Since the commencement of water fluoridation in Australian State capital cities in 1964 and the Tasmanian Royal Commission in 1968 (Crisp, 1968), water fluoridation has been promoted as the cornerstone of public health policy for the prevention of dental caries in Australia. However, in recent years questions have been raised about the effectiveness of water fluoridation. In particular, the need for this public health measure when children’s caries levels are at historically low levels, and other fluoride vehicles (particularly toothpaste) are widely available (Diesendorf, 1986; Colquhoun, 1990; Diesendorf et al, 1997).

This information sheet examines the issue of the continuing relevance of water fluoridation in Australia through a review of current Australian epidemiological studies investigating the caries-preventive effects of fluoridation.

**Rationale for water fluoridation**

The Second World War acted as a coincidental event that triggered great interest in dental health, largely as a result of the high percentage of enlistable young men who were found dentally unfit to serve. At the same time the DMF index was developed and documentation of dental caries in Australian children and adolescents became possible (Spencer et al, 1994). The rationale for water fluoridation seems to have rested on the poor dental health of Australian children and adolescents. At the peak of caries activity among Australian children, the mean DMFT of 12-year-olds approximated the child’s age. Adults also had widespread and extensive caries experience (Spencer et al, 1996).

Caries preventive approaches were needed that were effective, efficient and had broad coverage of the population. Water fluoridation satisfied all three of these criteria, without causing any deleterious effects on general health. The extensive work on the association of fluoride and caries, and the finding that the optimal concentration of fluoride could be mimicked through controlled adjustments of public water supplies, led to the introduction of water fluoridation in the small town of Beaconsfield, Tasmania in 1953 (Spencer et al, 1996).

**Extent of water fluoridation**

In Australia today nearly two-thirds of the population reside in an area with adjusted fluoride levels in the water supply (Commonwealth Department of Health, 1984). Between 1964 and 1977, seven of the eight capital cities implemented fluoridation of public water supplies. Figure 1 presents an overview of the timing of the implementation of water fluoridation across Australia and the climatic variation in the level of fluoride considered optimal.
Historical support

Over the past 50 years, since the first fluoridation project in North America, there has been an accumulation of epidemiological evidence that supports the benefit of water fluoridation. In Australia, the Tamworth study, which began in 1963 with a pre-fluoridation survey and carried through to 1988, reported on the decrease in caries in 6- and 12-year-old residents in the fluoridated city (Barnard, 1989; 1990). Several other pre-1980 studies have also firmly supported the benefits of fluoridation in Australia (Medcalf, 1970; Carr, 1972; 1976; Videroni et al, 1976).

“...since the first fluoridation project in North America, there has been an accumulation of epidemiological evidence that supports the benefit of water fluoridation in Australia.” (Spencer et al, 1996)

During the 1980s, epidemiologic studies were conducted in Tasmania (Wimmer, 1985), Victoria (Brown et al, 1990) and Western Australia (Stockwell et al, 1990). In each of the studies, lower levels of caries experience were observed among children with lifetime exposure to fluoridated drinking water compared to children with no exposure. Relative differences in mean levels of caries experience ranged from 20 per cent to 52 per cent for DMF, and from 26 per cent to 55 per cent for dmft. In 1986, a study that used findings from Australian surveys of adolescents between 1965 and 1978, found that water fluoridation made the greatest contribution of several fluoride sources to the decline in DMFT during that period (Spencer, 1986).

The National Health and Medical Research Council of Australia (NHMRC) in 1990 evaluated claims against the effectiveness of water fluoridation and reanalysed the Australian school dental services’ time-series data. The NHMRC working group concluded that water fluoridation was effective and was associated with a 60 per cent lower DMFT in 1977 which decreased to a 40 per cent lower DMFT in 1987 (NHMRC, 1991).

Opposition to fluoridation

During the last decade, there has been criticism of existing public health policy supporting the benefits of water fluoridation. Questioning of the need for water fluoridation has centred around allegations that the beneficial effects of water fluoridation are exaggerated (Diesendorf, 1986; Diesendorf et al, 1997), and that significant reductions in children’s caries are likely to be related to factors other than water fluoridation.

Other issues concerning water fluoridation include: whether fluoridation is necessary when children’s caries experience is low by historical standards, and when other fluoride vehicles (particularly fluoride-containing tooth-paste) are widely available.

How effective is water fluoridation?

Current research has shown water fluoridation to be associated with reduced caries experience in Australian children (Spencer et al, 1996). Since the NHMRC review of water fluoridation in 1991, three Australian studies have examined the association between caries experience and exposure to water fluoridation:

- Western Australian children (Riordan, 1991);
- New South Wales children (Patterson and Weidenhofer, 1993); and,
- South Australian and Queensland children (Slade et al, 1995; 1996a; 1996b).

Western Australia

In 1991, Riordan reported on 11- and 12-year-olds with different fluoride exposures in Western Australia. He found higher caries prevalence in the permanent dentition in children in non-fluoridated Bunbury than in children in fluoridated Perth – a result that confirmed earlier studies of different age groups from the same two localities (Stockwell et al, 1990).

New South Wales

A study conducted in the Blue Mountains region of New South Wales found lower caries experience in deciduous teeth of children with a lifetime exposure to fluoridated water. Patterson and Weidenhofer concluded that the most significant factor in reducing the level of dental disease in the children appeared to be the effect of drinking water from the fluoridated mains supply (Patterson and Weidenhofer, 1993).

South Australia and Queensland

The Child Fluoride Study commenced in 1991, is a longitudinal epidemiological study designed to assess associations between exposure to fluoride vehicles and caries experience among school children in Queensland and South Australia. Significant features of the study design include: the classification of residential and fluoride history; exposure to other fluoride vehicles such as supplements, toothpastes and professional care; and, socio-economic characteristics of households. Analyses conducted with the baseline data have indicated that:

- greater lifetime exposure to fluoride in water was associated with lower dmfs and DMFS in both Queensland and South Australia; (see Figure 2)
- caries-fluoride exposure associations were stronger for deciduous compared with permanent teeth and for Queensland compared with South Australia; and,
- caries experience was substantially lower among children with lifelong exposure compared to those with no history of exposure to water fluoridation in Queensland. (Spencer et al, 1996)

In practical terms, if the 201,084 children aged 5 to 15 years in non-fluoridated Brisbane were to achieve the benefits of fluoridation apparent from the Child Fluoride Study, there would be approximately 300,000 fewer surfaces with caries experience in the deciduous and permanent dentition (Slade et al, 1996a).

Figure 2

Adjusted mean dmfs by exposure to water fluoridation - Child Fluoride Study, baseline 1991-92, 5-10 years of age (age standardised)

Source: Davies, 1993
Dental caries experience among children in Australia is at an historically low level. With this decline in dental caries experience the question has risen, “Is water fluoridation still necessary?”

The answer is yes, fluoridation is still necessary for two reasons. Firstly, the public health measure of fluoridating water supplies is necessary to maintain the low level of caries experience in children.

Secondly, the impact of altering current exposure to water fluoridation would be decreased benefits not only for children, but for people of all ages in the Australian community (Attwood and Blinkhorn, 1991; Kobayashi et al, 1992). This is because fluoride acts through two mechanisms. Fluoride is incorporated into the enamel before eruption (during childhood) providing some protective benefit. However, fluoride may act predominantly through a post-eruptive mechanism where the maintenance of a low fluoride concentration at the tooth/plaque interface is necessary to ensure that the caries-prevention benefits continue throughout life.

Why fluoridate water when children’s caries experience is low?

Why fluoridate water when fluoride is widely available from other sources?

The number of vehicles through which exposure to fluorides may occur has increased in recent decades. In Australia the main fluoride vehicles are water fluoridation, toothpaste with fluoride and fluoride supplements. The changing pattern of fluoride exposure has accentuated the need to determine the relative benefits of fluoride from water versus other contemporary sources.

Current research in Australia has demonstrated a continued benefit of fluoridation in caries prevention (Riordan, 1991; Patterson and Weidenhofer, 1993; Slade et al, 1995; 1996a). These findings, that caries experience was lower among children in fluoridated than non-fluoridated areas, indicate that water fluoridation provides caries-prevention benefits additional to those provided by exposure to other fluoride sources alone.

Over 95 per cent of toothpaste marketed contains fluoride. Analysis of the interaction of brushing frequency with lifetime exposure to water fluoridation has indicated that even among children brushing regularly there is a 24 per cent advantage of lifetime exposure to water fluoridation over those with no exposure (see Figure 3). This finding indicates that:

• water fluoridation has an additive effect with fluorides from other sources in the prevention of dental caries in children; and,
• neither toothbrushing with a fluoride-containing toothpaste nor water fluoridation make the other fluoride vehicle redundant in the prevention of caries (Davies, 1993).

Other benefits of water fluoridation

Lower socio-economic status (SES) is associated with a disproportionate burden of illness in Australia, both for oral health (National Health Strategy, 1992) and general health (Australian Institute of Health and Welfare, 1992). Previous research has identified SES inequalities in dental decay rates among children (Roder, 1971; Wright and Spencer, 1980; Brown et al, 1990; Slade et al, 1996b) and in oral health among adults in Australia (National Health Strategy, 1992).

Water fluoridation has been found to reduce socio-economic inequalities in caries experience in children. The Child Fluoride Study demonstrated a reduction in the caries differential between high and low SES groups. Water fluoridation, therefore, represents a socially-equitable public health measure through its ability to reduce caries in all socio-economic groups, and to reduce existing socio-economic inequalities in caries experience (Spencer et al, 1996).

Water fluoridation provides caries-prevention benefits additional to those proved by exposure to other fluoride sources alone.
• Current research has shown water fluoridation to be associated with reduced caries experience in Australian children.
• Water fluoridation has been found to be effective in preventing caries, even in the presence of other fluoride vehicles such as toothpaste with fluoride.
• Water fluoridation reduces socio-economic inequalities in caries experience in children. There is a clear social justice argument for both the continuation and expansion of water fluoridation, and evidence that the discontinuation of water fluoridation in Australia would result in a widening gap between the disease experience of socio-economic groups within the Australian community.
• Water fluoridation remains the most effective and socially equitable measure of achieving community-wide reduction in dental caries.

**References**


Patterson AF, Weidenhofer RNG. A study of the dental health of primary schoolchildren in the local government areas of the Blue Mountains and Hawkesbury, New South Wales, 1993. Sydney: Dental Health Unit, New South Wales Health Department, 1993.


**Further information**

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