



Office of the Prime Minister's Chief Science Advisor  
Kaitohutohu Mātanga Pūtaiao Matua ki te Pirimia

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EVIDENCE SUMMARY: Fluoride in our drinking water: An update on the evidence - Figures

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## Fluoridation: Figures

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Figure 1 Example of tooth decay in front teeth of upper jaw (primary teeth). Credit: Phantumvanit P. Source: [WHO](#)



Figure 2 Dental decay in five-year olds in Auckland and Northland. Data from [Aung et al. \(2019\)](#)<sup>1</sup>

<sup>1</sup> Aung et al., "Dental Caries and Previous Hospitalisations among Preschool Children: Findings from a Population-Based Study in New Zealand," *New Zealand Medical Journal* 132, no. 1493 (2019)

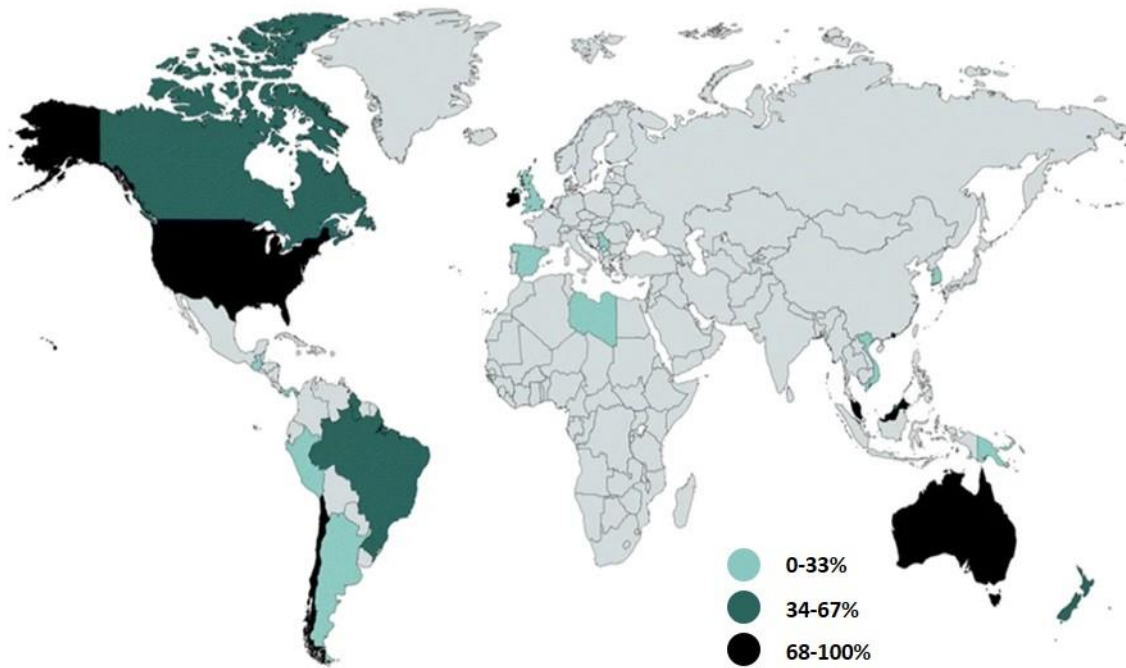


Figure 3 Proportion of the population given government-regulated fluoridated water (light teal 0–33%, teal 34–67%, black 68–100% of population). From [Johnston and Strobel \(2020\)](#)<sup>2</sup>

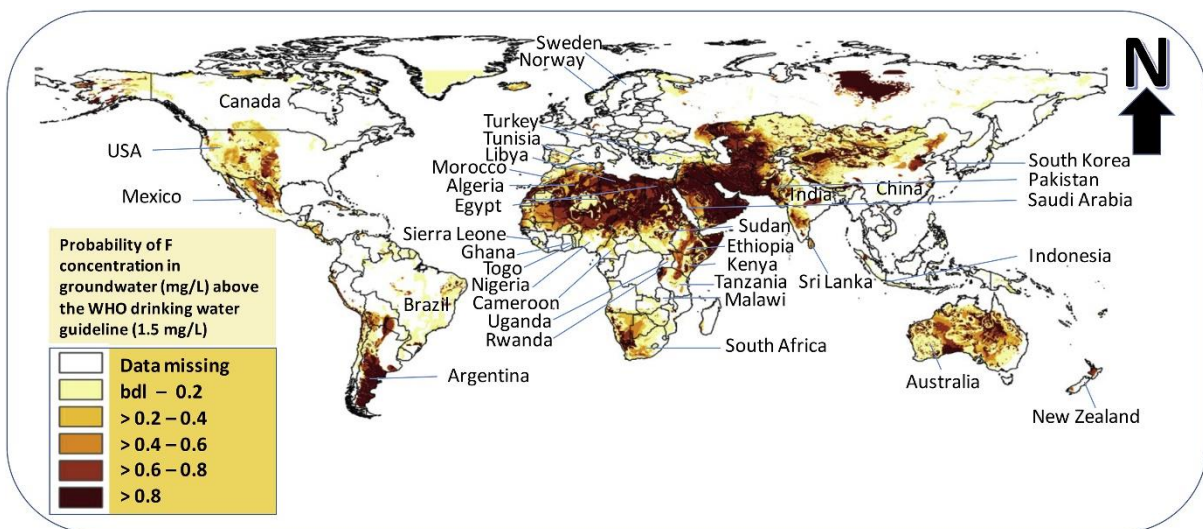


Figure 4 Map showing the occurrence and distribution of fluoride in groundwater in different parts of the world. From [Kimambo et al. \(2019\)](#)<sup>3</sup>

<sup>2</sup> Johnston et al., "Principles of Fluoride Toxicity and the Cellular Response: A Review," *Archives of Toxicology* 94, no. 4 (2020)

<sup>3</sup> Kimambo et al., "Fluoride Occurrence in Groundwater Systems at Global Scale and Status of Defluoridation – State of the Art," *Groundwater for Sustainable Development* 9 (2019)

**On average, children living in non-fluoridated areas have 1.7 times as many decayed, missing or filled teeth than those in fluoridated areas**

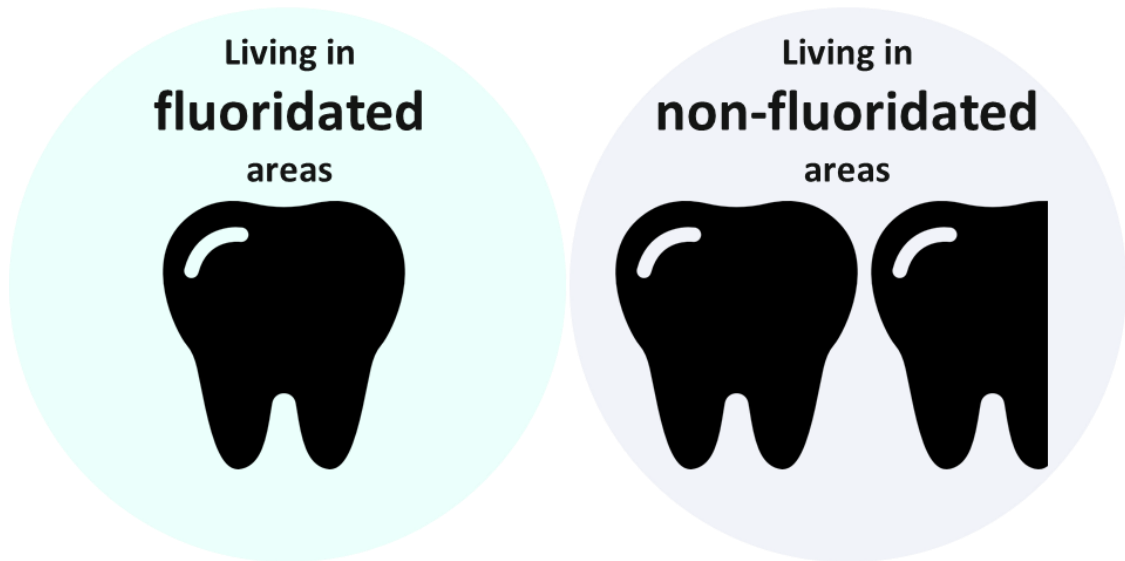


Figure 5 The adjusted ratio of means of decayed, missing or filled teeth per person, among children (aged 2-17 years old), by fluoridation status (adjusted by age, sex, ethnic group, and index of deprivation) data from Ministry of Health.<sup>4</sup>

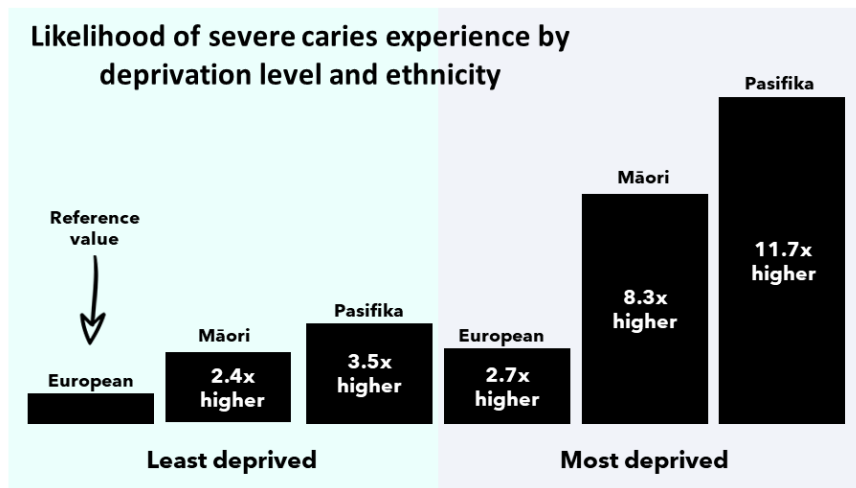


Figure 6 Adjusted odds ratios from the final multivariable model of severe caries experience reported in [Schluter and Mattingley 2020](#)<sup>5</sup>

<sup>4</sup> Moore et al., "The Costs and Benefits of Water Fluoridation in Nz," *BMC Oral Health* 17, no. 1 (2017)

<sup>5</sup> Schluter et al., "Association between Community Water Fluoridation and Severe Dental Caries Experience in 4-Year-Old New Zealand Children," *JAMA Pediatrics* 174, no. 10 (2020)

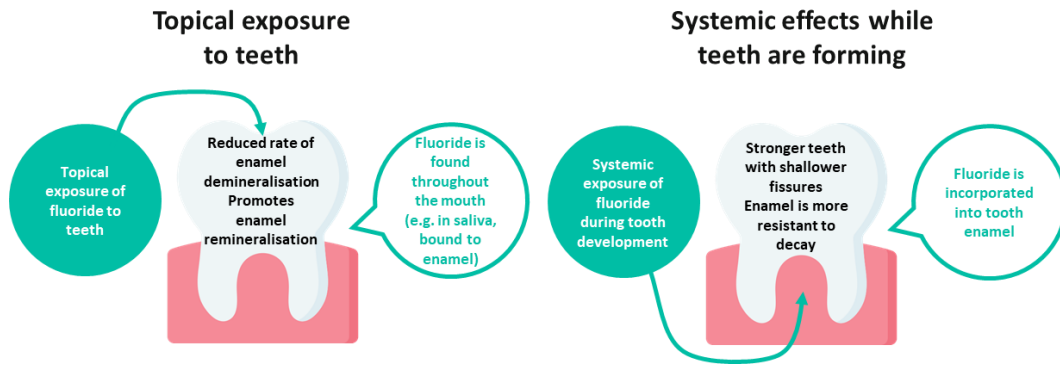


Figure 8 Illustrative figure of how fluoride impacts teeth

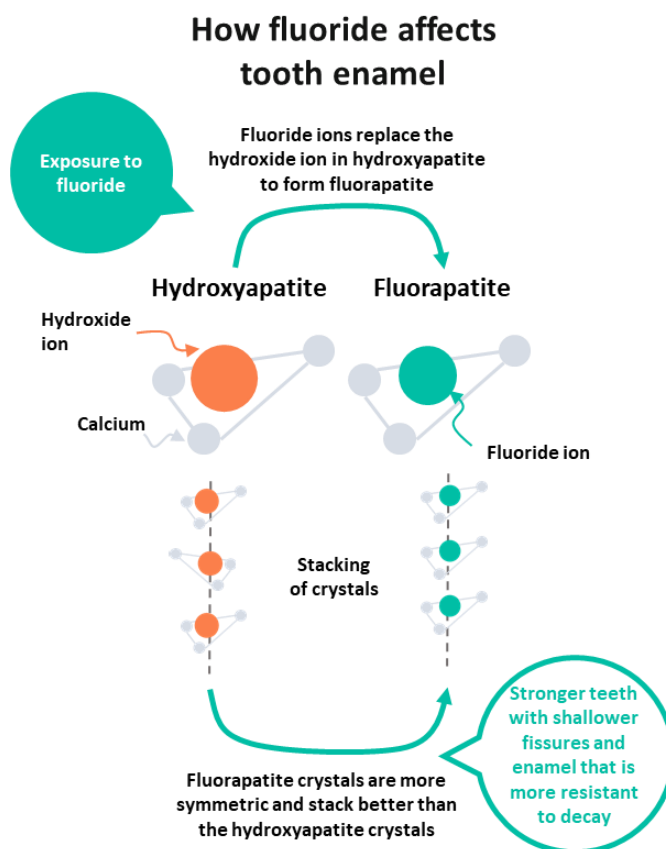


Figure 7 Illustrative figure of how fluoride affects tooth enamel.



Figure 9 An example of mild dental fluorosis (CC BY-NC-ND 4.0) from [Cavalheiro et al. 2017](#)

## Categories of dental fluorosis from normal to severe

Level of fluorosis	Description
0 = Normal	The enamel surface is smooth, glossy and usually a pale creamy-white colour
1 = Questionable	The enamel shows slight aberrations from the translucency of normal enamel, which may range from a few white flecks to occasional spots
2 = Very mild	Small opaque, paper-white areas scattered irregularly over the tooth but involving less than 25% of the labial tooth surface
3 = Mild	The white opacity of the enamel of the teeth is more extensive than for category 2, but covers less than 50% of the tooth surface
4 = Moderate	The enamel surfaces of the teeth show marked wear and brown stain is frequently a disfiguring feature
5 = Severe	The enamel surfaces are badly affected and hypoplasia is so marked that the general form of the tooth may be affected. There are pitted or worn areas and brown stains are widespread; the teeth often have a corroded appearance

Figure 10 Categories of dental fluorosis used in the 2009 New Zealand Oral Health Survey (see [methodology report](#))

### Prevalence and severity of dental fluorosis in Aotearoa New Zealand

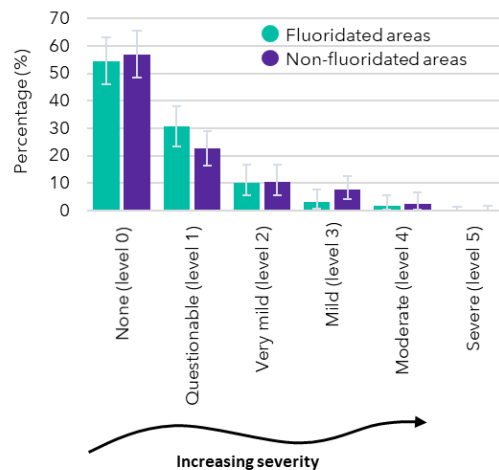
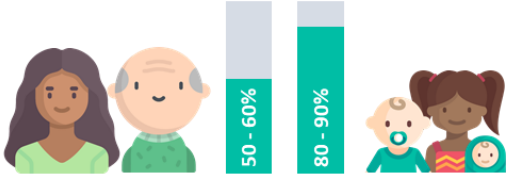


Figure 11 Prevalence and severity of dental fluorosis in Aotearoa New Zealand in 2009 (see [2009 New Zealand Oral Health Survey](#)).

**Retention of absorbed fluoride  
varies by age**



Young people retain a higher proportion of absorbed fluoride than adults

Figure 12 Retention of absorbed fluoride in adults and infants. See [WHO](#)

## Recommended fluoride intake varies by age and sex



Age group	Adequate intake (mg/day)	Upper level of intake (mg/day)
<b>Infants</b>		
0-6 months	Not applicable (previously 0.01)	1.2 (previously 0.7)
7-12 months	0.5	1.8 (previously 0.9)
<b>Children</b>		
1-3 years	0.6 (previously 0.7)	2.4 (previously 1.3)
4-8 years	1.1 (previously 1.0)	4.4 (previously 2.2)
9-13 years	2	10
<b>Adolescents</b>		
14-18 years	3	10
<b>Adult females</b>		
19+ years, including pregnant or lactating women	3	10
<b>Adult males</b>		
19+ years	4	10

Figure 13 The recommended fluoride intake in Aotearoa New Zealand varies by age and sex. See Nutrient Reference Values set by the Australian and New Zealand Governments.



## Australia and New Zealand (FSANZ), United States (NIH) and European (EFSA) reference values (males)

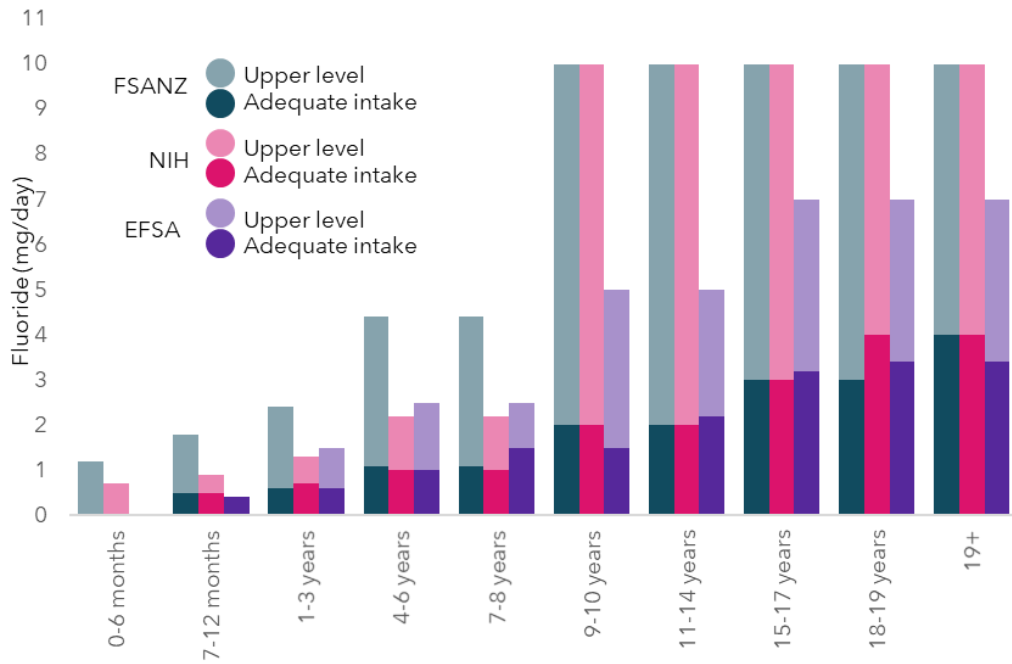


Figure 14 Reference values for males in Australia and New Zealand, the United States and Europe



## Fluoride recommended intake: 7-12 month age group

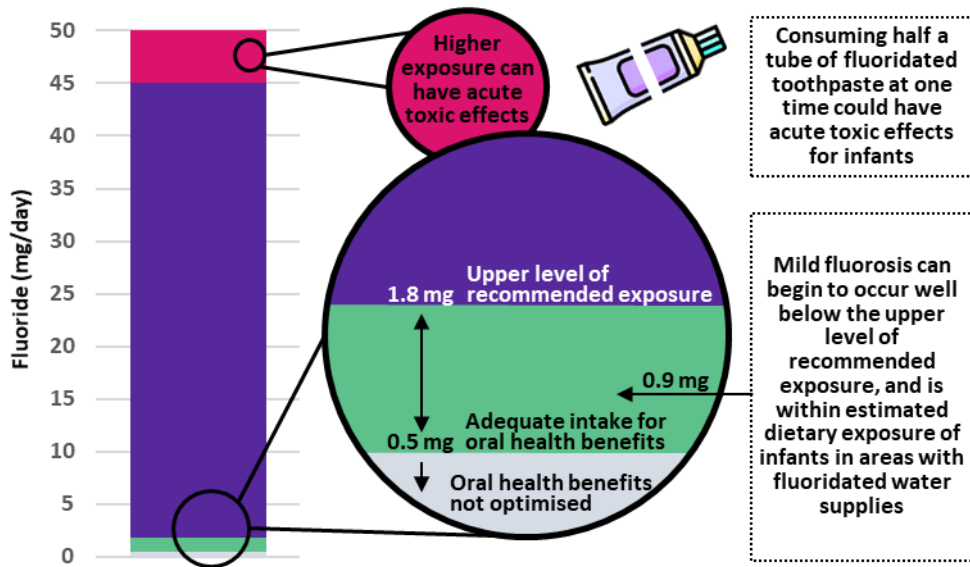


Figure 15 Recommended fluoride intake levels for infants aged 7-12 months old



## Fluoride recommended intake levels: 5-6 year age group

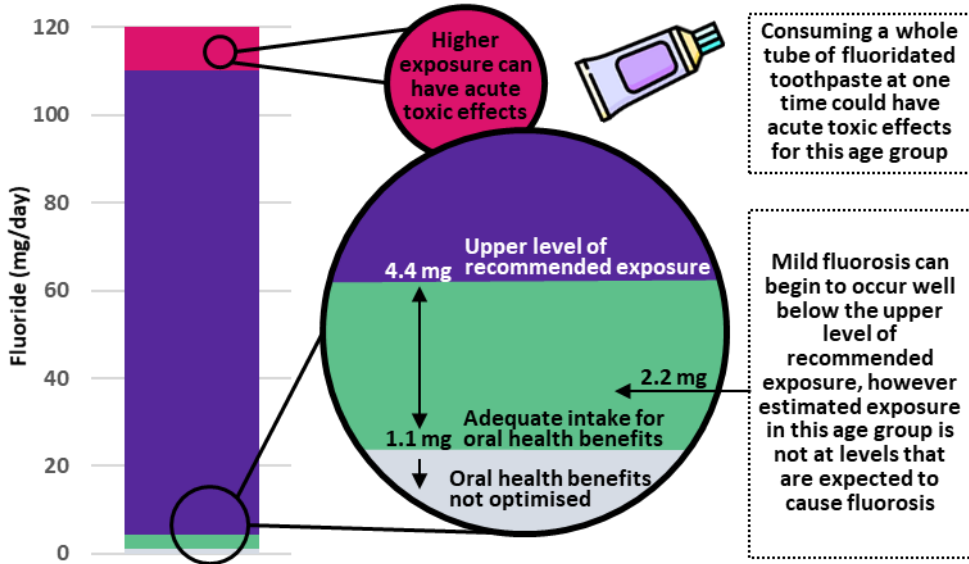


Figure 16 Recommended fluoride intake levels for children aged 5 to 6 years old



## Fluoride recommended intake levels: Males 25+

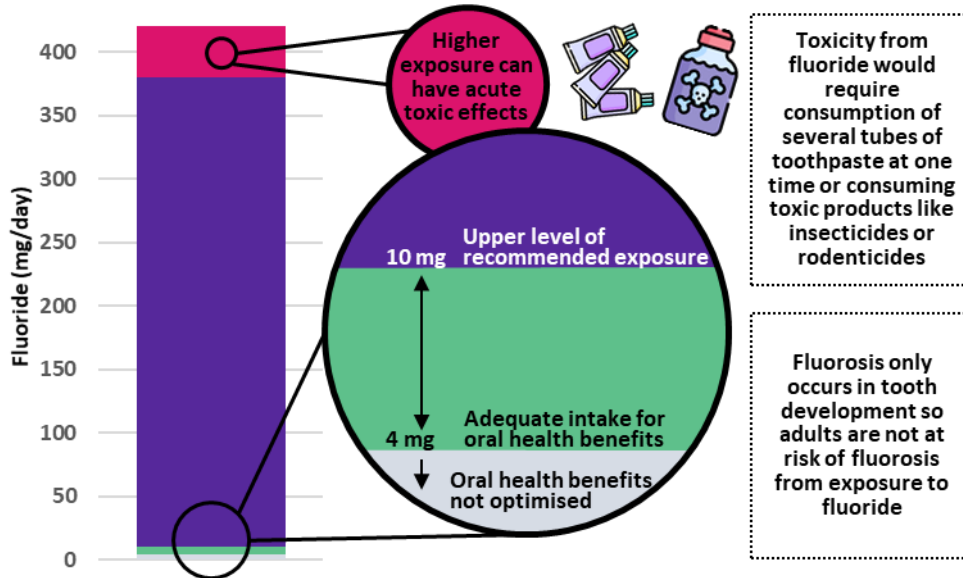


Figure 17 Recommended fluoride intake levels for males over 25 years old

## How much fluoride should we have in our drinking water?

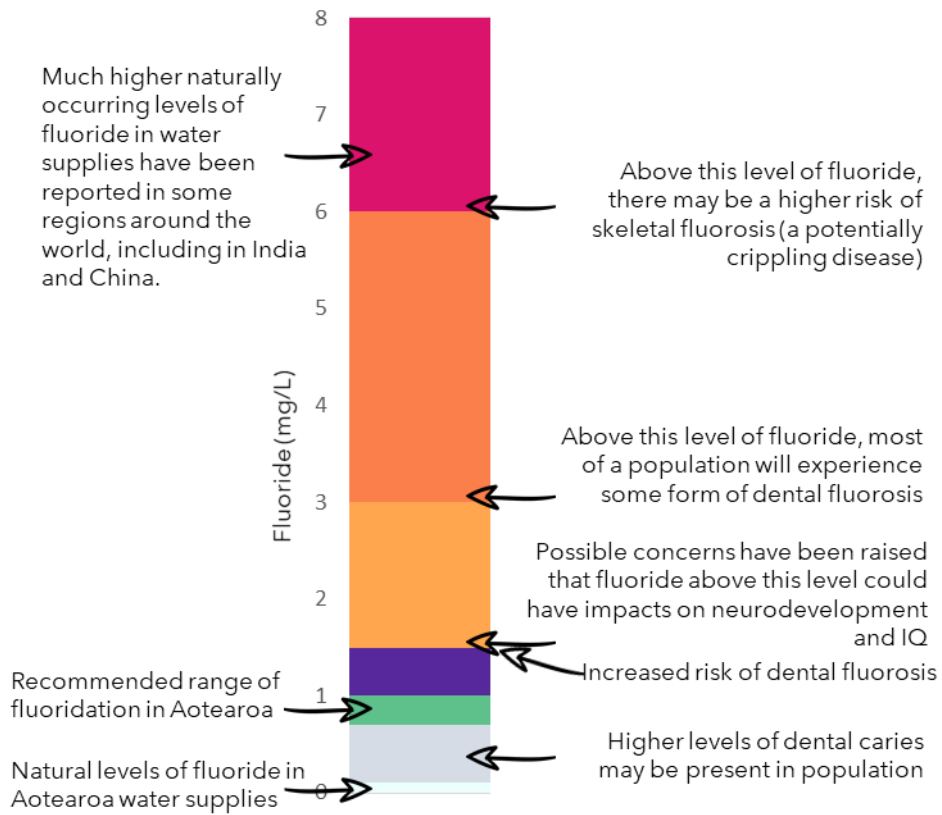


Figure 18 Concentration of fluoride in water and the potential impacts this can have on health

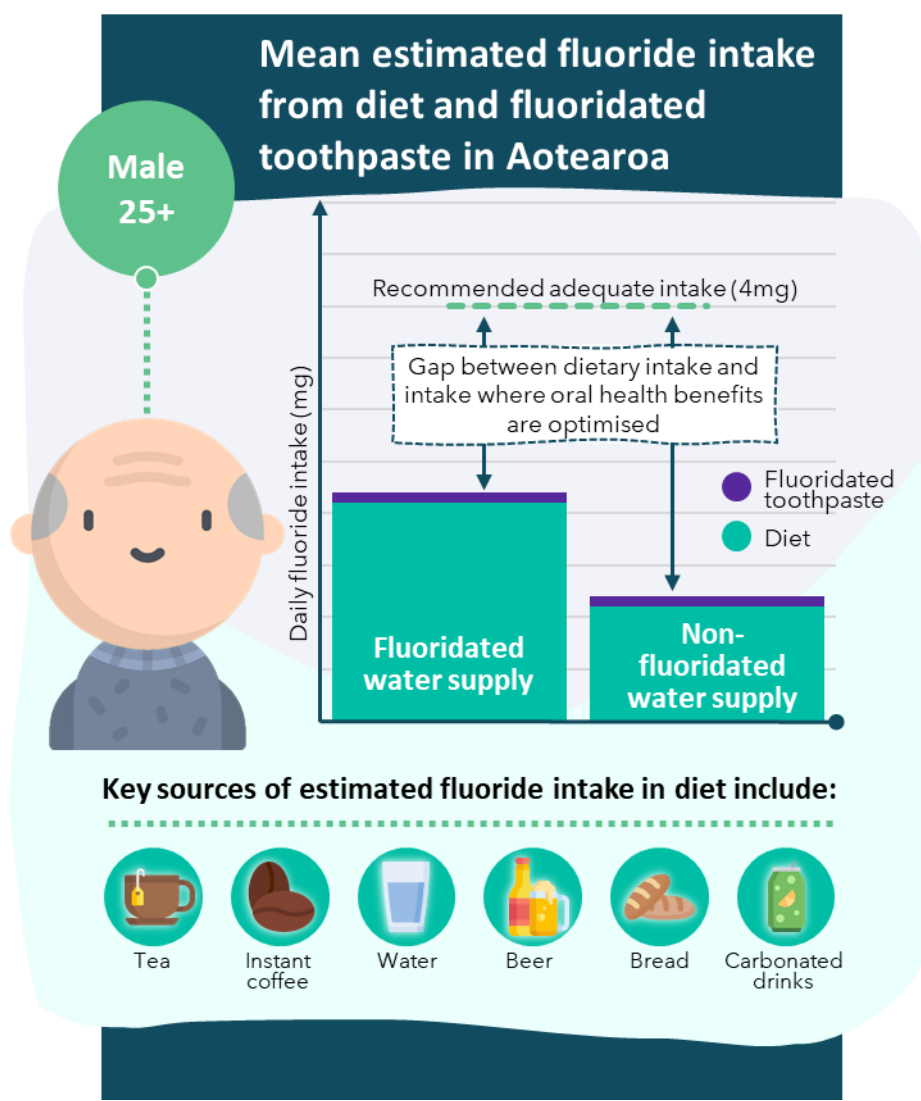


Figure 19 Mean estimated dietary fluoride intake from diet and fluoridated toothpaste in Aotearoa New Zealand for men aged over 25 years old. Data drawn on from Cressey *et al.*

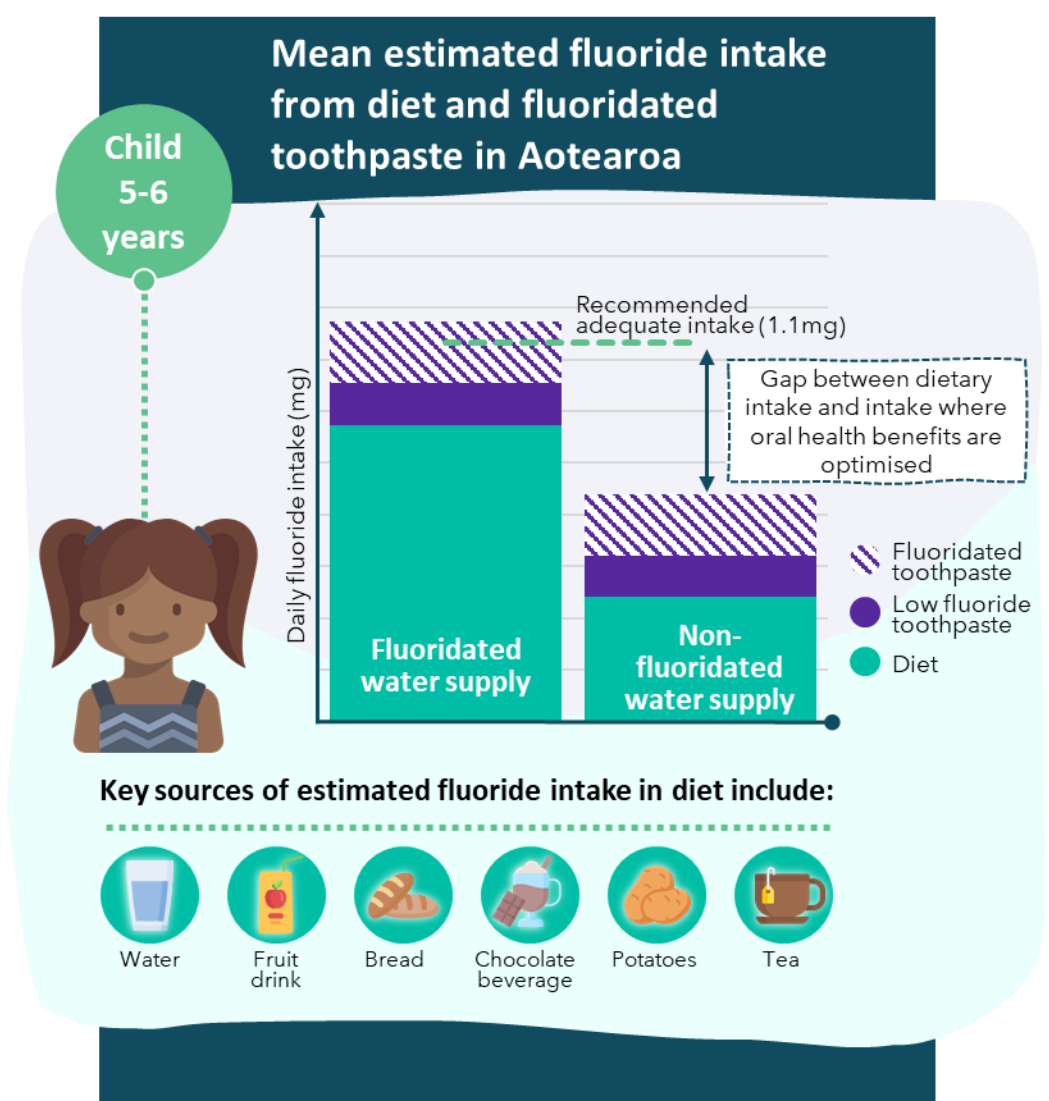


Figure 20 Mean estimated dietary fluoride intake from diet and fluoridated toothpaste in Aotearoa New Zealand for children 5-6 years old. Data drawn on from Cressey *et al.*

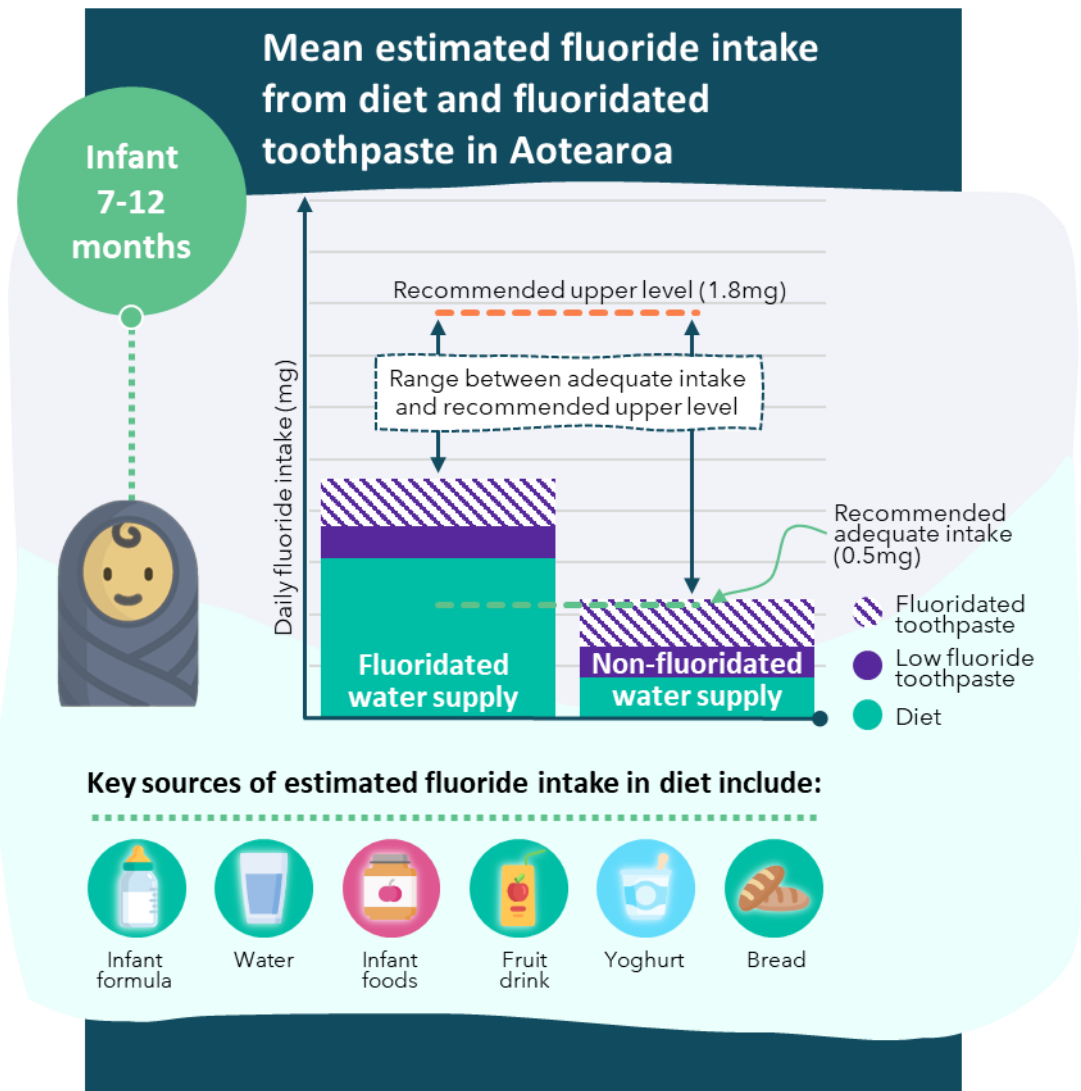


Figure 21 Mean estimated dietary fluoride intake from diet and fluoridated toothpaste in Aotearoa New Zealand for infants 7-12 months old. Data drawn on from Cressey *et al.*