



Australian Government
National Health and Medical Research Council

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Water Fluoridation and Human Health in Australia: Questions and Answers



Australian Government
Department of Health and Ageing

**National Health and
Medical Research Council**

WATER FLUORIDATION AND HUMAN HEALTH IN AUSTRALIA: QUESTIONS AND ANSWERS

NATIONAL HEALTH AND MEDICAL RESEARCH COUNCIL

These Questions and Answers have been developed by the National Health and Medical Research Council (NHMRC) in consultation with the jurisdictional health departments. They aim to provide helpful information to support the *NHMRC Public Statement 2017: Water fluoridation and human health in Australia*.

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ABOUT WATER FLUORIDATION

I. WHY DRINK FLUORIDATED WATER?

There is consistent and reliable evidence that community water fluoridation helps to reduce tooth decay. The National Health and Medical Research Council (NHMRC) found that water fluoridation reduces tooth decay by 26 to 44% in children and adolescents, and by about 27% in adults (1). Recent Australian research suggests that access to fluoridated water from an early age is associated with less tooth decay in adults (1).

The consequences of tooth decay are costly due to time off school and work, and the costs of dental treatment. Tooth decay also leads to pain and can cause concerns about appearance. In Australia, community water fluoridation programs are considered a safe, ethical and effective way of reducing tooth decay across the population. Fluoridated water helps reduce tooth decay in all members of society, at all stages of life. This includes those who have less access to dental care and other measures that protect the teeth from decay.

2. WHAT IS FLUORIDE?

Fluoride (F⁻) is a chemical ion of the element fluorine (F) and is part of the earth's crust (2). It is a naturally occurring component of mineral salts found in rocks, soil, natural water sources, plants and animals. The amount of fluoride naturally occurring in water depends on the type of soil and rock through which the water drains. If rock formations are fluoride-rich, the amount of fluoride that can dissolve out of the rock as water passes over them is greater (2).

3. WHAT IS WATER FLUORIDATION?

Water fluoridation is the process of adjusting the amount of fluoride in drinking water to an optimal level to help reduce tooth decay. NHMRC supports Australian states and territories fluoridating their drinking water supplies within the range of 0.6 to 1.1 milligrams of fluoride per litre (mg/L) (3).

4. WHO BENEFITS FROM COMMUNITY WATER FLUORIDATION?

Community water fluoridation allows everybody to benefit from the protective effect of fluoride, without individuals having to make a conscious effort to change their behaviours (4). It benefits people of all ages throughout their life regardless of education, income or access to dental care (4, 5).

Tooth decay can develop at any age, so water fluoridation is an important way of reducing tooth decay in children and adults (6). Fluoridation of drinking water particularly benefits children, and those on a lower income who tend to have higher rates of tooth decay and less access to dental treatment and other forms of fluoride.

5. WHERE IS COMMUNITY WATER FLUORIDATION PRACTISED?

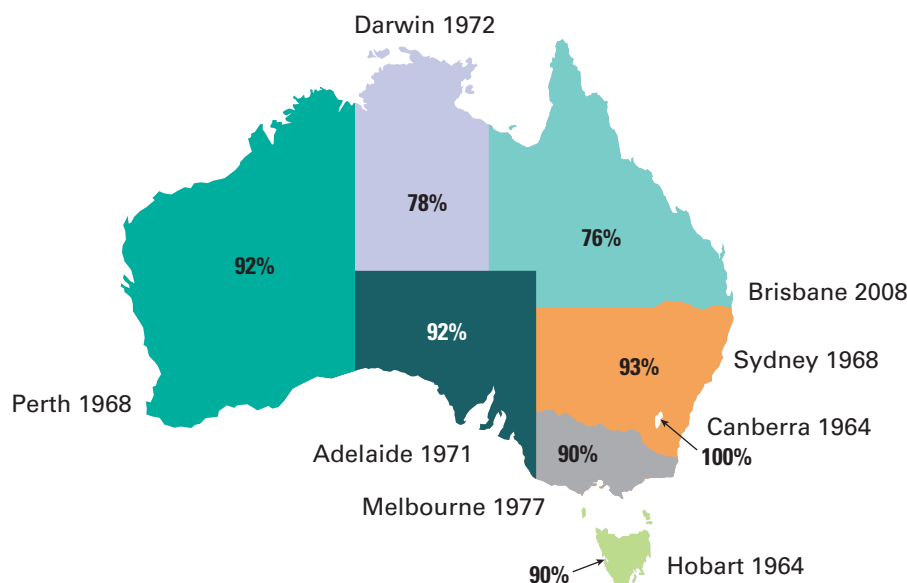
More than 400 million people around the world benefit from fluoridated drinking water – approximately 370 million accessing community water fluoridation schemes and about 50 million drinking naturally occurring optimal levels of fluoridated water (7). Countries with or planning to implement water fluoridation schemes include New Zealand, the United States, Canada, the United Kingdom, Ireland, Spain, Israel, Brazil, Chile, Argentina, Hong Kong, South Korea, Singapore and Malaysia (7). Many countries also use salt fluoridation schemes.

In Australia, the first community water fluoridation program began in 1953 in Beaconsfield, Tasmania (8) followed by Yass, New South Wales in 1956 (9). Most large Australian cities have fluoridated their water since the 1960s and 1970s.

6. HOW MANY AUSTRALIANS HAVE ACCESS TO FLUORIDATED DRINKING WATER SUPPLIES?

As of February 2017, 89 percent of Australians have access to fluoridated drinking water (10), which includes those areas with naturally occurring fluoride at a concentration of 0.5 mg/L and above (11). All Australian states and territories have fluoridated drinking water; however coverage in each jurisdiction varies (see Figure 1).^a

FIGURE 1: PERCENTAGE OF POPULATION WITH ACCESS TO FLUORIDATED WATER AS AT FEBRUARY 2017 AND DATES OF INTRODUCTION OF WATER FLUORIDATION TO AUSTRALIAN CAPITAL CITIES (BASED ON: HEALTHY MOUTHS HEALTHY LIVES: AUSTRALIA'S NATIONAL ORAL HEALTH PLAN 2015 – 2024, UPDATED WITH JURISDICTION STATISTICS)



7. IS COMMUNITY WATER FLUORIDATION A COST EFFECTIVE PUBLIC HEALTH POLICY?

Fluoridating water in Australia is a population-wide investment. In Australia, for every dollar that is spent on fluoridation, between \$7 and \$18 is saved due to avoided treatment costs (12-14).

Studies have reported that following the introduction of water fluoridation in Victoria, the community saved about \$1 billion over a 25 year period through avoided costs from dental treatment and days absent from work/school (15).

8. WHAT ROLE DOES COMMUNITY WATER FLUORIDATION PLAY IN AUSTRALIA'S NATIONAL ORAL HEALTH PLAN?

Australia has a national oral health plan that has been endorsed by all state and territory governments and the Australian Government. The purpose of *Healthy Mouths Healthy Lives: Australia's National Oral Health Plan 2015–2024* is to improve health and wellbeing across the Australian population by improving oral health status and reducing the burden of oral disease. The plan aims to help all Australians retain as many teeth as possible throughout their lives, have good oral health as part of good general health and have access to affordable and quality oral health services.

One of the plan's goals is to continue to extend water fluoridation of public water supplies. The plan reiterates the evidence that community water fluoridation is a safe, cost-effective and protective strategy that improves oral health by reducing tooth decay across the population.

^a Some Australian drinking water supplies contain naturally occurring fluoride at a concentration of 0.5 mg/L. It is recognised that some protection against tooth decay can be derived from concentrations of 0.5mg/L and above. [WHO (2017)]: *Guidelines for Drinking Water Quality*, Fourth Edition. Geneva: World Health Organization (WHO) p372.

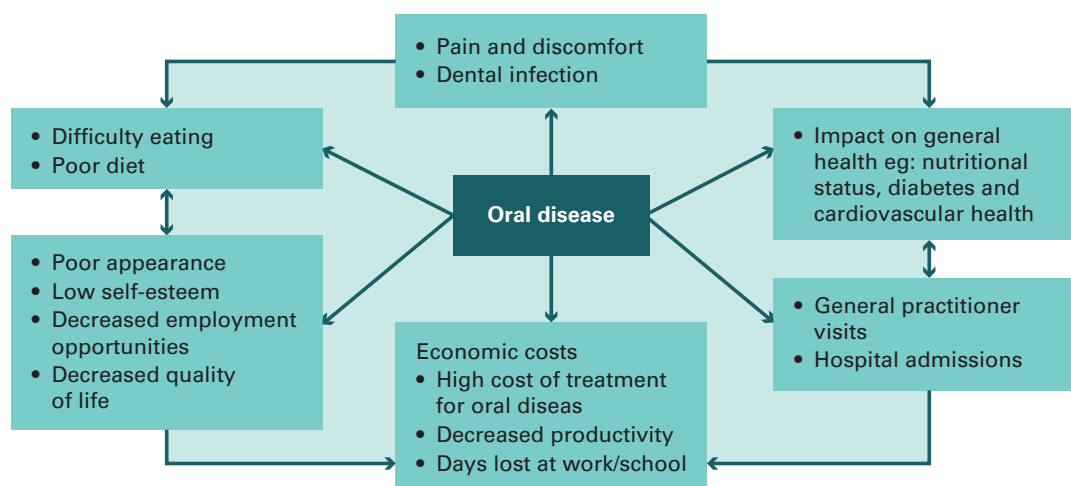
FLUORIDE AND ORAL HEALTH

9. WHY IS ORAL HEALTH IMPORTANT?

Oral health is important because it is fundamental to overall health, wellbeing and quality of life (11). A healthy mouth enables people to eat, speak and socialise without pain, discomfort or embarrassment (11).

Figure 2 shows the links between oral health and general health, as well as some of the social and economic implications of oral disease.

FIGURE 2: THE LINKS BETWEEN ORAL AND GENERAL HEALTH AND SOCIAL/ ECONOMIC COSTS OF ORAL DISEASE



Adapted from [Australia's National Oral Health Plan 2015–2024](#)

10. WHAT IS TOOTH DECAY AND WHY IS IT A PROBLEM?

Tooth decay is the breakdown of the outer layers of teeth. It is caused by bacterial acids that are produced when bacteria in the mouth break down sugar in foods and drinks (16). The acid removes calcium and phosphates from the tooth structure (called demineralisation), leading eventually to cavities or holes in the teeth, as well as potentially pain, infection and tooth loss (16).

The consequences of tooth decay are costly due to time off school and work, the costs of dental treatment, and pain and suffering (11, 17). Once a tooth is filled, it becomes structurally weaker and will almost certainly require further treatment in the future (18).

If left untreated, tooth decay can have serious, potentially life-threatening consequences (19).

Tooth decay is one of the most common chronic health problems in Australia, particularly in children and communities with insufficient fluoride in their drinking water. Tooth decay still occurs in populations with access to fluoridated water; however, rates of decay are much lower in communities with water fluoridation. There is a consistent association between sugar intake and tooth decay (20).

The most commonly used measure of tooth decay is called the decayed, missing or filled teeth index (DMFT/dmft index) (21). This is a measure of the number of teeth that are decayed, missing because of extraction or filled (21). Upper case lettering refers to permanent ('adult') teeth, while lower case lettering refers to primary ('baby') teeth (21). The DMFT index ranges from zero to 32, which is the maximum number of teeth in an adult; the dmft index ranges from zero to 20 (21).

II. HOW DOES FLUORIDE IN DRINKING WATER HELP TO REDUCE TOOTH DECAY?

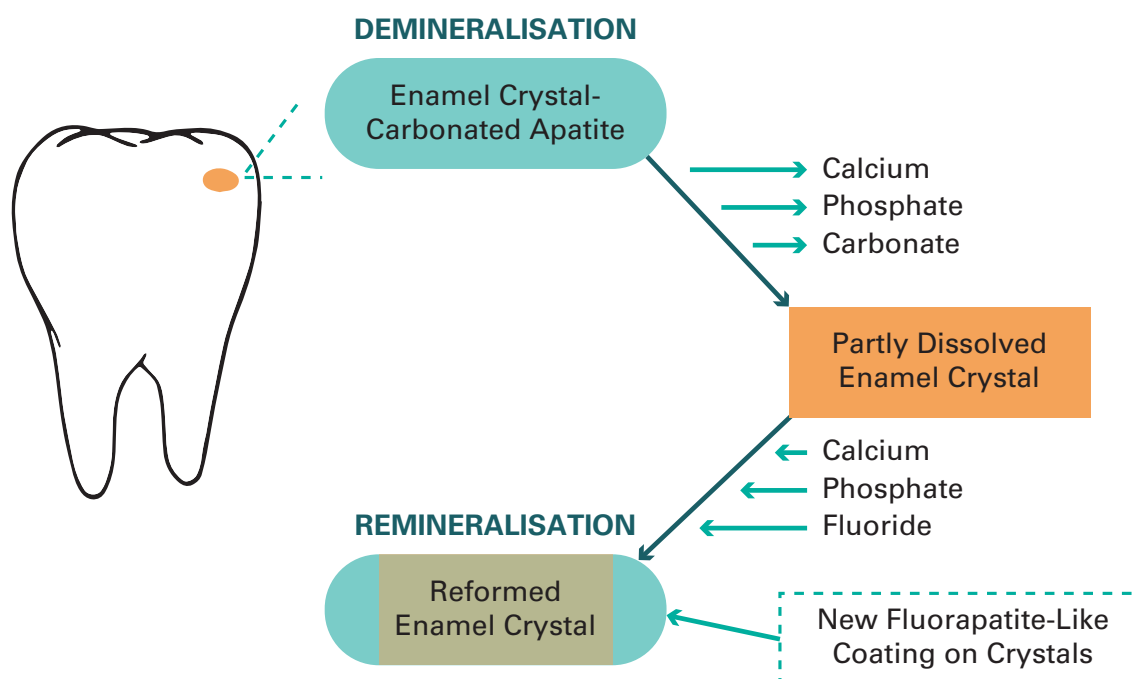
Fluoride in drinking water acts like a repair kit for teeth, working in a number of ways to strengthen teeth and make them more resistant to tooth decay for people of all ages (22).

There are two ways in which the fluoride in drinking water acts to reduce tooth decay:

- Reducing demineralisation (i.e. where the enamel begins to dissolve). This makes teeth more resistant to decay.
- Enhancing remineralisation (i.e. recovery of weakened enamel). This helps the repair of early tooth decay.

Fluoride also slows the activity of bacteria that cause decay and combines with enamel on the tooth surface to make it stronger and better able to resist decay (23, 2).

FIGURE 3: SCHEMATIC REPRESENTATION OF THE DEMINERALISATION AND REMINERALISATION PROCESSES WHICH LEAD TO REMINERALISED CRYSTALS WITH SURFACES RICH IN FLUORIDE AND OF LOW SOLUBILITY



Source: Adapted from Featherstone JDB (24). Reprinted with permission from Munksgaard International Publishers Ltd., Copenhagen, Denmark.

12. SHOULD I STILL USE FLUORIDATED TOOTHPASTE IF I AM DRINKING FLUORIDATED WATER?

Yes. Fluoridated drinking water and toothpaste with fluoride provide important and complementary benefits. Fluoridated water keeps low levels of fluoride in saliva and in dental plaque all day. The much higher concentration of fluoride in toothpaste offers additional benefit. Together, the two sources offer more protection than using either one alone.

For children aged between 18 months and under six years, it is recommended to use only a pea-sized amount of low-fluoride toothpaste and avoid fluoride mouth rinses.

13. WHAT IS DENTAL FLUOROSIS?

Dental fluorosis is caused by a high intake of fluoride from multiple sources during the time when teeth are developing inside the jawbone, usually from birth to six or eight years of age (2). It can appear as white lines or areas on the surface of both primary and permanent teeth and is identified after teeth erupt.

14. WHAT IS THE PATTERN OF DENTAL FLUOROSIS OCCURRENCE IN AUSTRALIA?

In Australia dental fluorosis has declined over the time period during which the extent of community water fluoridation has expanded (25-28). The decline in dental fluorosis is linked to reduced exposure to fluoride from other sources such as toothpaste, which is now available in low fluoride toothpastes for children. The use of low fluoride toothpaste is now actively promoted along with public health messages and guidelines about the appropriate use of these products (e.g. use only a small pea-sized amount; encourage children not to swallow toothpaste).

In Australia, where dental fluorosis has been identified, in most cases it is classified as very mild or mild. Mild to very mild dental fluorosis does not affect the function of the teeth, is not of aesthetic concern to those who have it and is associated with a protective benefit against tooth decay in adult teeth (1). Moderate dental fluorosis is very uncommon and severe dental fluorosis is rare in Australia. The very small amount of moderate and severe dental fluorosis in Australian children aged 8-14 years is not statistically different between fluoridated and non-fluoridated areas, meaning there is no evidence that community water fluoridation gives rise to these forms of dental fluorosis (1).

15. SHOULD I TAKE FLUORIDE SUPPLEMENTS?

Fluoride supplements in the form of drops or tablets should only be used on the advice of an oral health professional (4). They are no longer readily available in Australia.

THE SCIENTIFIC EVIDENCE SUPPORTING WATER FLUORIDATION

16. WHO REVIEWS SCIENTIFIC EVIDENCE RELEVANT TO AUSTRALIA?

NHMRC is Australia's leading expert body promoting the development and maintenance of public health and clinical standards. It is responsible for providing the Australian community with health advice based on the best available scientific evidence.

In 2014-2015, NHMRC conducted a comprehensive review of the latest scientific research on the health effects of water fluoridation relevant to Australia. This review identified and assessed new studies published between 2006 and 2015 to add to evidence identified in previous reviews [2000 McDonagh Review (29) and the 2007 NHMRC Review (21)].

Information about the recent review process is published in the 2016 Evidence Evaluation Report (6), Technical Report and Information Paper (1).

17. WHAT CONCLUSION DID NHMRC REACH IN ITS LATEST REVIEW OF THE EVIDENCE?

The conclusion reached by NHMRC is that the existing body of evidence consistently shows that water fluoridation safely reduces tooth decay. The findings from the latest review are summarised in the *Information Paper - Water fluoridation: dental and other human health outcomes, 2017*.

The NHMRC Public Statement 2017 (3) on water fluoridation and human health in Australia states:

NHMRC strongly recommends community water fluoridation as a safe, effective and ethical way to help reduce tooth decay across the population. NHMRC supports Australian states and territories fluoridating their drinking water supplies within the range of 0.6 to 1.1 milligrams per litre (mg/L).

There is reliable evidence that community water fluoridation as practised in Australia is not associated with cancer, Down syndrome, cognitive dysfunction, lowered intelligence or hip fracture (1).

There is no reliable evidence of an association between community water fluoridation as practised in Australia and other human health conditions such as chronic kidney disease, kidney stones, hardening of the arteries (atherosclerosis), high blood pressure, low birth weight, all-cause mortality, musculoskeletal pain, osteoporosis, skeletal fluorosis, thyroid problems or other self-reported ailments such as gastric discomfort, headache, and insomnia (1).

The term 'no reliable evidence' is used by NHMRC when there is a lack of confidence that the evidence reviewed is relevant to Australia or valid to accept any association between community water fluoridation and human health outcomes. Confidence in the body of evidence can be affected by several issues including the small numbers of studies, the study designs, the low quality of the studies and the lack of control for possible confounding factors. Confounding factors can include lack of consideration of fluoride from other sources, socioeconomic status and exposure to other chemicals such as iodine or lead.

18. HOW DID NHMRC ASSURE QUALITY OF ITS REVIEW OF EVIDENCE?

NHMRC takes care to ensure that its health advice, and the evidence it is based on, are of the highest possible quality. When reviewing evidence such as described in NHMRC's 2016 Evidence Evaluation Report (6), bias can occur when more attention is given to research studies supporting a particular view. Seeking or interpreting evidence in ways that support existing beliefs is referred to as confirmation bias (30). NHMRC addressed this type of bias by contracting the Clinical Trials Centre, University of Sydney, to identify and assess the available evidence. This was done using internationally recognised systematic review methods and having an independent group with expertise in the methodologies for evidence evaluation review the methods used by the Clinical Trials Centre.

Bias in research can also come from poorly designed studies, or from problems in the collection, analysis, reporting, publication or review of study data. This type of bias, referred to as research bias, can lead to invalid results (31). Where research bias was of concern in any of the included studies, it was noted in the NHMRC 2016 Evidence Evaluation Report (6) and the NHMRC Information Paper (1).

NHMRC sought feedback from experts on the research methods of the Evidence Evaluation and how the evidence was translated into the Information Paper. Feedback was also sought from independent external experts and the public.

19. WHAT DOES THE LATEST EVIDENCE SAY ABOUT WHETHER SOME PARTICULAR HEALTH EFFECTS OF COMMUNITY CONCERN ARE RELATED TO WATER FLUORIDATION?

NHMRC searched for evidence reporting any possible human health outcomes of water fluoridation. Those health effects which are of particular interest to the community are discussed in more detail below.

A. CANCER

There is no association between community water fluoridation and any form of cancer, including osteosarcoma and Ewing sarcoma (types of bone cancer) (1).

B. COGNITIVE FUNCTION AND INTELLIGENCE

There is no association between community water fluoridation as practised in Australia and cognitive function or intelligence of children and adults.

While some overseas studies suggested a possible link, these studies took place in countries where fluoride levels greatly exceed the levels seen in Australia and did not take into account factors such as parental education and the presence of arsenic in drinking water (1).

C. KIDNEY HEALTH

There is no reliable evidence of an association between community water fluoridation as practised in Australia and kidney stones or chronic kidney disease (1).

Kidney Health Australia state that there is no evidence that consumption of optimally fluoridated water causes chronic kidney disease or poses any risks for people with established chronic kidney disease.

D. MUSCLE AND SKELETAL HEALTH

There is no association between community water fluoridation as practised in Australia and hip fracture (1).

There is no reliable evidence of an association between community water fluoridation as practised in Australia and skeletal fluorosis, osteoporosis or musculoskeletal pain (1).

E. THYROID HEALTH

There is no reliable evidence of a link between community water fluoridation as practised in Australia and thyroid function, including goitre (enlargement of the thyroid gland) and hypothyroidism (underactive thyroid) (1).

Other possible health effects were considered by the NHMRC review and published in the Information Paper. Some of the findings are summarised in the answer to Question 17.

20. IS COMMUNITY WATER FLUORIDATION SUPPORTED BY HEALTH AND SCIENTIFIC AUTHORITIES AROUND THE WORLD?

Fluoridation of drinking water is supported by a range of national and international health research agencies and government bodies including:

- All Australian State Government health agencies
- Council of Australian Governments Health Council via [“Healthy Mouths Healthy Lives - Australia’s National Oral Health Plan 2015-2024”](#) (refer to Q8).
- [National Health and Medical Research Council \(Australia\)](#)
- [Australian Dental Association](#)
- [World Health Organization](#)
- [International Association for Dental Research](#)
- [Centres for Disease Control and Prevention \(USA\)](#)
- [US Surgeon General](#)
- [Harvard Medical School](#)
- [Harvard School of Dental Medicine](#)
- [Harvard School of Public Health](#)
- [Australian Medical Association](#)
- [Australian and New Zealand Society for Paediatric Dentistry](#)
- [Australasian Academy of Paediatric Dentistry](#)
- [Australian Academy of Science](#)
- [Australian Centre for Human Health Risk Assessment](#)
- [Australian Research Centre for Population Oral Health \(ARCPOH\)](#)
- [Public Health Association of Australia](#)
- [Alzheimer’s Australia](#)
- [Kidney Health Australia](#)
- [Royal Society of New Zealand and the Office of the Prime Minister’s Chief Science Advisor](#)
- [Ministry of Health New Zealand](#)
- [US Environmental Protection Agency](#)
- [US Department of Health and Human Services](#)
- [Health Research Board, Ireland](#)
- [National Cancer Institute \(USA\)](#)

21. HAS SCIENTIFIC EVIDENCE ON COMMUNITY WATER FLUORIDATION BEEN REVIEWED ELSEWHERE AND WHAT HAVE THE REVIEWS CONCLUDED?

The science underpinning community water fluoridation and indeed the use of fluorides generally for preventing tooth decay is reviewed periodically worldwide. In all cases the conclusions support the ongoing continuation of community water fluoridation initiatives.

The 2015 New Zealand review found compelling evidence that fluoridation of water at the established and recommended levels produced broad benefits for the dental health of New Zealanders (32).

The 2015 United States Public Health Service review found that community water fluoridation remains an effective public health strategy for delivering fluoride to prevent tooth decay and is the most feasible and cost-effective strategy for reaching entire communities (33).

The 2015 Ireland review found that, in community water fluoridated areas, there is no strong evidence that community water fluoridation is definitively associated with negative health effects. However, the evidence base examining the association between health effects and community water fluoridation is limited (34).

22. HOW WILL NHMRC KEEP UP TO DATE ON ANY NEW EVIDENCE ON WATER FLUORIDATION AND HUMAN HEALTH?

The NHMRC is responsible for providing current and evidence-based advice on health. To do this, NHMRC monitors any new evidence, in particular any significant new body of evidence, including its quality and how applicable it is to Australian conditions. This is done in consultation with state and territory representatives working in the field of drinking water and human health, and any NHMRC expert committee that advises on the NHMRC *Australian Drinking Water Guidelines*. Additionally, the Council of NHMRC considers guidelines and advice 5 years after publication and recommends to the NHMRC Chief Executive Officer if there is a need to update the publication, based on any new body of evidence.

FLUORIDE AND DRINKING WATER

23. WHERE DOES THE FLUORIDE THAT IS ADDED TO DRINKING WATER COME FROM?

The fluoride compounds used to fluoridate water are derived from a mineral rock called fluorapatite ($\text{Ca}_5(\text{PO}_4)_3\text{F}$) (2). Commonly used as source material for the fertiliser industry, when phosphate is removed, an extra step in the refining process may be taken to collect fluoride gas (35, 36). This gas can be converted into a liquid or powder form for the specific purpose of adding to water supplies (36). Fluoride is a by-product, not a waste product, of this process (37).

24. WHAT FLUORIDE COMPOUNDS ARE ADDED TO DRINKING WATER?

There are three fluoride-releasing compounds recommended in the *Australian Drinking Water Guidelines* for use in fluoridating water. These recommended fluoridating compounds are sodium fluoride (NaF : a compound of fluorine and sodium); sodium fluorosilicate (Na_2SiF_6 : a compound of fluorine, sodium and silicon); and fluorosilicic acid (H_2SiF_6 : a compound of fluorine, hydrogen and silicon).

Table 1 summarises these compounds, their chemical formulae, alternative names and physical forms. The type of compound selected is based on the type and size of the water treatment plant.

TABLE 1: FLUORIDE COMPOUNDS USED IN COMMUNITY WATER FLUORIDATION PROGRAMS

COMPOUND NAME	CHEMICAL FORMULA	ALTERNATIVE NAMES	PHYSICAL FORM
Hydrofluorosilicic acid	H_2SiF_6	Hexafluorosilicic acid Hydrofluosilicic acid Fluorosilicic acid	Liquid
Sodium fluorosilicate	Na_2SiF_6	Sodium hexafluorosilicate Disodium hexafluorosilicate Sodium silicofluoride	Powder
Sodium fluoride	NaF		Powder

Adapted from Australian Drinking Water Guidelines, Chapter 8 (38)

25. HOW ARE PURITY STANDARDS MAINTAINED FOR FLUORIDE COMPOUNDS ADDED TO DRINKING WATER?

Procedures have been established to ensure that impurities present in chemicals added to drinking water supplies do not represent a risk to public health. The *Australian Drinking Water Guidelines* recommends exacting requirements regarding maximum levels of impurities for all chemicals added to drinking water supplies (38). All additives used to treat drinking water (including disinfectant, and other water treatment substances) contain low levels of impurities (28). It is also important to note that water itself naturally contains dissolved or suspended impurities – hence the reliance upon the *Australian Drinking Water Guidelines* (38, 39).

Water utilities ensure that any impurities in fluoride chemicals do not pose a risk to public health. The *Australian Drinking Water Guidelines* recommends that chemicals added to drinking water cannot add more than 10% of the maximum safe value when the chemical is added. Commercially available fluoridation chemicals consistently meet this requirement.

State and Territory regulations usually specify that all chemicals added to drinking water have to be accompanied by test certificates detailing the strength of the active ingredient and concentrations of impurities (38). No chemical is to be accepted or used without a batch analysis certificate showing that all quality requirements have been met (38).

26. HOW ARE FLUORIDE COMPOUNDS ADDED TO THE WATER SUPPLY?

State and territory water authorities add fluoride to community water supplies using strict controls that are typically set out in legislation or Codes of Practice. This includes controls on the quality and purity of chemicals used in accordance with the Australian Drinking Water Guidelines (38).

Fluoride is added to water at drinking water treatment plants, which have been designed to add carefully controlled amounts (40). Safety at the water treatment plant is maintained by a risk management, multi-barrier approach. Equipment is designed to shut down if fluoride exceeds predetermined levels at key points in the water treatment system. The fluoride level in the water is at least monitored daily and in most cases continuously (40). Samples of water are taken from sites in the distribution system to ensure adequate fluoride levels ‘at the tap’ (40).

In all cases the compounds containing fluoride that are added to water supplies at a treatment plant dissolve into their components well before the water leaves the treatment plant. This means that in a glass of drinking water, there is no difference between fluoride ions that are present naturally or fluoride ions from compounds added as part of a community water fluoridation scheme.

27. HOW MUCH FLUORIDE IS RECOMMENDED IN DRINKING WATER?

To help protect teeth against tooth decay, only a very small amount of fluoride is needed in drinking water. NHMRC supports adjusting fluoride in Australian drinking water supplies to between 0.6 and 1.1 mg/L to be the most effective way to reduce tooth decay (3). This range of 0.6 and 1.1 mg/L is aimed at reducing tooth decay, while avoiding any risk of dental fluorosis of aesthetic concern.

28. DOES FLUORIDE AFFECT THE TASTE OF WATER?

Fluoride has no taste or smell, so water fluoridation will not affect the taste or smell of drinking water.

29. DO HOUSEHOLD FILTERS REMOVE FLUORIDE FROM DRINKING WATER?

The optimum fluoride level in public drinking water supplies is a safe and effective way of helping to protect teeth against dental decay, and it is not necessary or desirable to remove the fluoride.

Distillers and filtering systems containing ion exchange resins, activated aluminium or reverse-osmosis membranes have been shown to be effective and will remove most of the fluoride from water.

More information about removing fluoride from water can be obtained from a professional water treatment company.

30. IS BOTTLED WATER FLUORIDATED?

In most cases, the answer is no, although some bottled water products contain naturally occurring fluoride from the source. Australian food regulations allow the addition of fluoride to bottled water within the permitted range of 0.6 – 1 mg/L. As with all packaged food in Australia bottled water must be clearly labelled and state the product contents.

FLUORIDE AND DIET

31. IS FLUORIDE A NUTRIENT?

Yes. In 2006 and updated in 2017, the National Health and Medical Research Council, the Australian Government Department of Health and the New Zealand Ministry of Health included fluoride as a 'nutrient' in its *Nutrient reference values for Australia and New Zealand including recommended dietary intakes* (41, 42). This document states:

Because of its role in the prevention of dental caries [decay], fluoride has been classified as essential to human health.

32. DOES FLUORIDATED TAP WATER CAUSE ALLERGIES?

There is no link between community water fluoridation as practised in Australia and allergic reactions or allergy like symptoms.

According to medical specialists from the Department of Allergy, Immunology and Respiratory Medicine at The Alfred Hospital in Melbourne, no clinical or scientific evidence exists to confirm fluoride at current Australian levels causes allergies or affects immunity (43). Specifically, they state:

... during the last 25 years, whether in Melbourne or in the UK, we have never seen a patient with any respiratory symptoms nor any allergy-like symptoms that could be attributed to fluoride 1ppm [1 mg/L] as in our fluoridated water (43).

33. HOW MUCH FLUORIDE DO WE NEED?

The *NHMRC Nutrient reference values for Australia and New Zealand: including recommended dietary intakes: Fluoride* (updated 2017) states that the Adequate Intake level of fluoride for the average adult male and female is 4.0 milligrams per day and 3.0 milligrams per day, respectively. The Adequate Intake in children varies by age (due to different body weights), ranging from 0.5 milligrams per day in 7 to 12 month olds, to 1.1 milligrams per day in children aged 4 to 8 years (42). This amount helps to minimise tooth decay in children, adolescents and adults, and can be obtained by drinking fluoridated water and consuming foods with fluoride in them.

34. WHAT FOODS AND DRINKS CONTAIN FLUORIDE?

Most foodstuffs contain traces of fluoride (2, 44). Higher amounts of fluoride can be found in dried tea leaves, for example, because of natural concentration by the tea plant (44). Other common sources of fluoride include cereal and grain based foods, almonds, apples, minced beef, chocolate and milk (45).

35. CAN DRINKING FLUORIDATED TAP WATER RESULT IN THE CONSUMPTION OF TOO MUCH FLUORIDE?

No. NHMRC found no evidence that community water fluoridation at current Australian levels causes human health problems. To help protect teeth against tooth decay, only very small amounts of fluoride are needed in water (46). NHMRC supports Australian states and territories fluoridating their drinking water supplies within the range of 0.6 to 1.1 mg/L.

The *NHMRC Nutrient Reference Values for Australia and New Zealand* identifies 10 milligrams per day as the upper level of fluoride intake for an average-sized adult (41). To meet or exceed this level of intake means drinking at least 10 litres per day of water with fluoride at current Australian levels. However, regardless of any fluoride content in the water, this is a dangerously high level of water intake and is not recommended (47) because of the risk of water overloading, even for people such as athletes, outdoor workers, military personnel and those living in hot and humid climates, who may approach this level of consumption occasionally.

People with specialised needs, such as renal dialysis patients, should follow the advice of their medical professionals based on their particular circumstances, which may include a wide variety of factors such as diet, body mass, history and other more significant ions in the water such as potassium, sodium or chloride. In no case would the level of fluoride in fluoridated water be the limiting factor in the amount of water that could be safely consumed.

36. WHAT IS THE ADVICE PROVIDED FOR INFANT FORMULA RE-CONSTITUTED WITH FLUORIDATED WATER?

Infant formula products sold in Australia are safe to feed to infants when made up with fluoridated drinking water.

NHMRC recommends exclusive breast feeding until around six months of age. However, this is not always possible and, for infants who are not breastfed or who are partially breastfed, NHMRC recommends that infant formula be used as an alternative until 12 months of age. All infant formula in Australia must comply with the composition and safety requirements of the *Australia New Zealand Food Standards Code (revised 1 March 2016)* (48).

37. WHAT ADVICE IS PROVIDED ABOUT DRINKING FLUORIDATED WATER FOR PREGNANT OR BREAST FEEDING MOTHERS?

It is safe for the unborn child and infant when pregnant and breast feeding mothers drink water fluoridated at Australian levels. Breast milk naturally contains about 5–10 µg (micrograms) of fluoride per litre of milk (2). The level of fluoride in breast milk remains steady when a nursing mother drinks fluoridated water (49).

38. DOES RAINWATER TANK WATER CONTAIN FLUORIDE?

Rainwater collected in domestic tanks will not contain fluoride. It is not recommended that tank water be fluoridated as it can be difficult to maintain the correct concentration. People relying on tank water for drinking and food preparation should seek advice concerning fluoride requirements from their local dental professional, school dental service, community dental service or from the Australian Dental Association.

People using rainwater for drinking and food preparation will gain some dental benefits when they consume food and beverage products processed in nearby fluoridated centres or work and study in fluoridated areas. Another source of fluoridated water for people who rely on rainwater tanks for drinking and food preparation is packaged (bottled) water with added fluoride (50).

39. IS FLUORIDATED DRINKING WATER CONSIDERED A DRUG OR MEDICATION?

No. In Australia, the Therapeutic Goods Administration (TGA) does not require fluoride compounds, such as those added to fluoride toothpaste and to community drinking water supplies, to be registered as medicines if they are used for the prevention of dental decay - nor are they scheduled as drugs or poisons when they are added to community drinking water supplies at optimal levels.

Fluoridated drinking water is thus not considered to be a therapeutic drug or medicine by the TGA in Australia, or by comparable therapeutic goods regulators in any other country where water is fluoridated. Fluoride is a natural component of most water supplies. The TGA is the Australian regulator responsible for making sure that therapeutic goods used to prevent or manage health conditions in Australia are safe and of good quality.

FLUORIDE AND ETHICS

40. IS IT ETHICAL TO FLUORIDATE WATER?

NHMRC considers that it is ethical to fluoridate water. The *2017 NHMRC Information Paper – Water fluoridation: dental and other human health outcomes* states that water fluoridation is ethical because it provides an oral health benefit by reducing tooth decay in people of all ages and social groups (1).

Furthermore the Centre for Social Ethics and Policy, University of Manchester states:

In considering the ethics of fluoridation ... we should ask not are we entitled to impose fluoridation on unwilling people, but are the unwilling people entitled to impose the risks, damage and costs of failure to fluoridate on the community at large (51)

Community water fluoridation is also consistent with the Report of the International Bioethics Committee of UNESCO on Consent (2008) (52).

41. IS INDIVIDUAL CONSENT REQUIRED FOR WATER FLUORIDATION?

No. Governments and health professionals have a responsibility to make decisions that balance the best possible community health outcomes with individual choice. Decisions relating to community water fluoridation are made at state and/or local government level by representatives who are responsible directly or indirectly to the people. Many Government decisions impact on individual choice to some extent.

People are free to choose whether or not to drink fluoridated water supplied to them, as they please. Some effort and expense is required to avoid fluoridated water by the use of bottled water, the provision of rainwater tanks, or the installation of specifically designed filters. But in the absence of community water fluoridation, great effort and expense is required of those who wish to provide the protective benefits of fluoride for themselves and their children. A greater effort is required to 'opt in' to access fluoride if there is no community water fluoridation, than to 'opt out' of community water fluoridation. In Australia, the large majority of the public support water fluoridation (1). From a social equity perspective, water fluoridation protects a whole community including those who might be less likely to adopt preventive dental behaviours or who struggle to pay for dental care.

42. IS COMMUNITY WATER FLUORIDATION CONSTITUTIONAL?

Yes. The Australian Constitution allows state governments to pass legislation to protect and enhance public health (53).

Section 51(xxiiiA) of the Commonwealth Constitution is a provision giving the Commonwealth Parliament the power to make laws for, amongst other things, "the provision of dental services (but not so as to authorise any form of civil conscription)." The bracketed words prevent the Commonwealth from conscripting dentists and other oral health professionals to provide dental services in peace time.

The provision of fluoridated water to communities is not a dental service within the meaning of the above provision of the Constitution, nor are members of fluoridated communities "conscripted" to receive a dental service.

FLUORIDE REGULATIONS

43. HOW IS COMMUNITY WATER FLUORIDATION IN AUSTRALIA REGULATED?

In every Australian state or territory, community water fluoridation is regulated by an Act of Parliament or government policy.

Table 2 lists the current regulatory frameworks used in each Australian state and territory.

TABLE 2 STATE AND TERRITORY FLUORIDE LEGISLATION AND REGULATIONS

Australian Capital Territory	Licensed condition issued under the <i>Public Health Act 1997</i> http://www.legislation.act.gov.au/a/1997-69/ Clause 36 of the <i>Utilities (Technical Regulation) Act 2014</i> http://www.legislation.act.gov.au/a/2014-60/
New South Wales	<i>Fluoridation of Public Water Supplies Act 1957</i> <i>Fluoridation of Public Water Supplies Regulation 2017</i> <i>NSW Code of Practice for Fluoridation of Public Water Supplies</i> http://www.health.nsw.gov.au/environment/water/Pages/fluoridation.aspx
Northern Territory	The Use of Fluorides in the Northern Territory – position statement 2010 http://www.health.nt.gov.au/Oral_Health/Water_Fluoridation/index.aspx
Queensland	<i>Water Fluoridation Act 2008 (current as at 1 November 2013)</i> https://www.legislation.qld.gov.au/LEGISLTN/CURRENT/W/WatrFluorA08.pdf <i>Water Fluoridation Regulation 2008 (current as at 21 December 2012)</i> https://www.legislation.qld.gov.au/LEGISLTN/CURRENT/W/WatrFluorR08.pdf <i>Water Fluoridation Code of Practice (revised September 2013)</i> https://www.health.qld.gov.au/public-health/industry-environment/environment-land-water/water/fluoridation/default.asp
South Australia	Water fluoridation is implemented by SA Water as a matter of Government policy and maintained by Ministerial direction under the <i>Public Corporations Act</i> .
Tasmania	<i>Fluoridation Act 1968</i> http://www.thelaw.tas.gov.au/tocview/content.w3p;doc_id=87++1968+AT@EN+20111005000000;rec=0 <i>Fluoridation (Interim) Regulations 2009</i> http://www.thelaw.tas.gov.au/tocview/index.w3p;cond=ALL;doc_id=%2B14%2B2009%2BBAT%40EN%2B20160817150000;histon=;pdfauthverid=;prompt=;rec=;rtfauthverid=;term=fluoride;web)authverid= <i>Tasmanian Code of Practice for the Fluoridation of Public Water Supplies (2017)</i> www.dhhs.tas.gov.au/publichealth/water/drinking/mains/fluoride
Victoria	<i>Health (Fluoridation) Act 1973</i> <i>Code of practice for fluoridation of drinking water supplies 2009</i> https://www2.health.vic.gov.au/public-health/water/water-fluoridation/water-fluoridation-legislation
Western Australia	<i>Fluoridation of Public Water Supplies Act 1966</i> https://www.slp.wa.gov.au/legislation/statutes.nsf/main_mrtitle_348_homepage.html

FLUORIDE AND THE ENVIRONMENT

44. HOW DOES FLUORIDATED WATER AFFECT THE ENVIRONMENT?

In the marine environment, the naturally occurring background level of fluoride in sea water is around 1.4 mg/L, which is greater than the fluoride level in fluoridated drinking water supply systems in Australia.

The New Zealand Public Health Commission reported on the impact of fluoridated water on the environment in 1994. This study found that:

“Given the distribution of fluoride in most ecosystems, it would seem very unlikely that any hazard to the environment exists at a water fluoridation level of 1ppm [1 mg/L]” (54).

There is insignificant risk to the environment from fluoridated drinking water being discharged directly to a waterway.

45. CAN FLUORIDATED WATER BE USED IN ORGANIC FARMING?

Yes. Water fluoridation does not impact on the ability of organic producers to obtain or retain organic certification for their produce (55). Under the Australian Certified Organic Standard, all drinking water is permitted as a conventional (non-certified) ingredient (56).

46. CAN FLUORIDATED WATER BE USED IN AQUAPONICS?

Yes. Fluoridated water can be used in aquaponics systems. All natural water systems contain some level of fluoride with some parts of Australia having naturally occurring fluoride at levels similar to the level used in community water fluoridation programs. As fluoride is found in all water supplies, plants, fish, animals and other organisms can metabolise fluoride. This metabolism ensures the fluoride level remains relatively constant, although some variation can be expected – as also occurs in natural water systems.

FURTHER READING

The National Child Oral Health Study undertaken between 2012 and 2014 was a cross-sectional study of the child population aged five to 14 years in Australia:

Do IG and Spencer AJ (eds), 2016. Oral health of Australian children: the National Child Oral Health Study 2012–14. Adelaide: University of Adelaide Press.

In 2008 the Australian Research Centre for Population Oral Health presented the results of a study that examined the effectiveness of water fluoridation on children’s dental health across four Australian states: Queensland, Victoria, Tasmania and South Australia:

Armfield J, Spencer A, Roberts-Thomson K and Slade G, 2008. ‘Lifetime exposure to water fluoridation and child caries experience.’ Presented at the 86th General Session and Exhibition of the International Association for Dental Research. Toronto, Canada.

The Australian Institute of Health and Welfare report, *Australia’s dental generations: the National Survey of Adult Oral Health*, describes the beneficial effects of water fluoridation in young children and adults up to 97 years of age.

Australian Institute of Health and Welfare, 2007. Australia’s dental generations: the National Survey of Adult Oral Health 2004–06. Canberra: AIHW.

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