. A study of 2832 white children, aged 12-14 years, of

8 suburban communities, including Lactobacillus acidophilus studies of 1761 children. Public Health Reports 1941;56(15):761-92.

Depatment of National Health and Welfare 1952

Dental Health Division and Research and Statistics Division. Department of National Health and Welfare, Ottawa: A suggested Methodology for Fluoridation Surveys in Canada. 1952.

Dye 2007

Dye BA, Tan S, Smith V, Lewis BG, Barker LK, Thornton-Evans G, et al. Trends in Oral Health Status: United States, 1988-1994 and 1999-2004. Vital and Health Statistics Series. Series 11, No 248. National Center for Health Statistics 2007:1-92.

European Union 1998

European Union 1998 Council Directive 98/83/EC. On the Quality of Water Intended for Human Consumption. Official Journal of the European Communities 1998;L330/42.

Feitosa 2005

Feitosa S, Colares V, Pinkham J. The psychosocial effects of severe caries in 4-year-old children in Recife, Pernambuco, Brazil. Cadernos de Saúde Pública 2005;21(5):1550-6.

Frieden 2010

Frieden TR. A framework for public health action: the health impact pyramid. American Journal of Public Health 2010;100(4):590-5.

Higgins 2011

Higgins JPT, Green S (editors). Cochrane Handbook for Systematic Reviews of Interventions Version 5.1.0 [updated March 2011]. The Cochrane Collaboration, 2011. Available from www.cochrane-handbook.org.

Kearney 2010

Kearney J. Food consumption trends and drivers. Phil. Trans. R. Soc. B 2010;365:2793–2807.

Knapp 2003

Knapp G, Hartung J. Improved tests for a random effects meta-regression with a single covariate. Statististics in Medicine 2003;22(17):2693-710.

Landis 1977

Landis JR, Koch GG. An application of hierarchical kappa-type statistics in the assessment of majority agreement among multiple observers. Biometrics 1977;33(2):363-74.

Leclercq 1987

Leclercq M, Barmes D, Sardo-Infirri J. Oral Health: Global trends and projections. World health statistics quarterly (Wld hlth statist quart) 1987;40:116-28.

Loke 2007

Loke YK, Price D, Herxheimer A, Cochrane Adverse Effects Methods Group. Systematic reviews of adverse effects: framework for a structured approach. BMC Medical Research Methodology 2007;7:32.

Marinho 2003

Marinho V, Higgins J, Logan S, Sheiham A. Topical fluoride (toothpastes, mouthrinses, gels or varnishes) for preventing dental caries in children and adolescents. Cochrane Database of Systematic Reviews 2003;(4). [Art. No.: CD002782 DOI: 10.1002/14651858.CD002782]

Marinho 2013

Marinho VCC, Worthington HV, Walsh T, Clarkson JE. Fluoride varnishes for preventing dental caries in children and adolescents. Cochrane Database of Systematic Reviews 2013, Issue 7. Art. No.: CD002279 DOI: 10.1002/14651858.CD002279.pub2.

McDonagh 2000

McDonagh M, Whiting P, Bradley M, Cooper J, Sutton A, Chestnutt I, et al. A Systematic Review of Community Water Fluoridation. NHS Centre for Reviews and Dissemination, University of York 2000.

MRC 2000

Medical Research Council (MRC). Working Group Report: Water Fluoridation and Health. www.mrc.ac.uk/pdf-publications-water_fluoridation_report.pdf.

NHMRC 2007

National Health and Medical Research Council (NHMRC), Australian Government. A Systematic Review of the Efficacy and Safety of Water Fluoridation. Canberra: National and Medical Research Council 2007.

OECD 2011

Organisation for Economic Co-operation and Development (OECD). Health at a Glance 2011: OECD Indicators. OECD Publishing 2011.

Pendrys 2001

Pendrys DG. Fluoride ingestion and oral health. Nutrition 2001;17(11-12):979-80.

Petersen 2003

Petersen PE. The World Oral Health Report 2003: continuous improvement of oral health in the 21st century--the approach of the WHO Global Oral Health Programme. Community Dentistry and Oral Epidemiology 2003;31 Suppl 1:3-23.

Petersen 2004

Petersen PE, Peng B, Tai B, Bian Z, Fan M. Effect of a school-based oral health education programme in Wuhan City, Peoples Republic of China. International Dental Journal 2004;54(1):33-41.

Rozier 1994

Rozier RG. Epidemiologic indices for measuring the clinical manifestations of dental fluorosis: overview and critique. Advances in Dental Research 1994;8(1):39-55.

Selwitz 2007

Selwitz RH, Ismail AI, Pitts NB. Dental caries. Lancet 2007;369(9555):51-9.

Sheiham 2005

Sheiham A. Oral health, general health and quality of life. Bulletin of the World Health Organization 2005;83(9):644.

Slimani 2009

Slimani N, Deharveng G, Southgate DAT, Biessy C, Chajes V, van Bakkel MME et al. Contribution of highly industrially processed foods to the nutrient intakes and patterns of middle-aged populations in the European Prospective Investigation into Cancer and Nutrition study. European Journal of Clinical Nutrition 2009;63:S206–S225.

SucDen 2015

SucDen. World Sugar Consumption. http://www.sucden.com/statistics/4_world-sugar-consumption (accessed February 2015).

Ten Cate 1991

Ten Cate JM, Featherstone JD. Mechanistic aspects of the interactions between fluoride and dental enamel. Critical Reviews in Oral Biology and Medicine 1991;2(3):283-96.

Truman 2002

Truman BI, Gooch BF, Sulemana I, Gift HC, Horowitz AM, Evans CA, et al. Reviews of evidence on interventions to prevent dental caries, oral and pharyngeal cancers, and sports-related craniofacial injuries. American Journal of Preventive Medicine 2002;23(1 Suppl):21-54.

Walsh 2010

Walsh T, Worthington HV, Glenny A-M, Appelbe P, Marinho VCC, Shi X. Fluoride toothpastes of different concentrations for preventing dental caries in children and adolescents. Cochrane Database of Systematic Reviews 2010, Issue 1. Art. No.: CD007868 DOI: 10.1002/14651858.CD007868.pub2.

WHO 2006

World Health Organization (WHO). Fluoride in Drinking Water. Geneva: World Health Organization 2006.

WHO 2011

World Health Organization (WHO). Guidelines for Drinking-Water Quality, 4th edition. Geneva: World Health Organization 2011.

Other published versions of this review

Classification pending references

1996 1974

1996 CRD Report Number 4 Needleman HL, Pueschel SM, Rothman KJ. Fluoridation and the occurrence of Down's syndrome. N Engl J Med 1974;291:821-82 3.

25 1995

25 and 2. ppm fluoride in the drinking water. Int J Paediatr Dent 1995;5(4):223-9.

77 1954

77 Hagan T, Pasternack M, Scholz G. Water-borne fluorides and mortality. Pub Health Rep 1954;69:450-454.

86 1992

86 Warnakulasuriya K, Balasuriya S, Perera PAJ, Peiris LCL. Determining Optimal Levels of Fluoride in Drinking-Water For Hot, Dry Climates - a Case-Study in Sri-Lanka. Community Dentistry and Oral Epidemiology 1992;20(6):364-367.

Eklund 1987a

Eklund S, Ismail A, Burt B, Calderon J. High-fluoridated drinking water, fluorosis and dental caries in adults. J Am Dent Assoc 1987;114(March):324-328.

Elwood, 1998 Oxford, Oxford Univ Press Ellwood RP, Omullane D. The association between developmental enamel defects and caries in populations with and without fluoride in their drinking water. J Pub Health Dent 1996

Elwood, JM. Critical Appraisal of epidemiological studies and clinical trials. 2nd edition 1998 Oxford, Oxford Univ Press Ellwood RP, Omullane D. The association between developmental enamel defects and caries in populations with and without fluoride in their drinking water. J Pub Health Dent 1996;56(2):76-80.

Erickson 1978

Erickson JD. Mortality in selected cities with fluoridated and nonfluoridated water supplies. N Engl J Med 1978;298:1112-1116.

Erickson 1980;21(177-180). Erickson JD, Oakley GP, Flynt JW, Hay S. Water fluoridation and congenital malformation: No association. J Am Dent Assoc 1976;76(981). Evans DJ, Rugg-Gunn AJ, Tabari ED. The effect of 25 years of water fluoridation in Newcastle assessed in 4 surveys of 5-year-old children over an 18-year period. Br Dent J 1995

Erickson JD. Down syndrome, water fluoridation, and maternal age. Teratology 1980;21(177-180). Erickson JD, Oakley GP, Flynt JW, Hay S. Water fluoridation and congenital malformation: No association. J Am Dent Assoc 1976;76(981). Evans DJ, Rugg-Gunn AJ, Tabari ED. The effect of 25 years of water fluoridation in Newcastle assessed in 4 surveys of 5-year-old children over an 18-year period. Br Dent J 1995;178(2):60-64.

Evans 1996

Evans D, Rugg-Gunn A, Tabari E, Butler T. The effect of fluoridation and social class on caries experience in 5-year-old Newcastle children in 1994 compared with results over the previous 18 years. Comm Dent Health 1996;13(Suppl 2):27-37.

Evans 1996a

Evans D, Rugg-Gunn A, Tabari E, Butler T. The effect of fluoridation and social class on caries experience in 5-year-old Newcastle children in 1994 compared with results over the previous 18 years. Comm Dent Health 1996;13(Suppl 2):27-37.

Evanston 1955

Evanston dental caries study; caries experience rates of 12, 13 and 14 year old children after exposure to fluoridated water for 59 to 70 months. J. Dent Res 1955;34:77-88.

Farkas 1983

Farkas G, Fazekas A, Szekeres E. The fluoride content of drinking water and menarcheal age. Acta Univ Szeged Acta Biol 1983;29(1-4):159-168.

Fluoridation 1975

Fluoridation in Anglesey. A clinical study. Br Dent J 1975;138(5):165-7 1.

Fluorosis 1955

Fluorosis and dental caries in the community of Barcellona Pozzo di Gotto. Igiene Sanit. Pubbl 1955;11(7-8):403-410.

Forrest 1955

Forrest J. Mottled enamel and caries experience in fluoride and non-fluoride areas. Proc Roy Soc Med 1955;48:989.

Forrest 1956a

Forrest J. Caries incidence and enamel defects in areas with different levels of fluoride in drinking water. Br Dent J 1956;100:195-200.

Forrest 1965a

Forrest JR, James PM. A blind study of enamel opacities and dental caries prevalence after eight years of fluoridation of water. Br Dent J 1965;119(7):319-2 2.

Forsman 1977

Forsman B. Early supply of fluoride and enamel fluorosis. Scand J Dent Res 1977;85(1):22-30.

French 1982

French AD, Carmichael CL, Rugg-Gunn AJ, Furness JA. Caries preventive effect of 12 years water fluoridation in Newcastle and Northumberland 5 Year old children. J Dent Res 1982;61(4):537.

French 1984

French. Relationship between social class and dental health in 5-year old children in the North and South of England. Br Dent J 1984;156:83-86.

Freni 1992

Freni SC, Gaylor DW. International trends in the incidence of bone cancer are not related to drinking water fluoridation. Cancer 1992;70(3):611-618.

Freni 1994

Freni SC. Exposure to high fluoride concentrations in drinking water is associated with decreased birth rates. J Toxicol Environ Health 1994;42(1):109-2 1.

Gaspar 1995

Gaspar McR, Armbruster LM, Pereira AnC, Moreira BHW. Non-fluorosis and dental fluorosis opacities in aereas with lower (0, 2 ppm F0 andgood (0, 7 ppm F) fluoride concentration in drinking water [Opacidades de origem n„o-fluorotica efluorose dent ria em reas com baixa (0, 2ppm F) e otima (0, 7 ppm F) concentra"es de fluor na gua deabastecimento]. Rev Bras Odontol 1995;52(2):13-18.

Gaspar 1995a

Gaspar McR, Armbruster LM, Pereira AnC, Moreira BHW. Opacidades de origem n„o-fluorotica e fluorose dent ria em reas com baixa (0, 2ppm F) e otima (0, 7 ppm F) concentra"es de fluor na gua de abastecimento Non-fluorosis and dental fluorosis opacities in aereas with lower (0, 2 ppm F0 and good (0, 7 ppm F) fluoride concentration in drinking water. Rev Bras Odontol 1995;52(2):13-8.

Gedalia 1963

Gedalia I, Brand N. The relationship of fluoride and iodine in drinking water in the occurrence of goiter. Arch Int Pharmacodyn 1963;142:312-5.

Gelberg 1995;85(1678-1683). Gessner BD, Beller M, Middaugh JP, Whitford GM. Acute fluoride poisoning from a public water system. N Engl J Med 1994

Gelberg K, Fitzgerald E, Hwang S, Dubrow R. Fluoride exposure and childhood osteosarcoma: a case-control study. Am J Pub Health 1995;85(1678-1683). Gessner BD, Beller M, Middaugh JP, Whitford GM. Acute fluoride poisoning from a public water system. N Engl J Med 1994;330(2):95-9.

Glattre 1979

Glattre E, Wiese H. Inverse relationship between fluoride and cancer in mouth and throat? Acta Odentol Scand 1979;37:9-14.

Goodall 1980

Goodall C, Foster F, Fraser J. Fluoridation and cancer mortality in New Zealand. NZ Med J 1980;92:164-7.

Gopalakrishnan 1999

Gopalakrishnan P, Vasan R, Sarma P, Nair K, Thankappan K. Prevalence of dental fluorsis and associated risk factors in Alappuxha district, Kerala. Natl Med J India 1999;12(3):99-10 3.

Gray 2000

Gray M, Langford K. Notes on the results of the studies of 5 year old children conducted in the West Midland since 1985. Unpublished report.

Griffith 1963

Griffith GW. Anaemia in pregnancy in relation to the fluoride content of domestic water supplies. Mon Bull Min Health (London) 1963;22:30-8.

Grobler 1986

Grobler SR, Vanwyk CW, Kotze D. Relationship between enamel fluoride levels, degree of fluorosisand caries experience in communities with a nearly optimal and a high fluoride level in the drinkingwater. Caries Res 1986;20(3):284-288.

Grobler 1986a

Grobler SR, Vanwyk CW, Kotze D. Relationship between enamel fluoride levels, degree of fluorosis and caries experience in communities with a nearly optimal and a high fluoride level in the drinkingwater. Caries Res 1986;20(3):284-288.

Groeneveld 1985

Groeneveld A. Longitudinal study of prevalence of enamel lesions in a fluoridated and non-fluoridated area. Community Dent Oral Epidemiol 1985;13(3):159-6 3.

Guha-Chowdhury 1996

Guha-Chowdhury N, Drummond B, Smillie AC. Total fluoride intake in children aged 3 to 4 years--a longitudinal study. J Dent

Res 1996;75(7):1451-7.

Guo 1978

Guo M, Hsieh C, Hong Y. Effect of water fluoridation on caries prevalence in Chung-Shin Village after 3 years. The Formosan Science 1978;32:111-119.

Guo 1984

Guo MK, Hsieh CC, Hong YC, Chen RS 1984;83(10):1035-1043. Effect of water fluoridation on prevalence of dental caries in Chung-Hsing New Village Taiwan after 9 years. J Formosan Med Assoc 1984;83(10):1035-1043.

Guo 1984a

Guo MK, Hsieh CC, Hong YC, Chen RS. Effect of water fluoridation on prevalence of dental caries in Chung-Hsing New Village Taiwan after 9 years. J Formosan Med Assoc 1984;83(10):1035-104 3.

Gupta 1995

Gupta SK, Gupta RC, Seth AK, Chaturvedi CS. Increased incidence of spina bifida occulta in fluorosis prone areas. Acta Paediatrica Japonica Overseas Edition 1995;37(4):503-506.

Haavikko 1974a

Haavikko K, Helle A. The prevalence and distribution of enamel defects in with different fluoride contents in the drinking water. Proceedings of the Finnish Dental Society 1974;70(5):178-185.

Hardwick 1982

Hardwick J, Teasdale J, Bloodworth G. Caries increments over 4 years in children aged 12 at the start of water fluoridation. Br Dent J 1982;153:217-222.

Hardwick 1982a

Hardwick J, Teasdale J, Bloodworth G. Caries increments over 4 years in children aged 12 at the start of water fluoridation. Br Dent J 1982;153:217-22 2.

Heasman 1962

Heasman M, Martin A. Mortality in areas containing natural fluoride in their water supplies. Mon Bull Min Health 1962;21:150.

Heifetz 1988a

Heifetz SB, Driscoll WS, Horowitz HS, Kingman A. Prevalence of dental caries and dental fluorosis in areas with optimal and above-optimal water-fluoride concentrations: a 5-year follow-up survey. J Am Dent Assoc 1988;116(4):490-5.

Heintze 1998

Heintze SD, Bastos JR, Bastos R. Urinary fluoride levels and prevalence of dental fluorosis in threeBrazilian cities with different fluoride concentrations in the drinking water. Community Dent OralEpidemiol 1998;26(5):316-23.

Heintze 1998a

Heintze SD, Bastos JR, Bastos R. Urinary fluoride levels and prevalence of dental fluorosis in three Brazilian cities with different fluoride concentrations in the drinking water. Community Dent Oral Epidemiol 1998;26(5):316-2 3.

Heller 1997a

Heller KE, Eklund SA, Burt BA. Dental caries and dental fluorosis at varying water fluoride concentrations. J Pub Health Dent 1997;57(3):136-14 3.

Hellwig 1985

Hellwig E, Klimek J. Caries prevalence and dental fluorosis in German children in areas with different concentrations of fluoride in drinking water supplies. Caries Res 1985;19(3):278-28 3.

Hill 1950

Hill I, Blayney J, Wolf W. Evanston dental caries study VI; a comparison of the pre-fluoride with postfluoride caries experience of 6, 7 and 8 year old children in the study area. J Dent Res 1950;29:549- 555.

Hill 1952

Hill I, Blayney, Wolf N. Evanston dental caries study; caries experience rates of 6, 7 and 8 year old children with progressively increasing periods of exposure to artificially fluoridated water. J Dent Research 1952;31:346-35 3.

Hill 1956

Hill I, Blayney J, Wolf W. Evanston dental caries study, reduction in dental caries attack rates in children 6 to 8 years old. J Am Dent Assoc 1956;53:327-33 3.

Hill 1961

Hill I, Blayney J, Wolf W. Evanston fluoridation study: twelve years later. Dental Progress 1961;1(2):95-99.

Hill Dent

Hill I, Blayney J, Wolf W, Evanston dental caries study; effect of artificially fluoridated water on dental caries experience of 12, 13 and 14 year old school children. J. Res 1951 Dent;30:670-675.

Hillier 1997

Hillier S. Water fluoridation and fracture of the proximal femur. J Bone and Mineral Res 1997;12:153 3.

Hillier 2000

Hillier S, Copper C, Kellingray S, Russell G, Hughes H, Coggon D. Fluoride in drinking water and risk of hip fracture in the UK: a case control study. The Lancet 2000;335:265-269.

Hobbs 1994

Hobbs D. Annual report of the Director of Dental Public Health to Powys Health Authority. Powys 1984.

Holdcroft 1999

Holdcroft C. Five year old dental health in England, 1993-94. Unpublished report 1999.

Hong 1990a

Hong CY, Hong YC, Guo MK, Hsieh CC, Chen RS. Prevalence of mottled enamel after 12 years of water fluoridation in Chung-Hsing New Village (Taiwan). J Formosan Med Assoc 1990;89(3):225-230.

Hoover 1976

Hoover RN, McKay FW, Fraumeni JFJ. Fluoridated drinking water and the occurrence of cancer. J Natl Cancer Inst 1976;57(4):757-768.

Hrudey 1990

Hrudey SE, Soskolne CL, Berkel J, Fincham S. Drinking water fluoridation and osteosarcoma. Can J Public Health 1990;81(6):415-416.

Hsieh 1979

Hsieh C, Guo M, Hong Y. Effect of water fluoridation on prevalence of dental caries in Chung-Hsing New Village after 6 years. J Formosan Med Assoc 1979;78:168-176.

Hsieh 1986

Hsieh CC, Guo MK, Hong YC, Chen RS. An evaluation of caries prevalence in Chung-Hsing New Village Taiwan after 12 years of water fluoridation a final report. J Formosan Med Assoc 1986;85(8):822-83 1.

I 1995

I. Identification of risk factors associated with human exposure to fluoride. Environ Res 1995;68(1):25-30.

Ismail 1990

Ismail AI, Brodeur JM, Kavanagh M, Boisclair G, Tessier C, Picotte L. Prevalence of dental caries anddental fluorosis in students, 11-17 years of age, in fluoridated and non-fluoridated cities in Quebec(Canada). Caries Res 1990;24(4):290-297.

Ismail 1990a

Ismail AI, Brodeur JM, Kavanagh M, Boisclair G, Tessier C, Picotte L. Prevalence of dental caries and dental fluorosis in students, 11-17 years of age, in fluoridated and non-fluoridated cities in Quebec (Canada). Caries Res 1990;24(4):290-297.

J 1956

J. Pub. Health 1956;47:89-9 2.

Jackson 1995

Jackson RD, Kelly SA, Katz BP, Hull JR, Stookey GK. Dental fluorosis and caries prevalence in children residing in communities with different levels of fluoride in the water. J Pub Health Dent 1995;55(2):79-84.

Jackson 1999

Jackson RD, Kelly SA, Katz B, Brizendine E, Stookey GK. Dental fluorosis in children residing incommunities with different water fluoride levels: 33-month follow-up. Pediatr Dent 1999;21(4):248-254.

Jackson 1999a

Jackson RD, Kelly SA, Katz B, Brizendine E, Stookey GK. Dental fluorosis in children residing in communities with different water fluoride levels: 33-month follow-up. Pediatr Dent 1999;21(4):248-54.

Jacobsen 1992

Jacobsen S, Goldberg J, Cooper C, Lockwood S. The association between water fluoridation and hip fracture among white women and men aged 65 years and older; a national ecologic study. Ann Epidemiol 1992;2:617-626.

Jacobsen JAMA 1990

Jacobsen S, Goldberg J, Miles T, Brody J, Stiers W, Rimm A. Regional variation in the incidence of hip fracture: US white women aged 65 years and olders. JAMA 1990;264(4):500- 2.

Jacqmin-Gadda 1994

Jacqmin-Gadda H, Commenges D, Leteneur L, Barberger-Gateau P, Dartigues J-F. Components of drinking water and risk of cognitive impairment in the elderly. Am J Epidemiol 1994;139:48-57.

Jacqmin-Gadda 1995

Jacqmin-Gadda H. Fluorine concentration in drinking water and fractures in the elderly. JAMA 1995;273:775-776.

Jacqmin-Gadda 1998

Jacqmin-Gadda H, Fourrier A, Commenges D, Dartigues J. Risk factors for fractures in the elderly. Epidemiology 1998;9(4):417-42 3.

Jarman BMJ 1983

Jarman B. Identification of underprivileged areas. BMJ 1983;286(6379):1705-1709.

Jolly 1971a

Jolly SS, Prasad S, Sharma R, Rai B. Human Fluoride Intoxication in Punjab. Flouride 1971;4(2):64- 79.

Jones 1997

Jones C, Taylor G, Woods K, Whittle G, Evans D, Young P. . 1997;14(3):156-60.. Jarman underprivileged area scores, tooth decay and the effect of water fluoridation. Comm Dent Health 1997;14(3):156-160.

Jones 1997a

Jones C, Taylor G, Woods K, Whittle G, Evans D, Young P. Jarman underprivileged area scores, tooth decay and the effect of water fluoridation. Comm Dent Health 1997;14(3):156-60.

Jones 1999

Jones CM, Worthington H. The relationship between water fluoridation and socioeconomic deprivation on tooth decay in 5-year-old children. Br Dent J 1999;186(8):397-400.

Jones 2000

Jones C, Worthington H. Water fluoridation, poverty and tooth decay in 12-year-old children. Unpublished, submitted by author 2000.

Jooste 1999

Jooste P, Weight M, Kriek J, Louw A. Endemic goitre in the absense of iodine deficiency in schoolchildren of the Northern Cape Province of South Africa. Eur J Clin Nutr 1999;53(1):8-1 2.

Kalsbeek 1993a

Kalsbeek H, Kwant GW, Groeneveld A, Dirks OB, Vaneck A, Theuns HM. Caries Experience of 15- Year-Old Children in the Netherlands After Discontinuation of Water Fluoridation. Caries Res 1993;27(3):201-205.

Karagas 1996

Karagas M, Baron J, Barrett J, Jacobsen S. Patterns of fracture among the United States elderly: geographic and fluoride effects. Ann Epidemiol 1996;6:209-16.

Karjalainen 1982

Karjalainen S, Karja J, Harma R, Juola E. Effect Of Drinking Water Fluoridation On Stapedial Otosclerosis In A Low Fluoride Area. Acta Otolaryngologica 1982;94(1-2):111-119.

Karthikeyan Fluoride

Karthikeyan G, Pius A, Apparao BV, Contribution of fluoride in water and food to the prevalence of fluorosis in areas of Tamil Nadu in South India. 1996 Fluoride;29(3):151-155.

Kelsey 1971

Kelsey J, Keggi K. An epidemiological study of the effect of fluorides in drinking water on the frequency of slipped capital femoral epiphysis. J Biol Med 1971;44(3):274-85.

Kinlen 1975

Kinlen L. Cancer incidence in relation to fluoride level in water supplies. Br Dent J 1975;138:221-4.

Klein 1946

Klein H. Dental caries (DMF) experience in relocated children exposed to water containing fluorine II. J Am Dent Assoc 1946;33:1136-114 1.

Knijhnikigov 1958

Knijhnikigov V. The effect of water with a high fluorine content on the health of the adult population. Gig I San 1958;8:18-2 3.

Korns 1969

Korns R. Relationship of water fluoridation to bone density in two NY towns. Pub Health Rep 1969;84(9):815-25.

Kroger 1994

Kroger H. The effect of fluoridated drinking water on axial bone mineral density-a population based study. J Bone and Mineral Res 1994;27(1):33-4 1.

Kumar 1989

Kumar JV, Green EL, Wallace W, Carnahan T. Trends in dental fluorosis and dental caries prevalences in Newburgh and Kingston, NY. Am J Pub Health 1989;79(5):565-9.

Kumar 1998

Kumar JV, Swango PA, Lininger LL, Leske GS, Green EL, Haley VB. Changes in dental fluorosis and dental caries in Newburgh and Kingston, New York. Am J Pub Health 1998;88(12):1866-1870.

Kumar 1999a

Kumar JV, Swango PA. Fluoride exposure and dental fluorosis in Newburgh and Kingston, New York: policy implications. Community Dent Oral Epidemiol 1999;27(3):171-180.

Kunzel 1976a

Kunzel W, Padron F. Caries and dental fluorosis in Cuban children. Caries Res 1976;10(2):104-11 2.

Kunzel 1980

Kunzel W. Effect of an interruption in water fluoridation on the caries prevalence of the primary and secondary dentition. Caries Res 1980;14(5):304-310.

Kunzel 1997

Kunzel W, Fischer T. Rise and fall of caries prevalence in German towns with different F concentrations in drinking water. Caries Res 1997;31(3):166-173.

Kunzel 1997a

Kunzel W, Fischer T. Rise and fall of caries prevalence in German towns with different F concentrations in drinking water. Caries Res 1997;31(3):166-7 3.

Kunzel Stomat

Kunzel W, Water fluoridation in Karl Marx Stadt, IX, Caries after twelve years of control Trinkwasserfluoridierung Karl Marx Stadt, Ix. Kariesstatistische Ergebnisse Nach Zwolfjahriger. Ddr 1974 Stomat;24(4):290-297.

Kurttio 1999

Kurttio P, Gustavsson N, Vartiainen T, Pekkanen J. Exposure to natural fluoride in well water and hip fracture: A cohort analysis in Finland. Am J Epidemiol 1999;150(8):817-824.

Kwant 1973

Kwant G. Artificial fluoridation of drinking water in the Netherlands. Netherlands Dental Journal 1973;80(Supplement 9):6-27.

Kwant 1973a

Kwant G, Howink B, Backer Dirks O, Pot T. Artificial fluoridation of drinking water in the Netherlands; results of the Tiel-Culemborg experiment after 16 1/2 years. Netherlands Dental Journal 1973;80(9):6- 27.

Larsen 1987

Larsen MJ, Kirkegaard E, Poulsen S. Patterns of Dental Fluorosis in a European-Country in Relation to the Fluoride Concentration of Drinking-Water. J Dent Res 1987;66(1):10-1 2.

Latham 1967

Latham M, Grech P. The effects of excessive fluoride intake. Amer J Pub Health 1967;57/4:651-660.

Lehmann 1998

Lehmann R, Wapniarz M, Hofmann B, Pieper B, Haubitz I, Allolio B. Drinking water fluoridation: Bone mineral density and hip fracture incidence. Bone 1998;22(3):273-278.

Leverett 1986a

Leverett D. Prevalence of dental fluorosis in fluoridated and nonfluoridated communities--a preliminary investigation. J Pub Health Dent 1986;46(4):184-7.

Levine 1989a

Levine R, Beal J, Flemming C. A photographically recorded assesment of enamel hypoplasia in fluoridated and non

fluoridated areas. Br Dent J 1989;166:249-25 2.

Loh 1996

Loh T. Thirty-eight years of water fluoridation--the Singapore scenario. Comm Dent Health 1996;13 Suppl 2:47-50.

Madans 1983

Madans J, Kleinman JC, Cornoni-Huntley J. The relationship between hip fracture and water fluoridation: An analysis of national data. Am J Pub Health 1983;73(3):296-298.

Mahoney 1991

Mahoney MC, Nasca PC, Burnett WS, Melius JM. Bone Cancer Incidence Rates in New York State: Time Trends and Fluoridated Drinking Water. Am J Pub Health 1991;81(4):475-479.

Mansfield 1999

Mansfield P. The distribution of urinary fluoride concentration in the UK. Fluoride 1999;32(1):27-3 2.

Masztalerz 1990

Masztalerz A, Masztalerzowa Z, Szymanska M, Tomelka J. [Fluorine and the dentition]. FortschrKieferorthop 1990;51(4):234-7.

Masztalerz 1990a

Masztalerz A, Masztalerzowa Z, Szymanska M, Tomelka J. [Fluorine and the dentition]. Fortschr Kieferorthop 1990;51(4):234-7.

Maupome 2000;in press. Mazzotti L, Gonzalez Rivera M. Dental fluorosis in Mexico. Rev d Inst salub y enferm trop 1939

Maupome G, Clark D, Levy S, Berkpwitz J. Patterns of dental caries following the cessation of water fluoridation. Community Dent Oral Epidemiol 2000;in press. Mazzotti L, Gonzalez Rivera M. Dental fluorosis in Mexico. Rev d Inst salub y enferm trop 1939;1:105- 12 1.

Mazzotti 1939

Mazzotti L, Gonzalez Rivera M. Dental fluorosis in Mexico. Rev d Inst salub y enferm trop 1939;1:105-121.

McGuire 1991

McGuire S, Vanable E, McGuire M, JA B, CW D. Is there a link between fluoridated water and osteosarcoma? IJ Am Dent 1991;122:38-45.

McInnes 1982

McInnes PM, Richardson BD, Cleaton Jones PE. Comparison of dental fluorosis and caries in primaryteeth of preschool-children living in arid high and low fluoride villages. Community Dent Oral Epidemiol 1982;10(4):182-6.

McInnes 1982a

McInnes PM, Richardson BD, Cleaton Jones PE. Comparison of dental fluorosis and caries in primary teeth of preschool-children living in arid high and low fluoride villages. Community Dent Oral Epidemiol 1982;10(4):182-6.

Mella 1992

Mella S, Atalah E, Aranda W, Montagna R. Prevalence of Dental Fluorosis in Chile - a Pilot-Study. Revista Medica De Chile 1992;120(8):866-871.

Mella 1992a

Mella S, Atalah E, Aranda W, Montagna R. Prevalence of Dental Fluorosis in Chile - a Pilot-Study. Revista Medica De Chile 1992;120(8):866-87 1.

Mella 1994a

Mella S, Molina X, Atalah E. Prevalence of Dental Fluorosis and Its Relation With Fluoride Content of Communal Drinking-Water. Revista Medica De Chile 1994;122(11):1263-1270.

Mella 1994b

Mella S, Molina M X, Atalah Samur E. Prevalencia de fluorosis dental end,mica en relacion al contenido de fluoruros en las aguas de abasto publico Prevalence of dental endemic fluorosis in relation to fluoride content of comunal drinking water. Revista Medica De Chile; 1994;122(11 (nov)):1263-70.

Milsom 1990a

Milsom K, Mitropoulos C. Enamel defects in 8 year old children in fluoridated and non-fluoridated parts of Cheshire. Caries Res 1990;1990(24):286-289.

Mitchell 1991

Mitchell E, Thompson J, Borman B. No association between fluoridation of water supplies and sudden infant death

syndrome. NZ Med J 1991;104:500-50 1.

Morgan 1998

Morgan L, Allred E, Tavares M, Bellinger D, Needleman H. Investigation of the possible associations vetween fluorosis, fluoride exposure and childhood behaviour problems. Paediatric Dentistry 1998;20(4):244-25 2.

Mottling 1982

Mottling on deciduous incisor teeth. A study of 5-year-old Yorkshire children from districts with and without fluoridation. Br Dent J 1982;153(10):367-9.

Murray 1984a

Murray J, Gordon P, Carmichael C, French A, Furness JA. Dental caries and enamel opacities in 10- year old children in Newcastle. Br Dent J 1984;156:255-258.

Murray 1991

Murray J, Breckon J, Reynolds P, Nunn J. The effect of residence and social class on dental cariesexperience in 15-16 year old children living in three towns (natural fluoride, adjusted fluoride and lowfluoride). 1991.

Nanda 1974

Nanda RS, Zipkin I, Doyle J, Horowitz HS. Factors affecting the prevalence of dental fluorosis inLucknow, India. Archives of Oral Biology 1974;19(9):781-782.

Nanda 1974a

Nanda RS, Zipkin I, Doyle J, Horowitz HS. Factors affecting the prevalence of dental fluorosis in Lucknow, India. Archives of Oral Biology 1974;19(9):781-79 2.

Newburgh-Kingston 1954

Newburgh-Kingston caries fluorine study; pediatric aspects - current status. New York J. Med 1954;54(Sept 1 (pt.1)):2452-2457.

Nixon 1974

Nixon J, Carpented R. Mortality in areas containing natural fluoride in their water supplies, takin account of socio-environmental factors and water hardness. The Lancet 1974;2:1068-7 1.

Nunn 1992a

Nunn JH, Murray JJ, Reynolds P, Tabari D, Breckon J. The prevalence of developmental defects of enamel in 15-16-year-old children residing in three districts (natural fluoride, adjusted fluoride, low fluoride) in the north east of England. Comm Dent Health 1992;9(3):235-47.

Nunn 1993

Nunn JH, Ekanayake L, Rugg Gunn AJ, Saparamadu KD. Assessment of enamel opacities in childrenin Sri Lanka and England using a photographic method. Comm Dent Health 1993;10(2):175-88.

Nunn 1993a

Nunn JH, Ekanayake L, Rugg Gunn AJ, Saparamadu KD. Distribution of developmental defects of enamel on ten tooth surfaces in children aged 12 years living in areas receiving different water fluoride levels in Sri Lanka and England. Comm Dent Health 1993;10(3):259-68.

Nunn 1993b

Nunn JH, Ekanayake L, Rugg Gunn AJ, Saparamadu KD. Assessment of enamel opacities in children in Sri Lanka and England using a photographic method. Comm Dent Health 1993;10(2):175-88.

Oldham 1977

Oldham P, Newell D. Fluoridation of water supplies and cancer: a possible association. Appl Stat 1977;26:125-35.

On 1980

On the incidence of primary degenerative dementia vs. water fluoride content in South Carolina. Neurotoxicology 1980;1(4):125-13 1.

Opinya 1991

Opinya GN, Valderhaug J, Birkeland JM, Lokken P. Fluorosis of Deciduous Teeth and 1st Permanent Molars in a Rural Kenyan Community. Acta Odontologica Scandinavica 1991;49(4):197-20 2.

Pitts 1998

Pitts NB. Inequalities in children's caries experience: the nature and size of the UK problem. Comm Dent Health 1998;1:296-300.

Pot 1974

Pot T, Purdell Lewis DJ, Groeneveld A. The influence of 17 years of water fluoridation upon the dentition of adults [De Invloed Van 17 Jaren Drinkwater Van Volwassenen]. Ned.T.Tandheelk 1974;81(1):5-12.

Pot Tandheelk

Pot T, Purdell Lewis DJ, Groeneveld A, The influence of 17 years of water fluoridation upon the dentition of adults De Invloed Van 17 Jaren Drinkwater Van Volwassenen, Ned. T. 1974 Tandheelk;81(1):5-1 2.

Pub 1998

Pub Health Rep; 66: 1389-140 Rwenyonyi MC, Birkeland JM, Bjorvatn K, Haugejorden O. Dental fluorosis in Ugandans related to fluoride in drinking water and altitude. J Dent Res 1998;77:1299.

Rapaport 1957

Rapaport I. Contribution a l'etude du mongolisme,; role pathogenique du fluor. Bull Acad nat med (Paris) 1957;140(28-29):529-53 1.

Rapaport 1959

Rapaport. New research on mongolism: concerning the pathogenic role of fluoride. Bull Acad Natl Med (Paris) 1959;143:367-370.

Rapaport 1963

Rapaport I. Oligophrnic mongolienne et caries dentairs. Rev Stomatol Chir Maxillofac 1963;46:207-18.

Richards 1979

Richards G, Ford J. cancer mortality in selected New South Wales localities with fluoridated and nonfluoridated water supplies. Med J Aust 1979;2:521- 3.

Riley 1999a

Riley J, Lennon M, Ellwood R. The effect of water fluoridation and social inequalities on dental caries in 5-year-old children. Intl J Epidemiol 1999;28:300-305.

Riordan 1991

Riordan PJ, Banks JA. Dental fluorosis and fluoride exposure in Western Australia. J Dent Res 1991;70(7):1022-1028.

Riordan 1991a

Riordan PJ, Banks JA. Dental fluorosis and fluoride exposure in Western Australia. J Dent Res 1991;70(7):1022-1028.

Rogot 1978

Rogot E, Sharrett AR, Feinleib M, Fabsitz RF. Trends in urban mortality in relation to fluoridation status. Am J Epidemiol 1978;107(2):104-11 2.

Rozier 1981

Rozier RG, Dudney GG. Dental fluorosis in children exposed to multiple sources of fluoride: implications for school fluoridation programs. Public Health Reports 1981;96(6):542-546.

Rugg-Gunn 1977

Rugg-Gunn A, Carmichael C, French A, Furness JA. Fluoridation in Newcastle and Northumberland: a clinical study of five year old children. Br Dent J 1977;142:395-40 2.

Rugg-Gunn 1981

Rugg-Gunn A, Nicholas K, Potts A, Cranage J, Carmichael C, French A. Caries experience of 5-year old children living in four communities in North East England receiving differing water fluoride levels. Brit Dent J 1981;150:9-1 2.

Rugg-Gunn 1988

Rugg-Gunn A, Carmichael C, Ferrell R. Effect of fluoridation and secular trend in caries in 5-year old children living in Newcastle and Northumberland. Br Dent J 1988;165:359-364.

Rugg-Gunn 1997

Rugg-Gunn AJ, Al Mohammadi SM, Butler TJ. Effects of fluoride level in drinking water, nutritional status, and socio-economic status on the prevalence of developmental defects of dental enamel in permanent teeth in Saudi 14-year-old boys. Caries Res 1997;31(4):259-267.

Russell 1951

Russell A, Elvove E. Domestic water and dental caries; study of fluoride-dental caries relationship inadult population. Pub Health Rep 1951;66:1389-1401.

Rwenyonyi 1998

Rwenyonyi MC, Birkeland JM, Bjorvatn K, Haugejorden O. Dental fluorosis in Ugandans related tofluoride in drinking water and altitude. J Dent Res 1998;77:1299.

Rwenyonyi 1999

Rwenyonyi CM, Bjorvatn K, Birkeland JM, Haugejordan O. Altitude as a risk indicator of dentalfluorosis in children residing in areas with 0.5 and 2.5 mg fluoride per litre in drinking water. CariesRes 1999;33(4):267-274.

Rwenyonyi 1999a

Rwenyonyi CM, Bjorvatn K, Birkeland JM, Haugejordan O. mg fluoride per litre in drinking water. Caries Res 1999;33(4):267-274.

Sack 1969

Sack A. Caries incidence in children of Zittau and Karl Marx Stadt. Dtsch Stomat 1969;19(3):212-216.

Schlesinger 1950

Schlesinger E, Overton D, Chase H. Newburgh-Kingston caries fluorine study: pediatric study - preliminary report. Am J Pub Health 1950;40:725-727.

Sellman 1957

Sellman S, Syrrist A, Gustafson G. Fluorine and dental health in Southern Sweden. Odont T 1957;65:61-93.

Sellman 1957a

Sellman S, Syrrist A, Gustafson G. Fluorine and dental health in Southern Sweden. Odont T 1957;65:61-9 3.

Seppa 1998

Seppa L, Karkkainen S, Hausen H. Caries frequency in permanent teeth before and after discontinuation of water fluoridation in Kuopio, Finland. Community Dent Oral Epidemiol 1998;26:256-62.

Seppa 1998a

Seppa L, Karkkainen S, Hausen H. Caries frequency in permanent teeth before and after discontinuation of water fluoridation in Kuopio, Finland. Community Dent Oral Epidemiol 1998;26:256- 6 2.

Shaw 1975

Shaw L, Murray JJ. Inter-examiner and intra-examiner reproducibility in clinical and radiographic diagnosis. Int Dent J 1975;25(4):280-8.

Simonen 1985

Simonen O, Laitinen O. Does fluoridation of drinking water prevent bone fragility in osteoporosis? The Lancet 1985;2:432-434.

Skotowski 1995a

Skotowski MC, Hunt RJ, Levy SM. Risk-Factors For Dental Fluorosis in Pediatric Dental Patients. J Pub Health Dent 1995;55(3):154-159.

Smith 1980

Smith A. An examination of the relationship between fluoridation of water and cancer mortality in 20 large US cities. NZ Med J 1980;91:413-16.

Sowers 1986

Sowers M, Wallis R, Lemke J. The relationship of bone mass and fracture history to fluoride and calcium intake: a study of three communities. Am J Clin Nutrition 1986;44:889-98.

Sowers 1991

Sowers M, Clark M, Jannausch M, Wallace R. A prospective study of bone mineral content and fracture in communities with differential fluoride exposure. Am J Epidemiol 1991;133:649-660.

Spadaro 1955

Spadaro O, Pagano V. Fluorosis and dental caries in the community of Barcellona Pozzo di Gotto. Igiene Sanit. Pubbl 1955;11(7-8):403-410.

Spittle 1993

Spittle B. Allergy and hypersensitivity to fluoride. Fluoride 1993;26(4):267-27 3.

Stephen 1999

Stephen K. A blind dental caries and fluorosis prevalence study of school children in naturallyfluoridated and non-fluoridated townships of Moray, Glasgow: University of Glasgow Dental School. 1999.

Suarez-Almazor 1993

Suarez-Almazor M, Flowerdew G, Saunders L, Soskolne C, Russel A. The fluoridation of drinking water and hip fracture hospitalization rates in two Canadian connunities. Am J Pub Health 1993;83:689-69 3.

Swanberg 1953

Swanberg H. Fluoridation of Water and its relation tocancer. Miss Valley Med J 1953;75:125-8.

Szpunar 1988

Szpunar S, Burt B. Dental caries, fluorosis, and fluoride exposure in Michigan school children. J DentRes 1988;67:802-806.

Szpunar 1988a

Szpunar S, Burt B. Dental caries, fluorosis, and fluoride exposure in Michigan school children. J Dent Res 1988;67:802-806.

Teng 1996

Teng GX, Zhao XH, Shi YX, Yu GQ, Wang LH, Shen YF, et al. A study of water-borne endemic fluorosis in China. Fluoride 1996;29(4):202-206.

The 1961

The results of 6 1/2 years of artificial fluoridation of drinking water in the Netherlands. The Tiel-Culemborg experiment. Arch Oral Biol 1961;5:284-300.

Unpublished 1991 Xinjiang Institute for Endemic Disease Control and Research, Office of Leading Group for Endemic Disease Control of Hetian Prefectural Committee of the Communist Party of China and County Health and Endemic Prevention Station, Yutian, Xinjiang. Unpublished report submitted through NHS CRD web site. Loh T. Thirty-eight years of water fluoridation--the Singapore scenario. Comm Dent Health 1996

Unpublished report, submitted by author. Lin F-F, Zhao H-X, Lin J, Jian J-Y. The relationship of a low-iodine an high-fluoride environment to subclinical cretinism in Xinjiang 1991 Xinjiang Institute for Endemic Disease Control and Research, Office of Leading Group for Endemic Disease Control of Hetian Prefectural Committee of the Communist Party of China and County Health and Endemic Prevention Station, Yutian, Xinjiang. Unpublished report submitted through NHS CRD web site. Loh T. Thirty-eight years of water fluoridation--the Singapore scenario. Comm Dent Health 1996;13 Suppl 2:47-50.

V 1953

V. Pediatric aspects - continuation report. Am J Pub Health 1953;43(8):1011-1015.

Venkateswarlu 1952

Venkateswarlu P, Narayanu Rao D, Ranganatha Rao K. Endemic fluorosis: Visakhaptnam and suburban areas; fluorine, mottled enamel and dental caries. Indian J M Res 1952;40(October):535-548.

Venkateswarlu 1952a

Venkateswarlu P, Narayanu Rao D, Ranganatha Rao K. Endemic fluorosis: Visakhaptnam and suburban areas; fluorine, mottled enamel and dental caries. Indian J M Res 1952;40(October):535- 548.

Villa 1998a

Villa AE, Guerrero S, Villalobos J. Estimation of optimal concentration of fluoride in drinking water under conditions prevailing in Chile. Community Dent Oral Epidemiol 1998;26(4):249-55.

Wang 1993

Wang J, Yang C, Xu X. An investigation into the fluoride levels of drinking water and the condition offluorosis in some areas of south Xinjiang. Endemic Diseases Bulletin 1993;8(3):57-60.

Wang 1993a

Wang J, Yang C, Xu X. An investigation into the fluoride levels of drinking water and the condition of fluorosis in some areas of south Xinjiang. Endemic Diseases Bulletin 1993;8(3):57-60.

Weaver 1944

Weaver R. Fluorine and dental caries: further investigations in Tyneside and in Sunderland. Brit Dental Journal 1944;77:185-19 3.

Wells 2008

Wells GA, Shea B, O'Connell D, Peterson J, Welch V, Losos M, et al. The Newcastle-Ottawa Scale (NOS) for assessing the quality of nonrandomized studies in meta-analyses. 2008. Available from: http://www.ohri.ca/programs/clinical_epidemiology/oxford.htm (Accessed 16th February 2012).

Wragg 1992

Wragg K. Dental Caries Experience of 5 year olds in South Derbyshire. (unpublished) 1992.

XIX 1959

XIX. Prevalence of malocclusion of children in a fluoridated and control area. J Dent Res 1959;38:782-94.

XXIV 1964

XXIV. Prenatal fluorides--value of waterborne fluorides during pregnancy. J Am Dent Assoc 1964;69:291-4.

Yiamouyiannis 1977

Yiamouyiannis J, Burk D. Fluoridation and caner: Age-dependence of cancer mortality related to artificial fluoridation. Fluoride 1977;10:102-125.

Yiamouyiannis 1993

Yiamouyiannis JA. Fluoridation and cancer: The biology and epidemiology of bone and oral cancer related to fluoridation. Fluoride 1993;26(2):83-96.

Zhao 1996

Zhao L, Liang G, Zhang D, Wu X. Effect of a high fluoride water supply on children's intelligence. Fluoride 1996;29:190-19 2.

Zheng 1986

Zheng C, et al. A Survey of Dental Caries in Guangzhou China After 18 Years of Community Water Fluoridation. Chin J Prev Med 1986;20(2):79-82.

Zheng 1986a

Zheng C, et al. A Survey of Dental Caries in Guangzhou China After 18 Years of Community Water Fluoridation. Chin J Prev Med 1986;20(2):79-8 2.

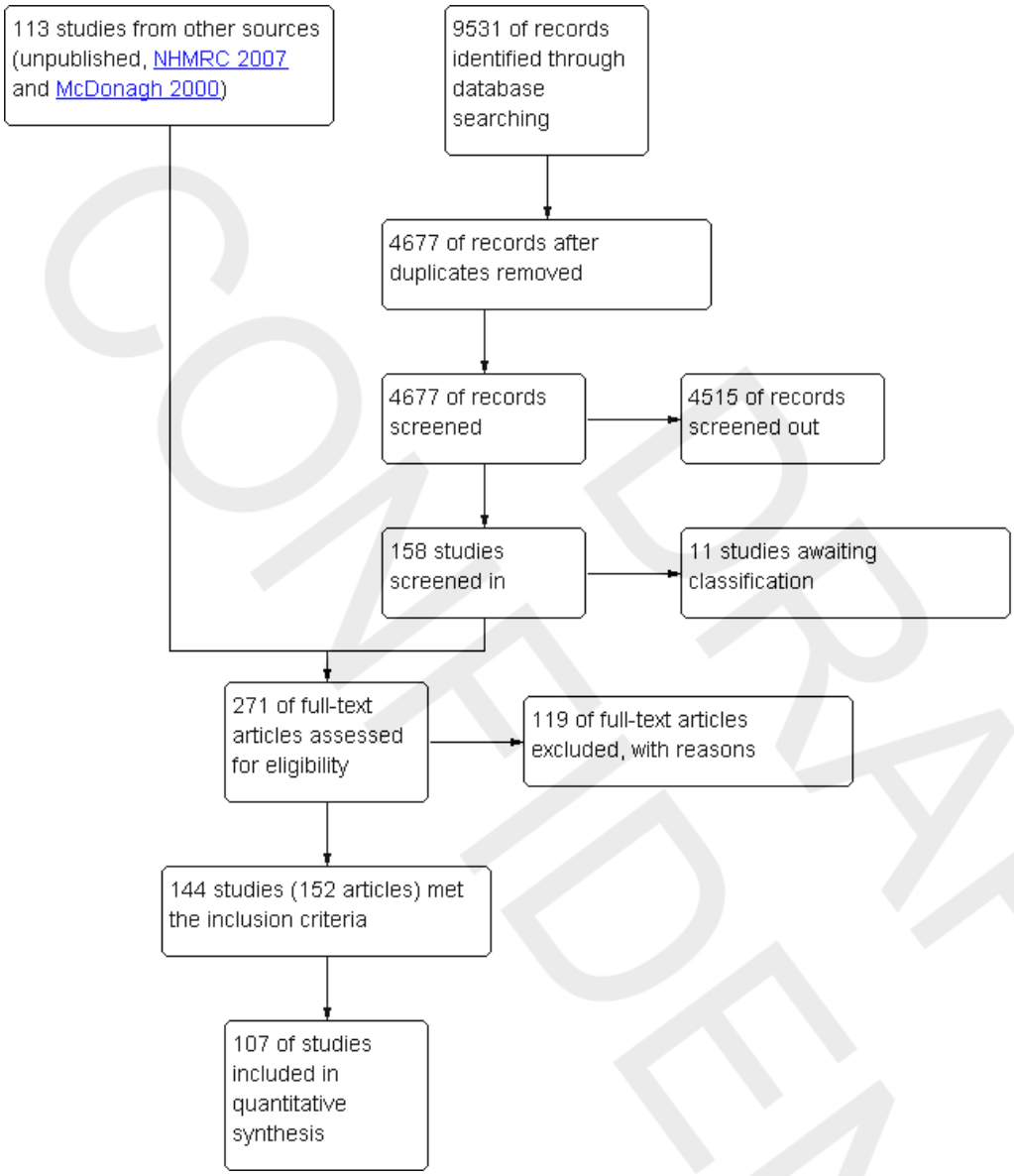
Data and analyses

1 Initiation of water fluoridation compared with low/non-fluoridated water

Outcome or Subgroup	Studies	Participants	Statistical Method	Effect Estimate
1.1 Change in decayed, missing or filled deciduous teeth (dmft)	9	22134	Mean Difference(IV, Random, 95% CI)	1.81[1.31, 2.31]
1.2 Change in decayed, missing or filled permanent teeth (DMFT)	10	39382	Mean Difference(IV, Random, 95% CI)	1.16[0.72, 1.61]
1.3 Change in proportion of caries free children (deciduous teeth)	10	19983	Mean Difference(IV, Random, 95% CI)	-0.15[-0.19, -0.11]
1.4 Change in proportion of caries free children (permanent teeth)	8	26769	Mean Difference(IV, Random, 95% CI)	-0.14[-0.23, -0.05]

Figures

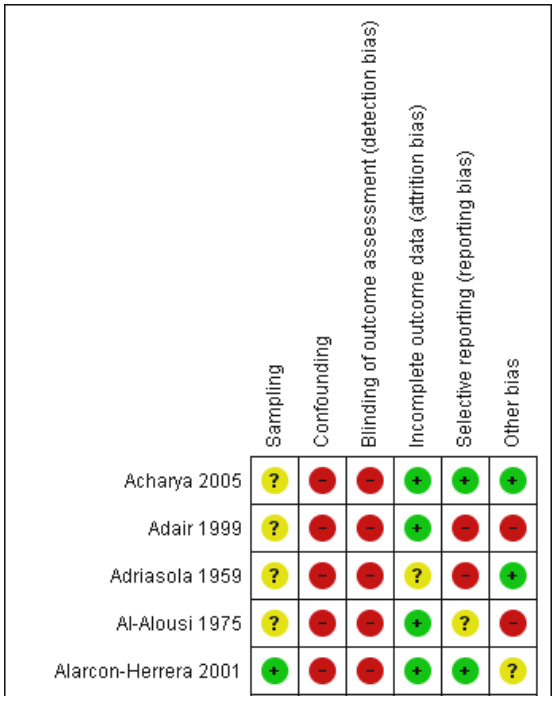
Figure 1

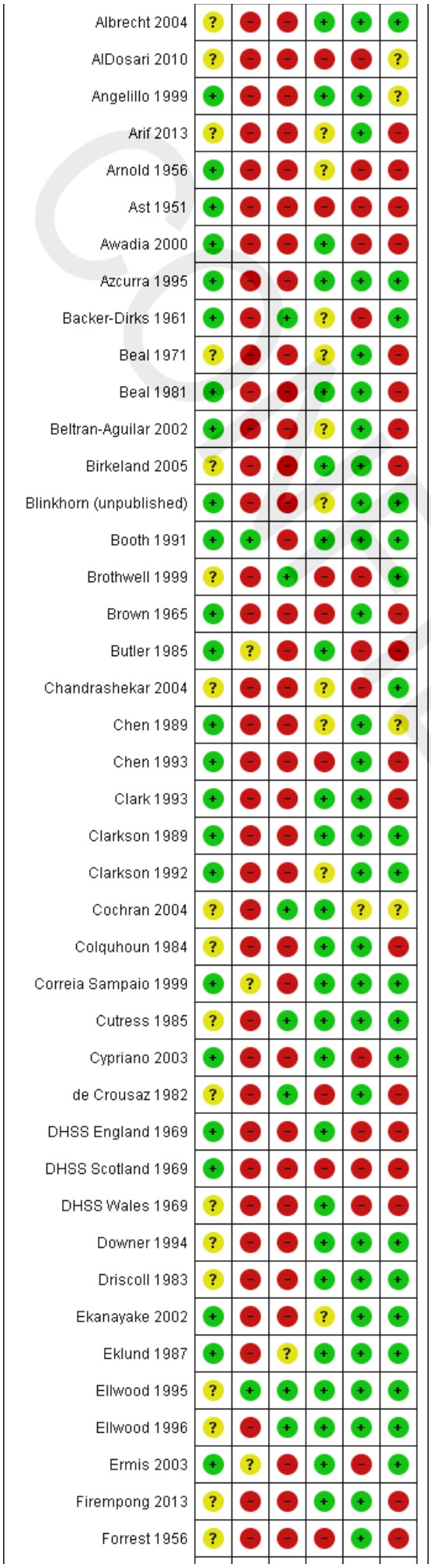


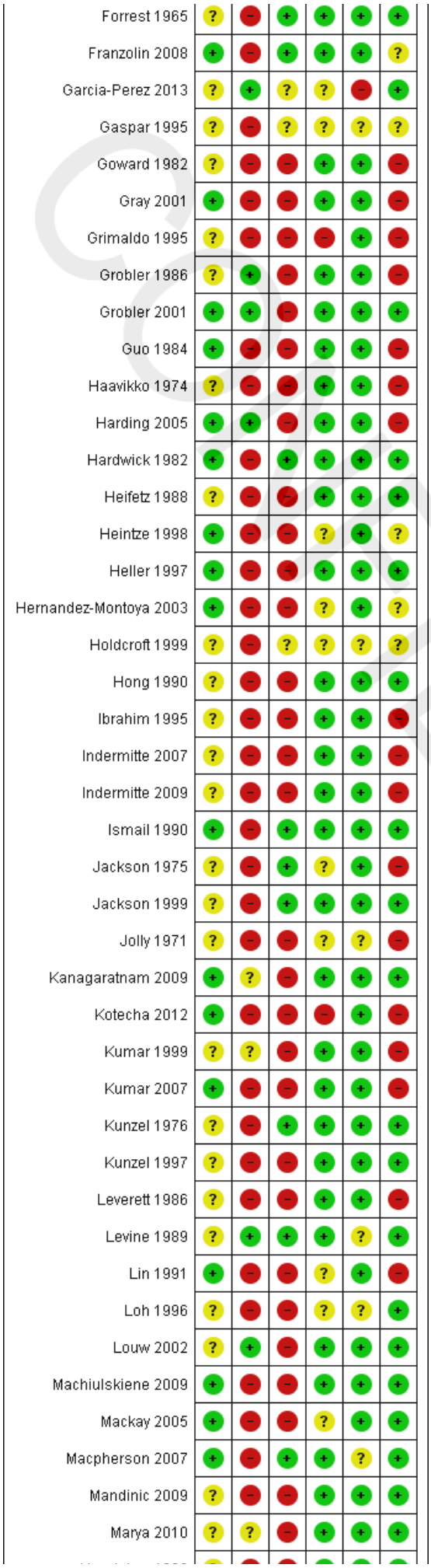
Caption

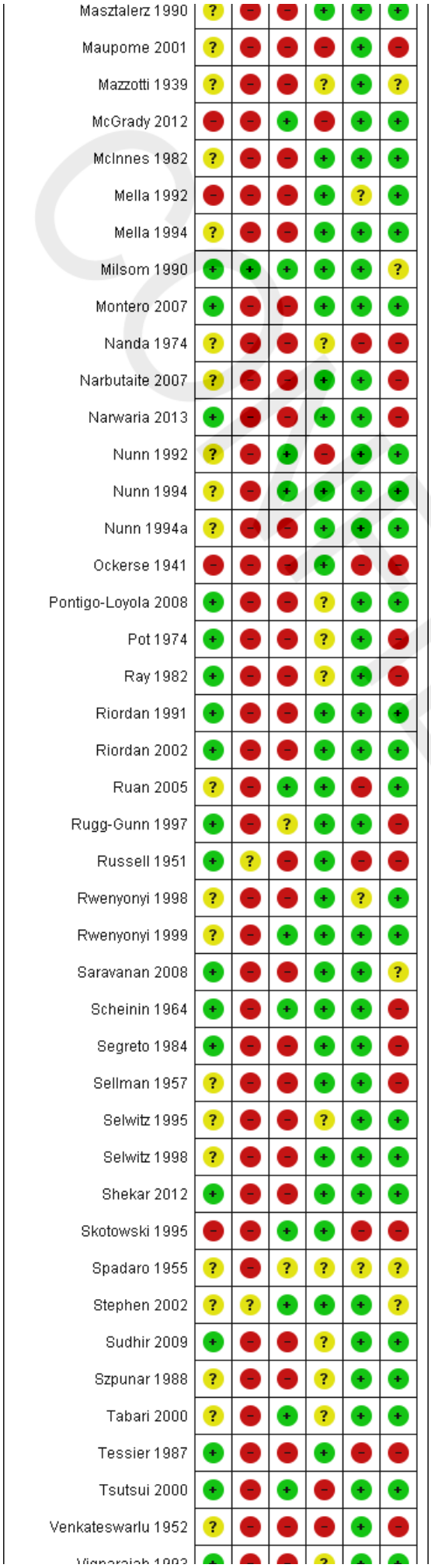
Study flow diagram.

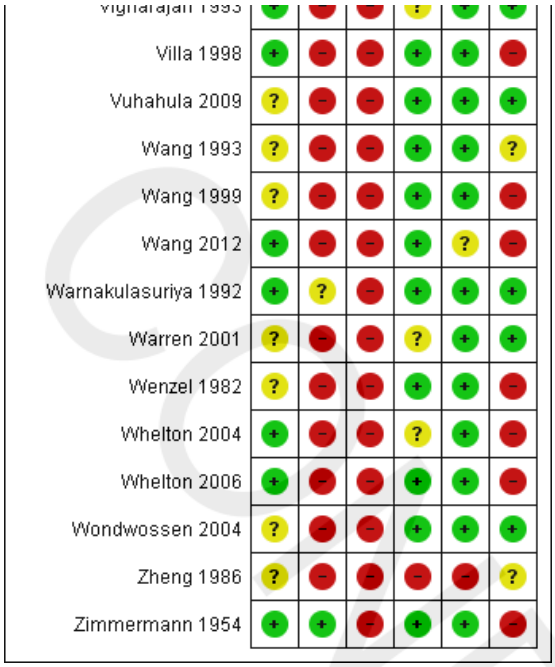
Figure 2







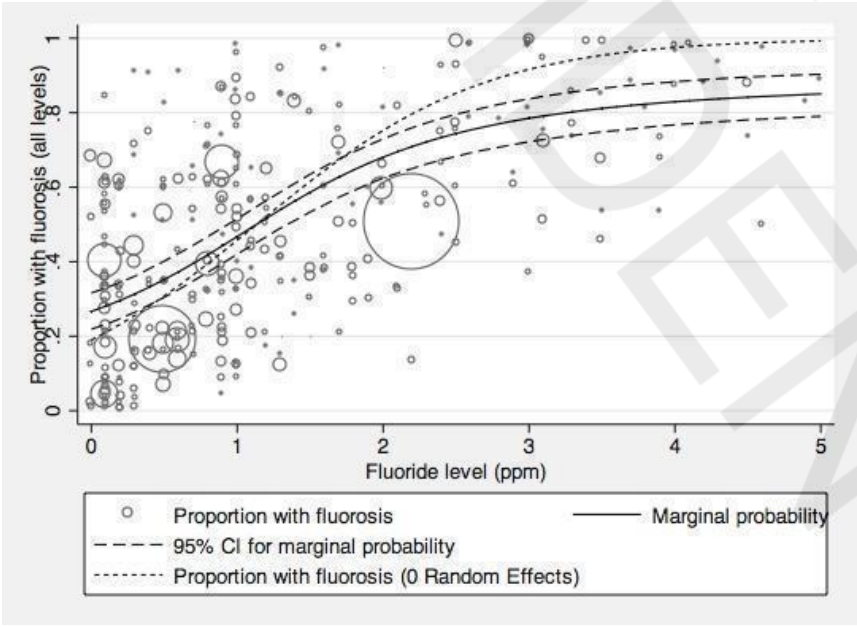




Caption

Risk of bias summary: review authors' judgements about each risk of bias item for each included study.

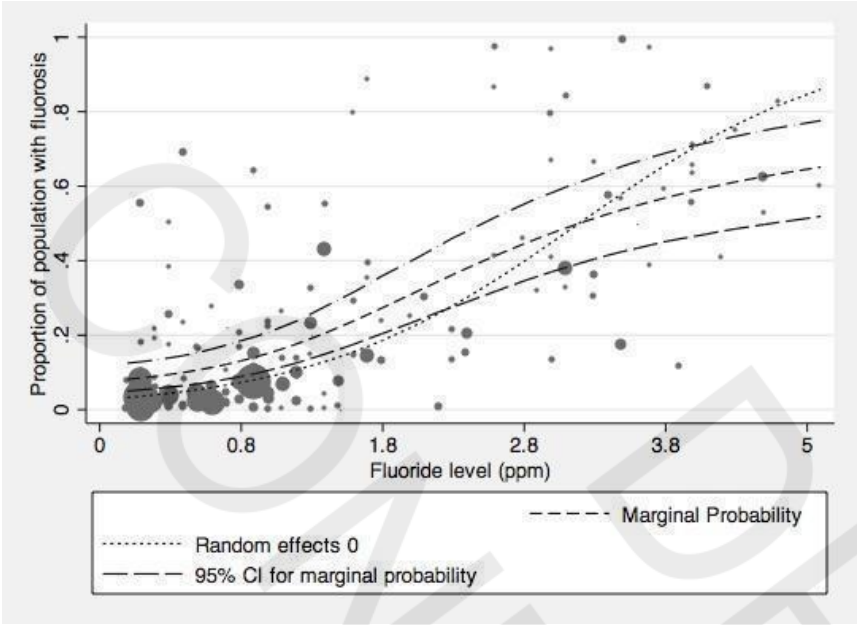
Figure 3



Caption

Proportion of the population with dental fluorosis of any level by water fluoride level together with 95% confidence limits for the proportion (studies reporting up to and including 5ppm F)

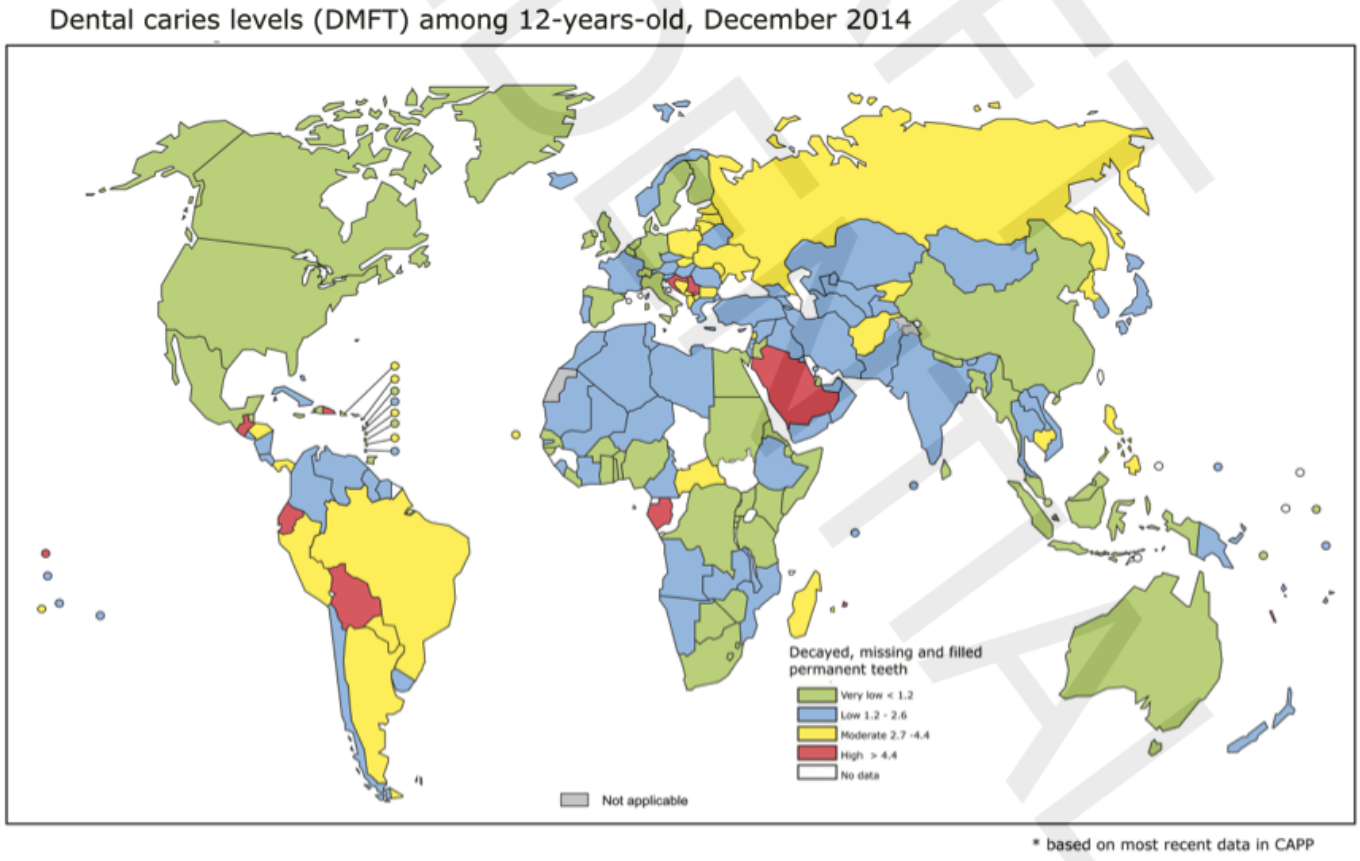
Figure 4



Caption

Proportion of the population with dental fluorosis of aesthetic concern by water fluoride level together with 95% confidence limits for the proportion (studies reporting up to and including 5ppm).

Figure 5

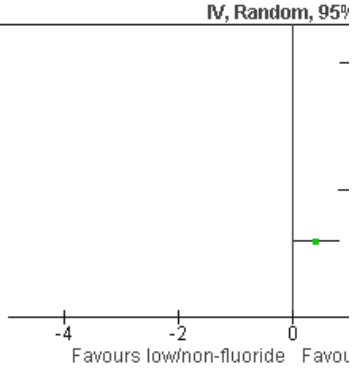


Caption

Figure 6 (Analysis 1.1)

Study or Subgroup	Water fluoridation Mean	SD	Total	Low/non-fluoridated water Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI	Year
Arnold 1956	2.75	4.99	4931	1.18	5.8	1437	12.6%	1.57 [1.24, 1.90]	1951
Adriasola 1959	2.5	7.04	263	0.3	6.72	157	6.8%	2.20 [0.85, 3.55]	1956
DHSS Wales 1969	2.87	4.68	1910	0.64	5.54	959	12.3%	2.23 [1.82, 2.64]	1965
DHSS England 1969	3.09	4.3	654	1.04	4.22	557	11.9%	2.05 [1.57, 2.53]	1967
Beal 1971	2.46	5.8	182	-0.12	6.27	223	7.7%	2.58 [1.40, 3.76]	1970
Kunzel 1997	1.65	4.05	3726	0.13	5	1312	12.8%	1.52 [1.22, 1.82]	1971
Beal 1981	2.02	4.18	361	0.57	4.6	367	11.0%	1.45 [0.81, 2.09]	1975
Guo 1984	0.23	5.39	2018	-2.47	5.35	1696	12.6%	2.70 [2.35, 3.05]	1984
Blinkhorn (unpublished)	1.3	3.56	813	0.88	3.74	568	12.4%	0.42 [0.03, 0.81]	2012
Total (95% CI)			**14858**			**7276**	**100.0%**	**1.81 [1.31, 2.31]**	

Heterogeneity: Tau² = 0.49; Chi² = 86.18, df = 8 (P < 0.00001); I² = 91%
Test for overall effect: Z = 7.05 (P < 0.00001)



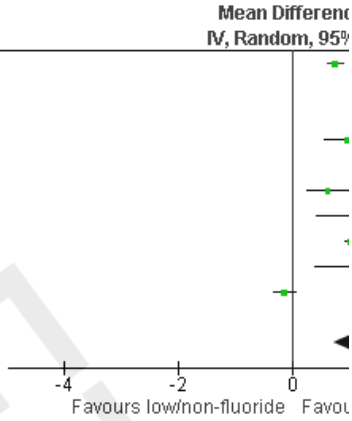
Caption

Initiation of water fluoridation compared with low/non-fluoridated water: change in dmft

Figure 7 (Analysis 1.2)

Study or Subgroup	Water fluoridation Mean	SD	Total	Low/non-fluoridated water Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI	Year
Arnold 1956	0.9	3.2	10647	0.15	3.51	2824	11.2%	0.75 [0.61, 0.89]	1951
Brown 1965	3.03	3.31	1097	0.52	4.18	1032	10.7%	2.51 [2.19, 2.83]	1959
DHSS Wales 1969	0.66	3.72	1833	-0.73	4.95	1390	10.8%	1.39 [1.08, 1.70]	1965
DHSS England 1969	1.62	3.92	939	0.65	4.39	725	10.4%	0.97 [0.56, 1.38]	1967
Kunzel 1997	1.02	2.94	6690	-0.85	3.26	2421	11.2%	1.87 [1.72, 2.02]	1971
Beal 1981	0.82	2.5	369	0.2	2.644	367	10.5%	0.62 [0.25, 0.99]	1975
Hardwick 1982	-3.76	2.86	144	-4.85	3.39	199	9.1%	1.09 [0.43, 1.75]	1978
Guo 1984	-0.11	1.69	3190	-1.14	2.59	4194	11.3%	1.03 [0.93, 1.13]	1984
Tessier 1987	5.12	6.16	76	2.83	6.18	89	3.7%	2.29 [0.40, 4.18]	1986
Blinkhorn (unpublished)	0.14	1.44	710	0.28	1.92	446	11.1%	-0.14 [-0.35, 0.07]	2012
Total (95% CI)			**25695**			**13687**	**100.0%**	**1.16 [0.72, 1.61]**	

Heterogeneity: Tau² = 0.46; Chi² = 351.88, df = 9 (P < 0.00001); I² = 97%
Test for overall effect: Z = 5.11 (P < 0.00001)



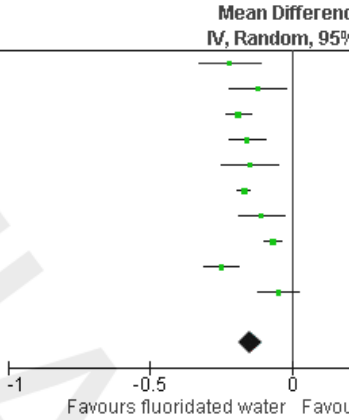
Caption

Initiation of water fluoridation compared with low/non-fluoridated water: Change in DMFT

Figure 8 (Analysis 1.3)

Study or Subgroup	Water fluoridation Mean	SD	Total	Low/non-fluoridated water Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI	Year
Ast 1951	-0.27	0.64	246	-0.05	0.61	292	7.2%	-0.22 [-0.33, -0.11]	1951
Adriasola 1959	-0.16	1.155	633	-0.04	0.425	356	7.6%	-0.12 [-0.22, -0.02]	1956
DHSS Wales 1969	-0.22	0.669	1910	-0.03	0.474	959	12.0%	-0.19 [-0.23, -0.15]	1965
DHSS England 1969	-0.3	0.652	654	-0.14	0.481	557	10.3%	-0.16 [-0.22, -0.10]	1967
Beal 1971	-0.23	0.63	306	-0.08	0.533	223	7.7%	-0.15 [-0.25, -0.05]	1970
Kunzel 1997	-0.2	0.311	3726	-0.03	0.369	1312	13.1%	-0.17 [-0.19, -0.15]	1971
Beal 1981	-0.17	0.581	361	-0.06	0.517	367	9.1%	-0.11 [-0.19, -0.03]	1975
Guo 1984	-0.02	0.464	2068	0.05	0.42	1696	12.8%	-0.07 [-0.10, -0.04]	1984
Gray 2001	-0.16	0.509	2493	0.09	0.644	443	10.4%	-0.25 [-0.31, -0.19]	1997
Blinkhorn (unpublished)	-0.24	0.656	813	-0.19	0.689	568	9.7%	-0.05 [-0.12, 0.02]	2012
Total (95% CI)			**13210**			**6773**	**100.0%**	**-0.15 [-0.19, -0.11]**	

Heterogeneity: Tau² = 0.00; Chi² = 56.44, df = 9 (P < 0.00001); I² = 84%
Test for overall effect: Z = 6.95 (P < 0.00001)



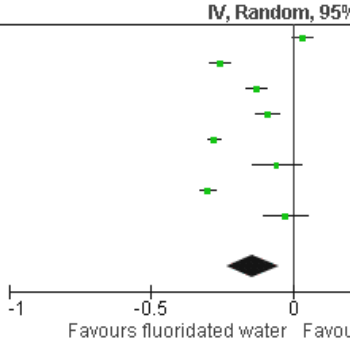
Caption

Initiation of water fluoridation compared with low/non-fluoridated water: Change in proportion of caries free children (deciduous teeth).

Figure 9 (Analysis 1.4)

Study or Subgroup	Water fluoridation Mean	SD	Total	Low/non-fluoridated water Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI	Year
Adriasola 1959	0	0.192	356	-0.03	0.219	204	12.7%	0.03 [-0.01, 0.07]	1956
Brown 1965	-0.28	0.507	1097	-0.02	0.328	1032	12.7%	-0.26 [-0.30, -0.22]	1959
DHSS Wales 1969	-0.08	0.655	1833	0.05	0.38	1390	12.7%	-0.13 [-0.17, -0.09]	1965
DHSS England 1969	-0.16	0.469	939	-0.07	0.422	761	12.6%	-0.09 [-0.13, -0.05]	1967
Kunzel 1997	-0.22	0.417	6690	0.06	0.502	2421	12.9%	-0.28 [-0.30, -0.26]	1971
Beal 1981	-0.11	0.686	369	-0.05	0.489	367	11.6%	-0.06 [-0.15, 0.03]	1975
Guo 1984	0.06	0.617	3657	0.36	0.684	4497	12.8%	-0.30 [-0.33, -0.27]	1984
Blinkhorn (unpublished)	-0.08	0.639	710	-0.05	0.676	446	11.8%	-0.03 [-0.11, 0.05]	2012
Total (95% CI)			**15651**			**11118**	**100.0%**	**-0.14 [-0.23, -0.05]**	

Heterogeneity: Tau² = 0.02; Chi² = 332.63, df = 7 (P < 0.00001); I² = 98%
Test for overall effect: Z = 3.10 (P = 0.002)



Caption

Initiation of water fluoridation compared with low/non-fluoridated water: Change in proportion of caries free children (permanent teeth).

Sources of support

Internal sources

- The University of Manchester, UK
- MAHSC, UK
  The Cochrane Oral Health Group is supported by the Manchester Academic Health Sciences Centre (MAHSC) and the NIHR Manchester Biomedical Research Centre.

External sources

- National Institute for Health Research (NIHR), UK
  CRG funding acknowledgement:
  The NIHR is the largest single funder of the Cochrane Oral Health Group.

  Disclaimer:
  The views and opinions expressed therein are those of the authors and do not necessarily reflect those of the NIHR, NHS or the Department of Health.
- Cochrane Oral Health Group Global Alliance, UK
  All reviews in the Cochrane Oral Health Group are supported by Global Alliance member organisations (British Association of Oral Surgeons, UK; British Orthodontic Society, UK; British Society of Paediatric Dentistry, UK; British Society of Periodontology, UK; Canadian Dental Hygienists Association, Canada; National Center for Dental Hygiene Research & Practice, USA; Mayo Clinic, USA; New York University College of Dentistry, USA; and Royal College of Surgeons of Edinburgh, UK) providing funding for the editorial process (http://ohg.cochrane.org/).

Feedback

Appendices

1 Databases searched in the original systematic review (McDonagh 2000)

• MEDLINE
• EMBASE
• NTIS (National Technical Information Service)
• Biosis
• Current Contents Search (Science Citation Index and Social Science Citation Index)
• Healthstar (Health Service Technology, Administration and Research)
• HSRProj
• TOXLINE
• Chemical Abstracts
• OldMEDLINE
• CAB Health
• FSTA (Food Science and Technology Abstracts)
• JICST- E Plus (Japanese Science and Technology)
• Pascal
• EI Compendex (Engineering Index)
• Enviroline
• PAIS (Public Affairs Information Services)
• SIGLE (System for Information on Grey Literature in Europe)
• Conference Papers Index
• Water Resources Abstracts
• Agricola (Agricultural Online Access)

• Waternet
• AMED (Allied and Complementary Medicine Database)
• Psyclit
• LILACS (Latin American and Caribbean Health Sciences Literature)

2 The Cochrane Oral Health Group Trials Register search strategy

#1 ((fluorid* or flurid* or fluorin* or flurin*))
#2 water*
#3 (#1 and #2)

3 The Cochrane Central Register of Controlled Trials (CENTRAL) search strategy

#1 MeSH descriptor Fluoridation this term only
#2 MeSH descriptor Fluorides explode all trees
#3 MeSH descriptor Fluorine this term only
#4 (fluorid* in All Text or fluorin* in All Text or flurin* in All Text or flurid* in All Text)
#5 (#1 or #2 or #3 or #4)
#6 MeSH descriptor Dietary supplements this term only
#7 MeSH descriptor Water supply this term only
#8 water* in All Text
#9 (#6 or #7 or #8)
#10 MeSH descriptor Tooth demineralization explode all trees
#11 (caries in All Text or carious in All Text)
#12 (teeth in All Text and (cavit* in All Text or caries in All Text or carious in All Text or decay* in All Text or lesion* in All Text or deminerali* in All Text or reminerali* in All Text))
#13 (tooth in All Text and (cavit* in All Text or caries in All Text or carious in All Text or decay* in All Text or lesion* in All Text or deminerali* in All Text or reminerali* in All Text))
#14 (dental in All Text and (cavit* in All Text or caries in All Text or carious in All Text or decay* in All Text or lesion* in All Text or deminerali* in All Text or reminerali* in All Text))
#15 (enamel in All Text and (cavit* in All Text or caries in All Text or carious in All Text or decay* in All Text or lesion* in All Text or deminerali* in All Text or reminerali* in All Text))
#16 (dentin in All Text and (cavit* in All Text or caries in All Text or carious in All Text or decay* in All Text or lesion* in All Text or deminerali* in All Text or reminerali* in All Text))
#17 (root* in All Text and (cavit* in All Text or caries in All Text or carious in All Text or decay* in All Text or lesion* in All Text or deminerali* in All Text or reminerali* in All Text))
#18 MeSH descriptor Dental plaque this term only
#19 ((teeth in All Text or tooth in All Text or dental in All Text or enamel in All Text or dentin in All Text) and plaque in All Text)
#20 MeSH descriptor Dental health surveys explode all trees
#21 ("DMF Index" in All Text or "Dental Plaque Index" in All Text)
#22 (#10 or #11 or #12 or #13 or #14 or #15 or #16 or #17 or #18 or #19 or #21) #23 (#5 and #9 and #22)

4 MEDLINE (OVID) search strategy

1. Fluoridation/
2. exp Fluorides/
3. Fluorine/
4. (fluorid$ or fluorin$ or flurin$ or flurid$).mp.
5. or/1-4
6. Dietary supplements/
7. Water supply/
8. water$.mp.
9. or/6-8
10. exp TOOTH DEMINERALIZATION/
11. (caries or carious).mp.
12. (teeth adj5 (cavit$ or caries$ or carious or decay$ or lesion$ or deminerali$ or reminerali$)).mp.
13. (tooth adj5 (cavit$ or caries$ or carious or decay$ or lesion$ or deminerali$ or reminerali$)).mp.
14. (dental adj5 (cavit$ or caries$ or carious or decay$ or lesion$ or deminerali$ or reminerali$)).mp.
15. (enamel adj5 (cavit$ or caries$ or carious or decay$ or lesion$ or deminerali$ or reminerali$)).mp.
16. (dentin$ adj5 (cavit$ or caries$ or carious or decay$ or lesion$ or deminerali$ or reminerali$)).mp.
17. (root$ adj5 (cavit$ or caries$ or carious or decay$ or lesion$ or deminerali$ or reminerali$)).mp.
18. Dental plaque/
19. ((teeth or tooth or dental or enamel or dentin) and plaque).mp.
20. exp DENTAL HEALTH SURVEYS/
21. ("DMF Index" or "Dental Plaque Index").mp.
22. or/10-21
23. case reports.pt.
24. Comment/
25. Letter/

26. Editorial/
27. or/23-26
28. exp animals/ not humans.sh.
29. 5 and 9 and 22
30. 29 not (28 or 27)

5 EMBASE (OVID) search strategy

1. Fluoridation/
2. exp Fluoride/
3. Fluorine/
4. (fluorid$ or fluorin$ or flurin$ or flurid$).ti,ab.
5. or/1-4
6. Diet supplementation/
7. Water supply/
8. water$.ti,ab.
9. or/6-8
10. exp Dental caries/
11. (caries or carious).ti,ab.
12. (teeth adj5 (cavit$ or caries$ or carious or decay$ or lesion$ or demineral$ or remineral$)).ti,ab.
13. (tooth adj5 (cavit$ or caries$ or carious or decay$ or lesion$ or demineral$ or remineral$)).ti,ab.
14. (dental adj5 (cavit$ or caries$ or carious or decay$ or lesion$ or demineral$ or remineral$)).ti,ab.
15. (enamel adj5 (cavit$ or caries$ or carious or decay$ or lesion$ or demineral$ or remineral$)).ti,ab.
16. (dentin$ adj5 (cavit$ or caries$ or carious or decay$ or lesion$ or demineral$ or remineral$)).ti,ab.
17. (root$ adj5 (cavit$ or caries$ or carious or decay$ or lesion$ or demineral$ or remineral$)).ti,ab
18. Tooth plaque/
19. ((teeth or tooth or dental or enamel or dentin) and plaque).ti,ab.
20. ("DMF Index" or "Dental Plaque Index" or "dental health survey*").ti,ab.
21. or/10-20
22. 9 and 21
23. (exp animal/ or animal.hw. or nonhuman/) not (exp human/ or human cell/ or (human or humans).ti.)
24. 22 not 23

6 Proquest search strategy

ab(fluorid*) AND ab(water*) AND ab(caries OR carious OR dental OR tooth OR teeth OR plaque)

7 Web of Science Conference Proceedings search strategy

#1 TS=(fluorid* or fluorin* or flurin* or flurid*)
#2 TS=water*
#3 TS=(caries or carious)
#4 TS=(teeth and (cavit* or caries* or carious or decay* or lesion* or demineral* or remineral*))
#5 TS=(tooth and (cavit* or caries* or carious or decay* or lesion* or demineral* or remineral*))
#6 TS=(dental and (cavit* or caries* or carious or decay* or lesion* or demineral* or remineral*))
#7 TS=(enamel and (cavit* or caries* or carious or decay* or lesion* or demineral* or remineral*))
#8 TS=(dentin* and (cavit* or caries* or carious or decay* or lesion* or demineral* or remineral*))
#9 TS=(root* and (cavit* or caries* or carious or decay* or lesion* or demineral* or remineral*))
#10 TS=((teeth or tooth or dental or enamel or dentin) and plaque)
#11 TS=("DMF Index" or "Dental Plaque Index")
#12 #3 or #4 or #5 or #6 or #7 or #8 or #9 or #10 or #11
#13 #1 and #2 and #12

8 ZETOC Conference Proceedings search strategy

fluoride AND water AND caries
fluoridation AND water AND caries
fluoride AND water AND carious
fluoridation AND water AND carious
fluoride AND water AND dental
fluoridation AND water AND dental
fluoride AND water AND tooth
fluoridation AND water AND tooth
fluoride AND water AND teeth
fluoridation AND water AND teeth

9 US National Institutes of Health Trials Registry and WHO International Clinical Trials Registry Platform search strategy

fluoride and water and caries

10 Fluorosis studies

Studies included in the analysis of all level of fluorosis:

Acharya 2005; Adair 1999; Al-Alousi 1975; Alarcon-Herrera 2001; Albrecht 2004; AlDosari 2010; Angelillo 1999; Arif 2013; Azcurra 1995; Beltran-Aguilar 2002; Booth 1991; Brothwell 1999; Chandrashekar 2004; Chen 1989; Chen 1993; Clark 1993; Clarkson 1989; Cochran 2004; Correia Sampaio 1999; Cutress 1985; Driscoll 1983; Ekanayake 2002; Eklund 1987; Ellwood 1995; Ellwood 1996; Firempong 2013; Forrest 1965; Garcia-Perez 2013; Gaspar 1995; Grimaldo 1995; Grobler 1986; Grobler 2001; Haavikko 1974; Heintze 1998; Heller 1997; Hernandez-Montoya 2003; Hong 1990; Ibrahim 1995; Indermitte 2007; Indermitte 2009; Ismail 1990; Jackson 1975; Jackson 1999; Kanagaratnam 2009; Kotecha 2012; Kumar 2007; Kunzel 1976; Leverett 1986; Levine 1989; Lin 1991; Louw 2002; Machiulskiene 2009; Mackay 2005; Macpherson 2007; Mandinic 2009; Marya 2010; Masztalerz 1990; McGrady 2012; McInnes 1982; Mella 1992; Mella 1994; Milsom 1990; Montero 2007; Nanda 1974; Narbutaite 2007; Narwaria 2013; Nunn 1994; Ockerse 1941; Pontigo-Loyola 2008; Ray 1982; Riordan 1991; Riordan 2002; Rwenyonyi 1998; Rwenyonyi 1999; Saravanan 2008; Sellman 1957; Shekar 2012; Stephen 2002; Szpunar 1988; Tabari 2000; Tsutsui 2000; Wang 1993; Wang 1999; Wang 2012; Warnakulasuriya 1992; Warren 2001; Wenzel 1982; Wondwossen 2004; Zheng 1986; Zimmermann 1954

Studies included in the analysis of fluorosis of aesthetic concern:

Acharya 2005; Alarcon-Herrera 2001; AlDosari 2010; Angelillo 1999; Arif 2013; Beltran-Aguilar 2002; Chen 1989; Clark 1993; Correia Sampaio 1999; Driscoll 1983; Eklund 1987; Forrest 1965; Gaspar 1995; Grimaldo 1995; Grobler 1986; Grobler 2001; Haavikko 1974; Heller 1997; Hernandez-Montoya 2003; Hong 1990; Ibrahim 1995; Jackson 1999; Kunzel 1976; Leverett 1986; Louw 2002; Macpherson 2007; McGrady 2012; Mella 1992; Mella 1994; Montero 2007; Nanda 1974; Pontigo-Loyola 2008; Ray 1982; Riordan 1991; Riordan 2002; Ruan 2005; Russell 1951; Sellman 1957; Stephen 2002; Tabari 2000; Zheng 1986; Zimmermann 1954

Studies not able to be included in analysis:

Awadia 2000; Berndt 2010a; Birkeland 2005; Butler 1985; Chen 1993; Clarkson 1992; Colquhoun 1984; Cypriano 2003; de Crousaz 1982; Downer 1994; Driscoll 1983; Ermis 2003; Forrest 1956; Franzolin 2008; Harding 2005; Heifetz 1988; Jolly 1971; Kumar 1999; Mazzotti 1939; Rugg-Gunn 1997; Scheinin 1964; Segreto 1984; Selwitz 1995; Selwitz 1998; Skotowski 1995; Spadaro 1955; Sudhir 2009; Venkateswarlu 1952; Villa 1998; Vignarajah 1993; Vuhahula 2009; Whelton 2004; Whelton 2006

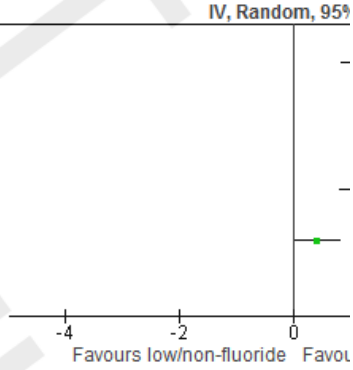
Graphs

1 - Initiation of water fluoridation compared with low/non-fluoridated water

1.1 Change in decayed, missing or filled deciduous teeth (dmft)

Study or Subgroup	Water fluoridation Mean	SD	Total	Low/non-fluoridated water Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI	Year
Arnold 1956	2.75	4.99	4931	1.18	5.8	1437	12.6%	1.57 [1.24, 1.90]	1951
Adriasola 1959	2.5	7.04	263	0.3	6.72	157	6.8%	2.20 [0.85, 3.55]	1956
DHSS Wales 1969	2.87	4.68	1910	0.64	5.54	959	12.3%	2.23 [1.82, 2.64]	1965
DHSS England 1969	3.09	4.3	654	1.04	4.22	557	11.9%	2.05 [1.57, 2.53]	1967
Beal 1971	2.46	5.8	182	-0.12	6.27	223	7.7%	2.58 [1.40, 3.76]	1970
Kunzel 1997	1.65	4.05	3726	0.13	5	1312	12.8%	1.52 [1.22, 1.82]	1971
Beal 1981	2.02	4.18	361	0.57	4.6	367	11.0%	1.45 [0.81, 2.09]	1975
Guo 1984	0.23	5.39	2018	-2.47	5.35	1696	12.6%	2.70 [2.35, 3.05]	1984
Blinkhorn (unpublished)	1.3	3.56	813	0.88	3.74	568	12.4%	0.42 [0.03, 0.81]	2012
Total (95% CI)			**14858**			**7276**	**100.0%**	**1.81 [1.31, 2.31]**	

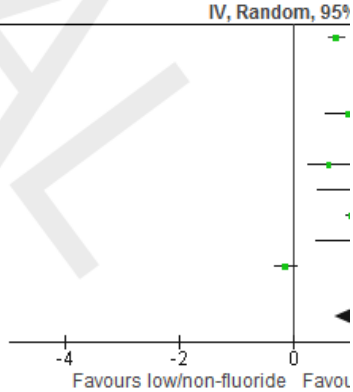
Heterogeneity: Tau² = 0.49; Chi² = 86.18, df = 8 (P < 0.00001); I² = 91%
Test for overall effect: Z = 7.05 (P < 0.00001)



1.2 Change in decayed, missing or filled permanent teeth (DMFT)

Study or Subgroup	Water fluoridation Mean	SD	Total	Low/non-fluoridated water Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI	Year
Arnold 1956	0.9	3.2	10647	0.15	3.51	2824	11.2%	0.75 [0.61, 0.89]	1951
Brown 1965	3.03	3.31	1097	0.52	4.18	1032	10.7%	2.51 [2.19, 2.83]	1959
DHSS Wales 1969	0.66	3.72	1833	-0.73	4.95	1390	10.8%	1.39 [1.08, 1.70]	1965
DHSS England 1969	1.62	3.92	939	0.65	4.39	725	10.4%	0.97 [0.56, 1.38]	1967
Kunzel 1997	1.02	2.94	6690	-0.85	3.26	2421	11.2%	1.87 [1.72, 2.02]	1971
Beal 1981	0.82	2.5	369	0.2	2.644	367	10.5%	0.62 [0.25, 0.99]	1975
Hardwick 1982	-3.76	2.86	144	-4.85	3.39	199	9.1%	1.09 [0.43, 1.75]	1978
Guo 1984	-0.11	1.69	3190	-1.14	2.59	4194	11.3%	1.03 [0.93, 1.13]	1984
Tessier 1987	5.12	6.16	76	2.83	6.18	89	3.7%	2.29 [0.40, 4.18]	1986
Blinkhorn (unpublished)	0.14	1.44	710	0.28	1.92	446	11.1%	-0.14 [-0.35, 0.07]	2012
Total (95% CI)			**25695**			**13687**	**100.0%**	**1.16 [0.72, 1.61]**	

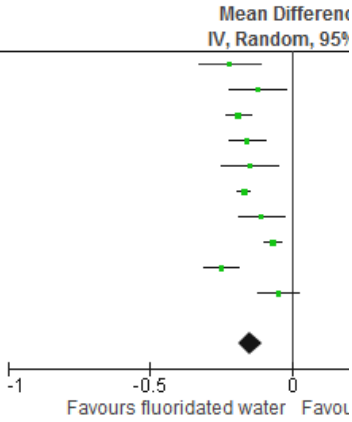
Heterogeneity: Tau² = 0.46; Chi² = 351.88, df = 9 (P < 0.00001); I² = 97%
Test for overall effect: Z = 5.11 (P < 0.00001)



1.3 Change in proportion of caries free children (deciduous teeth)

Study or Subgroup	Water fluoridation Mean	SD	Total	Low/non-fluoridated water Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI	Year
Ast 1951	-0.27	0.64	246	-0.05	0.61	292	7.2%	-0.22 [-0.33, -0.11]	1951
Adriasola 1959	-0.16	1.155	633	-0.04	0.425	356	7.6%	-0.12 [-0.22, -0.02]	1956
DHSS Wales 1969	-0.22	0.669	1910	-0.03	0.474	959	12.0%	-0.19 [-0.23, -0.15]	1965
DHSS England 1969	-0.3	0.652	654	-0.14	0.481	557	10.3%	-0.16 [-0.22, -0.10]	1967
Beal 1971	-0.23	0.63	306	-0.08	0.533	223	7.7%	-0.15 [-0.25, -0.05]	1970
Kunzel 1997	-0.2	0.311	3726	-0.03	0.369	1312	13.1%	-0.17 [-0.19, -0.15]	1971
Beal 1981	-0.17	0.581	361	-0.06	0.517	367	9.1%	-0.11 [-0.19, -0.03]	1975
Guo 1984	-0.02	0.464	2068	0.05	0.42	1696	12.8%	-0.07 [-0.10, -0.04]	1984
Gray 2001	-0.16	0.509	2493	0.09	0.644	443	10.4%	-0.25 [-0.31, -0.19]	1997
Blinkhorn (unpublished)	-0.24	0.656	813	-0.19	0.689	568	9.7%	-0.05 [-0.12, 0.02]	2012
Total (95% CI)			**13210**			**6773**	**100.0%**	**-0.15 [-0.19, -0.11]**	

Heterogeneity: Tau² = 0.00; Chi² = 56.44, df = 9 (P < 0.00001); I² = 84%
Test for overall effect: Z = 6.95 (P < 0.00001)



1.4 Change in proportion of caries free children (permanent teeth)

Study or Subgroup	Water fluoridation Mean	SD	Total	Low/non-fluoridated water Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI	Year
Adriasola 1959	0	0.192	356	-0.03	0.219	204	12.7%	0.03 [-0.01, 0.07]	1956
Brown 1965	-0.28	0.507	1097	-0.02	0.328	1032	12.7%	-0.26 [-0.30, -0.22]	1959
DHSS Wales 1969	-0.08	0.655	1833	0.05	0.38	1390	12.7%	-0.13 [-0.17, -0.09]	1965
DHSS England 1969	-0.16	0.469	939	-0.07	0.422	761	12.6%	-0.09 [-0.13, -0.05]	1967
Kunzel 1997	-0.22	0.417	6690	0.06	0.502	2421	12.9%	-0.28 [-0.30, -0.26]	1971
Beal 1981	-0.11	0.686	369	-0.05	0.489	367	11.6%	-0.06 [-0.15, 0.03]	1975
Guo 1984	0.06	0.617	3657	0.36	0.684	4497	12.8%	-0.30 [-0.33, -0.27]	1984
Blinkhorn (unpublished)	-0.08	0.639	710	-0.05	0.676	446	11.8%	-0.03 [-0.11, 0.05]	2012
Total (95% CI)			**15651**			**11118**	**100.0%**	**-0.14 [-0.23, -0.05]**	

Heterogeneity: Tau² = 0.02; Chi² = 332.63, df = 7 (P < 0.00001); I² = 98%
Test for overall effect: Z = 3.10 (P = 0.002)