The Risks of Consumption of Fluoridated Water for People with Chronic Kidney Disease

A Position Statement*

Research on the effects of fluorides on dental health has been in existence for almost a century. Following the observation that communities with naturally fluoridated drinking water had a lower incidence of tooth decay, many developed countries initiated artificial water fluoridation programs whereby fluoride is added to the community water supply such that it reaches approximately 1 part fluoride per million parts water (ppm) or 1 milligram fluoride per litre of water (mg/L). Compared to other methods of systemic fluoridation (including fluoridated sugar, milk or salt, fluoride toothpastes, fluoride supplements), water fluoridation is argued to be the most cost-effective, equitable, and safe means to provide community-wide protection against tooth decay[1]. Artificial fluoridation of community water supplies is currently supported by numerous international health and dental organisations including the World Health Organisation and the International Association for Dental Research.

However, while access to fluoridated drinking water has positive effects on dental health, the characteristics of fluoride metabolism mean that fluoride consumption may have implications for the kidney. Healthy kidneys are responsible for removing approximately 50% of fluoride that is consumed. If the kidneys are not functioning properly, it is possible that fluoride may accumulate in the body, which may lead to negative side-effects. Considering the pivotal role of the kidney in the body's ability to metabolise fluoride, there have been surprisingly few attempts to synthesise studies relating to the relationship between fluoride and kidney health. The most recent literature reviews on the health effects of fluoride intake have contained limited discussion relating to the potential impact on the kidneys[2-6].

Approximately 1 in 7 Australians have chronic kidney disease (CKD)[7], which is diagnosed according to the kidneys' ability to filter and remove waste products (referred to as glomerular filtration rate (GFR)), or by evidence of proteins in the urine (albuminuria or proteinuria), blood in the urine (haematuria), or abnormalities detected by biopsy or ultrasound[8].

The five stages of CKD and estimates of prevalence in Australian adults aged ≥25 years (1999-2000)

Stage	Description	GFR (mL/min/1.73m^2)	% prevalence from AusDiab[7]	Numbers in Australia
1	Kidney damage with normal or ↑ GFR	≥90	0.9%	120,000
2	Kidney damage with mild ↓ GFR	60-89	4.9%	660,000
3	Moderate ↓ GFR	30-59	8.1%	1,100,000
4	Severe ↓ GFR	15-29	0.2%	27,000
5	End-stage kidney disease	<15 (or dialysis)	0.1%	14,000

Recently there has been a resurgence of interest in artificial water fluoridation in Australia, with efforts to expand the fluoridation of public water supplies to the one remaining unfluoridated capital city (Brisbane) and several unfluoridated regional areas. With the renewed water fluoridation debate, questions have been raised concerning the impact of fluoride consumption for the large proportion of the population affected by CKD. In the absence of any recent summarised literature specifically relating to consumption of fluoridated drinking water and kidney function, a literature review was undertaken to inform the development of a Kidney Health Australia Position Statement on this issue.

Results:

The review identified a distinct lack of high-level evidence in the form of randomised controlled trials, with the majority of studies consisting of case-series, case reports, or comparative studies utilising historical controls. The poor evidence quality and deficient methodological rigour of the identified studies means that no definitive conclusions regarding the association between consumption of optimally fluoridated community water and chronic kidney disease can be made.

1. Does consumption of fluoridated drinking water increase the risk of developing CKD?

The National Health and Medical Research Council state that the optimal level of fluoride concentration in drinking water is ≤1.5 ppm[9]. People with access to this level of fluoride in their drinking water (1.5 ppm / 1.5 mg/L) drinking 1.0 L of water a day will consume 1.5 mg of fluoride a day (less than 0.021 mg/kg for the average 70kg person). Few studies have investigated the renal effects of long-term ingestion of fluoride at this concentration, but the available evidence suggests no link between consumption of optimally fluoridated drinking water and an increased risk of developing CKD.

2. Are there negative health effects for people with CKD who consume fluoridated drinking water?

Animal and human studies have demonstrated that as kidney function decreases, the level of fluoride excreted in the urine decreases and the amounts of fluoride in the serum and bone increases[10-15]. However, fluoride accumulation does not begin until stage 4 or 5 CKD (GFR ≤29 mL/min/1.73m^2) is present[10,16]. There is no consistent evidence that the retention of fluoride that occurs in people with stage 4 or 5 CKD following consumption of optimally fluoridated drinking water results in any negative health consequences[17-19]. However, there is some evidence to suggest that consumption of fluoride exceeding the optimal dose by people with stage 4 or 5 CKD may result in an increased risk of dental fluorosis and bone disease[20,21].

3. Are there particular risks of fluorosis for people using fluoridated water for dialysis?

People with end-stage kidney disease who undergo dialysis with fluoridated water receive an additional load of fluoride from the dialysis fluid. Advice regarding the suitability of water to be used for dialysis is available from the Australian and New Zealand Society of Nephrology[22] and the Caring for Australasians with Renal Impairment (CARI) guidelines[23]. These directives endorse investigation of local water supplies for normal quality and seasonal variation, analysis of water samples for fluoride, and removal of fluoride by water treatment systems (including deionisers or reverse osmosis) to ensure that fluoride concentrations in the final feed water to the dialysis machine do not exceed concentrations defined in the Association for the Advancement of Medical Instrumentation (AAMI) guidelines.

Conclusion

With increasing recognition of the role of the kidney in the metabolism and elimination of fluoride, the recent fluoride public debate in Australia has raised questions regarding the consequences of water fluoridation for the sizeable proportion of the population who experience reduced kidney function. It is important to note that nowadays fluoride intake is not necessarily dependent on the concentration in the drinking water supply, and may be influenced by ingestion of fluoride-containing dental products, the consumption of bottled water in place of tap water, and the use of water purification systems in the home.

On the basis of the available evidence Kidney Health Australia has developed the following position regarding consumption of optimally fluoridated drinking water:

- There is no evidence that consumption of optimally fluoridated drinking water increases the risk of developing CKD, although only limited studies addressing this issue are available
- There is consistent evidence that impairment of kidney function results in changes to the way in which fluoride is metabolised and eliminated from the body resulting in an increased burden of fluoride

- There is no evidence that consumption of optimally fluoridated drinking water poses any health risks for people with CKD, although only limited studies addressing this issue are available
- There is limited evidence that people with stage 4 or 5 CKD who ingest substances with a high concentration of fluoride (which exceeds the optimal dose) may be at risk of fluorosis
- Monitoring of fluoride intake and avoidance of fluoride-rich substances would be prudent for people with stage 4 or 5 CKD, in addition to regular investigations for possible signs of fluorosis
- Fluoride concentrations in the final feed water to the dialysis machine must comply with established water quality guidelines

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